snowy 2.0

EMM

VOLUME 1

RESPONSE TO SUBMISSIONS

EXPLORATORY WORKS FOR SNOWY 2.0

October 2018

RESPONSE TO SUBMISSIONS REPORT

Exploratory Works for Snowy 2.0

Final

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CHAPTER 1

INTRODUCTION

1 Introduction

1.1 Overview

Snowy Hydro Limited (Snowy Hydro) is pursuing Snowy 2.0 which is a pumped hydro-electric storage and generation project. Snowy 2.0 responds to major and unprecedented challenges faced by the New South Wales (NSW) energy system and broader National Electricity Market (NEM) through rising energy costs, deterioration in energy system security and reliability, and a transition in the generation mix away from coal-fired, dispatchable, base-load power to intermittent renewable wind and solar power.

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. This will increase the current Snowy Scheme generation capacity by almost 50%. The increased quick-start generation and large-scale storage capacity provided by Snowy 2.0 will increase the security and reliability of the NEM. As with most of the existing Snowy Scheme, the majority of Snowy 2.0 is in the Kosciuszko National Park (KNP). Snowy Hydro has been working with NSW National Parks and Wildlife Service (NPWS) since the announcement of Snowy 2.0 to ensure long term management objectives for KNP are considered in project development.

1.2 Approval process

On 7 March 2018 the NSW Minister for Planning declared Snowy 2.0 to be State Significant Infrastructure and Critical State Significant Infrastructure (CSSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on the basis that it is critical to the State for environmental, economic or social reasons.

Snowy Hydro is seeking approval to carry out Exploratory Works for Snowy 2.0. The primary purpose of Exploratory Works is to gain a greater understanding of the rock conditions at the proposed location of the underground power station for Snowy 2.0. An exploratory tunnel is the key element proposed to gain this critical information.

The Exploratory Works for Snowy 2.0 Environmental Impact Statement (EIS) was submitted by Snowy Hydro to the NSW Department of Planning and Environment (DPE) in July 2018 and publicly exhibited by the DPE in accordance with the EP&A Act between 23 July and 20 August 2018. Additionally, a digital EIS portal (https://v2.communityanalytics.com.au/snowy/eis) was established to provide the community with information on key findings through video and digital media forums.

A total of 58 submissions were received during the public exhibition period, including four from special interest groups and 54 individual community submissions. Of the 58 submissions, 19 (or 33%) were in support of the Exploratory Works, 16 (or 28%) objected to the works, and the remaining 23 provided comments. In addition, eleven submissions were received from State government agencies and councils. A detailed analysis of matters raised in the submissions is set out in Chapter 2.

1.3 Exploratory Works

1.3.1 Key elements of the exhibited project

Exploratory Works will involve construction of an exploratory tunnel to enable exploratory drilling and provide a greater understanding of the underground conditions at the power station cavern location. Several supporting elements will also be required to facilitate the construction of the exploratory tunnel. The key elements of Exploratory Works as exhibited in the EIS and include:

- an exploratory tunnel about 3.1 km long to the site of the underground power station;
- a portal construction pad for the exploratory tunnel. This will provide the entrance structure to the tunnel and an area for infrastructure and equipment needed to support tunnelling activities;
- an accommodation camp for the Exploratory Works construction workforce;
- road works and upgrades to enable access and haulage routes during Exploratory Works. This includes upgrades to 26 km of existing roads and creating about 2 km of new roads along with two new bridges;
- barge access infrastructure to enable access and transport by barge on Talbingo Reservoir. This includes one new barge ramp at Talbingo spillway in the northern part of Talbingo Reservoir and one new barge ramp at Middle Bay near Lobs Hole at the southern part of Talbingo Reservoir;
- excavated rock management, including subaqueous placement within Talbingo Reservoir. Up to 750,000 m^3 of excavated rock will need to be tested for its geochemical properties (ie whether the rock is reactive or non-reactive) before being managed by a combination of the following options:
    - re-use – suitable material can be used as construction materials for roads or similar. Some materials will be provided to NPWS for use in road maintenance and upgrades in other areas of KNP;
    - on land placement – material will be placed in one of two temporary on-land emplacement areas. The eastern emplacement area has been designed to safely treat reactive material. The western emplacement area will be used for temporary storage of materials for re-use;
    - subaqueous placement within Talbingo Reservoir – suitable material will be placed at a suitable location within Talbingo Reservoir, subject to several water quality controls and monitoring; and
- services infrastructure such as diesel-generated power, water and communication.

Horizontal and other test drilling, investigations and analysis is also proposed for the above elements to inform project viability and detailed design. Exploratory Works is estimated to take around 30 to 34 months to complete. All elements of Exploratory Works align with components of the proposed main works for Snowy 2.0. However, if Snowy 2.0 is not approved or does not progress, then impacted areas will be rehabilitated, and project elements decommissioned in consultation with the NSW National Parks and Wildlife Service (NPWS).

1.3.2 Key improvements since public exhibition

Following public exhibition of the EIS, several improvements have been designed and adopted. These improvements include changes to the design and/or management of Exploratory Works and have been developed in response to feedback from government and community stakeholders, as well as Snowy Hydro's shortlisted design and construct contractors. The key project improvements are summarised as follows:

- the eastern emplacement area for excavated rock will be stockpiled temporarily only (ie it will no longer be a permanent landform);
- dredge material from construction of barge access infrastructure will be disposed subaqueously and not on land;
- public access to Talbingo spillway will be closed for the duration of Exploratory Works;
- additional recreational facilities will be provided at Talbingo boat ramp;
- additional treatment of wastewater and process water will be undertaken;
- the stormwater discharge regime has been revised and updated;
- additional erosion and sediment controls will be implemented for road works and construction areas;
- revised water management will be undertaken at the eastern emplacement area; and
- alternate construction and slope support methods will be carried out at two sections of Lobs Hole Ravine Road.

1.4 Engagement

1.4.1 DPE community information sessions

DPE held two community information sessions in the local area to assist the community to better understand the assessment process and how to make a submission on Exploratory Works:

- 1 August 2018 – All Saints Anglican Church, Tumut; and
- 2 August 2018 – Monaro Car Clubhouse, Cooma.

1.4.2 Digital EIS portal

A digital EIS portal was established to provide the community with easily understood information on key findings through an interactive map, video and digital media forums. Links to access the digital EIS portal were provided from the websites of DPE Major Projects, Snowy Hydro and EMM Consulting Pty Limited (EMM). The EIS portal can be viewed at the following website:

https://v2.communityanalytics.com.au/snowy/eis

During the public exhibition period the EIS portal was accessed by 795 individual visitors (over a total of 1,339 sessions), with 846 video plays and 794 report downloads (comprising 221 downloads of the main EIS report, with the remainder being technical appendices).

The portal was mostly commonly viewed from locations in Sydney (postcode 2000) followed by Cooma (postcode 2630) and Canberra (postcode 2600). Figure 1.1 below shows the geographic extent of NSW visitors to the portal. A minor number of people from other state's also viewed the portal, but are not shown on the map in the figure below.

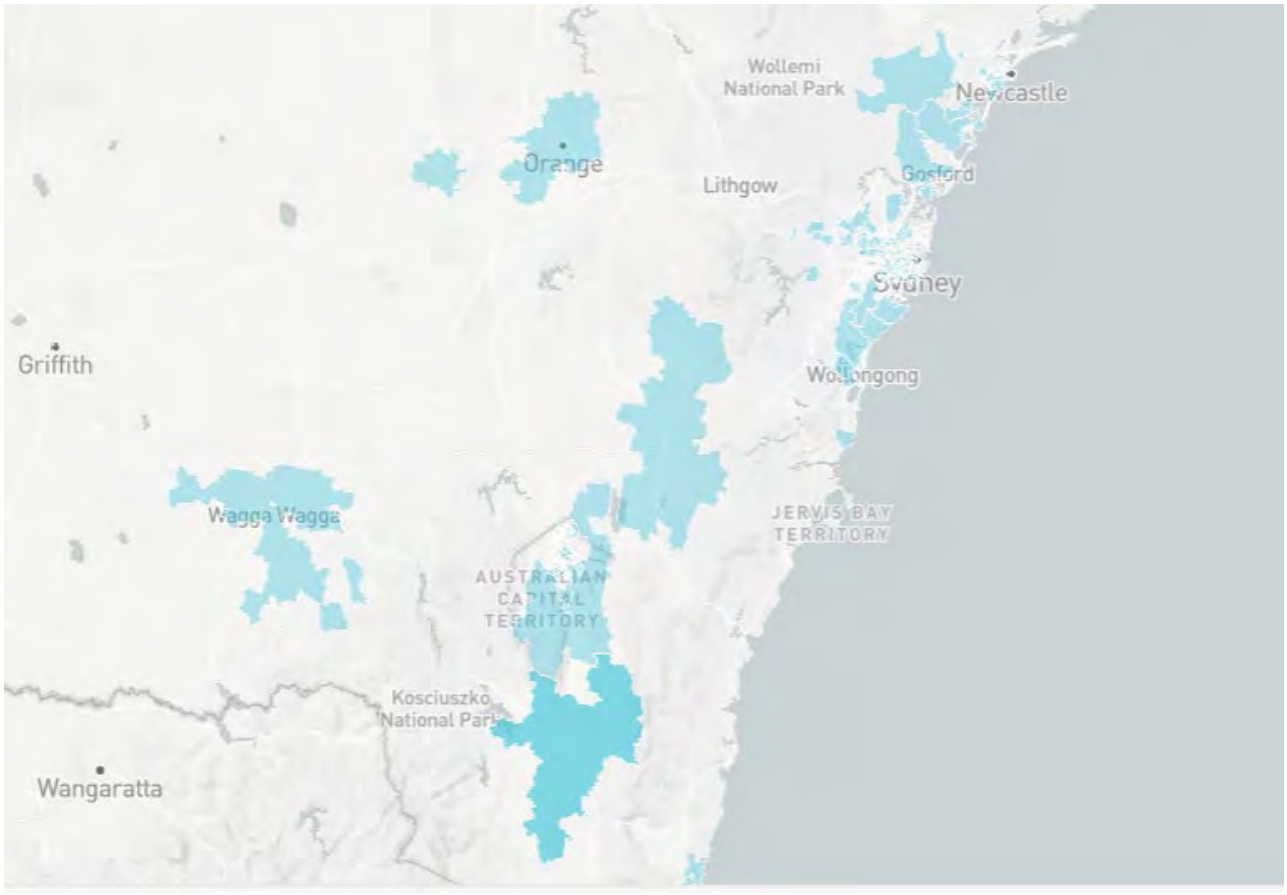


Figure 1.1 Digital EIS portal viewer geographic distribution

1.4.3 Stakeholders

During and post the public exhibition phase, engagement activities with stakeholders have been ongoing with the main purpose of discussing initial comments on the EIS and providing clarifications where required. Details of key engagements with government and other stakeholders are outlined in Table 1.1.

Table 1.1 Engagement during and post the public exhibition phase

Stakeholder	Date	Engagement activity	Purpose	Key outcomes
Talbingo Progress and Ratepayers Association and residents of Talbingo	8 August 2018	Community information meeting	Snowy Hydro provided information and answer questions on the Exploratory Works EIS.	Community members were provided with information on where to find and how to make a submission regarding the EIS. Meeting minutes were taken and provided to Snowy Valleys Council to inform their submission.
	6 September 2018	Meeting	A meeting was held to discuss concerns regarding impacts to recreational boating on Talbingo Reservoir and discuss options for mitigating these impacts.	Mitigations measures at the Talbingo boat ramp were presented at the meeting and generally agreed between Snowy Hydro, the association and residents, including the provision of pontoons and jetties and the upgrade of picnicking facilities at the boat ramp.
NPWS	31 July 2018	Workshop	While the purpose of the workshop was to provide an update on the design of Snowy 2.0, an update on the Exploratory Works EIS was provided.	Nil – for information purposes only.
	9 August 2018	Meeting	To develop and progress the offsets strategy.	Actions were documented for the progression of the offset strategy including offset funding arrangements and broad offset actions.
	7 September 2018	Meeting	Similar to the meeting on 9 August 2018, the meeting was to progress the offsets strategy.	Further actions were documented for the progression of the offset strategy.
	18 September 2018	Meeting	The purpose of the meeting was to provide an update on the response to NPWS's submission including an update on an assessment undertaken on the fossil, Karst and periglacial features in the study area.	Nil – for information purposes only.
Environment Protection Authority	9 August 2018	Meeting	The purpose of the meeting was to brief the EPA on the Exploratory Works EIS, particularly the surface water assessment ahead of the authority undertaking its final review of the document.	Nil – for information purposes only.
	20 August 2018	Teleconference	The purpose of the meeting was to discuss the EPA's submission on the Exploratory Works EIS.	Understanding of information required to address the EPA's submission.
	24 August 2018	Teleconference	Similar to the meeting on 20 August 2018, the purpose of the meeting was to discuss the EPA's submission on the Exploratory Works EIS.	Further understanding of information required to address the EPA's submission.

Table 1.1 Engagement during and post the public exhibition phase

Stakeholder	Date	Engagement activity	Purpose	Key outcomes
	29 August 2018	Meeting	Similar to the meetings on 20 and 24 August 2018, the purpose of the meeting was to discuss the EPA's submission on the Exploratory Works EIS.	The water quality objectives for Exploratory Works were agreed at the meeting.
	7 September 2018	Meeting	The purpose of the meeting was for the EPA to provide feedback on preliminary information prepared to address the authority's submission, including water treatment options	Clarification was provided by the EPA on its submission and requirements for the RTS.
	20 September 2018	Meeting	The purpose of the meeting was to present the results of the additional work undertaken since receipt of the EPA's submission.	Nil.
Office of Environment and Heritage	9 August 2018	Meeting	To develop and progress the offsets strategy	Actions were documented for the progression of the offset strategy including offset funding arrangements and broad offset actions.
DPE	14 August 2018	Meeting	The purpose of the meeting was for DPE to provide feedback from the community meetings held by DPE in Tumut and Cooma, an update on the status of submissions from government agencies, special interest groups and the general public and communicate the agenda for the next Working Group meeting.	Further understanding of key matters being raised by government agencies, special interest groups and the general public.
	28 August 2018	Meeting	The purpose of the meeting was for Snowy Hydro to outline its approach and timing to address matters raised by government agencies, special interest groups and the general public. DPE also provided an update on submissions that had not been received by some government agencies.	Expectations for engagement and communication of information with key stakeholders.
Roads and Maritime	9 August 2018	Teleconference	Provided the opportunity to discuss the Exploratory Works EIS and the RMS submission.	Understanding of key matters to be raised by RMS.
	16 August 2018	Meeting	Meeting with NSW Maritime Office of RMS to discuss the Exploratory Works EIS.	The NSW Maritime Office of RMS raised concerns regarding the safety of conflicts between recreational and commercial vessels at the Talbingo spillway. As such, it was determined to look at the closure of the spillway and provision of mitigation measures at the Talbingo boat ramp.

Table 1.1 Engagement during and post the public exhibition phase

Stakeholder	Date	Engagement activity	Purpose	Key outcomes
Department of Primary Industries – Fisheries	9 August 2018	Meeting	Meeting with DPI Fisheries to discuss the Exploratory Works EIS, specifically the aquatic ecology assessment.	Further understanding of the presence of Murray Crayfish within Talbingo Reservoir due to additional information provided by DPI.
	29 August 2018	Meeting	Meeting to discuss DPI Fisheries comments raised at 9 August 2018 meeting.	Feedback on preliminary comments on aquatic ecology assessment for Exploratory Works. Further understanding on the survey plans for Murray Crayfish.
	19 September 2018	Meeting	Meeting to discuss the DPI Fisheries submission and the approach in the response to submissions.	Agreed process to further investigate presence/absence of Murray crayfish and relationship to potential impacts following consideration of avoidance and minimisation measures from Exploratory Works.
Department of Industry – Water	4 September 2018	Teleconference	The purpose of the meeting was to discuss DOI-Water's submission on the Exploratory Works EIS.	Understanding of information required to address DOI-Water's submission.
	20 September 2018	Meeting	A meeting was held to discuss water licensing and matters raised in the DOI Water submission.	Further understanding of information required to address DOI Water's submission.
Snowy Valleys Council	30 August 2018	Meeting	A meeting was held to clarify mitigation of potential impacts at Talbingo township.	Further understanding of the following: • Proposed upgrade to Talbingo boat ramp recreation area; • Alternative waste disposal sites other than Talbingo and Tumbarumba can be used; • Traffic movements along Miles Franklin Drive.
	27 September 2018	Teleconference	The purpose was to discuss the proposed Talbingo boat ramp recreation area, traffic and general amenity.	Generally supportive of the proposed Talbingo boat ramp recreation area.
Snowy Monaro Regional Council	29 August 2018	Teleconference	The purpose was to clarify arrangements for waste disposal and traffic for Exploratory Works.	Further understanding of key matters raised.
Rural Fire Service	6 September	Meeting between NPWS, RFS and SHL	To clarify responsibilities for response to fire in the Exploratory Works area.	Clear understanding of responsibility for response to fire.

1.5 Purpose of this report

This response to submissions (RTS) report has been prepared pursuant to section 5.17(6)(a) of the EP&A Act and in accordance with the Draft *Environmental Impact Assessment Guidance Series Responding to Submissions June 2017* (Department of Planning and Environment 2017). The purpose of the document is to consider and respond to submissions made in relation to the EIS for Exploratory Works by various State and local government agencies, special interest groups and the public.

This report also presents details of further technical studies and impact assessment, improvements to the project, the revised project description and mitigation measures, and an updated evaluation of the project.

CHAPTER 2

ANALYSIS OF SUBMISSIONS RECEIVED

2 Analysis of submissions received

2.1 Exhibition details

The Exploratory Works for Snowy 2.0 EIS was publicly exhibited from 23 July to 20 August 2018 at the following locations:

- Snowy Monaro Regional Council Cooma office (81 Commissioner Street, Cooma);
- Snowy Monaro Regional Council Berridale office (2 Myack Street, Berridale);
- Snowy Monaro Regional Council Bombala office (71 Caveat Street, Bombala);
- Snowy Monaro Regional Council Jindabyne office (2/1 Gippsland Street, Jindabyne);
- Snowy Valleys Council Tumbarumba office (Bridge Street, Tumbarumba);
- Snowy Valleys Council Tumut office (76 Capper Street, Tumut);
- Nature Conservation Council (NCC) office (14/338 Pitt Street, Sydney); and
- DPE office in Sydney (320 Pitt Street, Sydney).

The EIS was also available for review on DPE's Major Projects website. In addition, an online web portal (https://v2.communityanalytics.com.au/snowy/eis) was established to communicate the EIS to the public and stakeholders in an accessible and interactive way. A link to the web portal was available via the DPE Major Projects website and on Snowy Hydro's website.

2.2 Overview

Following public exhibition of the EIS, 51 submissions were received by the DPE. Submissions were received from special interest groups and community members. Eleven submissions were also received from state government agencies and local government.

Submissions are available to view on the DPE's website at the link below.

http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=9208

A breakdown of the submissions received is provided in Table 2.1.

Table 2.1 Summary of submissions received

Source/type	Object	Support	Comment	Total
Community	12	19	16	**47**
Special interest group	3		1	**4**
Total	**15**	**19**	**17**	**51**

One additional submission was received from the Talbingo Rate Payers Association as an attachment to the Snowy Valleys Council submission. This was classified as a community submission.

The following NSW Government agencies provided submissions:

- Office of Environment and Heritage (OEH) including:
  - NPWS; and
  - Heritage Council.
- Fire and Rescue NSW;
- Environment Protection Authority (EPA);
- Roads and Maritime Services (RMS), including:
  - Roads; and
  - Maritime.
- Department of Industry – Water (DoI Water);
- Department of Primary Industries – Fisheries (DPI Fisheries);
- Department of Industry – Lands;
- Snowy Monaro Regional Council; and
- Snowy Valleys Council.

The following special interest groups provided submissions:

- National Parks Association of NSW (NPA);
- Australian Cave and Karst Management Association (ACKMA);
- Nature Conservation Council; and
- The Colong Foundation for Wilderness.

2.3 Response methodology

All submissions received were collated and categorised based on who they were from, in accordance with the following categories for submitters:

- community;
- special interest group; and
- government.

The submissions were reviewed, and the key matters raised in each submission identified. Matters raised in each submission were categorised by theme. The themes identified through the review of key matters were:

- biodiversity;
- heritage;
- KNP;
- land;
- mitigation measures;
- other;
- process;
- project elements;
- project justification;
- social and economic;
- stakeholder engagement;
- traffic and transport; and
- water.

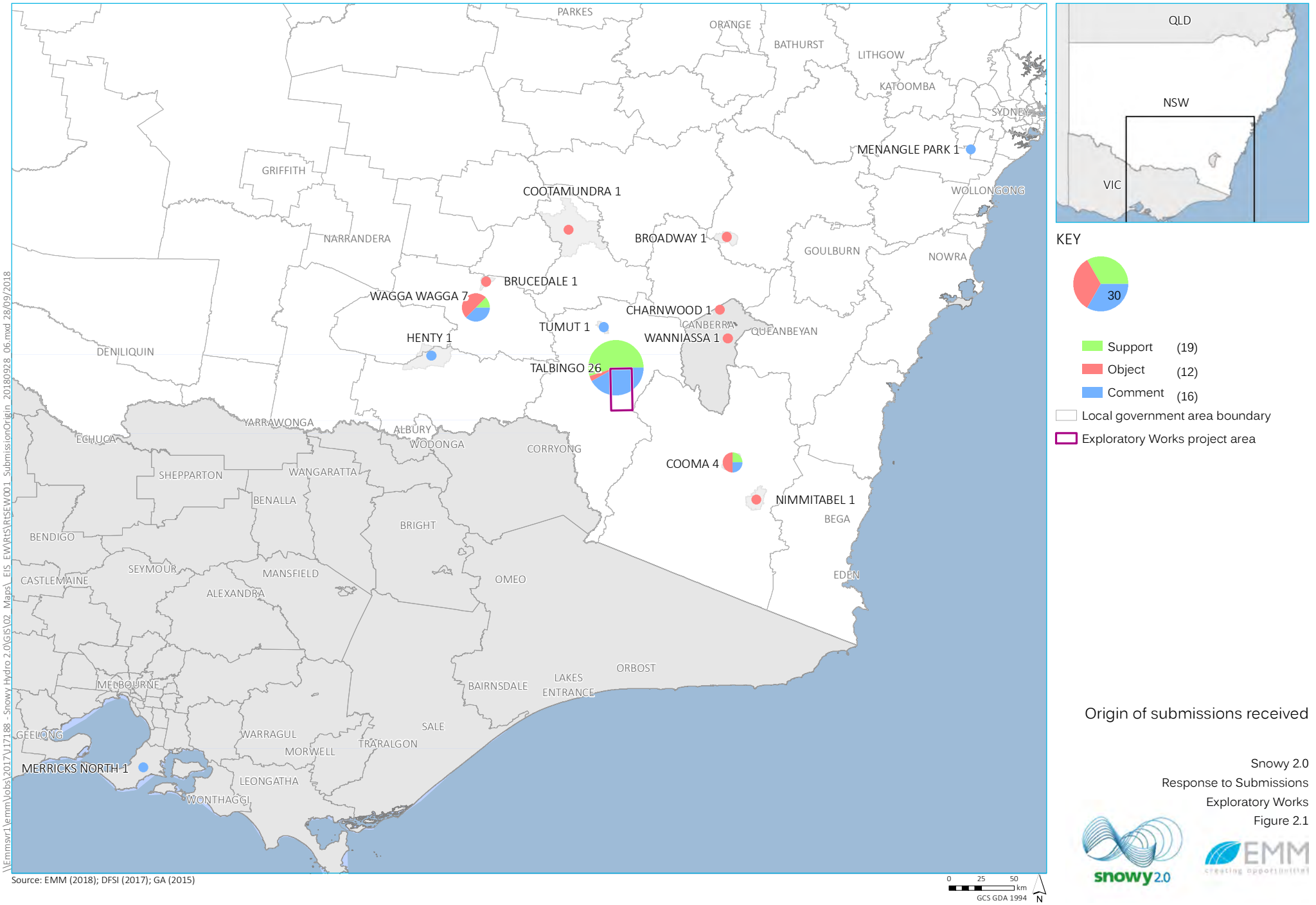
Responses were prepared to each matter by Snowy Hydro and EMM, with input from technical specialists who prepared the relevant impact assessment for the EIS. The study team was the same team that prepared the EIS, with the addition of:

- **Dr Ian Percival**, who was commissioned to prepare an assessment of significance of fossil and Karst geodiversity features to be impacted by Exploratory Works; and
- **Dr Bradley Opdyke**, who was commissioned to prepare an assessment of significance of periglacial geodiversity features to be impacted by Exploratory Works.

2.4 Origin of submissions

Figure 2.1 shows the source of the community submissions received and identifies the number that objected and supported the Exploratory Works. Figure 2.2 shows submissions received from the Snowy Valleys and Snowy Monaro Regional local government areas (LGAs).

The majority of submissions received were from NSW (91%), with two from Australian Capital Territory (ACT) and another two from Victoria (VIC). A large proportion of community submissions received came from Talbingo (55%). Several submissions were also received from nearby towns including Wagga Wagga (15%) and Cooma (9%). Only single submissions were received for all other localities which included: Tumut, Wanniassa, Charnwood, Brucedale, Nimmitabel, Henty, Cootamundra, Broadway, Menangle Park, Bonegilla and Merricks North.



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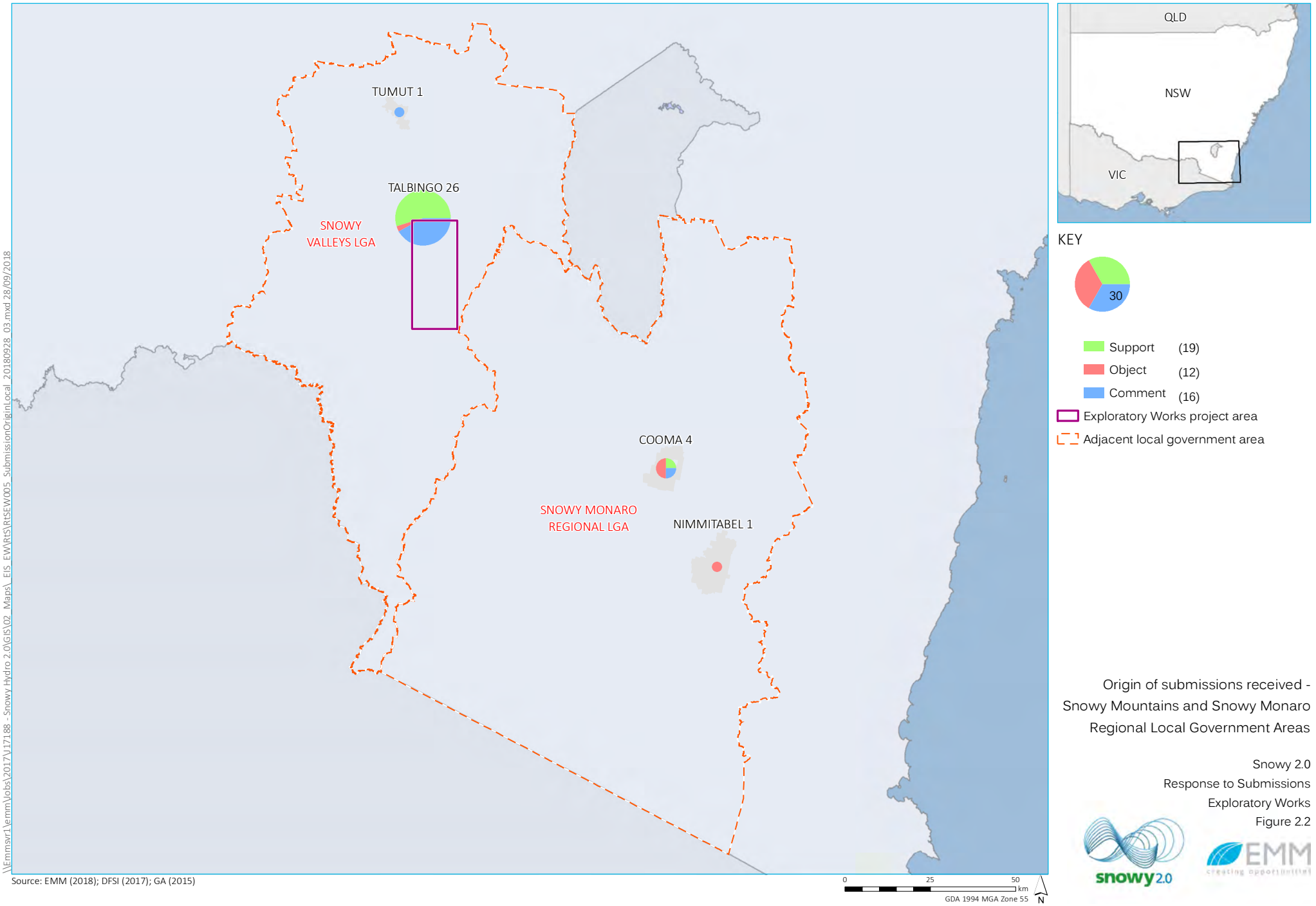
Source: EMM (2018); DFSI (2017); GA (2015)

Origin of submissions received

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 2.1



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Source: EMM (2018); DFSI (2017); GA (2015)

Origin of submissions received - Snowy Mountains and Snowy Monaro Regional Local Government Areas

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 2.2

2.5 Summary of matters raised

2.5.1 Submissions in support

As noted previously, 33%of overall submissions were in support of the Exploratory Works. This comprised 19 submissions from individuals. Frequency of matters raised is provided in Table 2.2.

Matters raised in submissions in support predominantly related to the social, economic and recreational impacts of the project. Supporting submissions also frequently referred to stakeholder engagement, transport and the approval process. Additional matters raised included support for Snowy 2.0, the proposed mitigation measures, impacts to water and other matters including noise, public safety and waste.

Table 2.2 Summary of matters raised in supporting submissions

Aspect	Quantity	Percentage
Stakeholder engagement	5	26%
Justification	2	11%
Mitigation measures	2	11%
Other	4	21%
Process	5	26%
Social and economic	17	89%
Traffic and transport	6	32%
Water	3	16%

2.5.2 Submissions in objection

As noted previously, 29% of overall submissions were in objection to the Exploratory Works. This comprised 12 submissions from individuals and 3 submissions from special interest groups. Frequency of matters raised is provided in Table 2.3.

Matters raised in submissions in objection predominantly related to social, economic and recreational impacts and the approval process. Additional matters raised frequently in objecting submissions included biodiversity, project elements, stakeholder engagement, heritage, project justification, KNP, Land, transport, water and other matters including noise, public safety and waste. One objecting submission raised matters relating to the proposed mitigation measures.

Table 2.3 Summary of matters raised in objecting submissions

Aspect	Quantity	Percentage
Biodiversity	7	47%
Project elements	7	47%
Stakeholder engagement	4	27%
Heritage	5	33%
Project justification	7	47%
KNP	5	33%
Land	4	27%
Mitigation measures	1	7%
Other	4	27%
Approval process	11	73%
Social and economic	12	80%
Traffic and transport	4	27%
Water	5	33%

2.5.3 Government

A summary of the matters raised in submissions from government agencies and local government is provided in Table 2.4.

Table 2.4 Summary of matters raised in government submissions

Aspect	Quantity	Percentage
Biodiversity	3	30%
Heritage	2	20%
KNP	1	10%
Land	2	20%
Mitigation measures	8	80%
Other	5	50%
Process	2	20%
Project elements	5	50%
Project justification	1	10%
Social and economic	2	20%
Traffic and transport	4	40%
Water	3	30%

As shown in Table 2.4 mitigation measures were raised in 80% of the government submissions. This included matters relating to construction environmental management, licenses and permits. Matters categorised as 'other' were also frequently raised being referenced in 50% of submissions. This included matters relating to noise, public safety and waste. Transport was raised in 40% of government submissions and included matters relating to the adequacy of assessment, public access, road repairs, road safety and vehicle movements. The project elements were also raised in 40% of government submissions. The matters raised in agency submissions are detailed further in Chapter 4.

2.5.4 Special interest groups

A summary of the matters raised in submissions from special interest groups is provided in Table 2.5.

Table 2.5 Summary of matters raised in special interest group submissions

Aspect	Quantity	Percentage
Biodiversity	4	100%
KNP	3	75%
Land	2	50%
Mitigation measures	1	25%
Other	1	25%
Process	4	100%
Project elements	3	75%
Project justification	3	75%
Social and economic	1	25%
Stakeholder engagement	1	25%
Water	4	100%

As shown in Table 2.5 the most commonly raised themes in special interest group submissions were biodiversity, the approval process and water. These themes were raised in every special interest group submission. Other matters that were raised in three of the four submissions were the project elements, project justification and impacts to KNP. Impacts to land were also raised in half the special interest group submissions. The matters raised in special interest group submissions are detailed further in Chapter 5.

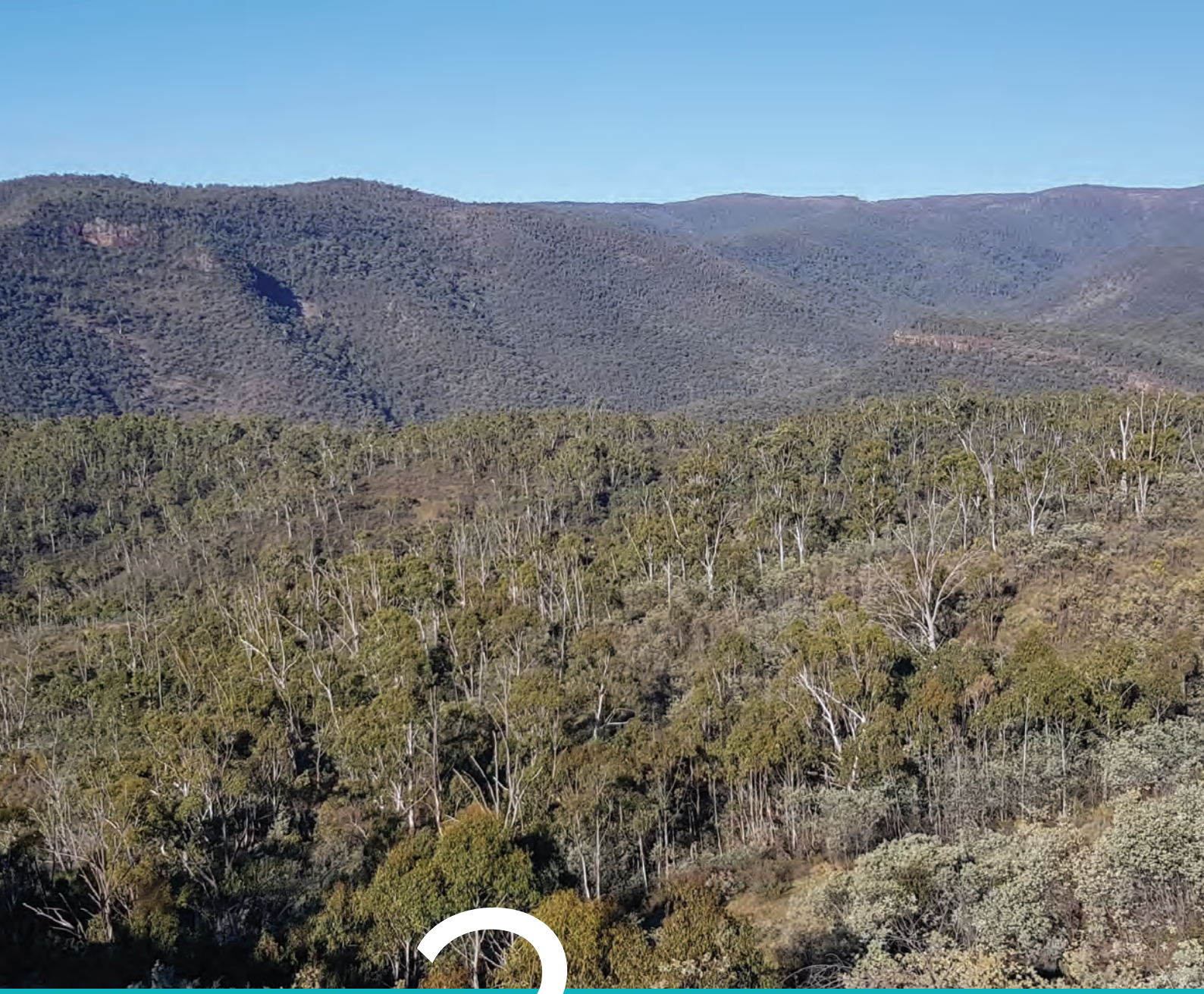
2.5.5 Community

A summary of the matters raised in community submissions is provided in Table 2.6.

Table 2.6 Summary of matters raised in community submissions

Aspect	Quantity	Percentage
Biodiversity	5	11%
Heritage	5	11%
KNP	3	6%
Land	3	6%
Mitigation measures	5	11%
Other	10	21%
Process	15	32%
Project elements	5	11%
Project justification	11	23%
Social and economic	44	94%
Stakeholder engagement	14	30%
Transport	15	32%
Water	10	21%

In total 47 community submissions were received by DPE following the public exhibition of the Exploratory Works EIS. Nearly all community submissions were received through the DPE major projects website with one community submission received from the Talbingo Progress and Rate Payers Association which was appended to the Snowy Valleys Council submission. The matters raised in community submissions are further detailed in Chapter 6. A register of submitters and where submissions have been addressed in this report is provided in Appendix A.



CHAPTER 3

PROJECT IMPROVEMENTS

3 Project improvements

3.1 Overview of design improvements

Following public exhibition of the EIS, feedback from government and community stakeholders, and the shortlisted design and construct contractors has been considered and several project improvements have been identified. The proposed project improvements involve design changes for the purposes of:

- further minimising environmental impacts;
- improving the constructability of Exploratory Works; and
- meeting stakeholder expectations for the project.

This section provides details of the proposed changes to Exploratory Works. The key project improvements are :

- excavated material management:
  - the eastern emplacement area for excavated rock will be stockpiled for the duration of Exploratory Works only (ie it will be a temporary rather than permanent landform) with material remaining (not subaqueously emplaced) to be removed from KNP within 5 years (should Snowy 2.0 Main Works not proceed);
  - dredge material from construction of barge access infrastructure will be disposed subaqueously and not on land;
- Talbingo recreational areas:
  - public access to Talbingo spillway will be closed for the duration of Exploratory Works;
  - additional recreational facilities will be provided at Talbingo boat ramp;
- water management:
  - additional treatment of wastewater and process water will be undertaken;
  - the stormwater discharge regime has been revised and updated;
  - additional erosion and sediment controls will be implemented for road works and construction areas;
  - revised water management will be undertaken at the eastern emplacement area; and
- amendments to clearance boundary:
  - alternate construction and slope support methods will be carried out at two sections of Lobs Hole Ravine Road to improve geodiversity outcomes.

3.2 Excavated material management

3.2.1 Eastern emplacement area

Following additional consultation with NPWS all remaining materials within the eastern emplacement area at the end of Exploratory Works will now be either subaqueously placed within Talbingo Reservoir or removed to a suitable location outside the KNP within five years of the completion of Exploratory Works (should Snowy 2.0 Main Works not proceed).

As the eastern emplacement area will now be a temporary (rather than permanent) landform the management of emplacement will also be modified slightly. This includes a modified approach to managing potential acid forming material (PAF) which is detailed in Section (i) below. A revised approach to the eastern emplacement water management is also proposed and is detailed further in Section 3.4.5.

The eastern and western emplacement areas will be rehabilitated following removal of all material. Lick Hole Gully will be resinated as part of the rehabilitation works. Geomorphic and ecological characterisation of Lick Hole Gully will be undertaken prior to disturbance to record the existing conditions and values of Lick Hole Gully. The rehabilitation approach will seek to create a physically stable landform that reinstates or improves the existing values.

i Geochemical risks and management approach

As described in the EIS, geochemistry analysis of rock samples from a drill hole near the exploratory tunnel identified that some material may be potentially acid forming (PAF), while other rock samples had excess acid neutralising capacity (ANC) and therefore have acid consuming (AC) potential (SGM environmental 2018).

To avoid the uncontrolled placement of PAF rock, excavated material will be geochemically characterised prior to placement. If any potentially acid forming material is encountered, it will be placed in a select area of the emplacement. The potential for acid rock drainage will be treated by placing and compacting layers of limestone (or other suitable AC material) between each rock and sediment layer as required. The volume of limestone (or other suitable AC material) in each layer will be determined stoichiometrically so that the maximum potential acidity from the overlying layer of rock and sediment is treated. This approach will neutralise AMD within the stockpile.

3.2.2 Dredge material

Dredge material from the barge ramp construction was previously described as being managed by either land placement or subaqueous placement. Following public exhibition and consultation with government stakeholders it has been determined that dredge material will only be subaqueously emplaced.

3.3 Talbingo recreational areas

After the publication of the Exploratory Works EIS, the shortlisted design and construct contractors have advised that due to public safety considerations access to the entire spillway area is required during the project (ie requiring closure of the spillway to the public). In addition, RMS raised concerns regarding the likely interaction of recreational and commercial vessels at the spillway.

A key concern raised in submissions from residents of Talbingo (permanent and part-time residents) was the restrictions to access to the spillway and boat ramp.

3.3.1 Talbingo boat ramp improvements

To mitigate the closure of the spillway for public access, additional recreational facilities at the public boat ramp will be developed. This area is owned by Snowy Hydro and will continue to be made available to the public. These include:

- provision of pontoons for the mooring of boats to the north of the boat ramp;
- provision of 'beach' area immediately south of boat ramp;
- provision a swimming pontoon off the 'beach' area;
- provision of an exclusive swimming area around the 'beach' area; and
- provision of picnic facilities and amenities at 'beach' area including picnic tables and BBQs.

Three design options are under consideration for the additional recreational facilities and will be finalised following further consultation with the community and government agencies. The options under consideration are listed below.

- Option 1: On-ramp pontoon – This option involves widening of the existing walkway alongside the boat ramp to provide a platform for an on-ramp pontoon. The on-ramp pontoon would be constructed on a rock fill foundation and comprise an in-situ concrete slab (above water level) and precast concrete planks (below water level). A larger pontoon would be provided at the end of the on-ramp pontoon to facilitate boat berthing. The pontoon would provide boat berthing and assisted disabled access at water levels down to Talbingo Reservoir's minimum operating level (MOL).
- Option 2: Gangways linking pontoons A – This option involves the construction of several gangways to link with floating pontoons. The gangway linking to the foreshore would be hinged from an abutment formed behind the existing gabion wall. Pontoons would be restrained by piles that would incorporate pontoon stops. The pontoon stops would limit the downward movement of pontoons at low water levels to ensure that the gangway slope remains adequate for access. This option would provide assisted disabled access at water levels down to MOL.
- Option 3: Gangways linking pontoons B – This option is similar to Option 2 but extends further offshore with flatter maximum gangway slopes. This option includes a longer structure that provides disabled access that is consistent with best practice guidance for accessibility.

The design options for the additional recreational facilities at Talbingo boat ramp are provided in Figures 3.1 to 3.3. A photograph of the existing recreational area at Talbingo boat ramp is provided in Photograph 3.1.

All three design options will also consider the following general improvements:

- Improvement of pathway access from existing pedestrian zebra crossing (to the boat ramp) to foreshore reserve and pontoon. Existing access is narrow, not level and interrupted by existing step structure. Improvement may include construction of a continuous ramped pathway through this area.
- The existing gabion wall along much of the beachfront is an impediment to beach access. This will be improved by provision of foreshore access stairs at intervals along the gabion wall.

- Improvement of grass cover over foreshore reserve and provision of other landscaping features to make the area more attractive for public recreation.

- Removal of surficial loose cobbles to improve beach safety and amenity within both the boat holding area and swimming enclosure. This could be achieved by a small excavator with a screening bucket. Sand and gravel could also be placed on the beach to improve the uniformity and comfort of the surface for beach users.

- Removal of fallen trees and woody debris from the beachfront along the southern area of the swimming enclosure. This would provide beach safety and amenity benefits.

An environmental impact assessment of the proposed additional recreational facilities is provided in the subsequent section.

Source: EMM (2018); Snowy Hydro (2018); Nearmap (2018); RHDHV (2018)

KEY

- Existing beach area
- Existing gabion wall
- Foreshore reserve

0 50 100 m

N

GDA 1994 MGA Zone 55

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Talbingo boat ramp additional recreational facilities indicative layout – Option 1

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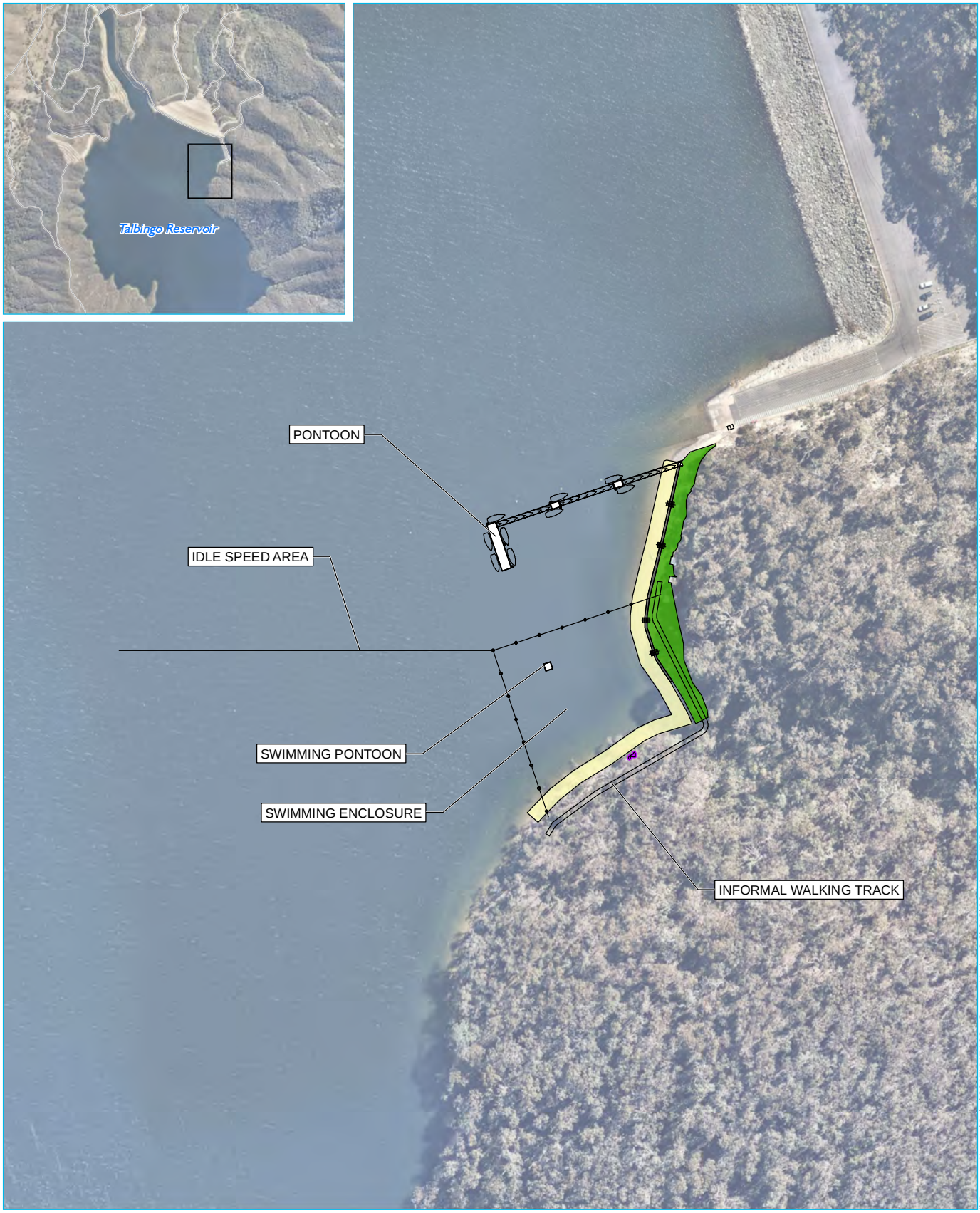
Figure 3.1

snowy2.0

EMM creating opportunities



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Source: EMM (2018); Snowy Hydro (2018); Nearmap (2018); RHDHV (2018)

KEY

- Existing beach area
- Existing gabion wall
- Foreshore reserve

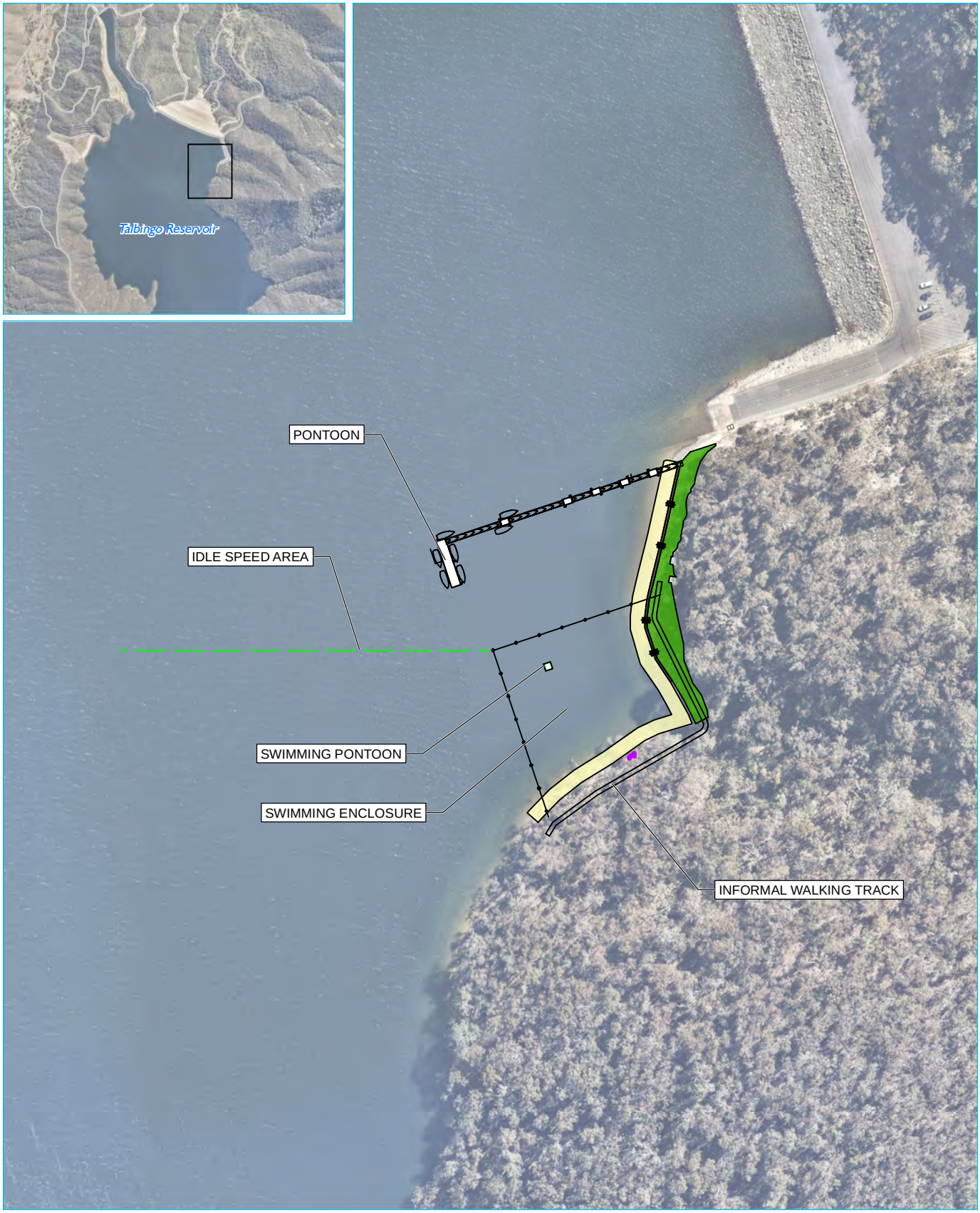
0 50 100 m

N

GDA 1994 MGA Zone 55

Talbingo boat ramp additional recreational facilities indicative layout – Option 2a

Snowy 2.0
Response to submissions
Exploratory Works
Figure 3.2



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Source: EMM (2018); Snowy Hydro (2018); Nearmap (2018); RHDHV (2018)

KEY

- Existing beach area
- Existing gabion wall
- Foreshore reserve

0 50 100 m

N

GDA 1994 MGA Zone 55

Talbingo boat ramp additional recreational facilities indicative layout – Option 2b

Snowy 2.0
Response to submissions
Exploratory Works
Figure 3.3

Photograph 3.1 Foreshore area south of the existing boat ramp at Talbingo Reservoir

3.3.2 Impact assessment

i Water

The following mitigation measures for water quality impacts during construction of the pontoons and recreational areas would be implemented:

- installation of silt curtain around the works site;
- selection of uncontaminated granular fill with less than 2% fines for fill materials; and
- installation of well-established erosion and sediment control measures for works on land.

In addition, the following measure will be considered during detailed design:

- surficial loose cobbles and the like removed from the existing beach to improve safety and amenity may be reused as granular fill, or otherwise disposed offsite.

ii Terrestrial ecology

a. Existing environment

The study area is at the northern end of Talbingo Reservoir, near the existing boat ramp. Areas adjacent to the boat ramp, at the northern end of the study area, are heavily disturbed and provide minimal biodiversity value. Areas to the south show lower levels of disturbance and provide higher biodiversity value, including good condition native vegetation.

Areas adjacent to the study area were surveyed for Exploratory Works. These areas were mapped as 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. Based on interpretation of photographs from the study area and aerial photo interpretation (API) vegetation in the study area, particularly at the southern end, appears consistent with this vegetation mapping. Vegetation does not form part of a threatened ecological community listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or NSW *Biodiversity Conservation Act 2016* (BC Act).

A search of the BioNet Atlas of NSW Wildlife indicates no threatened species have been recorded in or immediately adjacent to the study area. Several threatened species credit species would be considered to have potential to occur in the study area and be impacted by the proposed works based on presence of suitable habitat and likelihood that the species could be resident (as opposed to vagrant):

- Eastern Pygmy-possum (*Cercartetus nanus*);
- Koala (*Phascolarctos cinereus*); and
- Gang-gang Cockatoo (*Callocephalon fimbriatum*) – breeding habitat.

These species have not been recorded in the study area or adjacent habitats during surveys undertaken for Exploratory Works, but the potential for these species to occur cannot be discounted.

b. Potential impacts and recommendations

Potential impact arising from the proposed works include:

- removal of native vegetation and fauna habitat;
- increase in weeds and pathogens; and
- increase in predatory and pest animal species.

These impacts are likely to be minor in nature and restricted to a small, localised area adjacent to existing impacts. Recommendations to avoid, minimise and mitigate these impacts include:

- avoid impacts to native vegetation as far as practicable, limiting works to disturbed areas as much as possible;
- undertake pre-clearing surveys to document presence of the threatened species listed above. Ensure vegetation clearing is undertaken in accordance with the staged process outlined in the *Exploratory Works Biodiversity Development Assessment Report* (BDAR, EMM 2018b);
- limit access to areas of retained vegetation using appropriate fencing; and

- ensure appropriate ongoing management of retained vegetation.

Based on results of the BDAR (EMM 2018b) an offset of 20 credits for every hectare of vegetation removal would be required to offset these impacts. Offset requirements will be confirmed upon detailed design.

No threatened species credits have been calculated; presence of these threatened species would be confirmed during pre-clearing surveys.

c. Conclusions and recommendations

The study area supports native vegetation that appears to be in good condition and may support threatened species. The proposed works have potential to result in minor, localised impacts. Offsets would be required to offset impacts, with final offset requirements calculated following pre-clearing surveys and detailed design.

iii Aquatic ecology

a. Existing environment

For the purpose of this assessment, the study area is considered as that encompassed by the footprint of the proposed pontoons and swimming enclosure and a further 20 m buffer to the north, south and west of the proposed structures. The study area was visited by Cardno ecologists on 13 September 2018 and the foreshore surveyed by boat. At the time of survey, it appeared that the reservoir water level was between 2.5 m and 2 m below full supply level (FSL). Talbingo Reservoir is considered to contain Key Fish Habitat (NSW DPI 2018), however, habitat considered to be of a 'sensitive' nature ie that containing aquatic plants or riparian vegetation did not appear to occur within the extent of the proposed study area.

The habitat along the foreshore consisted of bare unconsolidated rock rubble with a small fraction of fine sediment backed by a stone retaining wall. Aquatic macrophytes, algae or woody debris were not observed along this stretch of foreshore and there was no evidence of these occurring subsurface (i.e. emergent branches). Several species of native fish and crayfish have been recorded within the reservoir including some which are protected under State and Commonwealth legislation. Noxious and pest species are also known to occur there. Further details are provided in the *Snowy 2.0 Exploratory Works Aquatic Ecology Assessment (AEA)* (Cardno 2018).

b. Impact assessment

Water quality

Installation of the piled walkways leading to the floating pontoons would result in minor disturbance to the reservoir bed and small area of foreshore affected. This may result in the mobilisation and suspension of finer sediments into the water column leading to a short term, localised increase in turbidity. Any fish or mobile macroinvertebrates potentially in this area would avoid turbid water by moving to unaffected areas.

Installation of new barbeques and picnic amenities would also involve minor earthworks along the foreshore and potential sediment run-off into the reservoir. The risk of this occurring would be readily mitigated by implementation standard erosion and sediment controls into the design.

Once operational, concentration of recreational boaters near the pontoons may result in the accidental release of fuels and hydrocarbons in the study area. The extent of this impact to water quality (if any) would depend on whether pontoon installation results in a net increase in boating activity at Talbingo Reservoir or whether it is simply re-distributed.

Loss or alteration of habitat

A very small area of rocky rubble/fine sediment foreshore and reservoir bed would be lost/smothered below where pontoon walkways and piles are installed. It is also assumed that the swimming pontoon would require a small mooring. Given the highly modified nature of the habitat at the northern end of Talbingo Reservoir and lack of submerged trees and macrophytes, this is not considered to provide any unique or significant habitat value to native biota, hence these impacts would be minimal. This would also be a small area of soft sediment habitat that would be affected and which occurs extensively throughout the reservoir.

Should the beach area adjacent to the picnic area be more significantly extended, a much larger area of foreshore habitat would be modified. However, given the limited and already modified nature of this foreshore this would not be expected to further impact its minimal habitat value.

Long term operation of pontoons has potential to shade submerged macrophytes and aquatic algae should they occur below the structures. Inspection of the foreshore and surrounding habitat suggests that other than the water weed *Elodea canadensis*, these are unlikely to occur within the study area. Should they occur there, they would likely also occur in more favourable undisturbed habitat elsewhere in the reservoir and the overall loss would be considered insignificant at a broader scale.

Potential impacts to threatened species

Based on recent and historical surveys of Talbingo Reservoir, species known or potentially occurring there and which are listed under the NSW *Fisheries Management Act 1994* (FM Act) and EPBC Act include: the Macquarie perch (*Macquaria australasica*), Trout cod (*Maccullochella macquariensis*), Silver perch (*Bidyanus bidyanus*) and Murray crayfish (*Euastacus armatus*).

Murray crayfish are known to occur within the reservoir; the likelihood of the other listed species occurring range from low to moderate. As described above, the habitat within the study area is not unique or considered to be of high value in terms of the requirements for the listed threatened species. Apart from temporary and localised increase in turbidity during the construction works potential impacts to fish species would be negligible as fish species would be expected to temporarily move to other parts of the reservoir. The lack of submerged timber and aquatic vegetation within the study area suggests this is unlikely habitat for Murray crayfish, although it is possible they could occur. Construction works and alteration of the habitat within the study area could temporarily deter Murray crayfish from the area if they did occur but would be unlikely to have any permanent detrimental impact such that any individuals would be directly impacted.

Barriers to fish movement

Structures associated with pontoon walkways, floating pontoons and swimming pontoons are not considered to cause any notable barrier to fish and mobile macroinvertebrates within the reservoir as they would be able to easily navigate through gaps between walkway pilings and under pontoons.

Provided that the swimming enclosure is demarcated only by surface floats (ie to avoid boating in the area) then this would not represent any barrier to fish movement or risk of netting. As per NSW policy and guidelines for fish habitat conservation and management (NSW DPI 2013), swimming enclosures constructed from collapsible nets should be avoided and will not generally be approved as they may result in inadvertent trapping of fish and other animals, especially where there is a possibility of threatened or protected species occurring. DPI Fisheries will generally only approve swimming enclosures constructed from corrosion resistant material (eg stainless steel) with a mesh size greater than 150 mm. NSW DPI may also require a management plan to be developed where there is potential for threatened or protected fauna to be affected, which would be the case in Talbingo Reservoir.

Spread of water weeds and other noxious species

Water weeds such as *E. Canadensis* are already prevalent within Talbingo Reservoir, particularly in summer months when temperatures exceed 15°C. It is possible that increased boating activity in summer due to new infrastructure has potential to exacerbate the translocation and spread of water weeds from boat propellers and moorings if not appropriately managed.

c. Recommendations and mitigation

- Potential impacts to water quality would be managed via standard erosion and sediment management controls during the installation process. Water quality around the pontoons and boat ramp should be regularly monitored for visible signs of hydrocarbons or spills once operational. This may be included as part of a broader Exploratory Works water quality monitoring program.

- Should woody debris be encountered during the installation of any structures this should be relocated to suitable habitat nearby.

- The design and materials used for the swimming enclosure should consider DPI Fisheries policy and guidelines for swimming pools and enclosures (NSW DPI 2013) to prevent risks to native and threatened fauna, in particular Murray crayfish.

- The study area should be monitored for any build-up of water weeds and management action undertaken as required. Management actions may include maintenance, education notices and physical removal.

- The area to be impacted by the upgrades to recreational facilities at Talbingo boat ramp area will be included in the updated assessment of significance for Murray crayfish that will be provided to DPI Fisheries and will further consider actions to avoid, minimise and offset impacts to this species as described in Section 4.3.2.

These recommendations will be incorporated into the Construction Environmental Management Plan.

iv Aboriginal heritage

a. Existing environment

Landscape context

The study area is situated within a significantly modified environment, on the eastern bank of the Talbingo Reservoir adjacent. The northern portion of the study area exhibits a high level of disturbance associated with construction of the Talbingo boat ramp (Plate 3.1), and public use recreation area (Plate 3.2). The southern portion of the study area demonstrates a lesser level of disturbance and is comprised of a mid-simple slope of moderate gradient, a landform which is not considered to be archaeologically sensitive.

The study area was partially surveyed by Dr Julie Dibden (NSW Archaeology) for the purposes of the *Snowy 2.0 Exploratory Works Aboriginal cultural heritage assessment* report (ACHAR) (2018a) for the Exploratory Works EIS. Dr Dibden completed a desktop review the current study area location on 11 September 2018 and assessed the area as being of very low to negligible archaeological potential.

Plate 3.1 Talbingo boat ramp

Plate 3.2 Talbingo boat ramp public recreation area

AHIMS search

A search of the Aboriginal Heritage Information System (AHIMS) database conducted on 11 September 2018 within a 10 km^2 area, centred on the study area. The search area is sufficient to define the pattern of previously recorded Aboriginal sites in the landscape as it covered adjacent catchments. Whilst 63 registered Aboriginal sites are found within 10 km^2 of the study area, there are no recorded Aboriginal sites within the study area, nor within a 5 km radius of the study area.

Of the 63 sites, the majority (90%) were artefact sites, including isolated artefacts and artefact scatters. The next most common sites were potential archaeological deposits (3%) and scarred trees (3%). One burial and one art site are documented in the AHIMS search; however these sites are 6.8 to 7.8 km northeast of the study area.

b. Summary

There are no recorded Aboriginal sites within the study area or within a 5 km radius. Further, the study area does not contain any landscape features on undisturbed land that are likely to indicate the presence of Aboriginal objects.

It is therefore assessed that there will be no impact on known or previously recorded Aboriginal sites and impacts to unknown Aboriginal objects are unlikely because of the proposed Talbingo boat ramp activity.

c. Conclusions and recommendations

No further investigation or assessment is required for the proposed works. Notwithstanding, unexpected finds protocols still apply for the construction of the proposed Talbingo boat ramp works. Importantly, if any mature native trees will be removed as part of the proposed works, the contractor should be made aware that the works must stop (ie the tree must not be felled) if any tree scars are suspected to be of Aboriginal origin. In this scenario, the unexpected finds protocol outlined in the project ACHA must be followed.

v Historic heritage

There are no heritage items within the project area listed on the World Heritage List, Commonwealth Heritage List, State Heritage Register, or local government heritage schedules. The 'Australian Alps National Parks and Reserves' and the 'Snowy Mountains Scheme' are two listed places on the National Heritage List. No impacts to national heritage are expected because of the proposed works.

The nearest heritage items identified by NSW Archaeology as part of *Snowy 2.0 Exploratory Works Historical Cultural Heritage Assessment* report (HCHAR, 2018) are approximately 2 km northwest of the project area on the opposite bank of the Talbingo Reservoir (2018b). These items include a laydown area, survey markers and a quarry which have been grouped into a Snowy Mountain Hydro-electric Authority (SMA) historical complex. None of these items have been assessed by NSW Archaeology as being of local significance but the HCHAR notes they contribute to the broader historical landscape of the project area.

No further investigation or assessment is required for the proposed works. Notwithstanding, unexpected finds protocols still apply for the construction of the proposed works.

vi Traffic

Following feedback from the community and agencies an additional traffic impact assessment was undertaken to evaluate a scenario where all construction vehicles are proposed to access Miles Franklin Drive. This assessment represents a worst-case scenario for traffic that would access the township of Talbingo. The assessment is provided in Section 4.11.2 and found that the capacity of Miles Franklin Drive is not anticipated to be impacted during the project.

The proposed construction activities at Talbingo boat ramp would fall within the minimal impacts identified in this additional traffic scenario.

3.3.3 Summary

An environmental impact assessment has been undertaken for the proposed additional recreational areas at Talbingo boat ramp. Environmental aspects including terrestrial ecology, aquatic ecology, Aboriginal heritage, historic heritage and traffic were considered and assessed in the section above. The impact of the proposed additional recreational areas was considered minimal for each environmental aspect considered. Mitigation measures were proposed to ensure any residual impacts are minimised or offset. This includes the implementation of standard unexpected finds protocols for Aboriginal and historic heritage, and application of biodiversity offsets for areas of vegetation clearing.

3.4 Water management

3.4.1 Process water treatment

As stated in the EIS, the process water system will incorporate a water treatment plant that will treat water to a suitable quality for its proposed use in construction activities. Additional treatment will be provided for any water that is to be discharged to Talbingo Reservoir via the controlled discharge pipeline. Additional treatment will be carried out to achieve prescribed discharge criteria before discharge into Talbingo Reservoir. Discharge specifications are detailed in the revised *Snowy 2.0 Exploratory Works Surface Water Assessment* (SWA) (EMM 2018c) and provided in Appendix E of this RTS.

The mixing zone for the process water treatment plant combined with the waste water treatment plant will be <10 m from the discharge point (ie within the near-field mixing zone). Further details on mixing zone analysis are detailed in the updated SWA which is provided in Appendix E of this RTS.

3.4.2 Wastewater treatment

As stated in the EIS, the wastewater treatment system will incorporate a wastewater treatment plant at the accommodation camp.

Waste water will be treated to meet the prescribed criteria for discharge into the Yarrangobilly River arm of Talbingo Reservoir. It is important to note that different technologies may be used to achieve these criteria. Discharge specifications are detailed in the updated SWA which is provided in Appendix E of this RTS.

3.4.3 Stormwater discharge

Following feedback from government agencies and the community the stormwater discharge regimes and controls have been further investigated and augmented. Revised stormwater discharge regimes and controls are detailed in the updated SWA which is provided in Appendix E of this RTS.

3.4.4 Erosion and sediment controls

Additional erosion and sediment controls are proposed for construction areas, road works and portal construction pad. The additional erosion and sediment controls are summarised in the sections below.

i Construction areas

Runoff from construction areas that are constrained by terrain or the proposed disturbance footprint and have catchment areas of greater than 2,500 m^2 will be captured in a sump and pumped to a water treatment plant. The water treatment plant will use water treatment chemicals to enhance sedimentation and phosphorous and dissolved metal removal rates using an automated chemical dosing system. Only water treatment chemicals that have a low risk of increasing the toxicity of treated stormwater will be used. The system will be designed to meet the water quality specifications provided in Appendix E. The design dewatering and treatment rate will be the 1 in 3 month average return interval (ARI) peak flow.

In construction areas that are not constrained by terrain, and where appropriate, sedimentation dams will be constructed in accordance with the methods recommended in *Managing Urban Stormwater: Soils and Construction: Volume 1* (Landcom 2004) and Volume 2D (DECC 2008). Sedimentation dam sizing methodologies are provided in the updated SWA (Appendix E).

Water treatment chemicals will be applied to sedimentation basins with catchment areas greater than 2,500 m^2 to enhance sedimentation and phosphorous and dissolved metal removal rates. Only water treatment chemicals that have a low risk of increasing the toxicity of treated stormwater will be used. Water treatment chemicals will be applied using an automated chemical dosing and mixing system. The system will be designed to meet the water quality specifications provided in the SWA (Appendix E). The design treatment rate will be the 1 year ARI peak flow.

ii Road works

Where practical, the sedimentation basins established to manage runoff during construction of the access roads will be modified to be constructed wetland type basins. Where practical, runoff from road embankments that have been stabilised by vegetation will be diverted into the clean water drainage system to minimise the contributing catchment area to the constructed wetlands.

iii Portal construction pad

All runoff from the portal construction pad and adjoining access road will be conveyed to a water management basin. The water management basin will have adequate capacity for the 5 day 95th percentile rainfall event plus additional volume to incorporate required water quality treatments (ie. a volume of at least 3,750 m^3). The basin will be designed as a constructed wetland and will provide a water quality improvement function. Water captured in the basin will be extracted to supply the process water system.

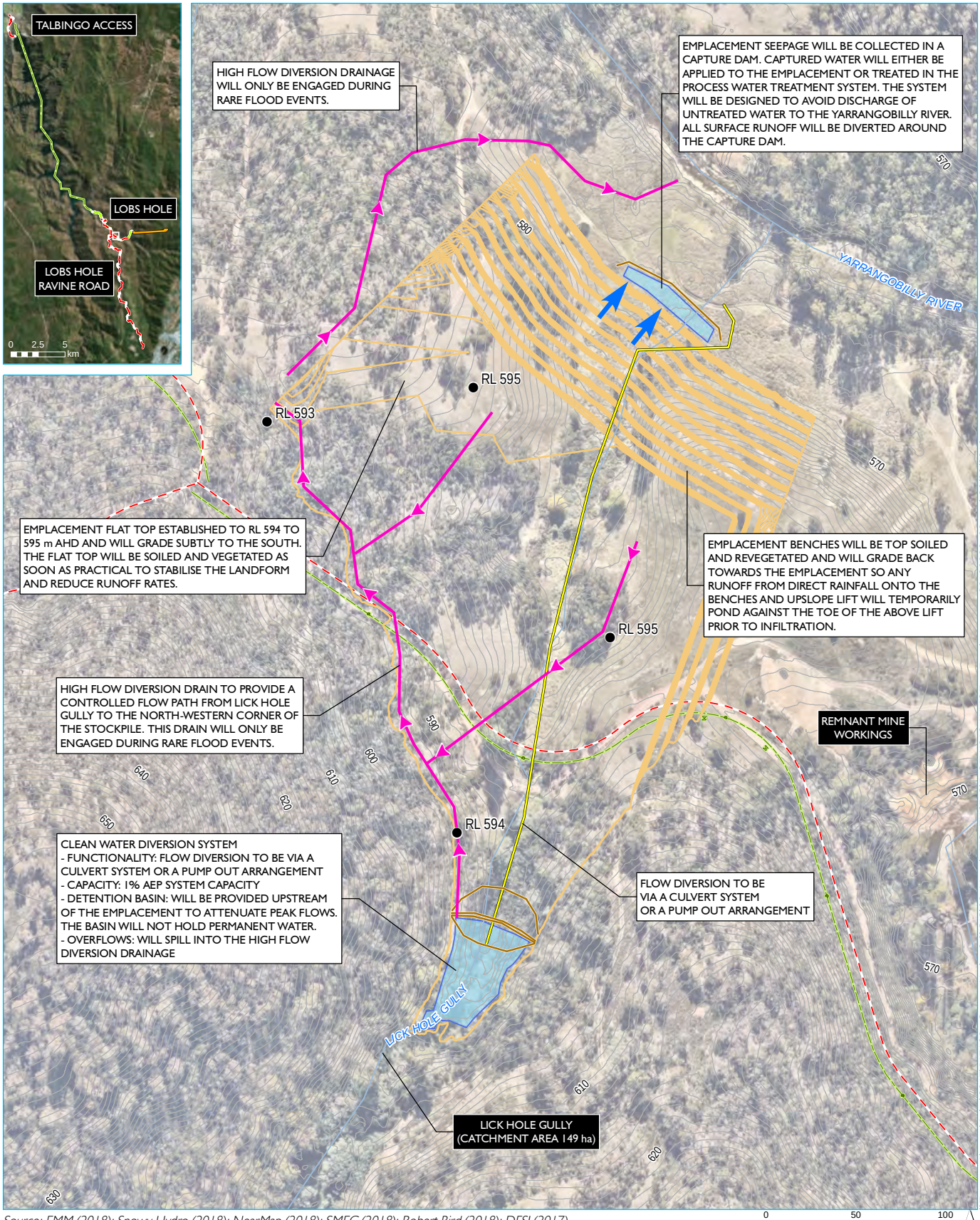
Water treatment chemicals will be applied to the water management basin to enhance sedimentation and phosphorous and dissolved metal removal rates. Only water treatment chemicals that have a low risk of increasing the toxicity of treated stormwater will be used. Water treatment chemicals will be applied using an automated chemical dosing and mixing system. The system will be designed to meet the water quality specifications provided in the SWA (Appendix E). The design treatment rate will be the 1 year ARI peak flow.

3.4.5 Eastern emplacement area water management

As discussed in Section 3.2.1 the eastern emplacement area will now be temporary only. A revised approach to water management has been prepared for this emplacement which will incorporate an active rather than passive treatment of runoff.

Water quality risks associated with emplacement seepage will be actively managed by capturing all seepage. Captured seepage (water) will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant (as described in Section 3.4.2). Lick Hole Gully will be diverted around the emplacement to minimise the volume of emplacement seepage.

The revised water management concept for the eastern emplacement area is provided in Figure 3.4.



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

KEY

- Exploratory tunnel and portal
- Access road upgrade
- Communications cable
- Watercourse
- Contour (1m LiDAR)
- Design level (indicative)
- Eastern emplacement design contours
- Culvert
- Dam embankment
- Emplacement drainage
- High flow diversion drainage
- Water management basin

Eastern emplacement: revised water management concept

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Figure 3.4

snowy2.0

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3.5 Amendments to clearance boundary

3.5.1 Design changes

Following further consideration of road designs minor changes to the disturbance footprint on Lobs Hole Ravine Road have been identified as necessary to meeting safety requirements. These sections of the road are areas of geodiversity already disturbed by the existing road. Fossiliferous beds are in the northern section and rock streams in the southern section. A key objective of the design process was to avoid and minimise impacts to these areas of geodiversity as much as possible.

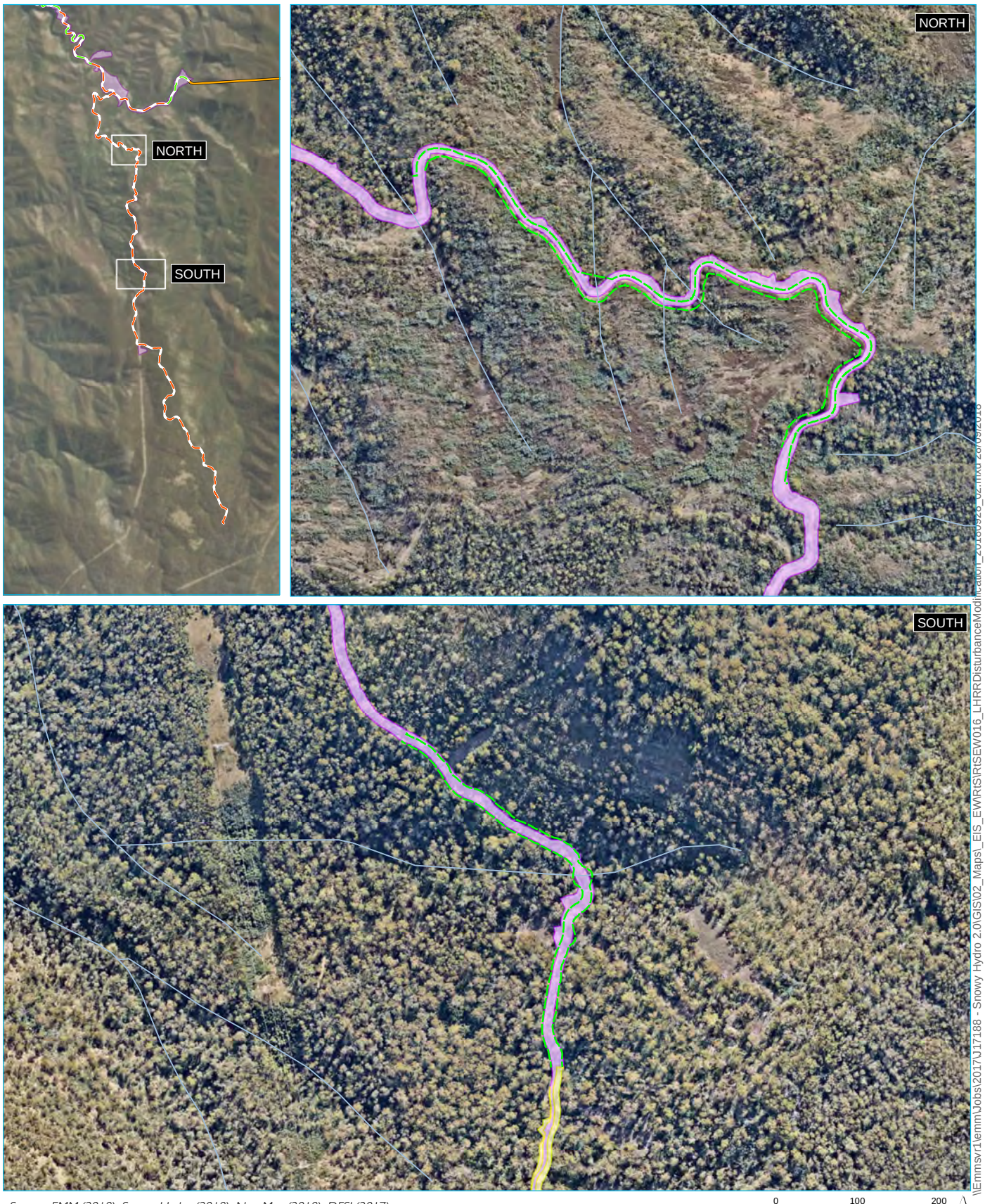
The proposed changes to the road boundary will improve the safety of the road through the addition of safety barriers and will also reduce the overall disturbance footprint and volumes of excavation, improving the geodiversity outcomes.

The proposed changes to the disturbance footprint of Lobs Hole Ravine Road are in two sections and are shown in Figure 3.4. Table 3.1 below summarises the changes in the disturbance boundary.

Table 3.1 Lobs Hole Ravine Road changes to disturbance footprint

Road section	Additional disturbance footprint (ha)	Reduction in disturbance footprint (ha)	Overall change in disturbance footprint (ha)
North section – fossiliferous beds	0.46	0.62	-0.16
South section – rock streams	0.12	0.12	0

An environmental assessment of the potential impacts from the proposed two sections of changed road boundaries was undertaken and is provided in Section 3.5.2 below.



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

0 100 200 m
GDA 1994 MGA Zone 55
N

KEY

- Modified disturbance boundary
- Watercourse
- Disturbance footprint
- Avoidance footprint

Proposed changes to the disturbance footprint of Lobs Hole Ravine Road

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Figure 3.5

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3.5.2 Impact assessment

A review of environmental aspects and impacts associated with the proposed widening in two sections of Lobs Hole Ravine Road is provided in Table 3.2 below.

Table 3.2 Impact assessment of proposed road widening

Assessment of impacts	Additional mitigation measures
Geodiversity	
The southern section of widening occurs on a section of road that has potential to impact on up to three periglacial rock streams. The road passes through three areas of periglacial deposits (known as rock streams), that will be intersected by minor widening (approximately 2 metres) of the Lobs Hole Ravine Road. An expert report on the periglacial rock stream was prepared by Dr Bradley Opdyke which reviewed the geodiversity feature's significance, assessed potential impacts and recommended mitigation measures for the road construction. The periglacial rock stream report is provided in Appendix D. Provided appropriate management measures are taken in the road construction methods, a safe and stable road can be constructed with minimal additional impacts to the periglacial deposits. Impact to the sites can be mitigated by ensuring widening the road is only done to the width needed to accommodate safe single lane access for construction vehicles, which, in the rock streams, would be minimal.	The following measures are proposed to mitigate the impacts of the road construction on the periglacial rock stream: • Digging the road deeper into the rock stream should be avoided where practical, and excavations that take place to widen the road should be undertaken on the upslope side of the road. • Because rock streams are stacked cobbles and boulders, they are extremely porous and permeable, they almost always sit in a valley or depression with potential water flow moving along their base. This should be considered when any development is done across them, like the road in question, so water flow along their base is not impeded. Appropriate drainage should be constructed under the road to ensure no build-up of water occurs above the road, within the rock stream, during heavy rain. • Educational signage should be provided in a nearby suitably widened area to provide information on the periglacial rock stream geoheritage features. • If any works are required to stabilise upslope sections of rock stream it is recommended that open mesh wire fencing is used so the general public and scientists can see and appreciate the architecture of the deposit. Building a solid wall or spraying concrete on the upslope side should be avoided.
The northern section of road widening occurs on a section of road adjacent to an outcrop of a fossiliferous bed. The fossiliferous bed is referred to as the Lick Hole Formation and is the only known occurrence of fossiliferous limestone of Early Devonian age in KNP. An expert report on the fossiliferous bed was prepared by Dr Ian Percival which reviewed the geodiversity feature's significance, assessed the impacts of road widening and recommended mitigation measures. The report regarding the fossiliferous bed geodiversity feature is provided in Appendix D. The report recommended a preferred road construction method that involves a cut of 2 m into the upslope of the fossil outcrop but minimises the volume of material for excavation. The report found that the additional road widening would be an acceptable impact to the geodiversity feature and could provide some benefits including making fossil materials available to research organisations and improving the safety and access to the features for the community.	The following measures are proposed to mitigate the impacts of the road construction on the fossiliferous bed: • Representative excavated spoil is to be preserved off site so that palaeontologists (from various research organisations) can look through the fresh material and collect fossil specimens for scientific research and curation in their respective collections. • Depending on the option of road upgrades to be implemented, interpretive signs could be installed in an appropriate location near the cuttings to highlight features in the exposures, provided the fossils were protected from being easily collected.

Table 3.2 Impact assessment of proposed road widening

Assessment of impacts	Additional mitigation measures
Biodiversity	
Lobs Hole Ravine Road has been subject to extensive and detailed biodiversity assessment, as outlined in the biodiversity development assessment report (EMM 2018b). In the northern section of proposed road widening one plant community type, 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 in low to moderate/good – Medium condition is mapped through this area. The revised design will result in a reduction in clearing of this PCT through this section of Lobs Hole Ravine Road by 0.16 ha. The area is subject to significant weed invasion, particularly from Blackberry. No threatened species credit species or key habitats for species credit species are mapped through this area. In the southern section of proposed road widening two plant community types, PCT 300 300 - 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 in moderate/good – High condition and PCT 643 Alpine shrubland on scree, rock streams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion in low condition is mapped through this area. The revised design will result in a reduction in clearing of PCT 643 by 0.05 ha and an increase in the clearance of PCT 300 by 0.05 ha through this section of Lobs Hole Ravine Road. No threatened species credit species or key habitats for species credit species are mapped through this area. It should be noted that these works have been designed to avoid the Smoky mouse habitat south of the proposed widening. The amended road design through the lower section of Lobs Hole Ravine Road will result in an overall reduction in impacts to biodiversity. No additional impacts to threatened species will result. Changes are considered negligible.	The revised design will be assessed as a part of the overall pre-clearing surveys, to determine actual impact arising from construction, as per the mitigation outlined in EMM (2018b). No other mitigation measures are warranted.
Aboriginal heritage	
Both sections of Lobs Hole Ravine Road proposed for widening have been previously assessed by NSW Archaeology in the Aboriginal cultural heritage assessment report (ACHAR) (2018a). No previously recorded Aboriginal sites or places were identified on AHIMS within the sections. The sections were covered by survey unit 21 (SU21) that followed Lobs Hole Ravine Road and covered a corridor 30 m wide. As such, the survey included the areas proposed for widening and did not identify any Aboriginal sites or areas of archaeological potential. The predicted artefact density for the survey unit was classed as low. Accordingly, the proposed road widening will not impact known Aboriginal sites or places and is unlikely to impact unknown Aboriginal objects.	No additional management measures required.

Table 3.2 Impact assessment of proposed road widening

Assessment of impacts	Additional mitigation measures
Historic heritage	
Both sections of Lobs Hole Ravine Road proposed for widening have been previously assessed by NSW Archaeology in the historical cultural heritage assessment report (HCHAR) (2018b). No previously recorded historical sites were identified on relevant historical search registers and no historical items were identified during survey for the HCHAR. The nearest heritage item is a ditch in Lick Hole Gully (R105) which is over 600 m north for the northern-most section. Overall, proposed road widening will not impact listed heritage items and is very unlikely to impact unknown heritage items or relics.	No additional management measures required.

3.5.3 Summary

In summary minor changes are proposed to the boundary of Lobs Hole Ravine Road in two sections. These changes are proposed to optimise the road design and improve safety. The overall change to the road boundary will reduce the size of the disturbance footprint. The environmental assessments undertaken for biodiversity, heritage and geodiversity found that the impacts from changing the design of these two road sections would be acceptable given the implementation of the additional mitigation measures.

CHAPTER 4

RESPONSE TO AGENCY AND COUNCIL SUBMISSIONS

4 Response to agency and council submissions

Reponses to the comments contained within the 11 respective state and local government submissions received are provided in the following subsections. Comments from the government agencies are presented verbatim within text boxes, with each respective comment followed directly with a response.

4.1 Office of Environment and Heritage – National Parks and Wildlife Service

4.1.1 Kosciuszko National Park

> The EIS does not address the following SEARs request; "identification of the impacts and management measures to allow continued NPWS Park Operations". OEH will require ongoing access for operational activities in and adjacent to the proposed work area for essential park management activities (ie fire management, weed control).
>
> OEH recommends their operational requirements can continue during the proposed works.

Access to carry out NPWS operational activities can continue within the Lobs Hole Ravine area during Exploratory Works. For safety reasons, Snowy Hydro is not able to guarantee continued site access and appropriate notification process and safety protocols will be discussed with NPWS during the preparation of the Environmental Management Strategy (EMS).

> The SEARs request; "a strategy for managing these impacts during construction and improving the amenity, recreational and conservation values of the KNP in the medium to long term". OEH and SHL are in negotiations to identify the terms of agreement for provision of a compensation package on KNP.
>
> OEH recommends that a formal head of agreement for a compensation package between SHL and OEH is finalised prior to construction.

Following extensive consultation with OEH, NPWS and DPE, and a review of submissions from a variety of interest groups and individuals, the best possible conservation outcome from the offset for Exploratory Works will be funding of conservation actions within the KNP, as stipulated in the SEARs.

The BC Act and its regulation (BC Regulation) don't allow for like-for-like offsetting through establishment of a stewardship site within KNP, or Biodiversity Conservation Fund (BCF) programs to be applied within national parks. If the offsets are to be realised within KNP the funding of a biodiversity conservation action that benefits the relevant threatened species or ecological community, as per section 6.2(c) of the BC Regulation, may provide the best option to enable this outcome. In addition, section 7.14 of the BC Act provides the NSW Minister for Planning with discretion on how offsets are provided.

OEH (NPWS) and Snowy Hydro will enter into a formal heads of agreement regarding the provision of compensation for predicted impacts on the KNP from the Exploratory Works for Snowy 2.0. OEH (NPWS) has confirmed their support of the general principles outlined within Snowy Hydro's recommended terms of agreement for provision of compensation.

These principles include:

- management measures/actions that achieve a direct conservation outcome KNP are preferred over out of park conservation or payment into the BCF;

- management measures/actions will seek to provide a net improvement in the biodiversity values of KNP over time;
- management measures/actions adopted should, where feasible, target threatened species, ecological communities or protected matters being impacted by the project;
- management measures/actions adopted should, where feasible, provide a measurable conservation gain for the threatened species, ecological communities or protected matters being impacted by the project;
- in some cases, a better conservation outcome may be achieved through broader management of the KNP that management measures/actions which target specific species;
- management measures/actions adopted will seek to provide a whole of catchment benefit, providing measurable conservation gains for biodiversity in KNP;
- management measures/actions will be informed by scientific advice and evidence, and will be transparent, effective and efficient; and,
- payment of any offsets by the project is to be made once and will be proportional to the residual impacts after all measures to avoid, minimise and mitigate impacts have been considered.

Snowy Hydro has agreed to compensate OEH (NPWS) for the following impacts of Exploratory Works on the KNP:

- Biodiversity – quantum for offsetting impacts under the BC Act through the biodiversity conservation actions pathway needs to be confirmed based on the actual area of land cleared, but preliminary estimates are in the order of $5,548,222. This would include programs and initiatives such as:
  - establish a program to restore and regenerate dry open Eucalypt forest and woodlands;
  - establish programs to restore habitat for species under threat in the KNP; and
  - develop Booroolong Frog Save our Species site in the Yarrangobilly River.
- Recreation – a monetary contribution of $410,000 to compensate for impacts to recreational users in and around the Exploratory Works area.
- Heritage – a monetary contribution of $160,000 for heritage management works in and around the Exploratory Works area.
- Land management – a monetary contribution of $1.39 million for land management works which includes the cost of weed and pest control programs for a period of 20 years.

In addition, Snowy Hydro has agreed to pay NPWS a biodiversity premium which is additional compensation for the predicted impacts to biodiversity recognising that the impacts will occur within a national park with unique environmental values. At the time of preparation of the RTS, the quantum of this biodiversity premium had not been agreed between NPWS and OEH.

The Biodiversity Offset Strategy which was provided to OEH and NPWS for review is within Appendix B of this RTS.

4.1.2 Rock emplacement areas

The EIS states that excavated material will be placed permanently within KNP at the proposed eastern emplacement area. Permanent placement of excavated material in KNP is not permitted unless OEH requires material for rehabilitation or reuse purposes.

As described in Section 3.2 of this report, the eastern emplacement area will be constructed as per the design and descriptions within the EIS. Suitable excavated rock will be sourced from this location for the subaqueous emplacement trial program.

In response to matters raised by OEH and in detailed discussions, any materials within the eastern emplacement area (that have not been subaqueously emplaced) that remain following the completion of Exploratory Works, should Snowy 2.0 Main Works not proceed, will be removed from KNP.

This material will be removed from KNP to nominated location(s) within five years of completion of Exploratory Works. The temporary stockpile will continue to be managed as per the design and descriptions within the EIS until all material is removed. Lick Hole Gully will then be rehabilitated.

The water management approach for the eastern emplacement seeks to:

- manage sediment laden runoff during establishment;
- manage ARD risks, through the selective placement of PAF material with AC material or acid neutralising material;
- capture and divert runoff from Lick Hole Gully around the emplacement;
- promote infiltration of direct rainfall onto the emplacement; and
- actively manage water quality risks by capturing all seepage from the emplacement. Captured water will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant at the portal construction pad.

The eastern and western emplacement areas will be rehabilitated following removal of all material. Lick Hole Gully will be resinated as part of the rehabilitation works. Geomorphic and ecological characterisation of Lick Hole Gully will be undertaken prior to disturbance to record the existing conditions and values of Lick Hole Gully. The rehabilitation approach will seek to create a physically stable landform that reinstates or improves the existing values.

The EIS states that excavated material will be placed permanently within KNP at the proposed eastern emplacement area. Dredge materials (removed from Talbingo Reservoir) are not to be stored in KNP.

Dredged sediment associated with the construction of the Middle Bay barge infrastructure will not be permanently stored on land. The dredged material will be subaqueously emplaced at nominated locations within Talbingo Reservoir.

The method of placement and management measures are outlined in Appendix L of the EIS. It is also further discussed in Section 4.3 in response to matters raised by DPI – Fisheries.

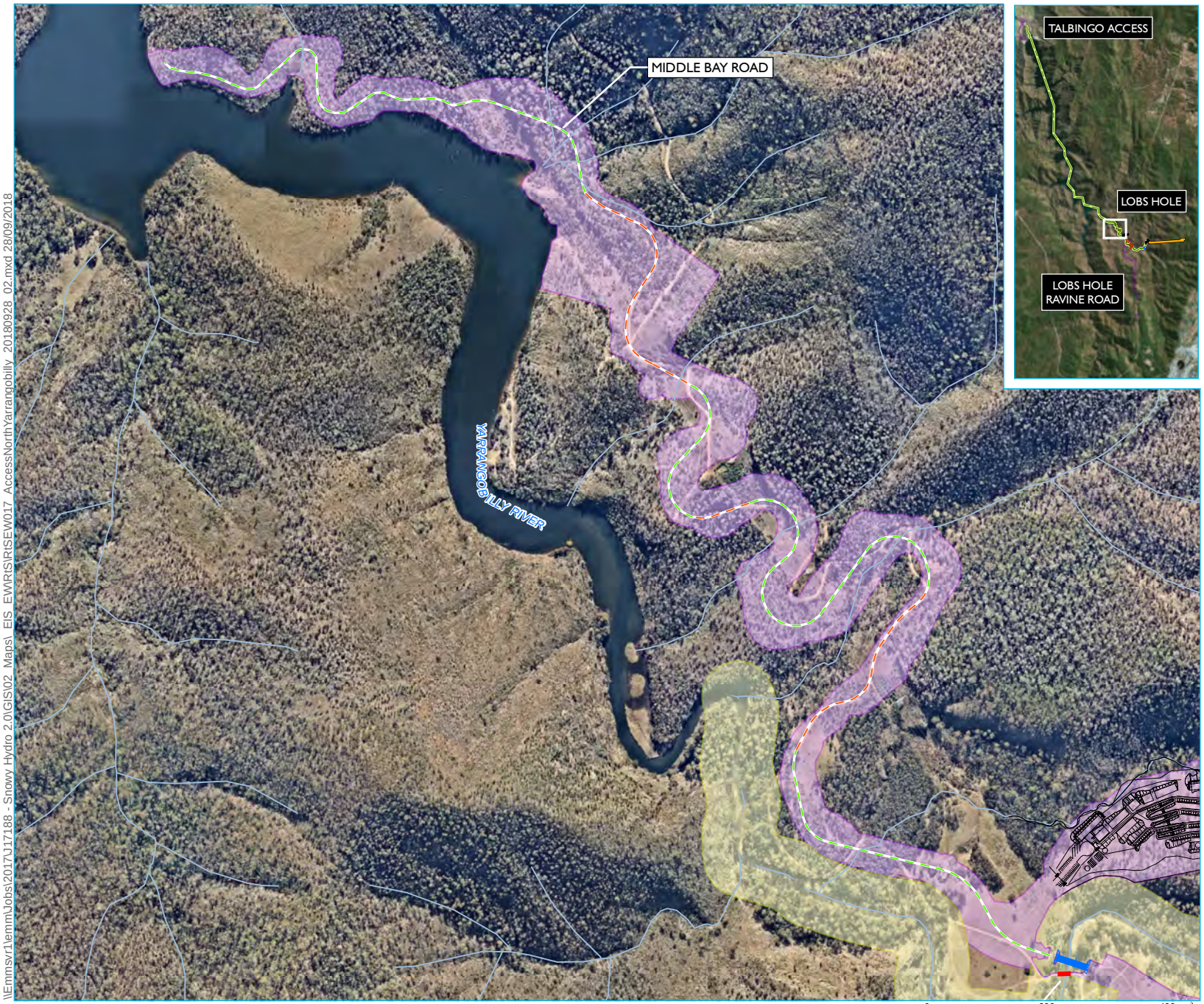
4.1.3 Traffic and transport

OEH seeks further information/justification on the new road alignment north of the Yarrangobilly River.

Exploratory Works comprises several road works to enable safe and continued access for the duration of the construction. There are several existing tracks at Lobs Hole in addition to the Lobs Hole Ravine Road which connects Lobs Hole to the Snowy Mountains Highway some 15 km to its north and 12 km to its south.

North of the Yarrangobilly River, roads works are proposed to establish Lobs Hole Road and Middle Bay Road. The establishment of these roads uses a mix of existing track (Lobs Hole Road) and new areas to provide for a safe and useable access for the construction of Exploratory Works.

Table 2.2 within the EIS described these works as an upgrade to the existing track for Lobs Hole Road and establishment of a new road for Middle Bay Road. The works associated with Lobs Hole Road, whilst upgrading sections of existing track, do also require establishment of new areas outside the existing track to provide for safe and continued access during construction. These new areas were considered in the EIS and are within the disturbance footprint assessed in the EIS. Figure 6.1 shows areas of existing and new track for Lobs Hole Road.



KEY

Access roads north of the Yarrangobilly River

- Access road upgrade
- Access road extension
- Temporary bridge
- Permanent bridge
- Watercourse
- Disturbance footprint
- Avoidance footprint

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

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Roads north of Yarrangobilly River at Lobs Hole

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 4.1

snowy2.0

EMM creating opportunities

The initial design works for Lobs Hole Road focused on using existing track where practical. However, in some areas, this was not practical where it compromised safe and continued access during construction of Exploratory Works. A summary of the design rationale is provided below.

- Road designs used a 'design vehicle' to determine where upgrades or divergences from the existing track were required.
- The 'design vehicle' swept paths (ie turning corners safely) were overlaid the existing track alignment.
- Existing topography (as this area is quite varied in terrain) and requisite cut and fill requirements to upgrade the existing alignment were evaluated against identified areas of divergence (and resultant cut and fill balance) from the existing alignment.
- Known environmental and engineering constraints, such as the vegetation type, 50 m buffer from the Yarrangobilly River (ie Booroolong Frog habitat), Yarrangobilly River flood plain and existing TransGrid easement and suspension towers, were also considered.

Integrating the above factors into the design considerations meant that divergences from the existing track north of the Yarrangobilly River were required to enable safe and continued access during construction.

Where divergences (or new sections of road) were required, environmental considerations were a key factor in determining the new alignment (eg minimizing cut and fill balance and avoiding encroachment into the 50 m buffer from the Yarrangobilly River). All these new sections of road have been considered in the vegetation disturbance calculations under the BC Act and form part of the Biodiversity Offset Strategy provided in Appendix B.

OEH seeks clarification as to whether a service road is proposed to be established beside the pipeline identified in Figure 2.13.

A services pipeline for the supply and discharge of water for Exploratory Works will pump water between Talbingo Reservoir and the exploratory tunnel portal and accommodation camp. The layout of the water services pipeline and associated water infrastructure is provided in Figure 2.14 of the EIS.

The pipeline (from the discharge/outlet to the accommodation camp and the portal construction pad) will be placed underground within the road alignment. As shown in Figure 2.13 of the EIS, a short section of pipeline, approximately 150 m in length from the inlet to the Lobs Hole Road will not be serviced by a formalised access road. It is likely this area near this section of pipeline would be used as ancillary facilities and laydown areas during construction. Should this be the case, access to the inlet would be gained via these laydown areas which would be established with environmental management controls implemented.

OEH seeks clarification on whether a temporary bridge or the splash crossing will be used prior to the establishment of a new permanent bridge over the Yarrangobilly River.

Continued access across the Yarrangobilly River during the construction of the permanent bridge is required. The EIS contemplated and assessed the construction of a splash crossing in this location. However, alternative design options have now been identified, which subject to detailed design, would result in the same or reduced environmental impact than the assessed splash crossing. These options include the installation of a pipe and culvert or a pre-fabricated 'Bailey bridge.

Snowy Hydro would consult with NPWS and DPI Fisheries regarding the final design to be constructed.

The EIS proposes public access restrictions for Lobs Hole Ravine Road from the Snowy Mountains Highway intersection in the north through to Ravine. Jounama Homestead and associated OEH recreational and heritage assets are situated within the first 6km of this road. OEH believe these assets could continue to be available to the public without significant impact on the project.

OEH recommends that public access is retained on Lobs Hole Ravine Road from Snowy Mountains Highway to Blue Creek Trail intersection.

Snowy Hydro accepts OEH's recommendation for retaining public access on Lobs Hole Ravine Road from Snowy Mountains Highway to Blue Creek Trail intersection. Snowy Hydro notes that this access may be used as an emergency access during Exploratory Works and appropriate protocols will be established during the preparation of the CEMP and relevant management plans.

The EIS identifies that the barge structure and Middle Bay Road will remain following works.

The infrastructure is not required for park management operations and would become a maintenance liability in the future. OEH does not support the retention (post construction) of the barge access infrastructure (including Middle Bay Road) and recommends that SHL provide detail on its removal and rehabilitation.

Middle Bay Road and the barge structure / infrastructure form an integral part of Exploratory Works access. It is intended for this infrastructure to remain for access for the construction and operation of Snowy 2.0, subject to it proceeding and obtaining the necessary planning and environmental approvals. During the construction and operation of Snowy 2.0, maintenance of this infrastructure would be carried out by Snowy Hydro.

Should Snowy 2.0 Main Works not proceed, this infrastructure will be removed, and areas rehabilitated in discussions with NPWS.

Link Road and Kings Cross Roads are OEH owned. OEH seek commitment that the CTMP and road dilapidation reports include Link Road and Kings Cross Road and require the routine defect assessment and subsequent rectification of damage for all OEH roads.

Snowy Hydro has committed to the preparation and implementation of a Construction Traffic Management Plan (CTMP) for Exploratory Works (refer to Section 5.6.4 of the EIS). The CTMP will include a Road Dilapidation Reports which would assess the current condition of the road surfaces the construction vehicles would traverse, including Link Road and Kings Cross Road, and describe mechanisms to restore any damage that may result due to its use by traffic and transport related to the project.

This Road Dilapidation Report will be submitted to the relevant road authority for review prior to the commencement of heavy vehicle movements. In the case of Link Road and Kings Cross Road, the report would be submitted to OEH.

Following completion of construction, a subsequent survey and report will be prepared to assess any damage to the roads accessed by all Exploratory Works heavy vehicles that may have resulted from the project. Consideration of damage caused during the Exploratory Works phase by construction vehicles that requires repairs to ensure network safety and efficiency, would be addressed by Snowy Hydro.

4.1.4 Geodiversity

The designs for Lower Lobs Hole Ravine Road are ambiguous regarding the impacts on the stream/bolder scree and fossil beds. No impact to occur to the stream/bolder scree and/or site of the Devonian strata fossil beds on Lower Lobs Hole Ravine Road.

Further design work since the public exhibition of the EIS has identified the need to alter the proposed road works in the fossiliferous area and boulder scree areas. These changes are required to ensure safe and continued access during construction of Exploratory Works. Section 3.5 provides a description and assessment of the proposed change to the Lobs Hole Ravine Road alignment in these sections.

Geodiversity/geoheritage specialists were commissioned to review the design options in these affected areas. These assessments are provided in Appendix D to this RTS and a summary provided below.

i Fossiliferous areas

The area is locally significant, principally as it is the only limestone of Devonian age in KNP. However, other areas of greater palaeontological significance of the Lick Hole Formation exist in the region, meaning that this area is not of significance to the region. Key observations regarding this area are listed below.

- The fossils found in the Lick Hole Formation occur in an artificial exposure (a road cutting, about 500 m in length) in which they are not evenly distributed.
- Based on the low dip of the beds and geological mapping in the vicinity, the fossiliferous beds extend into the ridge above the road. They also extend beneath the road surface (potentially up to a depth of over 500 m), based on the shallow dip of the bedding.
- The fossils are relatively unprotected at present – they continue to be subject to erosion and potential illegal collecting. Fossils such as complete brachiopod shells which occur at this site have a (small) value to collectors and dealers.

The proposed change in this section is described in Section 3.5. In simple terms, it requires a 2 m cut into the existing exposed fossiliferous area to minimise significant excavations of the existing road to avoid lateral disturbance. Of the design options considered, the proposed change presents to best opportunity to provide fossiliferous limestone, rather than have it buried, destroyed or used as fill.

Widening of road in this area is likely to yield fresher limestone that is very likely to contain more fossils. Careful management during these excavations will provide material for further research as well as enhanced opportunities for public education and interpretative signage of the outcrop, with measures to protect the fossils from erosion and scavenging. Management measures to be implemented (refer to Chapter 8) are listed below.

- Any excavated spoil is to be preserved off site so that palaeontologists (from Geoscience Australia in Canberra, ANU also in Canberra, the Geological Survey of NSW based in Sydney and Maitland, and the Australian Museum in Sydney) could look through the fresh material and collect fossil specimens for scientific research and curation in their respective collections.

- It would be advantageous to implement road safety improvements to the road which would benefit the general public in the longer term, as well as for the construction of Snowy 2.0 infrastructure.

- Depending on the option of road upgrades to be implemented, interpretive signs could be installed in an appropriate location near the cuttings to highlight features in the exposures, provided the fossils were protected from being easily collected.

ii Boulder screes (rock streams)

The boulder screes (known as rock streams) along Lobs Hole Ravine Road are locally significant as they provide information about the glacial history of the area. There are approximately 4,000 rock streams, boulder streams and similar features throughout the highlands of southeastern Australia. The rock streams with potential to be impacted by the proposed road works were bisected by the existing Lobs Hole Ravine Road in the late 19th century.

The proposed change in this section is described in Section 3.5 of this RTS. Road works will occur adjacent to rock streams in three sections on Lobs Hole Ravine Road. Road works in these sections will involve building a retaining wall/structure to avoid earthworks/disturbance downslope into the rock streams. To do this, the road needs to be built up vertically in this area. The retaining wall will be anchored into the existing road surface to provide for stability and safety. The road will be slightly widened in this area resulting in some encroachment, principally through fill, on the rock stream on the upslope.

The proposed changes to design in this section Lobs Hole Ravine Road upgrade will be carried out in such a manner as to minimise further damage to rock stream geoheritage features. Provided appropriate management measures are taken in the road construction methods, a safe and stable road can be constructed with minimal additional impacts to the periglacial deposits. Impact to the sites can be mitigated by ensuring widening the road is only done to the width needed to accommodate safe access for construction vehicles, which, in the area of the rock streams, would be minimal.

Management measures to be implemented (refer to Chapter 8) are listed below.

- Digging the road deeper (downslope) into the rock stream should be avoided where practical, and excavations that take place to widen the road should be undertaken on the upslope side of the road.

- Because rock streams are stacked cobbles and boulders, they are extremely porous and permeable, they almost always sit in a valley or depression with potential water flow moving along their base. Appropriate drainage should be constructed under the road to ensure no build-up of water occurs above the road, within the rock stream, during heavy rain.

- Educational signage should be provided in a nearby suitably widened area to provide information on the periglacial rock stream geoheritage features.

- If any works are required to stabilise upslope sections of rock stream it is recommended that open mesh wire fencing is used so the general public and scientists can see and appreciate the architecture of the deposit. Building a solid wall or spraying concrete on the upslope side should be avoided.

SEAR's requirements for Land identify "an assessment of any impacts on the Yarrangobilly and Ravine Karst system". The EIS does not consider the possibility of encountering un-recorded limestone during the construction of the exploratory tunnel.

OEH recommends that an appropriately scheduled monitoring regime of Karst features is implemented during construction. Should impact on Karst be detected works are to be suspended until an appropriately qualified and independent karst specialist/hydrologist assess and develop an OEH endorsed action plan.

The Yarrangobilly Limestone member has not been intercepted through recent drilling activities, nor is there any record of the unit at depth near Wallaces Creek, where the Exploratory Tunnel will be constructed.

Whilst limestone is not expected to be intercepted, Snowy Hydro will commit documenting any limestone intercepted through the construction of the exploratory tunnel, and where appropriate will pre-grout areas of expected high groundwater inflow to prevent potential changes in the local hydrology including flow within any unidentified karst features. This commitment will be included in the Exploratory Works Water Management Plan.

4.1.5 Heritage

The proponent has demonstrated a consideration of potential impacts to ACH and provided an Aboriginal Cultural Heritage Assessment Report (ACHAR) consistent with the SEARs.

EH strongly support the commitment for the preparation of a Cultural Heritage Management Plan to identify the management and mitigation measures required for Aboriginal cultural heritage values.

This comment is noted.

The Lobs Hole water race identified as R45 and R81 in Appendix P is identified as being impacted in Table 18 "not all this item would be impacted by the works". SHL to clarify the extent of the impact on Lobs Hole water race.

The Lobs Hole water race is recorded as two historic items in the HCHAR (NSW Archaeology 2018b, Appendix 3): R45 and R81. These are long linear features separated by Wallaces Creek. It is uncertain if they were once joined, although it is possible they were (perhaps by a timber overhead section of race, or other). Both were a part of the Lobbs Hole Copper Mine infrastructure (see Plan ML 9 Mineral Oil Lease in HCHAR, Appendix 3: 331). Note races are labelled as *Applicants race* (Julius Forsstrom).

The water races are shown on Figure 6.2 where it demonstrates that impacts to some sections of each water race will be avoided. Approximately one third of R45 is within the disturbance footprint whereas most of R81 is within the disturbance footprint and only small sections in the southern, middle and northern parts of it will be avoided.

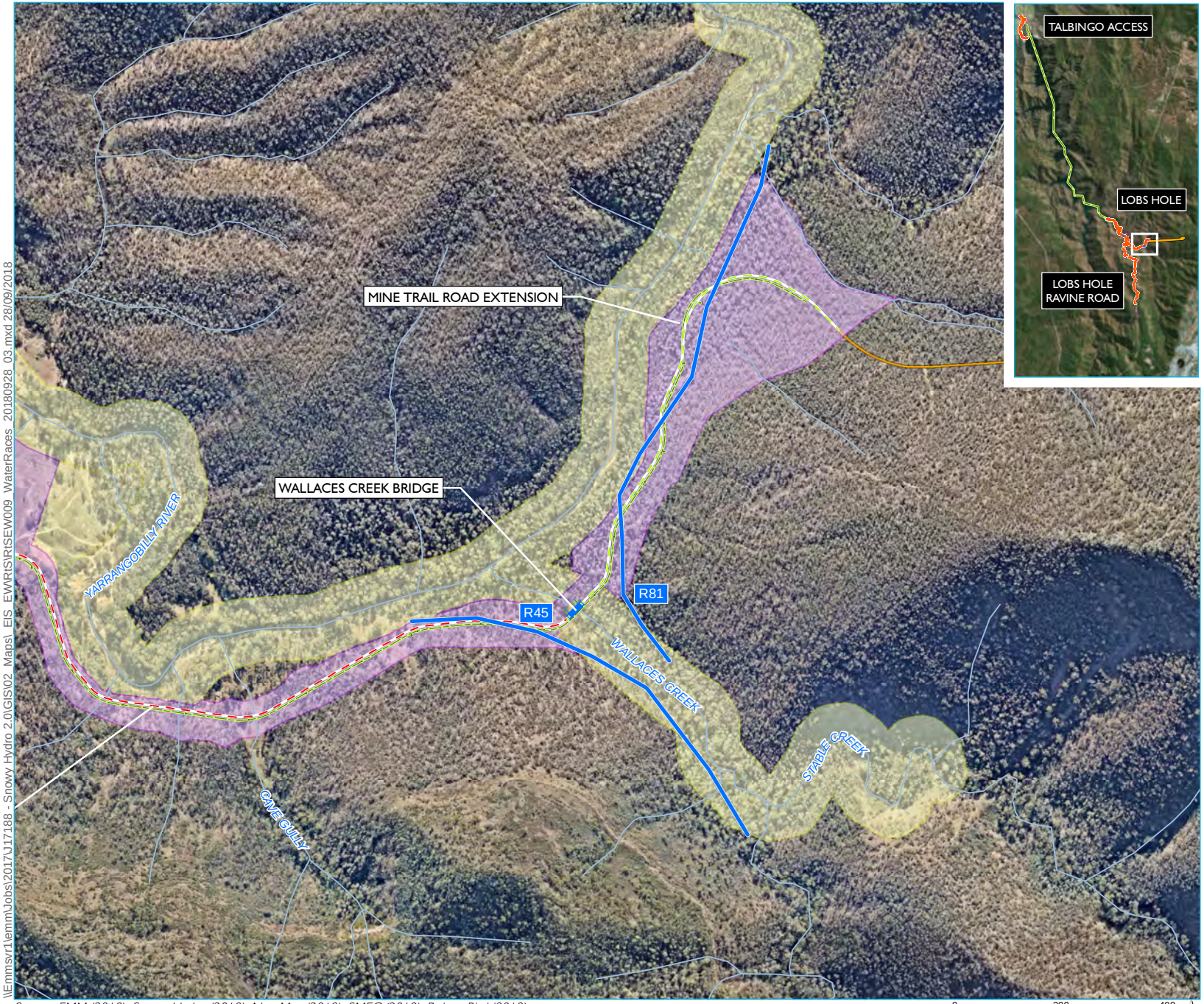
The impact on the items within the disturbance footprint may involve disturbance of the remnant water race channel. However, as it is was probably hand excavated (NSW Archaeology 2018b, Appendix 3) and does not seem to feature any structural components, the primary impact will be to the historical alignment rather than destruction of any archaeological fabric.

The impact to the Lobs Hole water race will be mitigated through an archival recording program as described in response to matters raised by NSW Heritage Council with revised management measures provided in Appendix C. These items will also be considered in an archaeological research design and excavation method report as a contributory item to the Lobs Hole Copper Mine Complex (refer Appendix C). The report will identify if archaeological excavation of the items is warranted, considering that there is low potential for structural features to be identified.

The pisé structure associated with the Washington Hotel ruins is adjacent to the Lobs Hole Road upgrade and the Camp Bridge installation. A qualified heritage architect is to undertake a pre-work condition assessment (including photographic records) for the Washington Hotel ruins. Following initial condition assessment, a monitoring regime is to be implemented to ensure vibration associated with the works avoid harm to pisé structure.

A qualified heritage specialist will undertake a pre-work condition assessment (including photographic records) for the Washington Hotel ruins (Item R20) with an ongoing monitoring regime implemented to ensure vibration associated with the works avoids harm to the pisé structure. This will be set out in the Cultural Heritage Management Plan (CHMP) prepared for Exploratory Works.

A suitably qualified heritage specialist, rather than a heritage architect specifically, is considered suitable for the assessment due to the nature of the ruins, which appear from investigations carried out so far to retain limited architectural integrity. Further, the association of surrounding features with the Washington Hotel will be investigated during the implementation of the CHMP to ensure that the features are recorded as one site.



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

Water race and disturbance from Exploratory Works

Snowy 2.0
Response to submissions
Exploratory Works
Figure 4.2

The CHMP must:

- be prepared in consultation with RAPs, NPWS Tumut Brungle, Gundagai Aboriginal Community Executive Advisory Committee and OEH;
- include procedures relating to:
  - establishing a 50 metre buffer zone from the bank of the Yarrangobilly River to protect the likely presence of Aboriginal cultural items;
  - minimising ground surface impacts
  - mitigating impacts in areas assessed to be of higher significance value in the form of partial impacts only (i.e. conservation of part of an Aboriginal site or Survey Unit) and/or salvage in the form of further research and archaeological analysis prior to impact;
  - conducting additional archaeological assessment including monitoring and salvage excavations after clearance, if required;
  - undertaking salvage excavations in five Survey Units (SU2, SU6, SU7, SU10 and SU25) to mitigate impacts to the archaeological resource in the project area.
  - set out guidelines for the management of movable heritage;
  - set out guidelines for ongoing consultation with the Aboriginal community and provide opportunities for undertaking a cultural values assessment and Aboriginal oral history recordings; and
  - include an unexpected finds protocol for Aboriginal and European objects and sites, including reference to the management of the unknown locations of unmarked graves at Lobs Hole.

Snowy Hydro will prepare separate CHMPs to manage Aboriginal heritage and historical heritage values, respectively, as outlined in the ACHAR and HCHAR (NSW Archaeology Pty Ltd 2018a and 2018b). These would be prepared prior to commencement of construction to allow for appropriate management of heritage values prior to and during all works. The CHMPs will include the information requested by OEH in their submission, as summarised in the above.

In respect of Aboriginal heritage, the development of the CHMP would be undertaken in consultation with the Registered Aboriginal Parties, NPWS Tumut Brungle Gundagai Aboriginal Community Executive Advisory Committee and the OEH.

For Aboriginal heritage, the CHMP would set out:

- procedures to manage impacts, avoidance of impacts and impact mitigation in accordance with the ACHAR recommendations and those as required by OEH (above);
- procedures relating to the conduct of additional archaeological assessment, if required, and the management of any further Aboriginal cultural heritage values which may be identified;
- guidelines for ongoing consultation and opportunities for cultural values assessment; and
- an unexpected finds protocol for Aboriginal objects and sites; and human skeletal material.

In respect of historic heritage, the CHMP would:

- set out procedures to manage impacts, avoidance of impacts and impact mitigation in accordance with the HCHAR recommendations;
- set out an unexpected finds protocol and the procedure to be followed for monitoring to undertaken for the purposes of inspecting areas for unrecorded heritage, when preliminary clearance of vegetation is made;

- outline a protocol for the management of potential unmarked graves and other human skeletal material in the project area; and
- set out guidelines for the management of movable heritage anywhere in or near the project areas, to ensure that it is not inadvertently impacted or removed.

4.1.6 Biodiversity

The Biodiversity Development Assessment Report (BDAR) has been correctly applied and provides an accurate calculation of the biodiversity credits required to be retired.

The BDAR provides a comprehensive inventory of the biodiversity values present in the development area and thorough assessment of impacts likely to result from the proposed works. The consultants EMM had ongoing discussions with OEH staff through all stages of the BDAR preparation, which has resulted in agreed solutions for avoiding and minimising impacts, including loss of breeding habitat for key threatened species that occur on site.

Impacts to Smoky Mouse and Booroolong Frog habitat have been reduced significantly from the Preliminary Environmental Assessment document. This was a key consideration in the avoidance of impacts and the identification of a development footprint acceptable to OEH. If in the development of the detailed engineering works plans the impact exceeds the calculated 0.2 ha in case of Smoky Mouse and 2.04 ha in the case of Booroolong Frog then the serious and irreversible impacts will need to be reassessed, and additional credits calculated to offset the new areas of impact.

The preparation of a Biodiversity Offset Strategy as described in the EIS is supported by OEH.

Recommended actions/condition of approval:

- The conditions of the consent reflect the BOAR derived credits to be retired are calculated as $5,548,222.
- That a biodiversity offset strategy be prepared for development applying the framework and guiding principles described in Section 5.14 of the EIS.
- That the offsets credits accruing be applied in the form of conservation actions focussed on improving the biodiversity and conservation values of Kosciuszko National Park in the medium to long term.

OEH's endorsement of the BDAR (EMM 2018b) and Biodiversity Offset Strategy (refer to Appendix B of this RTS) is noted. Snowy Hydro accepts the recommended biodiversity actions and proposed conditions of approval as articulated in OEH's submission.

It should be noted that this RTS proposed minor changes to the disturbance footprint with assessments undertaken and presented in Chapter 3 of this RTS. Additional vegetation clearance associated with these changes do not materially change the previously assessed biodiversity impacts for Exploratory Works.

The final credit requirements would be calculated before commencement of construction following completion of detailed design.

It is stated that a nursery would be established in the Ravine area. OEH has stated that a nursery is not to be established within KNP.

The EIS stated that an area near Camp Bridge had been identified for a plant nursery and organic stockpile area with no proposed clearing of vegetation required. This nursery and stockpile area would be managed by contractor personnel living at the accommodation camp with plants and organic material sourced from within KNP.

This location ensures impacts on existing vegetation and fauna habitat are avoided and provides a preferable location with regards to access for rehabilitation and environmental conditions for growing. A plant nursery and organic stockpile area within the disturbance footprint managed by personnel who would be within the accommodation camp avoids additional traffic movements that would be inevitable if it were to be managed by personnel external to the project area.

Similarly, using plant and organic materials from locations outside KNP would result in significant additional daily traffic movements to bring these materials to site for rehabilitation purposes.

The impact of collection of seed and plant materials in KNP and the associated impacts have not been addressed.

OEH has stated that any collection of seed in KNP is to only occur within the disturbance area.

This comment is noted and will be documented in the Biodiversity Management Plan.

4.1.7 Flooding

OEH has reviewed the flooding component in Section 5.4 and Appendix M of the EIS. The EIS addresses the Secretary's requirements for flooding.

This comment is noted.

OEH supports the proposed development of a Flood Emergency Response Plan due to the flash flood nature of the catchment.

A flood emergency response plan will be prepared as part of the emergency response plans for Exploratory Works. As discussed in Section 5.4 of the EIS, Exploratory Works elements avoid flood prone land where possible. However, some infrastructure will unavoidably need to be constructed on flood prone land.

The SWA (EMM 2018c) concluded that the predicted changes to flood regimes will not impact infrastructure or items of heritage significance. The accommodation camp and portal construction pad will both be predominantly established above the Probable Maximum Flood (PMF) extent and will therefore provide flood refuge for site personnel.

Residences and other critical infrastructure must be located above the PMF level in the accommodation camp precinct.

The SWA (EMM 2018c) proposes that flood risk to life will be managed through a flood emergency response plan and provision of designated flood refuge facilities above the PMF level.

The SWA (EMM 2018c) does not provide information on proposed flood planning levels for specific infrastructure. It is proposed to have the following critical infrastructure above the PMF level:

- tunnel portal entrance;
- critical infrastructure such as generators and communication facilities;

- any facilities that store hazardous materials (ie fuel storage facilities);
- flood refuge facilities; and
- medical treatment facilities.

Minimum floor levels for accommodation facilities and other non-critical infrastructure will be established based on the 1% AEP level plus 500 mm of freeboard. This is the approach recommended in the *Floodplain Development Manual* (DIPNR 2005) and is generally adopted in NSW. The detailed design of Exploratory Works will adopt this approach should alterations be made to the location of the accommodation facilities and other non-critical infrastructure within the disturbance footprint.

With reference to Figures C6 and C12 in the SWA (EMM 2018c) the accommodation camp and portal construction pad will be predominately established above the PMF level. Hence, evacuation of any facilities that are below the PMF level to designated flood refuge locations can be practically achieved.

The Flood Emergency Response Plan include an Emergency Evacuation Procedure developed in collaboration with the NSW SES.

A flood emergency response plan will be prepared as part of the emergency response plans for Exploratory Works. Refer to Section 5.4 of the SWA (EMM 2018c) for further information. Given the regional location of the project, the response plan will propose evacuation to onsite flood refuge locations rather than off-site evacuation.

A flood emergency response will be managed by the contractor. Sufficient systems and monitoring equipment will be in place to monitor rainfall and flood conditions to allow for the coordination of an emergency response. No assistance from the NSW State Emergency Service (SES) is expected to be required. Accordingly, it is not proposed to consult with the NSW SES. It is also noted that the NSW SES will generally not comment on flood emergency response plans.

4.1.8 Subaqueous placement

It is noted that the proposal includes a trial project for subaqueous placement of rock spoil into Talbingo Dam. The EIS proposes that a strategy be prepared for managing and monitoring the rock emplacement in the dam post EIS exhibition. The strategy should include:

- Assessment on the potential for fine particles from placement of excavated rock to be carried by the current, reaching and being discharged downstream of the Talbingo Reservoir.
- Sampling of the river below the dam to establish baseline conditions for existing community composition and river health.
- Surveys to establish the spatial extent and abundance of the Murray Crayfish (Euastacus armatus) in the Talbingo Reservoir and assessment of the impacts of the proposal on this species.
- Assessment of micro-invertebrate community composition in and around the proposed subaqueous rock placement areas, prior to any placement of rock in the dam.
- A macroinvertebrate monitoring program to detect and measure change in the Tumut River downstream of the Talbingo Reservoir.

As described in Section 3 of the Subaqueous Excavated Rock Placement Program (the SERP Report) (Appendix C of the *Barge Access Infrastructure report* (EIS Appendix L)), a series of measures are proposed during the initial subaqueous excavated rock placement (SERP) program to minimise any impacts from the program. These measures include:

- selecting rock that minimises the risk and extent of water quality impacts from physical (eg turbidity) and chemical (eg reduction in pH) changes;
- a range of physical controls, including the use of a fall pipe on the discharge barge to release excavated rock below the water surface and siltation curtains; and
- a real-time monitoring program that will compare water quality to agreed water quality criteria.

Further information is provided in response to EPA (refer to Section 4.2) and details of the controls and monitoring program will be provided in the Water Management Plan.

The outer-most monitoring point at which water quality criteria will need to be met will be 500 m (at the surface) or 1 km (in deep water) from the exterior silt curtain separating the placement area from the remainder of the reservoir. Corrective actions will be taken should water quality criteria be exceeded. These may include modifying the SERP or the environmental controls and ultimately ceasing SERP if the criteria cannot be met over a longer period.

These measures will prevent impacts to the northern end of Talbingo Reservoir (the T3 power station intakes and Talbingo Reservoir Spillway are at least 13 km from the placement areas) so with the implementation of the proposed management measures; there will be no impacts downstream of Talbingo Reservoir as a result of the SERP program.

As described above, the Tumut River below the dam is at least 13 km from the SERP areas and no impacts are predicted downstream of the dam/T3 power station because of SERP. The water quality in Talbingo Reservoir, including the northern part of the reservoir has been characterised (with further characterisation underway) and is indicative of the water quality of water discharged from the reservoir. Characterisation of the community composition downstream in the Tumut River downstream of the dam is not warranted for assessment of SERP as part of Exploratory Works due to the distance of the SERP from the T3 power station intakes and as water quality criteria will need to be met within 1 km of the placement areas.

Additional surveys, targeting Murray crayfish, will be carried out in early October 2018 to further investigate the presence, spatial extent and abundance of Murray crayfish within proposed emplacement areas in Talbingo Reservoir. Further information regarding this program and monitoring to be carried out post-approval is described within the response to similar matters raised by DoI – Fisheries in Section 4.3.

4.1.9 Groundwater dependent ecosystems

Groundwater Dependent Ecosystems (Stygofauna) are an important component of the KNP ecosystem. However they are inadequately addressed in the EIS. It is noted that further baseline data is to be gathered as part of the groundwater assessment on water quality. Further assessment (detailed below) should be included as part of this work and undertaken on Groundwater Dependent Ecosystems (Stygofauna). It is to include:

- A stygofauna assessment and monitoring program in the shallow aquifers, springs and caves to verify the presence of any stygofauna communities and to assess impacts during construction.
- Assessment of impacts to any identified stygofauna communities and mitigation measures and/or impact minimisation measures are devised to the satisfaction of OEH, for their protection.

Snowy Hydro will undertake further monitoring of Stygofauna post-approval. This will include commitment to sampling and interpretation and analysis of results to develop a strategy for potential mitigation.

Snowy Hydro proposes to meet with the OEH post-approval to agree on suitable parameters for the monitoring program.

4.1.10 Soil and land

> Adequate and appropriate soil erosion control measures are to be implemented particularly around drainage lines, roads and soil materials which have moderate - high erosion risk such as the Brown Tenosols and Red Dermosols, Grey Kandosols.

A summary of mitigation and management measures, one of which relates to soil erosion control measures is provided in Table 7.1 of Soil and Land Assessment (EMM 2018d) contained in Appendix H of the EIS. This measure outlines that erosion and sedimentation controls will be implemented to minimise erosion potential, particularly in areas of dispersive soils, in accordance with the guideline Managing Urban Stormwater, Volume 2A Installation of Services, or equivalent.

Erosion and sediment control plans (ESCPs) will be developed specifically for the construction works and these will address areas of increased erosion potential such as around drainage lines, roads and soils of increased erosion potential as well as all areas of disturbance.

Further information regarding erosion and sediment control during the construction of the access roads is provided in Section 4.2 in response to matters raised by the EPA.

> Land and Soil Capability (LSC) must incorporate the condition of the soil materials before respreading and refer to report OEH (2012) *The land and soil capability assessment*.

Section 6.4.1 of the Soil and Land Assessment (EMM 2018d) details soil stripping depth requirements and Section 7.1.5 details measures to minimise soil degradation, including topsoil and subsoil management and topsoil application procedure as part of rehabilitation works. This section addresses the condition of the soil materials prior to respreading. The land and soil capability class will be achieved through the management of topsoil and subsoil as outlined in sections 6.4.1 and 7.1.5 of the Soil and Land Assessment (EMM 2018d).

The land and soil capability assessment scheme: second approximation (OEH 2012) has been used as a guide on assessing the capability of the land to support different agricultural land uses. The document has not been correctly referenced in Section 6.3 of the Soil and Land Assessment (EMM 2018d) contained in Appendix H of the EIS, as it only refers to the 'scheme'.

> The following corrections and additions to the Soil and Land assessment report are required if it is considered to adequately address soil issues:
>
> - Raw soil profile descriptions to be detailed.
> - Soil erosion risk interpretations should be described as moderate not low.
> - Section 6.2 states that All disturbed land will be rehabilitated and returned to the agreed land use. This should be changed to 'All disturbed land will be rehabilitated and returned to the previous land and soil capability class'.

Soil profile information has been provided to OEH's Soils and Land Information System (SALIS) via the edirt platform which outlines all soil profile descriptions. This is a standard practice in NSW.

For each soil type within Chapter 4 of the Soil and Land Assessment (EMM 2018d) contained in Appendix H of the EIS, a section discussing the soil erosion potential has been included. This section has used the soil survey physical data and the soil chemical analysis data to provide a considered analysis of the erosion risks for that particular soil type (including the variability within a soil type). Some sites will have low risk while others will have moderate risk. This variability will be accounted for by the development of site-specific ESCPs for disturbance areas for construction works.

If agreed with NPWS, government regulators and other relevant stakeholders there may potentially be some areas of disturbance associated with infrastructure that remains following the cessation of the project. This has been addressed through the statement that all disturbed land will be rehabilitated and returned to the agreed land use. It is not feasible to state that all land will be reinstated to pre-existing land capability as some infrastructure upgrades will result in permanent changes should Snowy 2.0 proceed. These are outlined in Section 6.3 of the Soil and Land Assessment (EMM 2018d). For Exploratory Works, it is very likely that re-disturbing rehabilitated areas will be avoided for the Main Works. Section= 6.2 of the Soil and Land Assessment (EMM 2018d) provides flexibility, with the agreement of stakeholders, for the most suitable outcomes in rehabilitation.

4.1.11 Noise and vibration

SEAR's requirements for Land identify "an assessment of any impacts on the Yarrangobilly and Ravine Karst system". The EIS does not assess blast or vibration impacts on features in the Ravine or Yarrangobilly Karst.

The proximity of the Ravine and Yarrangobilly Karst systems to the Exploratory Works blasting and construction activities has been reviewed. The closest works at the northern end of the portal construction pad are approximately 700 m from the Ravine Karst whilst tunnelling/blasting activities at the exploratory tunnel portal entrance are generally more than 850 m from the Ravine Karst system.

The existing alignment of Lobs Hole Ravine Road traverses the Ravine Karst structure. A review of the Figure 3.2 of EIS identified heritage sites closer to works than the Ravine Karst that require limitations on the maximum instantaneous charge (MIC) and ground vibration impacts. The control of the MIC's to protect these heritage items would also limit any ground vibration impacts on Karst structures. Figures 6.3 and 6.4 have been updated to incorporate the extent of the Karst areas relative to the Exploratory Works area.

Upgrades and construction work for Lobs Hole Ravine Road will be managed in accordance with the assessment criteria outlined in Section 4.4.2 of the Noise and Vibration Assessment (EMM 2018e), contained in Appendix T of the EIS.

The Yarrangobilly Karst area is in excess of 6 km from the construction and tunnelling works and considering the distance separation would not be expected to receive any noise or vibration impacts. If noise and vibration impacts are managed to the closest assessment locations, locations significantly further away from the construction site, such as Yarrangobilly Caves, would also be managed.

Notwithstanding the limitations to MIC's imposed by the proximity of heritage items, blasting activities would adopt the limits of Australian Standard AS 2187.2 – 2006 "*Explosives - Storage and Use - Use of Explosives*" that recommends frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 "*Evaluation and measurement for vibration in buildings Part 2*" be used as they are 'applicable to Australian conditions'. Appropriate engineering investigations and advice will be part of the management process of ensuring these Karst areas are not impacted. A review of BS 7385 Section 7.5.5 also notes that structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition.

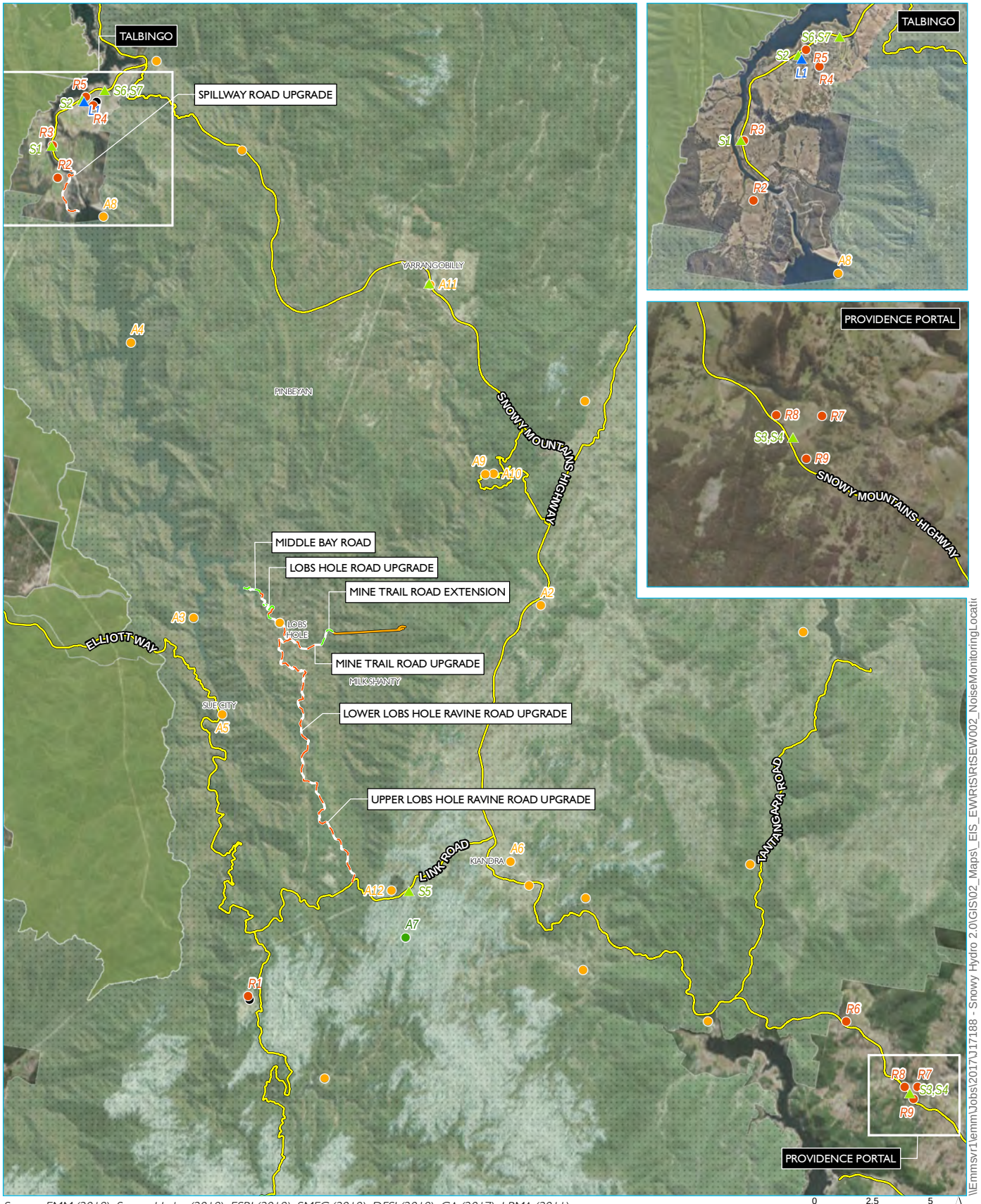
Yarrangobilly Caves precinct and associated accommodation facilities are not considered as a residential site, but rather passive recreation areas with respect to the noise and vibration impact assessments.

A review of Noise and Vibration Assessment (EMM 2018e) contained in Appendix T of the EIS, confirms that assessment location A9 was inadvertently labelled as Yarrangobilly campground in Table 3.1 and referenced as passive recreation in Table 6.2. It is acknowledged that accommodation is provided in the area comprising Yarrangobilly Village at location A9 depicted in Figure 3.1. These properties are owned by NPWS and for the purposes of assessing noise, operate as a commercial entity, including the accommodation facility.

Under the definitions of the *Interim Construction Noise Guideline* (ICNG) (DECC 2009) commercial assessment locations include temporary accommodation (such as caravan parks and camping grounds), which require a target external noise management level (NML) of 70 dB(A). For comparison purposes the ICNG recommends a target external NML of 60 dB(A) for passive recreation.

A more conservative approach would be to assess this location as a hotel type receiver having internal noise targets as per the appropriate AS2107 category. This would require an internal target noise level of 30-35 dB(A). Notwithstanding the difference in classification, the predicted noise levels outlined in Table 6.2 of the Noise and Vibration Assessment (EMM 2018e) confirm contributions under calm and noise enhancing meteorological conditions are <30 dB(A) externally and satisfy the requirements of the CNG for all receiver categories at the Yarrangobilly Caves precinct.

To provide further clarification, Table 4.1 has been updated to confirm the receiver descriptions, classifications and locations. Table 4.2 has also been updated for assessment location A9 classification. These are provided below.



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

KEY

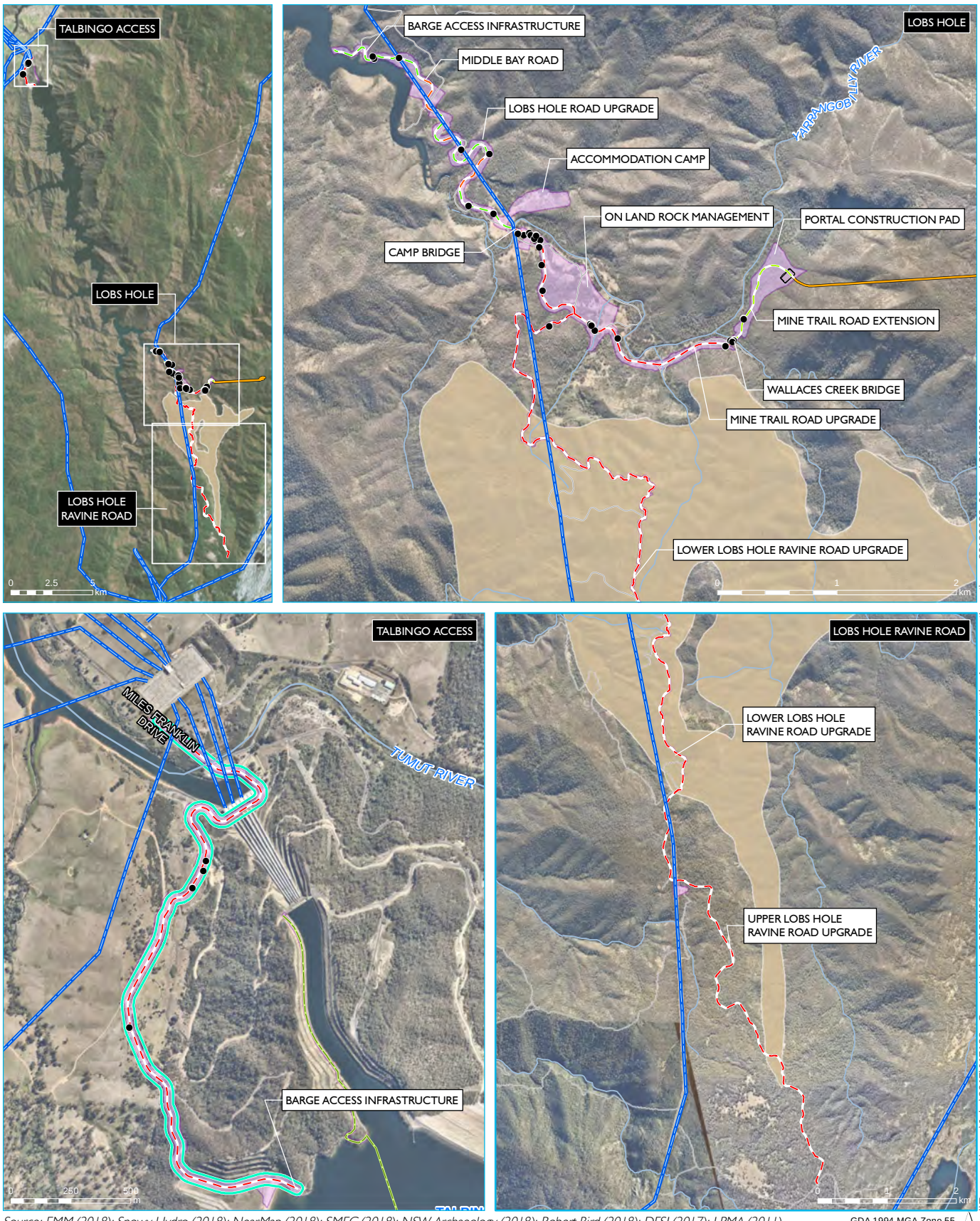
- Exploratory tunnel
- Access road upgrade
- Access road extension
- Main road
- Kosciuszko National Park
- State forest
- Attended noise monitoring location
- Unattended noise monitoring location

Receptors

- Passive recreation
- Active recreation
- Township
- Residential

Noise monitoring and assessment locations

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 4.3



\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWRtSIRtSEW003_VibrationAssessmentLocations_20180928_03.mxd 28/09/2018

Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); NSW Archaeology (2018); Robert Bird (2018); DFSI (2017); LPMA (2011)

GDA 1994 MGA Zone 55

N

KEY

- Access road upgrade
- Access road extension
- Exploratory tunnel
- Main road
- Local road or track
- Watercourse
- Disturbance footprint
- Ravine Karst areas
- Vibration assessment location
- Heritage site
- Electricity transmission line

Vibration assessment locations

Snowy 2.0
Response to submissions
Exploratory Works
Figure 4.4

Table 4.1 Noise assessment locations

ID	Description	Classification	Easting	Northing
A1	Buddong Falls	Passive recreation	612949	6054947
A2	Bullocks Hill campground	Passive recreation	637207	6039763
R1*	Cabramurra town	Residential	624617	6022721
A3	Coonara Point rest area	Passive recreation	622202	6039251
A4	Fishing	Passive recreation	618305	6056565
A5	O'Hares camp ground and rest area	Passive recreation	623443	6035053
A6	Old Kiandra	Passive recreation	635905	6028711
A7	Selwyn Ski resort	Active recreation	631364	6025420
R2	Buddong Cottage	Residential	616339	6058255
R3	563-571 Murray Jackson Drive	Residential	616128	6059648
A8	Talbingo reservoir rest area	Passive recreation	619502	6051134
R4	Talbingo town	Residential	617997	6061517
A9	Yarrangobilly Village	Commercial^	634825	6045448
R5	Talbingo Town#	Residential	617383	6061614
R6	6560 Snowy Mountains Highway#	Residential	650414	6021798
R7	6076 Snowy Mountains Highway#	Residential	653506	6018950
R8	6078 Snowy Mountains Highway#	Residential	652944	6018961
R9	6074 Snowy Mountains Highway#	Residential	653314	6018430
A10	Yarrangobilly Caves	Passive recreation	635163	6045458
A11	Yarrangobilly Village campground	Passive Recreation	632425	6053636
R11	Private properties at Nurrenmerenmong	Residential	615307	6040979
A12	Three Mile Dam campground	Passive recreation	630757	6027446

** Owned by the proponent*

 # Road traffic noise assessed only

^ Commercial property operated by National Parks and Wildlife Service (NPWS) and assessed as internal noise levels in accordance with AS/NZS 2107:2016.

Table 4.2 Predicted access construction noise levels

Assessment location	Classification	Period	Noise affected NML, dB	Highly noise affected NML, dB	Predicted construction noise level, dB LAeq,15min		Level above noise affected NML, dB LAeq,15min	
					Calm	Noise-enhancing	Calm	Noise-enhancing
A1	Passive recreation	Standard	60	n/a	<30	<30	0	0
		OOH	60	n/a	<30	<30	0	0
A2	Passive recreation	Standard	60	n/a	<30	<30	0	0
		OOH	60	n/a	<30	<30	0	0
R1[1]	Residential	Standard	40	75	<30	<30	0	0
		OOH	35	n/a	<30	<30	0	0

Table 4.3 Predicted access construction noise levels

Assessment location	Classification	Period	Noise affected NML, dB	Highly noise affected NML, dB	Predicted construction noise level, dB LAeq,15min		Level above noise affected NML, dB LAeq,15min	
					Calm	Noise-enhancing	Calm	Noise-enhancing
A3	Passive recreation	Standard	60	n/a	<30	<30	0	0
		OOH	60	n/a	<30	<30	0	0
A4	Passive recreation	Standard	60	n/a	<30	<30	0	0
		OOH	60	n/a	<30	<30	0	0
A5	Passive recreation	Standard	60	n/a	<30	<30	0	0
		OOH	60	n/a	<30	<30	0	0
A6	Passive recreation	Standard	60	n/a	<30	<30	0	0
		OOH	60	n/a	<30	<30	0	0
A7	Passive recreation	Standard	60	n/a	<30	<30	0	0
		OOH	60	n/a	<30	<30	0	0
R2	Residential	Standard	40	75	37	40	0	0
		OOH	35	n/a	37	40	**2**	**5**
R3	Residential	Standard	40	75	30	33	0	0
		OOH	35	n/a	30	33	0	0
A8	Passive recreation	Standard	60	n/a	44	47	0	0
		OOH	60	n/a	44	47	0	0
R4	Residential	Standard	40	75	<30	<30	0	0
		OOH	35	n/a	<30	<30	0	0
A9	Commercial^	Standard	50	75	<30	<30	0	0
		OOH	45	n/a	<30	<30	0	0

Notes: 1. Property owned by the proponent however has been conservatively assessed as a residential receiver.

^ Commercial property operated by NPWS and assessed in accordance with AS/NZS 2107:2016, eg 35dB(A) internal (night-time), becomes 45dB(A) external accounting for windows open for ventilation.

4.1.12 Public safety

Due to the location of the works area, constraints on access/egress during bush fire situations make appropriate on-site refuge critical.

OEH recommends a wildfire refuge is to be established and a village protection plan is to be prepared.

Section 5.6 of the *Snowy 2.0 Exploratory Works Bushfire Hazard and Risk Assessment* (EMM 2018f) (BFRHA) contained in Appendix V of the EIS recommends that a community bush fire refuge be established for Exploratory Works and provides standards and guidelines applicable to the design and construction of the refuge.

The *Kosciuszko National Park Plan of Management* (NPWS 2006) (KNP PoM) requires the NPWS to ensure that fire protection strategies (Village Protection Plans) are prepared by leaseholders for all lease areas within the KNP. The *Kosciuszko National Park Fire Management Strategy 2008-2013* (NPWS 2008) (KNP FMS) presents strategies and controls used to protect assets and values identified within the KNP FMS as being at risk from fire.

The KNP FMS identifies that Village Protection Plans that identify implementation of APZ standards and implementation of pre-season preparation actions contribute to the protection of assets from damage by fire. It also identifies that several actions taken prior to the commencement of each fire season can improve the survivability of buildings and other assets (pre-season actions). The KNP FMS states that the pre-season actions shall be implemented by all lease holders and staff living in all accommodations within the KNP and the actions shall be undertaken immediately before and then periodically throughout the fire season.

These Village Protection Plan requirements and associated pre-season actions, as outlined within the KNP FMS, and associated management measures and commitments were considered and incorporated into the BFRHA (EMM 2018f), where considered appropriate for Exploratory Works.

The KNP FMS notes that Cabramurra is a Snowy Hydro asset, identified in the KNP lease. The KNP FMS recognises that the maintenance of Cabramurra as an asset, for the purposes of bushfire protection and mitigation of risks is addressed in Chapter 3 and associated annexure of the *Snowy Hydro Emergency Management Plan*. The KNP FMS further notes that Chapter 3 of the S*nowy Hydro Emergency Management Plan* provides for a range of measures and risk mitigation processes for general Snowy Hydro asset protection like those required for a Village Protection Plan. The KNP FMS concludes that accordingly, a separate Village Protection Plan is not required to be prepared for Cabramurra. Therefore, a plan is not required for the accommodation camp at Lobs Hole.

The BFRHA (EMM 2018f) is sufficiently detailed to address the standard requirements of BFSA issued by the RFS for development proposals. Therefore, the BFRHA (EMM 2018f) addresses those elements identified within the KNP FMS for a Village Protection Plan specifically a detailed risk assessment using the RFS risk assessment methodology involving a detailed analysis of fire history, vegetation types and topography, as well as assessment of proximity of contiguous flammable vegetation to the asset as per APZ guidelines. The BFRHA (EMM 2018f) along with commitments to mitigation and management measures, including commitment to the *Snowy 2.0 Exploratory Works Bush fire Management Plan* (BFMP) and *Snowy 2.0 Exploratory Works Bush Fire Emergency Response and Evacuation Plan* will provide such detail (addressing the requirements listed within the KNP FMS for a Village Protection Plan) that a separate Village Protection Plan for the Exploratory Works is not proposed.

The mitigation measures provided in Table 5.1 have been updated to ensure that those elements listed in the KNP FMS for a Village Protection Plan (and listed above) are incorporated into the BFMP and *Snowy 2.0 Exploratory Works Bush Fire Emergency Response and Evacuation Plan*. Given the dynamic nature of the construction area, it is important the BFMP is a dynamic document regularly reviewed and approved by relevant agencies before Spring each year. This will allow sufficient time for corrective actions to be implemented before the commencement of the bushfire season. The plans will be provided to NPWS for comment.

A perimeter road around the accommodation facility is to be constructed within the current footprint.

Section 5.2.1 of the BFRHA (EMM 2018f) contained in Appendix V of the EIS, identifies that at the detailed design stage, consideration should be given to a fire trail, around the perimeter of the accommodation camp and within the APZ of the camp. This would provide access for fire fighting vehicles performing property protection, in the event of a bush fire in proximity to the camp. This fire trail could also form part of the inner protection area (IPA) of the APZ around the accommodation camp.

If incorporated into the design of the accommodation camp, the fire trail would need to comply with the applicable standards set out in *Planning for Bushfire Protection 2006* (RFS) for fire trails, as well as those set out in the KNP FMS (NPWS 2008). This fire trail could be accommodated within the current APZ which will be considered in the detailed design of Exploratory Works.

OEH routine fire management operations, including hazard reduction can continue during construction.

Yes, however sufficient notice of the proposed hazard reduction program in the area would be required. This is to allow the provision of feedback to OEH should this coincide with an activity where adverse impacts may be encountered from smoke, for example.

4.2 Environment Protection Authority

4.2.1 Surface water discharge quality

The EPA's review of the EIS has identified the need for the proponent to undertake surface water discharge quality impact assessments for discharges to receiving waters. The assessment will need to identify the environmental values of the receiving waters affected by any discharge (in accordance with the NSW Water Quality Objectives), assess the significance of any impacts on those environmental values, and consider the practical measures that need be taken to restore or maintain those environmental values. The default environmental values for waterways in the Snowy catchment include aquatic ecosystems protection, raw drinking water (for treatment), and primary and secondary recreation, with technical criteria derived using ANZECC/ARMCANZ (2000). Irrigation, livestock and homestead water use are recommended as additional environmental values outside Kosciuszko National Park.

Whilst the EIS nominates discharge criteria for the proposed sewage wastewater treatment plant, these criteria are based on other treatment facilities in the region. This approach is inconsistent with s.45 of the Act as it does not provide for case and site-specific matters to be considered. This includes the need to account for the different receiving waters, environmental values of the receiving waterway and what practical and reasonable methods are available to maintain those values.

i Water quality objectives for Talbingo Reservoir and Yarrangobilly River

The *NSW Water Quality and River Flow Objectives* (DECCW 2006) provides Water Quality Objectives that are consistent with ANZECC/ARMCANZ (2000) water quality guidelines for the protection of the aquatic environment. The Water Quality Objectives are "primarily aimed at maintaining and improving water quality, for the purposes of supporting aquatic ecosystems, recreation and where applicable water supply and the production of aquatic foods suitable for consumption and aquaculture activities" (DECCW 2006).

Water Quality Objectives are provided for catchments throughout NSW (DECCW 2006). Talbingo Reservoir and the Yarrangobilly River, the waterbodies potentially impacted by the Exploratory Works, are within the Murrumbidgee River and Lake George catchment. Specifically, they are classified as 'Streams affected by Snowy Scheme'. It is noted that the term 'Yarrangobilly River' in this response should be taken to include the lower reach of Wallaces Creek and minor tributaries impacted by Exploratory Works.

The following Water Quality Objectives are identified for 'Streams affected by Snowy Scheme':

- Protection of:
    - aquatic ecosystems;
    - visual amenity;
    - secondary contact recreation;
    - primary contact recreation;
    - irrigation water supply;
    - homestead water supply;
    - drinking water at point of supply-disinfection only;
    - drinking water at point of supply-clarification and disinfection;
    - drinking water at point of supply-groundwater; and
    - aquatic foods (cooked).

The Water Quality Objectives to be met and the application of these Exploratory Works are summarised in Table 4.3.

Table 4.4 Application of Water Quality Objectives

Environmental values	Water Quality Objective	Application to Exploratory Works
Aquatic ecosystems	Maintaining or improving the ecological condition of water bodies and their riparian zones over the long term	There are aquatic ecosystems immediately downstream of the Exploratory Works. The protection of aquatic ecosystems is the primary water quality objective to be met.
Visual amenity	Aesthetic qualities of waters	There will be no public views or access to the Yarrangobilly River downstream of Exploratory Works. Views to the majority of the Yarrangobilly Arm of the Talbingo Reservoir will be restricted as this area will be closed to public access. There will be views to most of Talbingo Reservoir from boats and public access areas at the north and south ends of the reservoir.
Secondary contact recreation	Maintaining or improving water quality for activities such as boating and wading, where there is a low probability of water being swallowed	There will be no public views or access to the Yarrangobilly River downstream of Exploratory Works for secondary contact recreation such as boating. Other than in the Yarrangobilly Arm, public boating on Talbingo Reservoir will continue.

Table 4.4 Application of Water Quality Objectives

Environmental values	Water Quality Objective	Application to Exploratory Works
Primary contact recreation	Maintaining or improving water quality for activities such as boating and wading, where there is a high probability of water being swallowed	There will be no public views or access to the Yarrangobilly River downstream of Exploratory Works for primary contact recreation such as swimming. Public access to the O'Hares Rest Area at the south end of Talbingo Reservoir will be maintained. This is about 7.5 km from the start of the Yarrangobilly Arm where Exploratory Works activities will occur. Public access at the north end of Talbingo Reservoir, inclusive of swimming, will be maintained (at the proposed Talbingo boat ramp recreation area – refer to Chapter 3 of this RTS). This area is approximately 18 km from the start of the Yarrangobilly Arm where Exploratory Works activities will occur and 16 km north of the Plain Creek Bay emplacement area.
Irrigation water supply	Protecting the quality of waters applied to crops and pastures	No water is extracted from the Yarrangobilly River or Talbingo Reservoir for irrigation. Water discharged from Talbingo Reservoir enters Jounama Pondage and is subsequently released into Blowering Reservoir about 25 km from the Plain Creek Bay emplacement area. Water discharged from Blowering Reservoir (25 km) is used for irrigation. Given these distances and associated dilution of any water discharged from Exploratory Works activities, the trigger values for irrigation water supply are not a primary consideration.
Homestead water supply	Protecting water quality for domestic use in homesteads, including drinking, cooking and bathing	No water is extracted from the Yarrangobilly River or Talbingo Reservoir for homestead water supply. Water discharged from Talbingo Reservoir is used for homestead water supply, downstream of Talbingo Reservoir. Given these distances and associated dilution of any water discharged from Exploratory Works activities, the trigger values for homestead water supply are not a primary consideration.
Drinking water at point of supply – Disinfection only Drinking water at point of supply – Clarification and disinfection Drinking water at point of supply – Groundwater	These objectives apply to all current and future licensed offtake points for town water supply and to specific sections of rivers that contribute to drinking water storages or immediately upstream of town water supply offtake points. The objective also applies to sub-catchments or groundwaters used for town water supply.	No water is extracted from the Yarrangobilly River for drinking water supply. Water discharged from Talbingo Reservoir is used for drinking water supply, downstream of Talbingo Reservoir. Given these distances and associated dilution of any water discharged from Exploratory Works activities, the trigger values for these uses are not a primary consideration.
Aquatic foods (cooked)	Refers to protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities.	Recreational fishers use Talbingo Reservoir. However, the trigger values for aquatic foods apply to aquaculture not recreational fishing. The required level of protection will be provided by meeting the trigger values for aquatic ecosystems.

ii Trigger values and discharge criteria

Since the publication of the EIS, Snowy Hydro has engaged with the EPA regarding the establishment of trigger values and further investigation of proposed treatment methods and controls which have been used to derive the discharge criteria for Exploratory Works. Revisions to the treatment methods and controls for wastewater, process water and stormwater are further described in Section 3.4 of this RTS and in the subsequent sections in response to matters raised by the EPA.

Trigger values applicable to each water quality objective are provided in DECCW (2006). The trigger values vary depending on the environmental value, with the trigger values for the protection of aquatic ecosystems generally being the lowest. Meeting the trigger values for the protection of aquatic ecosystems will ensure that the other water quality objectives will be achieved.

Tables 4.4 and 4.5 below provide for the derived trigger values and proposed discharge criteria for Talbingo Reservoir:

- wastewater for the accommodation camp (Table 4.4); and
- process water for the portal construction pad (Table 4.5).

Derived trigger values and proposed stormwater discharge criteria for stormwater into the Yarrangobilly River are provided in Tables 4.6, 4.7 and 4.8 for sediment and turbidity, nitrogen and phosphorus concentrations, respectively.

The establishment of criteria considered identified potential impacts and all practical controls to avoid or mitigate identified impacts. It is important to note that the controls presented are design principles or objectives, that will be further developed in the detailed design of the Exploratory Works. The management measures assessed are presented to determine the feasibility of achieving the proposed discharge water quality. The management measures implemented may vary from those presented but will still need to meet the proposed water quality or other stated objectives.

Table 4.5 Treated waste water discharge quality

	Units	Trigger value[1]	Max	DF
Physio-chemical				
Electrical conductivity (EC)	µS/cm	20–30	20-30	1
pH	-	6.5–8.5	6.5–8.5	-
Turbidity	NTU	2–25	<25	<1
Oil & grease	mg/L	5[2]	<5	<1
BOD	mg/L	-	<5	-
Nutrients				
Total ammonia - N	mg/L	0.01	0.1	10
Oxidised nitrogen (NOx)	mg/L	0.01	0.1	10
Total nitrogen (TN)	mg/L	0.35	0.2	<1
Reactive phosphorus	mg/L	0.005	0.06	12
Total phosphorus (TP)	mg/L	0.01	0.06	6
Pathogenic organisms				
E-coli	cfu/100 mL	150	<1	<1
Enterococci	cfu/100 mL	35	<1	<1

Table 4.5 Treated waste water discharge quality

	Units	Trigger value[1]	Max	DF
Protozoans	orgs/100 mL	nil	0	<1
Metals (dissolved)[2]				
Aluminium (Al)	mg/L	0.055	<0.055	<1
Cadmium (Cd)	mg/L	0.0002	<0.0002	<1
Chromium (Cr)	mg/L	0.001[3]	<0.001	<1
Copper (Cu)	mg/L	0.0014	<0.001	<1
Nickel (Ni)	mg/L	0.011	<0.004	<1
Lead (Pb)	mg/L	0.0034	<0.001	<1
Zinc (Zn)	mg/L	0.008	<0.008	<1

Notes: *1. Trigger values for Talbingo Reservoir*

2. Estimated metal concentrations are based on water quality data from publicly available information from large waste water treatment plants that have similar treatment processes. These values are potentially conservative as the reference plant receives some industrial waste via trade waste discharges.

3. For Cr(VI).

Max - refers to the maximum concentration. Typical or median concentrations are expected to be substantially lower.

DF - refers to dilution factor, which is calculated as the maximum concentration / trigger value.

Table 4.6 Treated process water discharge quality

	Units	Trigger value[1]	Groundwater inflows		Untreated process water[2]		Treated process water[3]			
			Median	Max	Median	Max	Median	DF	Max	DF
Physio-chemical										
Electrical conductivity (EC)	µS/cm	20–30	780	1,122	780	1,122	780	26	1,122	37
pH	-	6.5–8.0	8.4	9.3	6.5–8.0	6.5–8.0	6.5–8.0	1	6.5–8.0	1
Turbidity	NTU	1–20	1–20	1–20	50-100	150	1–20	1	1–20	1
Oil & grease	mg/L	5	Nil	Nil	<5	10	<5	1	<5	1
Nutrients										
Total ammonia - N	mg N/L	0.01	0.16	0.30	0.16	0.30	0.05	5	0.1	10
Oxidised nitrogen (NO_x)	mg N/L	0.01	0.03	0.20	0.6	0.8	0.18	18	0.25	25
Total nitrogen (TN)	mg N/L	0.35	0.55	0.70	0.6	1.0	0.23	<1	0.35	1
Reactive phosphorus	mg P/L	0.005	0.01	0.01	0.15	0.3	0.02	4	0.05	10
Total phosphorus (TP)	mg P/L	0.01	0.06	0.66	0.3	0.66	0.02	2	0.05	5
Metals (dissolved)										
Aluminium (Al)	mg/L	0.055	-	-	<0.055	0.01	<TV	<1	<TV	<1
Cadmium (Cd)	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<TV	<1	<TV	<1
Total chromium (Cr)	mg/L	0.001	0.001	0.013	0.003	0.013	<TV	<1	<TV	<1
Copper (Cu)	mg/L	0.0014	0.0015	0.004	0.003	0.007	<TV	<1	<TV	<1
Mercury (Hg)	mg/L	0.00006	<0.0001	<0.0001	<0.0001	<0.0001	<TV	<1	<TV	<1
Nickel (Ni)	mg/L	0.011	0.002	0.008	0.002	0.008	<TV	<1	<TV	<1
Lead (Pb)	mg/L	0.0034	<0.001	<0.001	<0.001	<0.001	<TV	<1	<TV	<1
Zinc (Zn)	mg/L	0.008	0.0095	0.128	0.020	0.128	<TV	<1	<TV	<1

Notes: 1. Trigger values (chronic) for Talbingo Reservoir.

2. Untreated process water accounts for some contamination due to tunnel construction activities.

3. Treated process water quality information is based on water treatment analysis and other available data.

DF - refers to dilution factor, which is calculated as the maximum concentration / trigger value. TV – refers to trigger value.

Table 4.7 Expected sediment and turbidity values

Category	Turbidity (NTU)		Suspended solids (mg/L)		Comments
	Typical	Max	Typical	Max	
Trigger value (Yarrangobilly River)	2–25		-		
Construction areas (<2,500 m²) and constrained access roads	2–50	150	25	40	Typical values from construction sites with best practice erosion and sediment controls.
Construction areas (>2,500 m² with chemical treatment)	2–25	25	<5	20	Water treatment chemicals will reduce turbidity and suspended solids levels.
Access roads (with basins)	2–25	50	<10	25	Constructed wetlands style basin will provide improved treatment during flow through conditions.
Accommodation camp	2–25	50	<10	25	Lower concentrations expected due the use of native landscaping and limited trafficable hardstand areas. Constructed wetlands style basin will provide improved treatment during flow through conditions.
Portal construction pad (with chemical treatment)	2–25	25	<5	20	Water treatment chemicals will reduce turbidity and suspended solids levels.

Notes: 1. Estimates are based on water quality data from representative sites.

Table 4.8 Expected nitrogen concentrations in stormwater runoff

Category	Oxidised nitrogen (mg N/L)		Total nitrogen[2, 3] (mg N/L)		Comments
	Typical	Max	Typical	Max	
Trigger value (Yarrangobilly River)	0.015		0.25		
Construction areas (<2,500 m²) and constrained access roads	0.2	0.5	0.6	1.5	Elevated nitrogen is generally not associated with elevated suspended sediments.
Construction areas (>2,500 m² with chemical treatment)	0.2	0.5	0.4	1.5	Water treatment chemicals may reduce organic nitrogen levels. No material reduction in oxidised nitrogen is expected.
Access roads (with basins)	0.1	0.4	0.4	1.0	Constructed wetlands style basin will provide treatment during flow through conditions.
Accommodation camp	0.1	0.4	0.4	1.0	Source controls such as native landscaping will reduce concentrations. Constructed wetlands style basin will provide treatment during flow through conditions.
Portal construction pad (with chemical treatment)	0.2	0.5	0.6	2.0	Higher concentrations expected due to the extensive impervious area. Water treatment chemicals may reduce organic nitrogen levels. No material reduction in oxidised nitrogen is expected.

Notes: *1. Estimates are based on water quality data from representative sites.*

2. Ammonium concentrations are expected to be similar to trigger values and are therefore not reported.

3. The majority of total nitrogen is expected to be in organic form, which has low bioavailability.

Table 4.9 Expected phosphorus concentrations in stormwater runoff

Category	Reactive phosphorous (mg P/L)		Total phosphorous (mg P/L)		Comments
	Typical	Max	Typical	Max	
Trigger value (Yarrangobilly River)	0.015		0.02		
Construction areas (<2,500 m^2) and constrained access roads	0.04	0.12	0.08	0.2	Elevated phosphorus can be associated with elevated suspended sediments.
Construction areas (>2,500 m^2 with chemical treatment)	0.02	0.05	0.02	0.05	Water treatment chemicals will reduce phosphorus concentrations.
Access roads (with basins)	0.02	0.05	0.05	0.1	Constructed wetlands style basins will provide improved treatment during flow through conditions.
Accommodation camp	0.02	0.05	0.05	0.1	Source controls such as native landscaping will reduce concentrations. Constructed wetlands style basin will provide treatment during flow through conditions.
Portal construction pad (with chemical treatment)	0.02	0.05	0.02	0.05	Water treatment chemicals will reduce phosphorus concentrations.

Notes: *1. Estimates are based on water quality data from representative sites.*

Further information regarding the treatment methods and controls to be implemented for wastewater, process water and stormwater are further described in Chapter 3 of this RTS and provided in an updated SWA in Appendix E.

The EIS did not include a mixing zone assessment for the discharges from the portal and sump water treatment plant and sewage wastewater treatment plant. The EPA advises that if a mixing zone is proposed, mixing zone modelling is recommended to enable an assessment of potential impacts from the portal and sump treated water and treated sewage wastewater discharges.

EPA understands that geochemical testing of the primary rock types as well as results of hydrodynamic modelling and sediment transport modelling were not available at the time of EIS submission. The EPA advises that the impact assessments should be undertaken using any additional data and other relevant information, and revised as necessary

The EPA recommends the proponent:

a) identify the relevant NSW Water Quality Objectives and environmental values for the receiving waters, including indicators and associated trigger values or criteria, in accordance with the National Water Quality Management Strategy and ANZECC/ARMCANZ 2000 guidelines. The guideline values for Talbingo Reservoir should refer to the ANZECC/ARMCANZ 2000 values for lakes and reservoirs for physical and chemical stressors;

b) characterise each proposed discharge to waters in terms of the expected concentrations and loads of all pollutants that may be introduced into the water cycle by source and discharge point, including residual discharges after mitigation measures are implemented;

c) assess the significance of any identified impacts including considering the relevant ambient water quality outcomes consistent with the practices and principles of the ANZECC/ARMCANZ 2000 Guidelines and relevant trigger values;

d) demonstrate that all practical and reasonable measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented;

e) Demonstrate how the proposal will be designed and operated to:

i)protect the Water Quality Objectives for receiving waters where they are currently being achieved; and

ii)contribute to achieving the Water Quality Objectives over time where they are not being achieved;

f) Propose additional or alternative treatment measures if non-trivial risks to waters are identified;

g) If a mixing zone is proposed, a mixing zone assessment that includes the full range of potential pollutants should be conducted. The level of the mixing zone assessment should be commensurate with the potential impacts on water quality and the restoration and protection of environmental values;

h) Propose discharge criteria for any pollutants that have the potential to cause non-trivial harm based on the impact assessment

As discussed in Section 4.2.1(ii), since the publication of the EIS, Snowy Hydro has engaged with EPA regarding the establishment of trigger values and further investigation of proposed treatment methods and controls which have been used to derive the discharge criteria for Exploratory Works. Revisions to the treatment methods and controls for wastewater, process water and stormwater are further described in Chapters 3 and 5 of this RTS.

A revised SWA incorporating EPA's requests in the matter raised above is provided in Appendix E. A summary of the key aspects is provided below.

iii Treatment methods, controls and discharge regime

As referenced in the preceding section, the establishment of criteria considered identified potential impacts and all practical controls to avoid or mitigate identified impacts. It is important to note that the controls presented are design principles or objectives, that will be further developed in the detailed design of the Exploratory Works. The management measures assessed are presented to determine the feasibility of achieving the proposed discharge water quality. The management measures implemented may vary from those presented but will still need to meet the proposed water quality or other stated objectives.

Discharges into Talbingo Reservoir via a piped outlet are proposed for both wastewater (from the accommodation camp) and the process water (from tunnel water at the portal construction pad and emplacement area runoff) management systems.

Additional treatment methods are designed to reduce metals and nutrients to manageable levels. Discharge quality criteria have been derived and are proposed based on achieving these treated levels. These criteria are documented in Tables 4.4 to 4.8.

Some constituents may exceed the water quality objectives at the point of discharge in Talbingo Reservoir. Because of this, a mixing zone is proposed. Modelling, using the hydrodynamic model for

Talbingo Reservoir, determined the size of the mixing zones for these discharges was less than 10 m (ie the water quality objectives of the Talbingo Reservoir are met within 10 m of the discharge point). This is considered negligible considering the size and flow of the reservoir.

a. Wastewater

A high-performance water treatment plant will be installed to meet the criteria specified in Table 4.4. The plant is likely to require regular local operational activities and remote monitoring.

The criteria specified in Table 4.4 will require a mixing zone of less than 10 m from the discharge point in Talbingo Reservoir (ie within the near-field mixing zone).

Further detailed information is available within the revised SWA provided in Appendix E of this RTS.

b. Process water

A high-performance water treatment plant will be installed to meet the criteria specified in Table 5.5.

The criteria specified in Table 4.5 will require a mixing zone of less than 10 m from the discharge point in Talbingo Reservoir (ie within the near-field mixing zone).

Further detailed information is available within the revised SWA provided in Appendix E of this RTS.

c. Eastern emplacement area

Since publication of the EIS, Snowy Hydro has responded to matters raised by EPA and NPWS regarding the management of the eastern emplacement area. As described in Section 3.2 of this RTS, the eastern emplacement area will now be a temporary stockpile for the duration of Exploratory Works rather than a permanent landform. Any materials remaining in the eastern emplacement area (that have not been subaqueously emplaced) upon completion of Exploratory Works, should Snowy 2.0 Main Works not proceed, will be transported off site out of KNP to a nominated location within five years of the completion of Exploratory Works. Given the change in its use, a revised active water management regime, rather than a passive design, is now proposed.

Water quality risks associated with emplacement seepage will be actively managed by capturing all seepage. Captured seepage (water) will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant (as described above). Lick Hole Gully will be diverted around the emplacement to minimise the volume of emplacement seepage.

The water management approach for the eastern emplacement seeks to:

- manage sediment laden runoff during establishment;
- manage ARD risks, through the selective placement of PAF material with AC material or acid neutralising material;
- capture and divert runoff from Lick Hole Gully around the emplacement;
- promote infiltration of direct rainfall onto the emplacement; and
- actively manage water quality risks by capturing all seepage from the emplacement. Captured water will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant at the portal construction pad.

The eastern and western emplacement areas will be rehabilitated following removal of all material. Lick Hole Gully will be resinated as part of the rehabilitation works. Geomorphic and ecological characterisation of Lick Hole Gully will be undertaken prior to disturbance to record the existing conditions and values of Lick Hole Gully. The rehabilitation approach will seek to create a physically stable landform that reinstates or improves the existing values.

d. Stormwater

Exploratory Works stormwater discharges are likely from the following sources:

- areas disturbed by construction;
- access roads for the duration of Exploratory Works;
- the accommodation camp for the duration of Exploratory Works; and
- the portal construction pad for the duration of Exploratory Works.

A thorough investigation has been carried out to design best practice stormwater controls to avoid sediment-laden water traversing these areas, in the first instance, and then secondly, design of appropriately sized basins in the available area to control sediment loads and minimise uncontrolled discharges. The design of these controls considered several factors, listed below.

- duration of disturbance;
- proposed basin functionality and size (ie treatment volume);
- proposed chemical treatment; and
- discharge frequency and regimes.

Chemical water treatment is proposed to improve the water quality of discharge from construction areas and the portal construction pad basin. The following treatment approach is proposed:

- Sedimentation dams will be partitioned into inlet and settling zones.
- Water will be pumped from the inlet zone into a chemical dosing and mixing unit. An iron salt coagulant and calcium carbonate will be dosed at a controlled rate and will be allowed to mix in a series of gravity mixing tanks. Outflow from the tanks will be discharged through floc blocks to add an anionic polymer flocculent.
- The settling zone will be sized to facilitate settling at the design treatment rate.

For non-terrain constrained construction areas that have catchment areas of greater than 2,500 m^2, the water treatment system will be incorporated into sedimentation basins. The chemical water treatment system will be designed to treat the 1 year ARI peak flow.

A similar system will be implemented for terrain constrained areas that have catchment areas of greater than 2,500 m^2. As sedimentation basins are not practical in terrain constrained areas, a pump-out system and a mobile water treatment plant will be used. The design treatment rate will be the 1 in 3 month ARI peak flow. The lower capacity is due to the need for settling to occur in tanks, rather than a basin.

The treatment approach is expected to provide the following water treatment benefits:

- suspended solid concentrations and turbidity levels will be significantly reduced;
- phosphorus concentrations will be significantly reduced; and
- the anionic polymer flocculent will improve suspended solids capture and settling rates and tends to bind dissolved metals. Hence, some dissolved metal concentrations will be reduced (if they are elevated in stormwater).

The use of calcium carbonate will provide a buffer against changes to pH and potential iron salt coagulant overdoses. The use of the proposed treatment chemicals will result in a minor (10 to 30 µS/cm) increase in salinity during discharges. This will be an unavoidable effect of using water treatment chemicals. The change to salinity levels can be minimised by optimising dosing rates.

The proposed approach is not expected to increase the toxicity of discharge due to the addition of iron salt coagulant and calcium carbonate if the dosing mechanism is operated effectively. Regular local input and monitoring is proposed to ensure the system is operating effectively.

The proposed source controls for all stormwater categories will remove coarse sediment. This will prevent sedimentation impacts (ie where sediment is deposited on the bed from sediment laden water) in receiving waters. Chemical water treatment is proposed to improve the water quality of discharge from construction areas and the portal construction pad basin. This is expected to remove fine and dispersive sediments and reduce suspended solid concentrations and turbidity levels.

Table 4.9 provides a summary of the stormwater discharge regimes following consideration of the above factors, inclusive of treatment and controls.

Table 4.10 Stormwater discharge regimes

Category	Duration of disturbance	Proposed basin size	Discharge regime and frequency
Construction areas (not including the portal construction pad)	Construction of all surface infrastructure will be completed within the initial 9 months only. Disturbance durations for individual construction areas will range from less than a week to several months	**Basin type**: Sedimentation basin, no controlled discharge, overflows will occur when the basin is full. **Treatment:** Water treatment chemicals will be applied to sedimentation basins with catchment areas greater than 2,500 m^2 to enhance sedimentation and phosphorous and dissolved metal removal rates. Water treatment chemicals will be applied using an automated chemical dosing and mixing system. A similar system will be implemented for terrain constrained areas using a pump-out system and a mobile water treatment plant. **Dewatering:** Basins will be de-watered (via pumping) as soon as possible following rainfall cessation. Water will be used for dust suppression within construction areas and will not be discharged to the river. **Basin size**: Basins will be sized to capture all runoff during a 5 day 85th percentile rainfall event (30.6 mm over 5 days). The basin sizes will be a function of catchment area and runoff coefficients. See Surface Water Assessment Appendix E for further information.	Terrain constrained areas (no basins): • Discharge will occur following any material rainfall – 50 days per year[1]. • For construction areas with catchments that are greater than 2,500 m^2, a pump dewatering and treatment system will be designed to treat the 1 in 3 month peak flow. This system will treat flows continuously. Discharge of treated water will occur following any material rainfall: 50 days per year[1]. Areas not constrained by terrain: • Discharge will occur approximately 8 to 10 times per year[2]. • Discharges will only occur during and shortly after rainfall. • The chemical water treatment system will be designed to treat all discharge during a 1 year ARI recurrence interval and lower magnitude rainfall events. • Discharge volumes are estimated to be on average, 40% of the runoff volume, with 60% of runoff volume removed from the basins via dewatering.

Table 4.10 Stormwater discharge regimes

Category	Duration of disturbance	Proposed basin size	Discharge regime and frequency
Access roads	Duration of Exploratory Works Some roads will be sealed and maintained as permanent infrastructure.	**Basin type**: Sedimentation basins established for the construction phase will be modified to be constructed wetland style basins. The basin will maintain permanent water. An extended detention zone will be provided above the permanent water zone. The extended detention zone will drain slowly through a low flow outlet. Overflows will occur via a high flow outlet when the basin is full. **Dewatering:** No dewatering is proposed. **Basin size**: The basins established for the road construction phase will be modified. It is expected that the catchment area can be reduced as runoff from rehabilitated batters can be diverted to clean water drainage. This will increase the effective size of the basin (in terms of mm of rainfall capture).	• It is not proposed to extract water from the basins. • Discharges from the extended detention zone will occur via the low flow outlet during and for 2 to 3 days after most material rainfall events – Discharge of low flows is expected to occur 50 to 100 days per year. • Overflows via the high flow outlet will occur occasionally during intense rainfall.
Accommodation camp	Duration of Exploratory Works The accommodation camp will be rehabilitated following the completion of construction works.	**Basin type**: Constructed wetlands style basin. The basin will maintain permanent water. An extended detention zone will be provided above the permanent water zone. The extended detention zone will drain slowly through a low flow outlet. Overflows will occur via a high flow outlet when the basin is full. **Dewatering:** No dewatering is proposed. **Basin size**: To be sized to achieve target pollutant load reductions	• It is not proposed to extract water from the basins. • Discharges from the extended detention zone will occur via the low flow outlet during and for 2 to 3 days after most material rainfall events – Discharge of low flows is expected to occur 50 to 100 days per year. • Overflows via the high flow outlet will occur occasionally during intense rainfall.

Table 4.10 Stormwater discharge regimes

Category	Duration of disturbance	Proposed basin size	Discharge regime and frequency
Portal construction pad (construction and operation)	Duration of Exploratory Works The pad area will be rehabilitated following the completion of construction works. However, it will remain a modified landform.	**Basin type**: Sedimentation basin, no controlled discharge, overflows will occur when the basin is full. **Treatment:** Water treatment chemicals such as iron coagulants and calcium carbonate will be applied to the basin to enhance sedimentation and phosphorous and dissolved metal removal rates. Water treatment chemicals will be applied using an automated chemical dosing and mixing system. **Dewatering:** Basins will be de-watered (via pumping) to top-up the process water system. Water will not be discharged to the river. **Basin size**: A basin with adequate capacity to capture all runoff from at least a 5 day 95th percentile rainfall event (56.8 mm over 5 days). A basin volume of 3,750 m^{3}is proposed to accommodate the above treatments, this is equivalent to the runoff volume from 85mm of rainfall over 5 days.	• Discharge will occur approximately 2 to 3 times per year[2]. • Discharges will only occur during and shortly after rainfall. • The chemical water treatment system will be designed to treat all runoff during a 1 year ARI and lower magnitude rainfall events. • Water balance model results estimate that discharge volumes are 31% of the runoff volume, with 69% of runoff removed from the basins via dewatering.

Notes: *1. Material rainfall refers to 5 mm or more in a day.*

2. A discharge event refers to a rainfall period where overflows occur intermittently within a wet weather period. Discharge periods will typically be 1 to 3 days (similar to most wet weather events).

iv Residual impacts

Detailed analysis is provided in the revised SWA in Appendix E of this RTS. A summary of residual impacts is provided below.

a. Wastewater and process water

Controlled discharges of treated waste water and process water to Talbingo Reservoir will not commence until the accommodation camp is commissioned (approximately nine months from the start of Exploratory Works).

Controlled discharges will progressively increase over the remainder of the Exploratory Works schedule as the need for process water discharges increases due to higher groundwater inflows into the tunnel. The peak load increase is estimated to be 1 to 4%.

The cumulative potential for Exploratory Works to increase of suspended sediment, nutrients and salt loads in the Yarrangobilly River arm of Talbingo Reservoir is conservatively estimated to be less than 5% of existing loads that occur naturally via inflows from the Yarrangobilly River.

The highest increase to loads will occurs during drought conditions. Most of the load increase will occur due to the discharge of treated waste water, with little to no discharge of stormwater or process water. The load increases will be highest under these conditions as due to the lower natural loads in the Yarrangobilly River.

Some water quality trigger values for salinity and nutrients chemical stressors are predicted to be exceeded in the mixing zone (10 m from the discharge point, meaning 20 m across, about 315 m^2) surrounding the discharge outlet. Mobile organisms that are intolerant of salinity or nutrient concentration increases in the mixing zone will not remain within the mixing zone for long periods so no significant impacts to mobile organisms are predicted. The species and/or abundance of benthic infauna within the mixing zone may be impacted by the increased salinity or nutrient concentrations. However, the habitat in the small mixing zone is widely represented in the reservoir so this impact will be negligible.

b. Emplacement area

No residual impacts are expected from the eastern emplacement area as:

- the diversion of Lick Hole Gully flows is not expected to alter water quality;
- ARD risks will be managed within the stockpile through the selective placement of PAF material with AC material; and
- discharge of emplacement seepage to the Yarrangobilly River will be avoided.

c. Stormwater

A conservative analysis of potential pollutant load impacts has been carried out. It has concluded that stormwater discharges into the Yarrangobilly River during the construction phase of Exploratory Works has potential to increase pollutant (TSS, TN, FRP and TP) loads by a maximum of 2.6%. This magnitude of impact is in line with expectations given that the estimated mean annual discharge volume is equivalent to 0.08% of the mean annual stream flows in the Yarrangobilly River. The potential pollutant load increases would be lower for the post-construction phase, due to a reduced disturbance area.

The Yarrangobilly River provides key habitat for the Booroolong frog and Murray crayfish, with interstitial spaces between cobbles providing key breeding habitat for these species. Potential impacts to the Booroolong frog and Murray crayfish and other aquatic ecology include:

- sedimentation that can smother habitat, fill deeper holes, smother snags and other cover, and bury clay banks required for burrowing;
- low dissolved oxygen concentrations such as those experienced in blackwater events after flooding;
- increases in salinity levels can lead to changes to the physical environment that can be detrimental; and
- exposure to elevated levels of nutrients and toxicants have potential to be detrimental.

The Booroolong frog and Murray crayfish is known to inhabit relatively disturbed environments, including watercourses in pastural areas, which are impacted by increased turbidity and nutrient concentrations and so must be tolerant to a range of water quality conditions.

v Conclusion

The water management systems have been thoroughly reviewed to determine application of reasonable and feasible controls in response to EPA's comments. This review has identified a range of additional controls which are now proposed as part of Exploratory Works. These controls include:

- a high level of treatment of accommodation camp waste water prior to controlled discharge;
- a high level of treatment of process water prior to controlled discharge;
- additional stormwater controls, including increasing basin sizes (portal construction compound only) and chemically treating the water in the basins prior to discharge; and
- active management of runoff and seepage at the rock and soil emplacements.

Despite the implementation of all reasonable and feasible controls, it is expected that there will be occasions when default trigger values are exceeded in the Yarrangobilly River as a result of discharges of stormwater. This is most likely to occur during or shortly after rainfall when contaminant concentrations in the river are also naturally most likely to exceed default trigger values, particularly for turbidity and nutrient concentrations.

The only suspended solids that will be discharged will be those that do not settle in the quiescent sedimentation basins and these will not deposit in the moving waters of the Yarrangobilly River. Any elevated contaminant concentrations in the Yarrangobilly River will occur over a short period and will be flushed through to Talbingo Reservoir. In addition, it may be required to use water treatment chemicals, such as iron salt coagulants, to treat stormwater discharge from construction areas and the portal construction compound. To determine potential risks to biodiversity of this approach, a risk assessment was carried out (refer to Appendix E of this RTS) and concluded the risks were negligible.

Given that all reasonable and feasible controls will be applied, any exceedences will be an unavoidable, but acceptable, residual impact of the Exploratory Works.

4.2.2 Wastewater and process water discharges

The EIS states that "extracted water from the tunnel and waste water will be piped to the waste water treatment plant proposed at the accommodation camp for treatment and discharged to the local watercourses, or transported off site to an appropriate facility." However, it is unclear from the information contained within the EIS what the proposed treatment method for sewage wastewater and treated portal and sump water will be, the expected discharge quality of the treated effluent from each treatment systems, the destination of the discharge/s and what the connection between the treatment systems and pipelines to the reservoir will be.

The EPA recommends that the proponent provide further clarity on the treatment method and movement of wastewater and process water so that any potential impacts on receiving waters are assessed, referencing the Water Quality Objectives setting process.

The proposed wastewater and process water discharge criteria are described in Section 4.2.1. These criteria were derived from treatment methods and controls to be implemented for Exploratory Works.

Discharges to the environment proposed for Exploratory Works are:

- treated wastewater from the accommodation camp discharged via a piped outlet into Talbingo Reservoir at Middle Bay;
- treated process water (ie tunnel-affected water and eastern emplacement area water) discharged via a piped outlet into Talbingo Reservoir at Middle Bay; and
- treated stormwater from construction areas, access roads, accommodation camp and portal construction pad discharged via an extensive suite of sediment basins with chemical treatment in identified areas into Yarrangobilly River.

Since the publication of the EIS, Snowy Hydro has engaged with EPA regarding the establishment of trigger values and further investigation of proposed treatment methods and controls which have been used to derive the discharge criteria for Exploratory Works. These have been summarised in the preceding sections.

A revised SWA has been prepared and is provided in Appendix E to this RTS. This report comprises relevant technical detail in response to matters raised by EPA.

4.2.3 Dredging and barge activity

The EPA recommends that emplacement of dredge material (on land or sub-aqueous) should consider the risk and impact of mobilising potential pollutants beyond the statement in the EIS that dredged sediment would be placed away from the outer edges to prevent pollutant runoff.

Increased project related barge/boating movements have the potential to impact on waters, including increasing turbidity levels during activities such as docking. The EPA recommends that consideration and assessment of potential impacts resulting from barging/boating movements be considered and appropriate mitigation measures nominated.

The below sections provide information on the assessment of potential impacts from barging with discussion of proposed mitigation measures to be implemented during Exploratory Works.

i On land placement of dredged material

The EPA recommends that the proponent:

a) advise on the location and process for dewatering dredged material to be placed on land;

c) consider and assess any potential risks of on-land placement of dredged sediments and propose appropriate mitigation measures;

It is no longer proposed to stockpile any of the dredged material on land.

ii Water quality impacts from dredging

The EPA recommends that the proponent:

b) consider and assess any potential impacts from mobilising contaminated sediments during dredging for the Middle Bay barge ramp and propose appropriate mitigation measures;

d) consider and assess any potential risks of sub-aqueous placement of dredged sediments as part of the water quality impact assessment as outlined in Point 1;

a. Proposed dredging

The impacts of dredging on water quality are assessed in Section 3 of the *Middle Bay Dredging and Dredge Impact Assessment* (Appendix C of the *Barge Access Infrastructure* report (EIS Appendix L)). Further details are provided below, including an assessment against the water quality objectives.

As described in Section 3.4 of the *Middle Bay Dredging and Dredge Impact Assessment,* the proposed dredging program is expected to generate localised turbidity because of the dredging of the sediments within Middle Bay. Removal of reservoir sediment will be by a barge-mounted long-reach excavator. The excavator will load the dredged material at around 30% water content by weight and the dredged material will not be drained at the dredging site. To further minimise water quality impacts, dredging will take place within a silt curtain or moon pool.

The excavator will load dredge material directly onto a transport barge. The transport barges will be fitted with bulwarks (or 'hungry boards'). These will be water tight to prevent loss of water and fines into the water column along the transport route to the placement area. Depending on the project sequencing, skip bins may still be used to mitigate loss of water and fines into the water column in lieu of bulwarks, which will require the barge to be modified.

b. Sediment testing

Section 2.4 of the *Middle Bay Dredging and Dredge Impact Assessment* presents the results of sediment quality testing of the material proposed to be dredged. A broad suite of organic and inorganic contaminants was tested in the sediment and compared to the screening levels provided in the *National Assessment Guidelines for Dredging* (NAGD) (Commonwealth of Australia 2009). The NAGD screening levels are generally the same values as the *Interim Sediment Quality Guideline* (ISQG) low values provided in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Sediment Quality Guidelines* (ANZECC/ARMCANZ 2000).

The sediment testing showed concentrations of all parameters were below the screening level or below laboratory detection except for nickel and copper. To assess the bioavailability of these contaminants, acid soluble metal analysis (dilute acid extraction (DAE)) was undertaken on three representative samples of the proposed dredge material. While the total concentrations of copper and nickel exceeded the NAGD screening level, DAE concentrations of copper and nickel were below the NAGD screening level indicating these that these metals are unlikely to be bioavailable.

c. Water column impacts

Elutriate tests are widely used to assess the potential impacts of dredging on water quality, in particular the desorption of contaminants from suspended sediment particles to the water column. As described in the NGAD, these laboratory tests consist of mixing the sediment to be dredged with water from the disposal location (in this case the southern end of Talbingo Reservoir), and then measuring the resulting contaminant concentrations in the water. The elutriate tests simulate the maximum concentrations released during placement of dredged material at the disposal site but also provide an indication of potential release of contaminants during dredging, ie at the dredging site. The elutriate tests described in the *Middle Bay Dredging and Dredge Impact Assessment* used a 1:4 sediment:water dilution, as is standard practice.

Results of the elutriate testing, without allowance for dilution beyond the 1:4 test dilution, showed exceedances of the ANZECC/ARMCANZ (2000) default trigger values for the protection of slightly–moderately disturbed ecosystems for chromium, copper, lead, and zinc, with the greatest number of dilutions required for copper.

A total initial dilution of about 1:25 (ie a 1:6.9 dilution of the mean copper concentration in combination with the 1:4 dilution in the elutriate test) is required to ensure that all default trigger values are met. The NAGD state that the relevant trigger values should not be exceeded after allowing for initial dilution, defined as “that mixing which occurs within four hours of dumping”. Based on the dredge site and proposed subaqueous placement area (Plain Creek Bay), specifically the available water depth and allowance for a four-hour mixing period, an initial dilution of 1:25 is readily achievable. These dilutions will occur within the silt curtain that will surround the placement area.

It is noted that the application of the default trigger values for copper and zinc may be overly conservative as the concentrations of copper and zinc in Talbingo Reservoir exceeded these default trigger values in samples collected in March 2018:

- the median copper concentration of 0.032 mg/L in Talbingo Reservoir exceeded the default trigger value of 0.0014 mg/L for the protection of slightly–moderately disturbed ecosystems by about 20 times; and

- the median zinc concentration of 0.024 mg/L in Talbingo Reservoir exceeded the default trigger value of 0.0080 g/L for the for the protection of slightly–moderately disturbed ecosystems by about by about three times.

It is proposed that the water quality monitoring program, and associated trigger values, described for the SERP will be applied during the placement of dredged material.

Adverse water quality impacts due to the release of metals into the water column during placement of material within the reservoir are not expected beyond 500 m (surface waters) or 1 km (bottom waters) of the exterior silt curtain around the placement area. There will be impacts within the placement area as described in Section 3.3 of the *Middle Bay Dredging and Dredge Impact Assessment*.

When sediments are dredged with a long-reach excavator, there will be some entrainment of sediment to the water column as the bucket is raised to the surface. The mass of sediment lost to the water column will be negligible compared to the amount in the bucket. The sediment entering the water column will increase the turbidity of the water within the silt curtain or moon pool surrounding the extraction area. Given the entrainment process, the 1:25 dilutions required to meet the default trigger values will be met almost immediately so no adverse water quality impacts due to the release of metals into the water column during dredging are expected. Mobile fauna, eg fishes, are expected to leave the water within the silt curtain or moon pool to avoid the turbid water that will be formed.

As the trigger values for the protection of aquatic ecosystems will be met outside of the silt curtains in the dredging and placement areas, the aquatic ecosystem water quality objectives will be met. There will be no public access to Middle Bay (where the channel will be dredged) or to the Plain Creek Bay dredge material/subaqueous excavated rock placement area. Therefore, there will be no opportunities for primary or secondary recreational contact in these areas so the water quality objectives for secondary or primary recreational contact are not relevant. However, compliance of with the trigger values for the protection of aquatic ecosystems outside of the silt curtains (except as described above) will mean that the secondary or primary recreational contact trigger values will also be met, given that the dredging will not result in the release of pathogens.

iii Barge movements

> The EPA recommends that the proponent:
>
> e) consider and assess any potential impacts from the construction and 'operation phase for barge movements, including turbidity impacts, and propose appropriate mitigation measures.

The impacts of dredging on reservoir traffic are assessed in Section 3 of the *Middle Bay Dredging and Dredge Impact Assessment* (Appendix C of the *Barge Access Infrastructure* report (EIS Appendix L)). Impacts from barge movements are not expected to be significant due to the low speed of the barges, draft of the proposed vessels, available water depths and the quality of the reservoir sediments. Further details on potential water quality impacts, including turbidity, are provided below.

It is noted that this information is equally relevant to the transport of excavated rock by barge for subaqueous placement.

a. Barges and movements

It is expected that the transport barges used to transport dredged material to the placement area will be modular flat-top barges approximately 50 m long and 20 m wide. The barges will be dumb (un-propelled) barges and will be moved and positioned using a shallow-draft pusher-tug. The minimum engine capacity of the tug will be approximately 600 horsepower. The tug will likely be a twin propeller vessel, which enhances maneuverability for navigating the narrow channels. The discharge barge in the placement area will be a modular flat top barge approximately 20 m long and 20 m wide.

The barges will be slow moving, travelling at approximately 4 knots (laden) and 5 knots (unladen) with about two round trips per day between Middle Bay and Plain Creek Bay (approximately 5.6 km each way). The low speeds will minimise potential impacts, including turbidity, from the barge movements.

The flat-top transport barges will have a laden draft of approximately 2.3 m. The 600 horsepower pusher tugs will have a draft of approximately 1 m. These drafts may vary depending on the contractors selected vessel configuration. Any disturbance to the reservoir bed from barge activity would be from propeller wash from the pusher tug. This is unlikely to occur in water depths greater than approximately 5 m, where a minimum of 4 m of clearance will be available below the pusher tug.

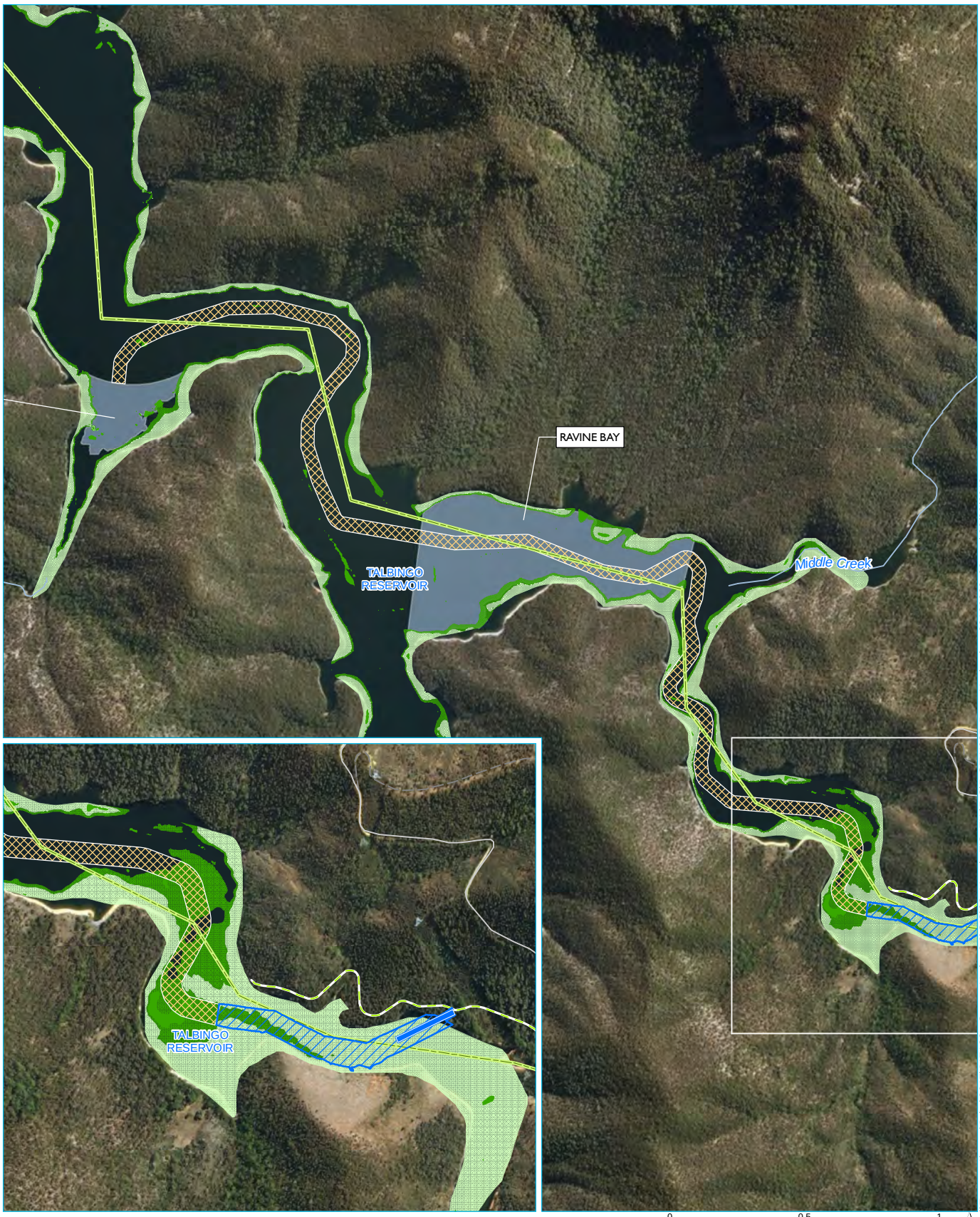
Water depths along the route between Middle Bay and Plain Creek Bay range from 2.3 m near the Middle Bay Barge Ramp to 40 m near Plain Creek Bay measured relative to the MOL – and much greater when the reservoir water levels are higher (see below).

The barge route between Middle Bay and Plain Creek Bay is shown in Figure 6.5. The shallower portion (less than 5 m below MOL) where bed disturbance due to barge movements may occur, is shown in the inset. Approximately 84% of the route (approximately 4.7 km) has a water depth greater than 5 m relative to MOL (elevation lower than approximately 529 m AHD). There is negligible potential of disturbance of the reservoir bed due to barge activity along this portion of the route.

Approximately 16% (approximately 880 m) of the barge route has a water depth shallower than 5 m relative to MOL (elevation above approximately 529m AHD). A section of this shallower zone is proposed to be dredged to provide navigation clearance for barge access, but will still be shallower than 5 m at MOL. Accordingly, disturbance of the reservoir bed due to propeller wash from the pusher tug is possible along the shallower, approximately 880 m long, portion of the barge route when the water level is at MOL.

Historical water level records for Talbingo Reservoir over a 20 year period indicate the water level has been more than 6 m above MOL approximately 80% of the time (on average 292 days per year) and more than 3.5 m above MOL approximately 99% of the time (on average 361 days per year). In practice, water depths will be greater than 5 m along the shallower portion of the barge route referred to above. The probability of actual reservoir bed disturbance due to propeller wash from the pusher tug is therefore low.

On the limited occasions when it may occur, any disturbance of sediment may cause visual impacts due to turbidity. These impacts will be localised to the shallower portion of the barge route approximately 880 m long within the Yarrangobilly Arm of the reservoir. As described in Section 3.4 of the *Middle Bay Dredging and Dredge Impact Assessment,* the bed sediments are predominantly coarse silt. This material will settle rapidly so any increased surface turbidity will be short-term (in the order of hours) and will occur on about four occasions per day corresponding to the barging movement (two trips per day). The results of the elutriate testing for the bed sediments and available dilution indicates that release of contaminants will not be expected to be an issue if sediment disturbance occurs. As discussed previously, mobilising contaminants due to disturbance of sediments will not result in trigger values being exceeded.



Source: EMM (2018); Snowy Hydro (2018); ESRI (2018); RHDHV (2018

0 0.5 1 km

GDA 1994 MGA Zone 55

N

KEY

- Access road extension
- Communications cable
- Subaqueous rock placement area
- Major watercourse
- Local road
- Track
- Indicative navigation channel
- Disturbance area - barge infrastructure

Bathymetry levels less than 5m below MOL

- Above RL532
- RL529 to RL532

Barge route

Snowy 2.0
Response to Submissions
Exploratory Works Figure 4.5

snowy2.0

EMM creating opportunities

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4.2.4 Sub-aqueous emplacement

The EPA notes that the method for developing the trigger values for sub-aqueous disposal suggested in the EIS has not been detailed, with no supporting justification for the nominated values. The EPA advises that trigger values should be developed based on the water quality objectives and environmental values of the receiving environment and what practical methods are available to restore or maintain those environmental values.

The EPA recommends that:

a) the proponent provides additional information supporting the proposed sub-aqueous disposal trigger values (as part of the water quality impact assessment detailed in Point 1); and

a. Overview

The strategy for developing the water quality trigger values/preliminary water quality criteria for subaqueous excavated rock disposal (SERP) is described in Section 3 of the *Subaqueous Excavated Rock Placement Program* (the SERP report) (Appendix C of the *Barge Access Infrastructure* report (EIS Appendix L)).

The term "trigger value" is used below in reference to assessing potential water quality impacts. This aligns with the definition provided in ANZECC/ARMCANZ (2000):

> Trigger values are concentrations that, if exceeded, would indicate a potential environmental problem, and so 'trigger' a management response, e.g. further investigation and subsequent refinement of the guidelines according to local conditions.

The term "criteria" is used below to denote a regulatory limit that will be specified in an approval or licence, such as an environment protection licence (EPL).

It is proposed that regulatory water quality criteria will be established for key indicators based on the ANZECC/ARMCANZ (2000) tiered framework. These water quality criteria will be based on the trigger values used for environmental impact assessment. They will be determined based on the baseline of water quality data (where sufficient data is available) and detailed engineering designs.

The preliminary criteria presented in the SERP report were developed between the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the SERP report authors, Royal HaskoningDHV (RHDHV), based on a review of the available baseline water quality data for March 2018, the ANZECC/ARMCANZ (2000) water quality guidelines and conceptual engineering designs. As noted in the SERP Report, it is proposed that the preliminary criteria will be reviewed and refined as further baseline monitoring data (see Section 2.1.2i), and the results of additional investigations (see Section 2.1.2ii), become available. The criteria will be finalised in consultation with the relevant government agencies as part of the development of the water management plan.

The following steps were taken in determining the water quality trigger values/preliminary water quality criteria:

1. Consideration of baseline conditions and the known characteristics of the rock;

2. Identification of stressors of potential concern (SOPCs);

3. Consideration of placement methods, environmental controls and monitoring; and

4. Determination of proposed water quality trigger values/preliminary water quality criteria.

Each of these stages is described below.

b. Baseline monitoring and SERP assessment program

Baseline monitoring

The hydrodynamic and water quality characteristics of the receiving environment are being determined based on historical environmental data, generally collected over the last 20 years, and data collected as part of the environmental assessment for Exploratory Works.

Historical water column profiling (ie measurements temperature, depth, conductivity, dissolved oxygen, pH and turbidity from the surface through to the bottom of the reservoir) results are available for Lobs Hole within Talbingo Reservoir based on monitoring undertaken by Snowy Hydro. Profiling has been undertaken biannually during spring (October/November) and autumn (March/April). Selected profiles are presented in SERP report Section 2.3.2.

The characterisation of the baseline environment in Talbingo Reservoir as part of the environmental assessment for Exploratory Works was undertaken by Cardno (NSW/ACT) Pty Ltd (Cardno). The fieldwork program started in March 2018 and includes:

- Water column profiling at 16 locations within Talbingo Reservoir (Figure 6.6), measuring temperature, conductivity, dissolved oxygen concentration, pH, turbidity, photosynthetically active radiation (PAR), and chlorophyll-a (fluorescence) through the water column. The first round of profiling was conducted in March 2018 and a second round of profiling was undertaken in September 2018.

- Collection of water quality sample through the water column at five locations in Talbingo Reservoir (Figure 2.1) at two or three depths depending on the water depth at the location. The first round of sampling was conducted in March 2018 (as reported in the SERP report) and a second round of profiling is being undertaken in September 2018. Analytical parameters measured include:

    - general: conductivity, pH, suspended solids and total dissolved solids;

    - particle size distribution (by laser diffraction);

    - nutrient concentrations: ammonia, nitrate, nitrite, total kjeldahl nitrogen, total nitrogen, reactive phosphorus, total phosphorus and reactive silica;

    - major ion concentrations/alkalinity: calcium, magnesium, potassium, sodium, chloride, fluoride, sulphate, bicarbonate alkalinity, carbonate alkalinity, hydroxide alkalinity, total alkalinity and hardness;

    - dissolved organic carbon and total organic carbon concentrations;

    - metals and metalloids concentrations (unfiltered and filtered): aluminium (Al), arsenic (As), barium (Ba), beryllium (Be), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), vanadium (V) and zinc (Zn);

- chlorophyll-a; and
- phytoplankton identification.

- Collection of sediment grab samples from 14 locations (Figure 6.7) in Talbingo Reservoir in March 2018. All sediment samples collected underwent laboratory analysis for the following:
  - moisture content;
  - particle size distribution (sieve and hydrometer);
  - total recoverable hydrocarbons;
  - benzene, toluene, ethylbenzene and xylene (BTEX) concentrations;
  - volatile organics concentrations;
  - polycyclic aromatic hydrocarbons (PAHs) concentrations;
  - pesticide concentrations: organochlorine and organophosphorus pesticides;
  - metal concentrations (Al, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mb, Ni, Se, Ag, V and Zn);
  - nutrient concentrations: nitrate, nitrite, total kjeldahl nitrogen, total nitrogen and total phosphorus;
  - total inorganic carbon and total organic carbon concentrations; and
  - benthic infauna classifications.

- An additional 11 sediment grab samples were collected in May 2018 in Middle Bay (Figure 6.7) and analysed as part of the dredging impact assessment (*Middle Bay Dredging and Dredge Impact Assessment* (Appendix C of the Barge Access Infrastructure report (EIS Appendix L)).

- Bulk sediment samples were collected from three locations (Figure 6.7) in the three placement areas (Plain Creek Bay, Ravine Bay and Cascade Bay) in July 2018 for use in the CSIRO testwork program.

- Sediment cores were collected from Middle Bay, near the proposed intake structure and at the three placement areas (Plain Creek Bay, Ravine Bay and Cascade Bay) in August 2018 using a vibrocorer.

- Currents are being measured through the water column using acoustic doppler current profilers (ADCPs), deployed in April 2018 at two locations (Figure 6.6) in Talbingo Reservoir (north end of the Tumut Arm and north end of the Yarrangobilly Arm). The ADCPs are bed-mounted and will be deployed for at least 12 months. The water-current data will be recovered progressively and used to inform the hydrodynamic modelling of the reservoir (see below).

- The temperature is being measured continually (15-minute intervals) through the water column using moored thermistor strings deployed in April 2018 on moorings at three locations (Figure 6.6) in Talbingo Reservoir (at the north end of the reservoir, opposite Cascade Bay and at the junction of the Yarrangobilly and Tumut arms). The thermistor strings will be deployed for at least 12 months. The temperature data will be recovered progressively and used to inform the hydrodynamic modelling.

- Conductivity and dissolved oxygen concentration are being measured continually (15-minute intervals) at each of the thermistor string moorings at two fixed depths (one above, and one below, the thermocline). The instruments will be deployed for at least 12 months. The data will be recovered progressively and used to inform the hydrodynamic modelling, and to characterise baseline conditions in the reservoir.

- Turbidity and fluorescence are being measured continually above the thermocline at each of the thermistor string moorings. The instruments will be deployed for at least 12 months. The data will be recovered progressively and used to inform the sediment transport modelling, and to characterise baseline conditions in the reservoir.

- Photosynthetically active radiation is being measured continually (15-minute intervals) at each of the moored thermistor strings thermistors at 3 m and 10 m below the water surface. The instruments will be deployed for at least 12 months. The data will be recovered progressively and used to characterise baseline conditions in the reservoir.

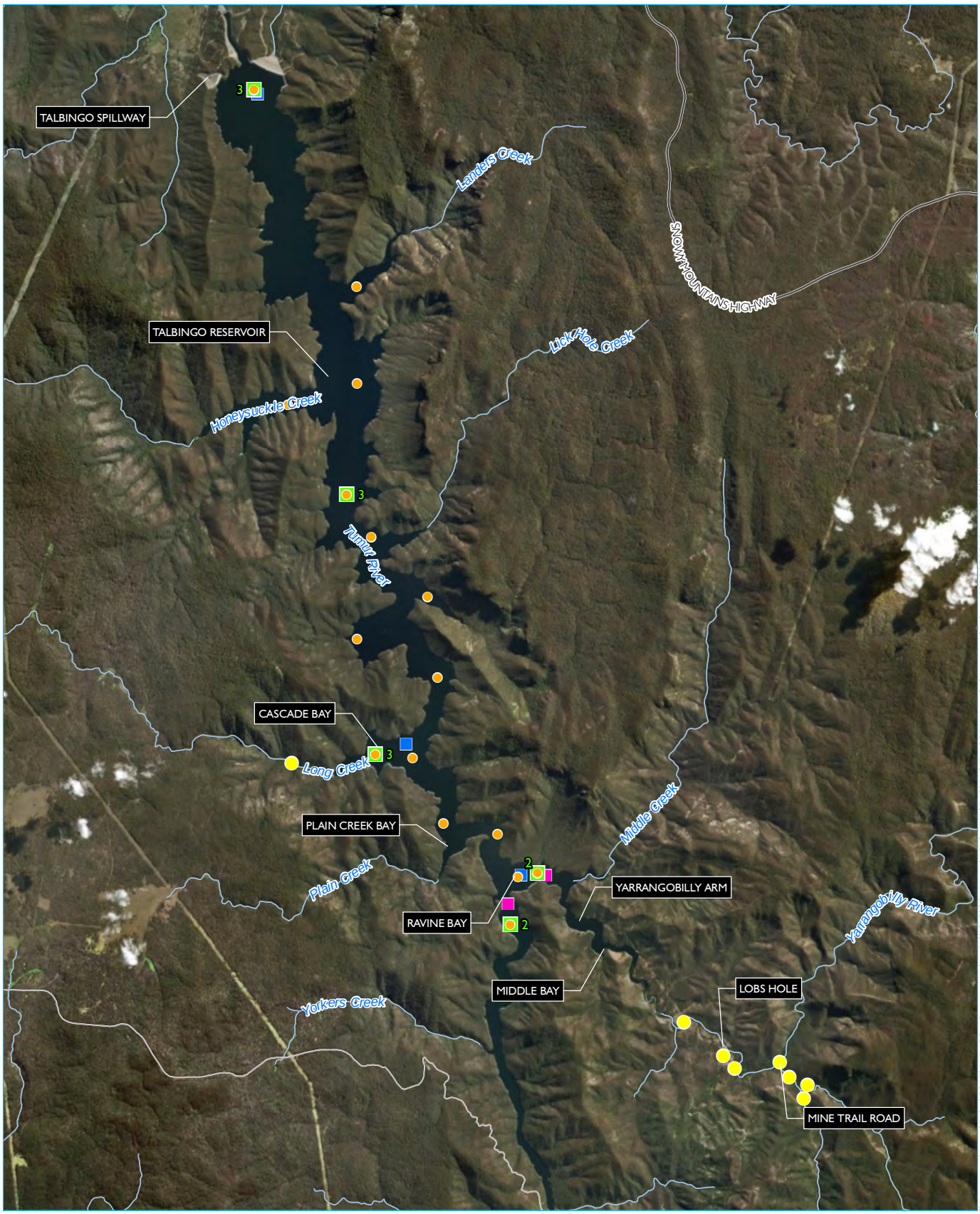
This monitoring program extends to Tantangara Reservoir as part of the Snowy 2.0 Main Works environmental investigations.

The available baseline results have been used to assess the potential impacts of SERP and inform preliminary water quality criteria. Additional baseline data over a longer period will be available when preparing the water management plan and over 12 months of data will be available prior to the start of any SERP.

The baseline water quality data indicate that waters within Talbingo Reservoir are generally clear (low suspended solids), have low conductivity (low salts), and have low buffering capacity (low alkalinity). Metal concentrations are low except for copper and zinc as previously discussed.

Sediments from across the Talbingo Reservoir bed are soft and muddy in texture with a dominance of particles in the coarse silt fraction. Metals concentrations are below the ANZECC/ARMCANZ (2000) interim sediment quality guideline (ISQG-Low) values (and below the more recently published sediment quality guideline values in *Sediment Quality Assessment, A Practical Guide*, by Simpson and Batley 2016)).

The concentrations of BTEX; organochlorine and organophosphorus pesticides; PAHs; TRHs; and volatile organics are all below detection limits. Except for measurable TRHs concentrations in a sediment sample collected from close to the spillway at the northern end of the reservoir.



Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); DFSI (2017); LPMA (2011)

KEY

- Water column profiling location
- Talbingo water quality sampling site (number of depths from which samples were taken)
- Thermistor mooring
- Current profiler
- Water quality sampling location
- Main road
- Local road
- Major watercourse

0 2.5 5 km

N

GDA 1994 MGA Zone 55

Water column monitoring locations

Snowy 2.0
Response to submissions
Exploratory Works
Figure 4.6

snowy 2.0

EMM creating opportunities

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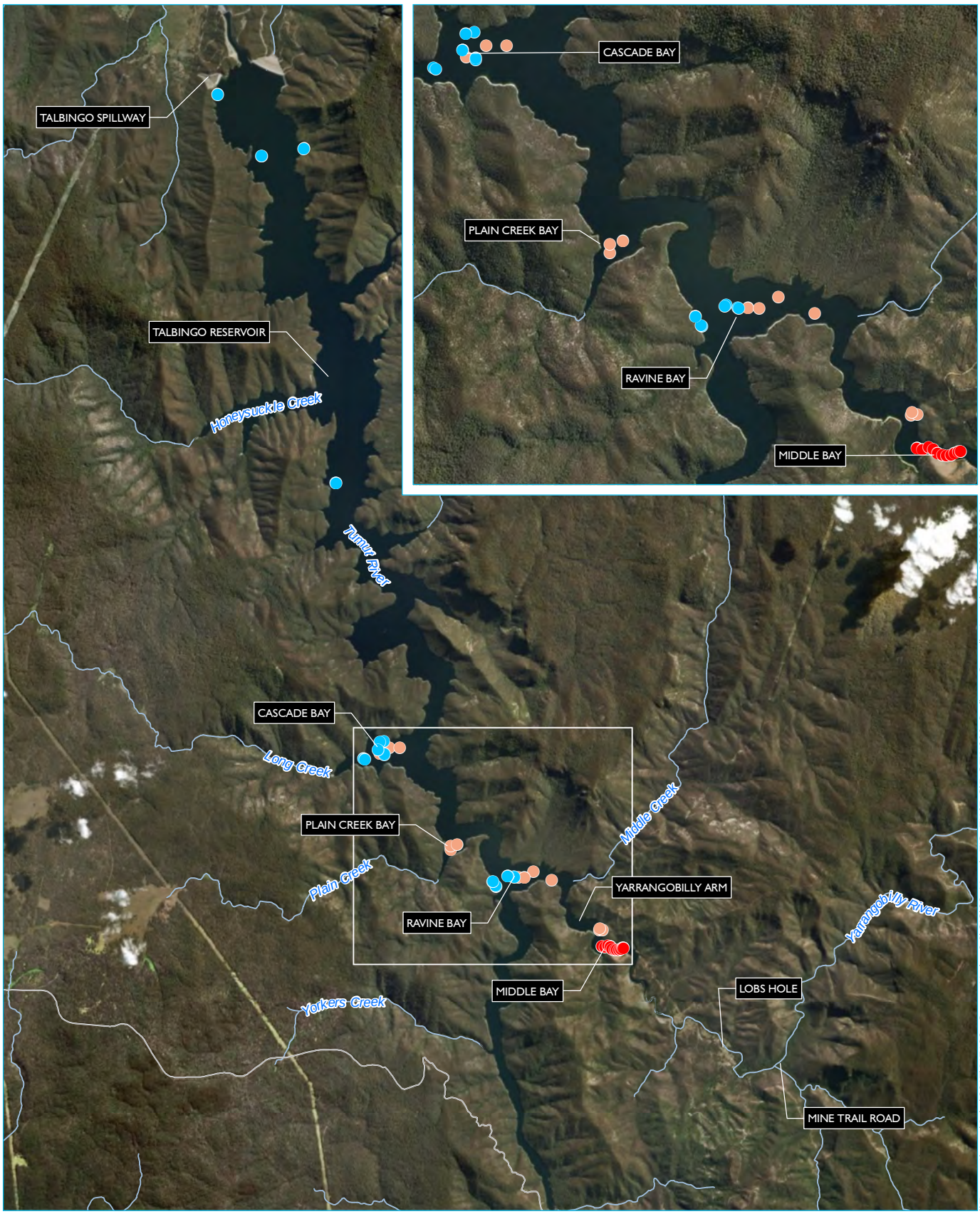


\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWRtSIRtSEW006_SedimentSamplingLocations_20180928_04.r

Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); DFSI (2017); LPMA (2011)

0 2.5 5 km

N

GDA 1994 MGA Zone 55

KEY

- Dredging assessment sampling location
- Reservoir assessment sampling location
- Vibrocoring location
- Main road
- Local road
- Major watercourse

Sediment sampling locations

Snowy 2.0
Response to submissions
Exploratory Works
Figure 4.7

Excavated rock characterisation and interactions in the environment

The assessment of the physical and chemical characteristics of excavated rock and the potential interactions with water and sediment in the reservoir are subject to extensive ongoing investigations by CSIRO and RHDHV. This program started in May 2018. This assessment is summarised in SERP report Section 3.6.3 and includes:

- analysis of rock cores by x-ray fluoresce (XRF) to measure the concentrations of a range of elements including sulfur and metals to identify rock types requiring special controls or detailed assessment (eg potentially acid generating materials);
- analysis of rock core samples by x-ray diffraction (XRD) to identify potentially problematic minerals (eg those with asbestos fibres);
- laboratory analysis of selected rock core samples to measure any acid generating or neutralising capacity;
- laboratory analysis of rock core samples and reservoir sediment to determine the potential release of contaminants to the water column;
- ecotoxicologial tests of rock core samples and reservoir sediment; and
- laboratory settling tests using rock core samples to determine the settling rate of material in the reservoir and the relationships between turbidity and total suspended solid concentrations.

Most of these assessments are being conducted by CSIRO.

Hydrodynamic and sediment transport modelling

Hydrodynamic and sediment transport modelling of the reservoirs is being undertaken by RHDHV to inform the SERP assessment and Snowy 2.0 Main Works environmental investigations. The models are primarily being used to investigate the fate of fine sediments and resultant TSS/turbidity at placement sites and further afield, considering existing environmental and operational conditions as well as additional inputs/changes caused by the proposed SERP and Snowy 2.0 Main Works.

The models are fully 3-dimensional hydrodynamic models developed using MIKE-3 flexible mesh finite volume model code with additional modules to simulate salinity/conductivity, water temperature, density, wind and atmospheric pressure, heat exchange and sediment transport. The extent and resolution of the models include the Talbingo and Tantangara reservoirs in their entirety and to their full supply levels (FSL) with additional floodplain storage provided as required. The horizontal and vertical resolution of the model is defined to resolve the dominant horizontal (surface) and vertical (water column) hydrodynamic and thermodynamic processes (eg catchment runoff events and thermal stratification of the water column during the warmer months).

Model boundary conditions are used to define point source inflows (eg catchment inflows, inflow/outflow from existing Snowy Hydro operations), moving point source inflows (eg excavated rock placement) and spatially and temporally varied forcing (eg wind field, solar radiation, rainfall applied to the water surface). Boundary conditions of the Talbingo Reservoir model include:

- environmental forcing data applied to the entire model including rainfall, air temperature, relative humidity, wind speed/direction;

- river flow, water temperature, salinity and suspended solids data for the Tumut and Yarrangobilly rivers;
- flow, water temperature, salinity and suspended solids data for catchment runoff generated by adjacent sub-catchments draining to the reservoirs; and
- flow, water temperature, salinity and suspended solids data for existing (and predicted) Snowy Hydro operational inflows and outflows.

Hydrodynamic and sediment transport models have been developed and are being used to:

- understand the physical features/processes of the existing reservoir environments and to establish a baseline for estimating the magnitude of change caused by SERP activities;
- understand the changes to suspended solids/turbidity in the reservoirs for different engineering variables (eg placement methods, placement sites and production rates), environmental variables (eg reservoir condition, wind conditions and catchment inflows), and operational variables (eg reservoir level and scheme inflows/outflows);
- estimate the scale and magnitude of the impact of SERP on hydrodynamics (water levels and current speeds) and sediment transport and deposition; and
- estimate the scale and magnitude of impact of Snowy 2.0 Main Works on sediment transport and lake thermal dynamics.

A range of scenarios will be modelled to investigate existing (pre-construction) conditions, initial placement activities, ongoing placement, operational scenarios and rare/extreme events.

c. Stressor of potential concern

The SOPCs were developed by CSIRO and RHDHV based on preliminary data on the chemical composition and the properties of the excavated rock (see SERP report Section 3.1). The rationale for the selected SOPCs is presented in Table 4.10.

Table 4.11 Stressors of potential concern

Stressors of potential concern	Selection rationale
Physical: suspended solids, including fine particles and benthic flocs	The reservoir water is clear with low turbidity. Discharge of excavated rock will result in suspended solids in the water column.
Physio-chemical: acidity/pH, dissolved oxygen, salts that increase water conductivity	The reservoir water has low conductivity (low salts) and low buffering capacity (low alkalinity). Excavated rock has potential to be acid generating or result in the release of dissolved salts. Mixing of excavated rock with reservoir water has potential to decrease dissolved oxygen concentrations.
Chemical: metals/metalloids	Excavated rock has potential to released dissolved metals.

d. Placement methods, environmental controls and monitoring

The SERP report (Section 1.3) presents a two phase SERP program during Exploratory Works. Initially 50,000 m^3 of excavated rock will be placed in Plain Creek Bay. This will include a range of management measures to minimise environmental risks and an intensive monitoring program. Should the results of monitoring of the initial placement show that, with the implementation of management measures and environmental controls, there are minimal impacts, then further excavated rock may be placed in the reservoir.

Proposed management measures are provided in the SERP report and are summarised below. However, it is noted that the measures may be modified: a) as more detailed environmental assessment information becomes available; or b) to provide a more realistic trial of SERP based on the final SERP method proposed by the selected contractor. Any proposed changes to SERP will be described in the water management plan.

Placement methods

It is proposed to transport and place excavated rock in the placement areas using barges as described in Section 1.4 of the SERP report. This will involve:

- temporarily stockpiling of excavated rock on land (environmental control);
- a geochemical testing and screening process to select suitable material for SERP (environmental control);
- transport of excavated rock by truck to the barge access infrastructure at Middle Bay;
- loading transport barges;
- towing transport barges to the subaqueous placement location;
- transfer of excavated rock to a receiving well (hopper) and fall pipe on a dedicated discharge barge at the placement location;
- discharge of the excavated rock from the fall pipe to a minimum of 5 m below the water surface (environmental control); and
- settling of the excavated rock to the bed of the reservoir.

Stockpiling and testing

The excavated rock will be stockpiled and tested prior to being selected for subaqueous placement as part of the initial 50,000 m^3 placement. This is to ensure that the environmental risks are minimised during the initial part of the SERP program while the environmental controls, such as silt curtains, are optimised.

As described in SERP report, the following key criteria for selection of excavated rock are proposed to minimise the risk that water quality criteria will be exceeded during SERP:

- materials must be NAF - to minimise the potential for SERP to result in acid conditions or elevated metal concentrations compared to pre-existing conditions;
- materials must not contain asbestiform mineral fibres - to minimise the risk from material handling during SERP; and

- fines content must not exceed 10% - to minimise the risk of excessive turbidity plumes forming.

Further information on the potential for ARD and the occurrence of asbestiform mineral fibres is presented in Section 1.5.2 of the SERP report.

Environmental controls

The SERP report (Sections 1.7 and 3.2) summarises environmental controls that will be employed during the SERP trial. These include:

- transport barges will be fitted with bulwarks ('hungry boards') which will be made water tight to prevent any loss of material into the water column;
- excavated rock will be discharged via a fall pipe to be fitted to the discharge barge, with an exit point a minimum of 5 m below the water surface, to mitigate the risk of surface turbidity plumes;
- fine material (silt and clay sized fraction) will be 'conditioned' before placement by wetting to promote rapid deposition;
- the fall pipe will be surrounded by a silt curtain to further mitigate turbidity;
- an additional silt curtain (exterior silt curtain) will be placed between the discharge barge and the main reservoir to further mitigate migration of turbidity; and
- a water quality monitoring program (that will be prepared in consultation with key government agencies and approved as part of the water management plan) will be commenced prior to SERP.

Additional controls will be considered, or the placement will be stopped if the criteria are not being met. Additional controls may include:

- reconfiguring, or installing additional, silt curtains;
- reconfiguring the discharge method, including the fall-pipe depth;
- varying the rate of discharge;
- creation of underwater linear rock bunds to limit migration of fines near the reservoir bed; and
- capping one size class of rock material with another.

Monitoring

The SERP report (Section 3.6) outlines the key monitoring during the initial SERP. The results of the SERP monitoring will be compared to the finalised water quality criteria in real-time (15-minute intervals) for key parameters (pH, dissolved oxygen concentration, conductivity and turbidity). The SERP report provides preliminary trigger values/criteria that will need to be amended as more results of the assessment program (see Section 2.1.2) become available (see below).

Water quality trigger values will be exceeded in the water column in the placement beneath the discharge area. This area will be immediately surrounded by an inner silt curtain to minimise the dispersion of fine material that does not immediately settle to the reservoir bed.

As described above, there will also be an exterior silt curtain close to the boundary of the placement area. This is expected to be placed across the entrance of Plain Creek Bay during the initial placement of 50,000 m^3 of excavated rock. The water quality within the exterior silt curtain during the placement of material is not expected to meet the baseline water quality within the wider reservoir.

Monitoring will be undertaken in relation to the placement area (eg within, at the boundary, and beyond) during and following SERP as described below.

In consultation with CSIRO, the SERP report proposed the following preliminary turbidity criteria during SERP:

- surface water (30–100 cm depth):
    - 10 m beyond the exterior silt curtain: <20 NTU;
    - 500 m beyond the exterior silt curtain: <2 NTU (ie baseline conditions if the baseline turbidity is 2 NTU – see below);
- deep water (5 m above the bed):
    - 50 m beyond the exterior silt curtain: <100 NTU;
    - 200 m beyond the exterior silt curtain: <20 NTU; and
    - 1,000 m beyond the exterior silt curtain: <2 NTU (ie baseline conditions assuming that the baseline turbidity is 2 NTU – see below).

As recommended by CSIRO, these trigger values and the distances/locations at which they be applied will be refined based on ongoing assessments, including characterisation of excavated rock, hydrodynamic modelling and sediment transport modelling.

The initial locations of the silt curtains will be determined based on ongoing SERP assessment and hydrodynamic modelling and will be described in the water management plan. Monitoring data collected during the initial SERP will be used to refine locations during the initial and potential subsequent placement.

In consultation with CSIRO, RHDHV proposed the following preliminary criteria to be met within the exterior silt curtain (shallow water to deep water) prior to removal of the curtain at the cessation of placement:

- pH: 6.0–7.5;
- dissolved oxygen concentration: 5–7 mg/L;
- conductivity: less than 35 µS/cm; and
- turbidity: less than 2 NTU.

As described below, the ongoing baseline data collection program indicates that these preliminary criteria are not currently met within Talbingo Reservoir on occasions.

Water samples will also be collected at least weekly for laboratory analysis of a wider range of parameters including:

- nutrient concentrations: ammonia, nitrate, nitrite, total kjeldahl nitrogen, total nitrogen, reactive phosphorus and total phosphorus; and
- metals and metalloids concentrations (unfiltered and filtered): Al, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, V and Zn.

Trigger values will be determined for these parameters based on the protection of water quality objectives.

Preliminary criteria/trigger values review

Water quality criteria will be determined based on the ANZECC/ARMCANZ (2000) tiered framework. The preliminary criteria/trigger values presented in the SERP report will be refined by considering the background conditions within the vicinity of placement areas. Historical and recent monitoring data will be reviewed and used to calculate percentiles for pH, dissolved oxygen concentration, conductivity, turbidity, nutrients and metals. The recommended monitoring criteria for the baseline condition will be that the "median of the measured data at the monitoring location should remain within the 20% and 80% percentiles of the baseline condition" (Commonwealth of Australia, undated). Where there is insufficient data, default ANZECC/ARMCANZ (2000) trigger values will be used.

As stated above, the preliminary criteria/trigger values presented in the SERP report are preliminary and will need to be updated as additional data becomes available. To illustrate this, turbidity baseline data for Talbingo Reservoir from May to July 2018 has become available since the SERP report was prepared. The 20% and 80% percentile turbidity for this period was 2.4 NTU and 3.8 NTU respectively. Therefore, the preliminary criteria/trigger value of 2 NTU is too low for this parameter.

The preliminary criteria/trigger values presented in the SERP report will be finalised in consultation with key agencies as part of the development of an approved environmental management plan for the program.

b) should approval for the project be granted, the EPA recommends that the proponent develop a Trigger, Action, Response Plan as part of the management plan that includes contingencies to identify and manage any unpredicted impacts and their consequences and to ensure corrective actions are implemented.

A Trigger Action Response Plan will be prepared as part of the management plan. This plan will expand on the information provided in the SERP report and include the information provided above.

4.2.5 Tunnel spoil management

The EIS states that prior to sub-aqueous placement, material will be stockpiled for visual examination and testing before transfer to the reservoir. Similarly, it states that only suitable material would be stored in the western emplacement. The EPA is seeking clarification on where initial stockpiling and testing of material is proposed to occur, and the surface and groundwater protections that will be established to manage/minimise leachate generation and impacts.

The EIS provides limited detail regarding proposed contingencies for the sub-aqueous disposal of spoil where unexpected volumes of material may be found to be unsuitable, or where environmental management outcomes cannot be met. In addition, there is limited information regarding contingencies should there be an inability to achieve expected environmental management outcomes in the eastern rock emplacement area.

The EPA recommends:

a) the proponent clarify where initial stockpiling of material prior to classification is proposed to occur;

It is expected that geochemical testing of excavated rock would be carried out within the tunnel or at the stockpile at the portal construction pad.

Excavated rock material will initially be taken out of the tunnel and stored at small temporary stockpiles at the portal construction pad (refer to Figure 2.3 of the EIS). Excavated material from the exploratory tunnel will be transported by truck via Mine Trail Road from the portal construction pad to the excavated material emplacement area at Lobs Hole. Excavated material haulage between the exploratory tunnel and the emplacement area will be undertaken 24 hours per day seven days per week.

b) outline mitigation measures and contingencies to be put in place to manage potential runoff to surface and groundwaters from material yet to be classified commensurate with the storage sites environmental risk;

Tunnel drainage systems will be progressively installed as tunnelling advances. This will typically consist of sumps constructed at 250–500 m intervals with the sumps connected to the tunnel portal and a sump at or near the tunnel face. It is expected that the sump at the tunnel face will be equipped with a submersible pump and flexible discharge hose to feed tunnel water to the closest sump. Water from the tunnel will be part of the process water management system. The process water management system will incorporate a water treatment plant that will treat water to a suitable quality for its use in construction activities or discharge to Talbingo Reservoir (if required).

The portal construction pad, including where excavated rock is to be initially stockpiled prior to its transport to the emplacement areas at Lobs Hole, will be constructed with environmental controls to avoid and minimise egress of runoff from areas comprising potential contaminants.

As stated in the SWA (EMM 2018c), several management measures will be incorporated into the detailed design of portal construction pad. These measures include:

- WM_5.2 - where practical, all activities that will occur on the portal construction pad with potential to contaminate stormwater runoff will be isolated from the stormwater system using covering (ie by a building or roof) and bunding. Water produced within the covered and bunded areas will be either:
    - managed by the process water system; or
    - disposed as liquid waste to an appropriate and licensed facility.
- WM_5.5 - all aggregate storage and stockpile areas will be bunded to prevent stormwater ingress. Runoff from these areas will be treated in sediment wedge pits to remove all coarse material. Sediment wedge pits will overflow into the piped drainage system.

The necessary safeguards to contain potential runoff from stockpiled excavated rock prior to its classification have been incorporated into the designs for Exploratory Works. These are documented in Chapter 8 of this RTS and will be included within the relevant management plans to be prepared and implemented during construction.

c) should approval for the project be granted, the EPA recommends that the proponent develop a Trigger, Action, Response Plan as part of the management plan that includes contingencies allowing for alternate spoil disposal in the case of:

- unexpected volumes of material unsuitable for sub-aqueous disposal or inability to achieve environmental management outcomes with sub-aqueous disposal.
- an inability to achieve environmental management outcomes in the eastern rock emplacement.

This information, including a Trigger Action Response Plan will be outlined in the Water Management Plan. This document will be prepared in consultation with DoI Water.

As described in Chapter 3 and Section 4.1.2, any materials within the eastern emplacement area (that have not been subaqueously emplaced) that remain following the completion of Exploratory Works, should Snowy 2.0 Main Works not proceed, will be removed from KNP.

This material will be removed from KNP to nominated location(s) within five years of completion of Exploratory Works. The temporary stockpile will continue to be managed as per the design and descriptions within the EIS until all material is removed. Lick Hole Gully will then be rehabilitated.

4.2.6 Rock emplacement areas

The EPA notes that the design of the eastern rock emplacement area is proposed to include the lining of the gully with aim deep layer of limestone to separate the excavated spoil from seepage occurring at the base of the emplacement. In addition, emplacement of spoil is proposed to be compacted to have a permeability similar to the existing landform.

The EIS states that the expected rate of infiltration through the floor of the ephemeral basin capturing runoff from the south of the emplacement is nominated to be in the range of 0.5-10 MLlday, with this range of variance a result of current uncertainties around hydraulic conductivity and percolation rates through the rock emplacement.

The water management strategy for the eastern rock emplacement in Lick Hole Gully includes diverting high flows around the rock emplacement. The EPA recommends that further assessment should be completed considering increased risks of mobilising contamination from the abandoned mine from the altered flow regime.

The EPA recommends:

a) the proponent clarify the intended infiltration rates for the eastern rock emplacement and water management systems;

In consultation with EPA and NPWS since the publication of the EIS, the status and management regime of the eastern emplacement area has changed. The eastern emplacement area is now only to be used to store excavated rock and soil temporarily for the duration of Exploratory Works. Any remaining material in this stockpile at the completion of Exploratory Works would be removed off site outside KNP to a nominated location.

Given this area is now temporary, an active water management regime, rather than a passive regime, is proposed. This approach and residual impacts were described in Sections 3.2 and 4.2.1 of this RTS.

b) the proponent consider and assess any potential risks and impact to receiving waters from the rock emplacements, including leachate, migration of sediment, surface water runoff and interactions with the existing contamination. If any potential impacts are identified, appropriate management and mitigation measures should be proposed.

As described in the above response, a revised water management approach is proposed.

Water quality risks associated with emplacement seepage will be actively managed by capturing all seepage. Captured seepage (water) will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant. Lick Hole Gully will be diverted around the emplacement to minimise the volume of emplacement seepage.

The revised water management approach seeks to:

- manage sediment laden runoff during establishment;
- manage ARD risks, through the selective placement of PAF material with AC material;
- capture and divert runoff from Lick Hole Gully around the emplacement;
- promote infiltration of direct rainfall onto the emplacement; and
- actively manage water quality risks by capturing all seepage from the emplacement. Captured water will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant (as described above).

c) should approval for the project be granted, the EPA recommends that the proponent develop a Trigger, Action, Response Plan as part of the management plan which includes contingencies for inadequate treatment of leachate from the rock emplacement and impacts from the abandoned mine workings.

This information, including a Trigger Action Response Plan will be outlined in the Water Management Plan.

4.2.7 Erosion and sediment control

Water management control 'WAT04' summarises the sizing of the stormwater controls as achieving pollution load reductions in the post development mean annual load of 85% for total suspended solids, 60% for total phosphorus, and 45% for total nitrogen. The EPA advises that these are standard urban pollutant load reductions, and therefore not suitable for this receiving environment or project. The EPA recommends that load reductions should refer to, and be based against, an impact assessment as referred to in Point 1.

The EIS states that sediment basins in non-terrain constrained areas (75% of the construction area) will be sized to capture the 5-day 85th percentile rainfall depth and be dewatered after rainfall for dust suppression. Given the sensitive nature of the receiving environment and duration of the project, the EPA recommends that consideration be given to achieving the 5-day 95th %ile design sizing. The EPA also recommends that additional controls should also be considered in terrain constrained areas to minimise erosion and sediment runoff based on the sensitivity of the receiving environment.

The EPA recommends that should approval for the project be granted, given the sensitive receiving environment of the proposed project area the proponent:

a) derive stormwater pollutant load reduction targets with reference to the receiving environment, and develop management and mitigation measures to achieve these reductions where practical;

The SWA (EMM 2018c) proposed that the water management basins for the accommodation camp area are sized using the pollutant load reduction method commonly used for Water Sensitive Urban Design applications.

Different methods were used to size sedimentation basins and the portal construction pad water management basin. The pollutant load reduction method was selected for the accommodation camp basins as the benefits of rainwater tanks and the other source controls can be accounted for in the basin sizing methodology. This approach is conservative relative to the standard Water Sensitive Urban Design application as most nutrient loads in urban areas originate from landscaped areas, such as lawns and gardens.

All pervious areas around the accommodation camp will be maintained or enhanced with native vegetation. Hence, the proposed approach is appropriate for the receiving water environment. Estimates of discharge quality are provided in Section 4.2.1 (Tables 4.4 to 4.8) and within the revised SWA contained in Appendix E of this RTS.

It is also noted that the accommodation camp will be established on steep (1 vertical to 4 horizontal) terrain that comprise shallow soils. These site conditions are not suitable for infiltration-based stormwater systems and larger basins are not considered to be practical.

(b) where practical in non-terrain constrained areas, adopt the 5-day 95th %ile design storm sizing;

The sedimentation basins have been sized using the methods recommended in the NSW Government guidelines titled *Managing Urban Stormwater: Soils and Construction* (Volume 1 and 2D). These guidelines provide sizing criteria for standard and sensitive receiving waters. The sensitive receiving water criteria have been adopted (refer to Appendix E of SWA (EMM 2018c) for detailed information on proposed sizing methods).

It is noted that the sedimentation basin for the portal construction pad will be substantially larger. It is also noted that a basin sized to capture the 95th percentile 5-day rainfall event will require a volume that is approximately 2.5 times greater than a basin sized to capture the 85th percentile 5-day rainfall event (see SWA (EMM 2018c) Appendix E Table E4). This is due to a higher rainfall depth and a higher runoff coefficient being applied to the volume calculation.

As most of the construction will occur in moderately steep terrain, substantially larger basins are not considered to be practical or suitable in this environment. This is because earthen embankments are normally constructed to have minimum batter slopes of 1 vertical to 3 horizontal (1 to 3) and desired maximum embankment heights of 3 to 3.5 m for stability and safety reasons. Higher embankments are possible but have a higher geotechnical risk profile and may require additional measures to manage embankment stability.

The terrain constraints are illustrated in Figure 4.8 which shows typical sections of sedimentation basins established on topography with 1 in 6 and 1 in 10 slopes. Typical sections for embankment heights of 3.5 m and 5.0 m are provided. The basin volume for each option is expressed in terms of a generic unit to enable comparison.

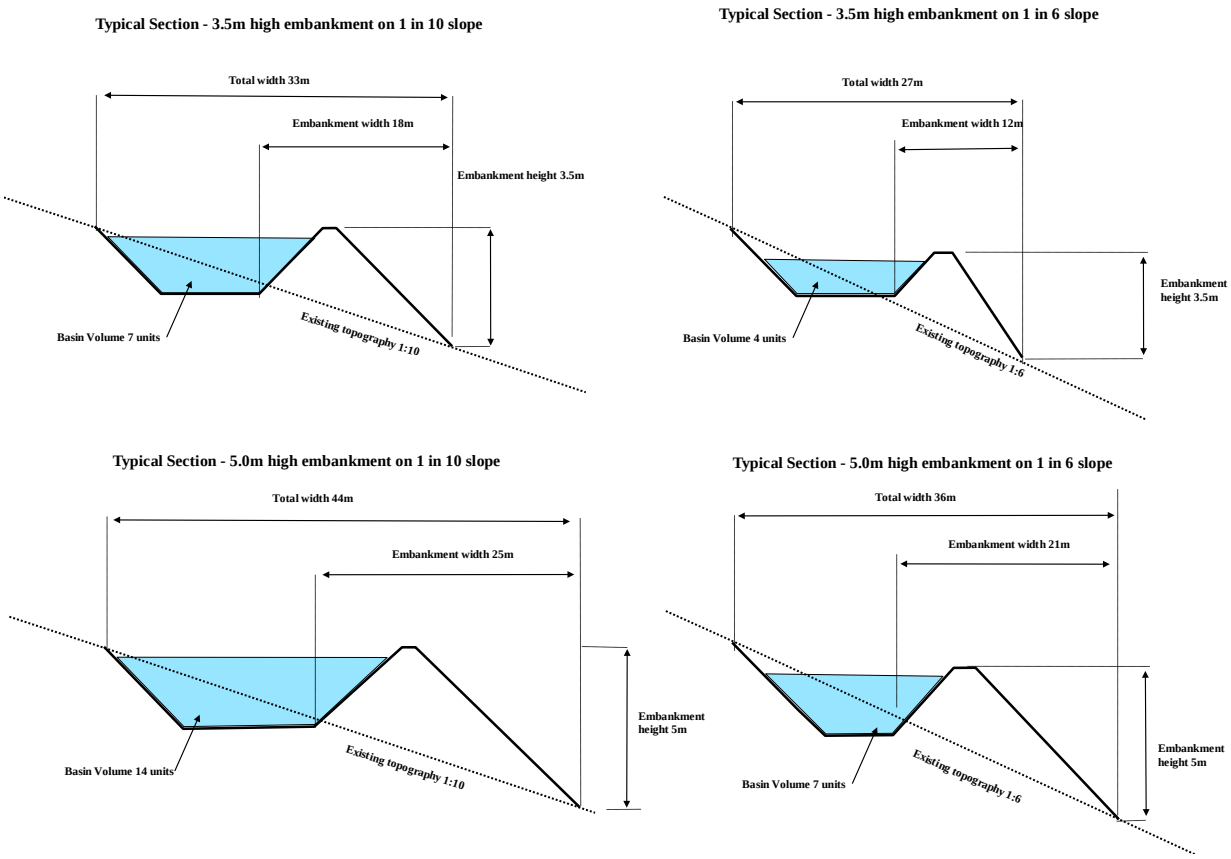


Figure 4.8 Typical profiles of sediment basins

With reference to Figure 4.8 a basin with a desired 3.5 m high embankment will achieve a volume of 4 generic units on terrain with a 1 in 6 slope and 7 generic units on terrain with a 1 in 10 slope. Increasing the embankment height to 5 m will increase the basin volume to 7 generic units on terrain with a 1 in 6 slope and 14 generic units on terrain with a 1 in 10 slope. This analysis demonstrates that there are practical limitations to increasing sedimentation basin sizes in steep terrain.

Slopes within the Exploratory Works disturbance area were analysed using LiDAR data. Table 4.12 provides the percentage of the construction disturbance area that is within four slope categories that range from less than 1 in 6 to more than 1 in 10.

Table 4.12 Slope analysis within disturbance area

Slope	Percentage of disturbance area[1]
1 in 10 or less steep	5.6%
Between 1 in 8 and 1 in 10	9.6%
Between 1 in 6 and 1 in 8	16.1%
1 in 6 or steeper	68.7%

Notes 1. The construction disturbance area refers to the areas listed in Surface Water Assessment Table 6.2, less the Spillway Road area.

c) commit to employing additional controls in terrain constrained areas to minimise erosion and transport of sediment;

It is estimated that about 30% of construction works will unavoidably occur in very steep terrain. These works will predominantly be road works that will be cut into the side of steep hill slopes. The proposed controls (including contingency measures) for terrain constrained areas provided in Section 6.3 of the SWA (Appendix E of this RTS) include:

- WM_2.2 - The clean water management controls WM_1.1 to 1.4 apply to all ESCPs.
- WM_2.3 - Stockpiles will be located where they are not exposed to concentrated or flood flow. Flood flow is defined as the 20% AEP flood extent. Monitoring for dispersion and erosion of soil stockpiles will be undertaken, particularly on moderately dispersive soils. Addition of ameliorants, such as gypsum and organic matter for dispersive soils will be undertaken as needed.
- WM_2.4 - Soils will be lightly scarified on the contour to encourage rainfall infiltration and minimise run-off. As soon as practicable after respreading, a cover crop will be established to limit erosion and soil loss. This will also provide good mulch for native plant establishment.
- WM_2.5 - Sediment traps or filters will be maintained at all discharge locations. The filters will only use non-toxic or materials which will not cause material harm to the environment, including biodegradable or natural materials where practicable. Sediment traps, filters and other appropriate sediment control devices will be installed to target the removal of coarse sediments.
- WM_2.6 - Runoff from construction areas that are constrained by terrain or the proposed disturbance boundary and are larger than 2,500 m^2 will be captured in a sump and pumped to a water treatment plant. The water treatment plant will use water treatment chemicals to enhance sedimentation and phosphorus and dissolved metal removal rates using an automated chemical dosing system. Only water treatment chemicals that have a low risk of increasing the toxicity of treated stormwater will be used. The design dewatering and treatment rate will be the 1 in 3 month average recurrence interval (ARI) peak flow.

The above-mentioned controls are the limits of practical controls for terrain constrained areas.

> d) develop a Trigger, Action, Response Plan as part of the management plan which includes impacts to the project's water balance if additional roads require sealing and contingencies for inadequate controls, particularly in terrain constrained areas.

A Trigger Action and Response Plan will be prepared as part of the Water Management Plan. The plan will include the above matters raised by EPA.

4.2.8 Water quality monitoring

> The EPA recommends that should approval for the project be granted, the proponent:
>
> a) include timing and frequency information for each sampling regime, noting that sampling should be more intensive in the early stages of construction and operation to identify any potential risks to waters; and

Section 8 of the SWA (EMM 2018c) includes a detailed water monitoring plan. The objectives of the plan are to:

- continue to monitor baseline conditions;

- enable the effectiveness of water quality controls to be assessed;
- identify and quantify water quality impacts; and
- enable compliance with relevant consent and licence conditions to be assessed.

The monitoring program includes commitments to monitor weather, stream flows, process water quantity and quality, stormwater quality and receiving water quality. Detailed information is provided in the following tables within the SWA:

- Table 8.1 provides a break-down of each aspect of the program and describes the monitoring objectives, locations and methods.
- Table 8.2 describes monitoring locations.
- Table 8.3 describes the proposed monitoring regime (or frequency).
- Table 8.4 describes monitoring methods, including the proposed analytes that will be sampled.

The monitoring plan will be adjusted in the Water Management Plan to reflect any changes to the water management system and to include an increased frequency of monitoring during early phases of the project (as requested by the EPA).

b) develop a Trigger, Action, Response Plan detailing water quality triggers and operational responses for water quality exceedances.

A Trigger Action and Response Plan will be prepared as part of the Water Management Plan. The plan will include the above matters raised by EPA.

4.2.9 Groundwater baseline

The EPA notes that monitoring bores used to collect the baseline data were drilled between mid January 2018 and early April 2018. As a result, the EPA recognises that the time between the drilling, installation and completion of the monitoring network and submission of the EIS has been insufficient on which to confidently establish baseline conditions or characterise groundwater in the vicinity of the project.

In addition, due to this limited baseline data it is difficult to determine if the current baseline groundwater monitoring points will be sufficient for a baseline dataset to be collected to characterise groundwater prior to the commencement of the proposed works. This includes the two closest nested monitoring bores to the exploration tunnel, which did not provide suitable data to represent the local and regional groundwater systems.

The EPA recommends that should approval for the project be granted, the proponent:

a) Review and update the existing groundwater monitoring points and baseline data, prior to exploratory works commencing, to determine if these existing points are sufficient to characterise groundwater within the project vicinity. The EPA recommends that the proponent consider the installation of additional baseline monitoring points where deficiencies are identified; and

b) Develop management plans and Trigger Action Response Plans, in consultation with the relevant agency, with appropriate trigger actions and thresholds determined from robust statistical analysis of baseline data trends.

Snowy Hydro acknowledges baseline data is limited and appreciate the need for further monitoring. Snowy Hydro continues to undertake regular groundwater monitoring. Baseline monitoring will continue throughout pre-construction and during construction, informing the preparation of a Water Management Plan – an appendix of the Environmental Management Strategy (EMS). The Water Management Plan will be prepared in consultation with the EPA and will include commitment to:

- monitoring sites, sampling frequency;
- site specific trigger values;
- Trigger Action Response Plan; and
- commitment to compliance reporting and data provision.

4.2.10 Access Roads

The waterways within Lobs Hole fall within Kosciusko National Park, and therefore are afforded the highest protection level under the ANZECC Guidelines (high conservation/ecological valued systems). Consequently, activities related to the proposed exploratory works that may impact on these waterways should not result in change beyond any natural variability.

The EIS predicts that access roads within Lobs Hole Ravine, despite having nominated engineered sediment and erosion controls to manage coarse sediments, will have potential to discharge fine or dispersive sediments during wet weather events. Whilst the EIS predicted that generally this runoff would be diluted during these events resulting in no material change to water quality, sections of road in close proximity to waterways may pose a higher risk of delivering sediment laden runoff.

The EPA recommends (in consultation with relevant stakeholders) that consideration be given to the sealed pavement of road sections that pose a higher risk to transmission of impacted runoff to waterways. This may include, but is not limited to, high traffic areas including the access roads linking the portal construction pad to the on-land rock emplacement area and accommodation area.

The EIS stated that road works associated with Exploratory Works comprised of maintenance activities to existing roads that do not require widening (which include rehabilitation of gravel pavement and requisite safety measures, including passing bays), upgrades to roads that require widening (which include culvert and drainage, retaining walls, gravel pavement and requisite safety measures) and establishment works for new roads (which include clearing and grubbing, culverts, drainage channels, road construction, gravel pavement and requisite safety measures).

Snowy Hydro has investigated all practical stormwater controls to be implemented to reduce sediment loads from roads entering the waterways. The controls to be implemented for roads and predicted discharge water quality set out in the SWA are based on the above proposed activities. These controls will be described within the Water Management Plan.

Snowy Hydro will continue to liaise with EPA and NPWS regarding controls to be implemented during the preparation of this plan.

4.3 Department of Primary Industries Fisheries

Engagement with DPI Fisheries occurred during and after the public exhibition period. Meetings were held with DPI Fisheries on 9 and 29 August and 19 September 2018 to discuss the Exploratory Works EIS. Preliminary comments were provided by DPI Fisheries on the *Snowy 2.0 Exploratory Works Aquatic Ecology Assessment* (Cardno 2018) (the AEA) in early August with a view to clarifying matters where possible, ahead of lodgement of receiving a formal submission.

During September, EMM and Snowy Hydro provided written clarifications on the matters raised by DPI Fisheries, and in particular, additional commitments were made by Snowy Hydro to undertake targeted surveys for crayfish in Talbingo Reservoir in response to matters raised by DPI Fisheries.

While clarifications were provided on several matters, the preliminary comments provided by DPI Fisheries in August 2018 form the basis of the formal submission made by DoI dated 17 September 2018 on the EIS for Exploratory Works. Further information was provided to DPI Fisheries to clarify a number of these matters, it is reproduced below and updated where necessary to reflect the latest discussions with DPI Fisheries on the matters raised.

4.3.1 Adequacy of baseline aquatic ecology survey

i Sampling effort

> The baseline established for impact assessment is not reasonable. The AEA does not consider the existing scientific literature that demonstrates the known population of Murray crayfish within Talbingo reservoir. Furthermore, the reliance on a single sampling technique (electrofishing) is unlikely to give a full understanding of the fish community within the reservoir, nor was the application of electrofishing assessments in accordance with established best-practice in terms of duration and frequency of sampling. The detailed comments below also indicate a number of inconsistencies with respect to the known presence/absence of native fish species within Kosciuszko National Park. DPI Fisheries also seeks further information on the use of e-DNA techniques and the findings regarding the presence of carp within the storage.

The baseline for impact assessment completed for the AEA is adequate for fish species with a moderate or higher likelihood of occurring in Talbingo Reservoir and watercourses in the project area. Electrofishing was the main survey technique used and further detail on this approach is provided below in response to DPI Fisheries' specific comments. EnviroDNA Pty Ltd was also engaged to implement eDNA metabarcoding techniques to investigate the presence of fish and decapod species in Talbingo Reservoir as a complementary method to electrofishing. The results were presented in AEA and were consistent with the results of electrofishing, with no threatened species identified in Talbingo Reservoir. Both electrofishing and eDNA metabarcoding identified the presence of Murray crayfish in the Yarrangobilly Arm.

In regard to the population of Murray crayfish in Talbingo Reservoir, a response was provided to this matter on 11 September 2018 and it is discussed below in Section 4.3.2. It is acknowledged that there is literature available (Zukowski et al. 2013) which identifies the presence of Murray crayfish in Talbingo Reservoir. While publicly available, the authors of the AEA were not aware of this information at the time of the assessment.

Sampling undertaken for this assessment consisted only of backpack electrofishing for the streams and boat electrofishing for Talbingo Reservoir. Electrofishing is not effective at detecting all taxa and used in isolation is not considered sufficient to detect all taxa particularly crayfish and some smaller fish species. The level of effort utilised for the backpack electrofishing consisted of 'four two minute shots (480 seconds) being performed at each site'. DPI fisheries considers that this is a relatively low amount of effort and this should be increased. The level of effort established for the Murray-Darling Basin Authority's Sustainable River Audit – Fish theme (Davies et al., 2008) consists of eight 150 second electrofishing shots (1200 seconds). Electrofishing effort should be at the least equal to that established for the Sustainable River Audit.

A response was provided to this matter on 11 September 2018. The level of effort adopted for the surveys is consistent with the Murray-Darling Basin Authority's Sustainable River Audit – Fish theme (Davies et al. 2008)

Section 3.3.1 of the AEA specifies that surveys were undertaken in January/February and March 2018, and that additional surveys were completed in the Yarrangobilly River and Wallaces Creek on 3 May 2018. The first survey event in Yarrangobilly River and Wallaces Creek in January/February 2018 consisted of four two-minute shots (480 seconds) at each site on Yarrangobilly River and Wallaces Creek.

The second survey event on 3 May 2018 involved three sites on the Yarrangobilly River (reach lengths of 180, 180 and 225 m) with an effort of approximately 1,800 seconds at each site and one site on Wallaces Creek (reach length of 200 m) with an effort of approximately 1,200 seconds. The two backpack electrofishing surveys combined for these watercourses generally exceed the effort suggested by DPI Fisheries from the Murray-Darling Basin Authority's Sustainable River Audit – Fish theme (Davies et al. 2008).

Survey using gill netting was completed in Talbingo Reservoir between 11 - 13 September 2018 as part of baseline surveys for Snowy 2.0 Main Works. Notably, no native species were caught during the survey, consistent with the results of the baseline survey for Exploratory Works. Sampling was undertaken at six locations within Talbingo Reservoir including:

- Plain Creek Bay (proposed placement area) x 5 net deployments;
- Cascade Bay (proposed placement area) x 5 net deployments;
- Talbingo Spillway/Proposed Barge Ramp/Dam Wall x 5 net deployments;
- Reference Location 1 (Honeysuckle Bay) x 2 net deployments;
- Reference Location 2 (Near Glendower Creek) x 4 net deployments; and
- Intake/Middle Arm Dredge Area and Barge Ramp x 4 net deployments.

Sampling was undertaken during daylight hours between 08:30 and 18:00 from a 5.5 m Websters twinfisher survey vessel. Each net was deployed for approximately three hours.

A total of 31 fish, including rainbow trout (*Oncorhyncus mykiss*), brown trout (*Salmo trutta*) and redfin perch (*Perca fluviatilis*) were caught in gill nets over the three-day survey. Brown trout were the most abundant species recorded across the survey (16 individuals), followed by rainbow trout (nine individuals) and redfin perch (six individuals).

Details should be provided regarding the level of effort undertaken for the boat electrofishing in Talbingo Reservoir, including the sample locations.

Survey in Talbingo Reservoir consisted of two days (total of 16 hours) of boat-based electrofishing in Talbingo Reservoir undertaken with approximately 8 hours of electrofishing effort (ie power on time) over the two days. This included electrofishing along both the Tumut Arm and Yarrangobilly Arm and generally at the 12 locations within the reservoir and the Yarrangobilly and Tumut arms, labelled as Tal1 – Tal12, and shown in the figure below. Power on time for the electrofishing equipment was not specifically recorded for each site. In addition, electrofishing equipment was also switched on during travel time between some sites.

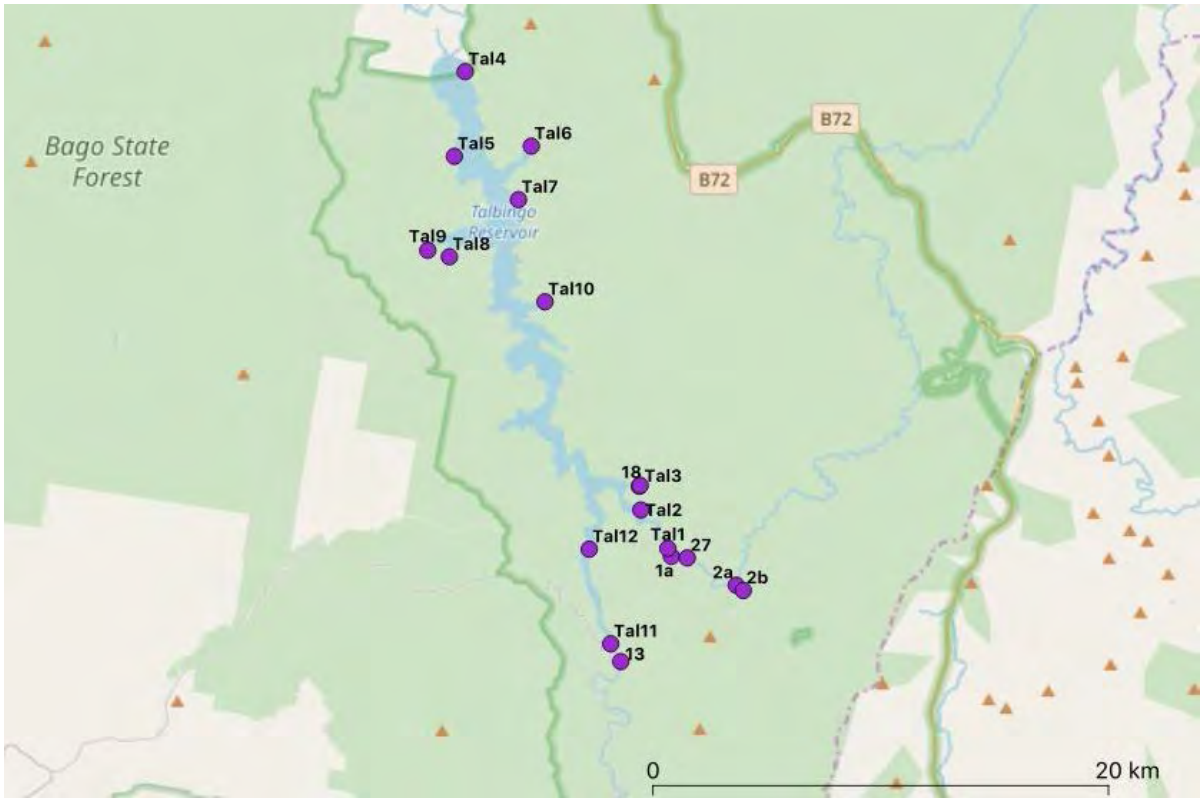


Figure 4.9 Boat-based electrofishing locations in Talbingo Reservoir labelled Tal1 – Tal12

ii Environmental DNA sampling

The methodology and provider of the DNA sampling work carried out for the assessment should be provided in the AEA.

EnviroDNA Pty Ltd was engaged to implement eDNA metabarcoding techniques to investigate the presence of fish and decapod species in Talbingo Reservoir. Sampling was conducted by EnviroDNA with during February 2018 using standardised techniques at site Tal1 – Tal10 (see Figure 6.8). Additional water samples from Talbingo Reservoir (Tal11, Tal12 – see Figure 6.8) were collected as part of a separate project in October 2017. At each site, water samples were collected in triplicate and filtered in situ by passing up to 500 ml water (range 61-500 ml) through a 0.22 µm filter (Sterivex) using a sterile syringe. Care was taken to minimise contamination between sites by using clean equipment and gloves at each site and avoiding the transfer of water, soil, or organic matter. Filters were stored on ice for a maximum of 48 hrs before being transported to the laboratory for processing. DNA was extracted from the filters using a commercially available DNA extraction kit (Qiagen DNeasy Blood and Tissue Kit).

Biodiversity assessments were performed with two separate metabarcoding assays - a universal fish and universal decapod crustacean assay. For each assay, Polymerase Chain Reaction (PCR) was used to amplify a short, hypervariable marker region (within the mitochondrial 12S ribosomal RNA gene) from the fish DNA or the decapod DNA present in each sample. This marker provides good resolution at lower taxonomic levels while having regions that are conserved at higher taxonomic levels. Four replicate reactions were performed per sample.

The sequence of individual marker DNA molecules was then determined by Next Generation Sequencing (NGS). Following quality control filtering, DNA sequence reads were clustered into Operational Taxonomic Units (OTUs) based on DNA sequence similarity (identity cut-off threshold = 98% fish, 99% decapods). The proportion of reads corresponding to each OTU were calculated for each sample. Low abundance OTUs (less than 1% of the total sample reads) were filtered from the dataset on a sample-wise basis.

Each OTU was assigned a species identity by comparing with a custom fish/decapod reference sequence database containing data for native and introduced species occurring within south-eastern Australia. One representative DNA sequence was selected per OTU and searched against all DNA sequences in the reference database. Matches to the database were recorded using a step-wise process that was designed to maximise the accuracy of species assignment, while allowing for some within species variability.

First, all OTUs sharing 100% DNA sequence identity with a database entry were assigned to that species. All unassigned OTUs were once again searched against the reference database, and those sharing ≥ 99% DNA sequence identity with a database entry were assigned. This process was repeated sequentially for identity thresholds of 98% and 97%. A DNA sequence identity threshold of 97% is considered informally by the scientific community to be a rough benchmark for delineating different closely related species, although this will vary across different taxonomic groups and DNA marker regions. Data analysis was repeated with the OTU abundance threshold set at 0.1% of the total sample count, to check for the possibility of low-level detections.

Environmental DNA sampling was undertaken to complement the traditional electrofishing technique applied throughout the study area. In general, the technique was effective at detecting all species identified during electrofishing as well as additional species including those that were subsequently identified in the recent gill net survey in Talbingo reservoir.

The AEA identified that the while the results of the environmental DNA analysis did not indicate the presence of any threatened species of fish in Yarrangobilly River, Wallaces Creek or Talbingo Reservoir, a precautionary approach has been adopted with the interpretation of the environmental DNA analysis where it has not been used as the basis to rule out threatened species occurring.

> DPI Fisheries also seeks further information on the use of e-DNA techniques and the findings regarding the presence of carp within the storage. The detection of Carp DNA provided in the AEA needs to be verified and validated, to confirm if carp are present or if there was a contamination issue or sampling, handling or processing error with the DNA sampling. This should include more comprehensive DNA sampling and/or targeted sampling techniques known to be effective at capturing carp.

A response was provided to this matter on 11 September 2018. The potential presence of Carp is not relevant for Exploratory Works (no water transfer between reservoirs is proposed). Section 5 of the AEA includes measures for plant hygiene to avoid the potential for movement of pests or pathogens between areas.

Further survey work completed in Talbingo Reservoir described in the response above. Gill netting is an effective method for detecting Carp. No Carp specimens were identified during the survey.

iii Description of existing environment

> There are a number of inconsistencies with respect to the known presence/absence of native fish species within Kosciuszko National Park. The KNP native fish community description [Page 21 3.1.2.2 of the AEA] is lacking a number of species that are present within the park, including, Stocky Galaxias (Galaxias tantangara), Kosciuszko Galaxias (Galaxias supremus) and potentially Roundsnout Galaxias (Galaxias terenasus), River Blackfish (Gadopsis marmoratus), Murray Cod (Maccullochella peelii peelii) and Golden Perch (Macquaria ambigua ambigua).
>
> Congolli (Pseudaphritis urvillii), Long-finned and Short-finned eels (Angulla australis, A. reonhardtii) have been included as being present in KNP. A reference or evidence for the presence of these species should be provided, otherwise they should be removed from the list.

A response was provided to this matter on 11 September 2018. Species cited as present in KNP are referenced in *An assessment of the values of Koscuiszko National Park* (Independent Scientific Committee, 2004), included in the references list of the AEA.

> The native fish community description should also include crayfish species, including; Murray Crayfish (Euastacus armatus), Alpine Crayfish (E. crassus), Riek's Crayfish (E. reiki) and Burrowing Crayfish (Engaeus cymus).

A response was provided to this matter on 11 September. Section 3.1.2.2 of the AEA includes reference to the presence of Murray crayfish and possible presence of Alpine Crayfish. The presence of Riek's Crayfish and Burrowing Crayfish within KNP is acknowledged and noted for future reference.

4.3.2 Murray crayfish

i Presence of Murray crayfish

> The AEA does not consider the existing scientific literature that demonstrates the known population of Murray crayfish within Talbingo reservoir. The scientific literature (ie Zukowski et al. 2013) clearly details a known population of Murray crayfish within Talbingo reservoir.

A response was provided to this matter on 11 September 2018. It is acknowledged that there is literature available (Zukowski et al. 2013) which identifies the presence of Murray crayfish in Talbingo Reservoir. While publicly available, the authors of the AEA were not aware of this information at the time of the assessment. The AEA considered the presence of this species was to be likely in the Yarrangobilly Arm of Talbingo Reservoir and the species was identified in the Yarrangobilly River and Wallaces Creek. In relation to its presence in Talbingo Reservoir, Section 3.3.3 of the AEA stated that "Murray crayfish may also occur in Talbingo Reservoir, however, as it is considered to prefer flowing streams and rivers, and due to the abundance of predatory redfin perch here, the probability of it occurring here is low. If it does occur, it is more likely to be found in shallower shore sections where it could construct burrows". Its likelihood of occurrence within Talbingo Reservoir was classified in Table 3.8 of the AEA as 'Low', as it met the following criteria:

- no recent records in the study area though it is within the potential historic, but not current, distribution range;
- recent records or stocking downstream of the study area, though substantial natural barriers to movement exist between known populations/stocking and study area; and
- study area contains potential habitat.

The potential presence of Murray crayfish in Talbingo Reservoir was not discounted, and mitigation measures specifically addressing the potential presence of this species in the reservoir were included in Section 5 the AEA relating to the SERP within Plain Creek, Ravine and Cascade bays, which are listed below.

- placement of subaqueous material no shallower than 3 m below MOL to avoid aquatic habitat, such as aquatic plants and macrophytes;
- mapping of aquatic habitats within and adjacent to the placement area to confirm of the presence/absence of the aquatic habitats and vegetation within and adjacent to the placement area;
- mapping of aquatic habitats, specifically including searches for crayfish burrows along the shoreline, as these could indicate the presence of Murray crayfish and would inform the final placement area extent.; and
- deployment of crayfish traps along the shorelines adjacent to the placement area and within the placement area could be used to re-locate any large mobile invertebrates (including any Murray crayfish) from these areas to nearby sections of the reservoir that would not be affected by placement.

These mitigation measures are consolidated in Chapter 8 of this RTS.

ii Survey effort and impact assessment

> Predictions of impact, especially on the threatened Murray crayfish population are not robust, as the assessment fails to adequately acknowledge the existence of a population within the storage. As a consequence, consideration of impacts, in particular the impact of subaqueous rock placement, both on the individuals and their associated habitats, is not sufficiently developed. The detailed comments below outline the lack of consideration of mitigation or impact controls within the AEA. This is largely due to the initial assessment that considers the presence of Murray crayfish within the reservoir to be 'unlikely'.
>
> The impact on the species has not been adequately assessed through the AEA. Page 36 Section 3.3.3 Likelihood of Occurrence of Threatened Aquatic Species – There is a known abundant population of Murray Crayfish within Talbingo Reservoir and they are known to inhabit sections of the reservoir to substantial depths (in excess of 10-15 meters). DPI suggest that the electrofishing sampling methods undertaken for this study are inappropriate to detect this and other species of crayfish. It is recommended that appropriate, dedicated and targeted crayfish surveys be undertaken to determine the abundance, distribution and depth to which crayfish are present within Talbingo Reservoir.

As discussed above, the potential presence of Murray crayfish in Talbingo Reservoir is acknowledged. DPI raised concerns in August 2018 regarding the suitability of the adopted survey methods to detect Murray crayfish in Talbingo Reservoir; in response, Snowy Hydro agreed to undertake an additional targeted survey.

A detailed survey plan was submitted to DPI for review in September 2018. The targeted survey is scheduled to be undertaken in early October 2018.

At a meeting between EMM, Snowy Hydro and DPI Fisheries on 19 September 2018, a general approach was agreed for assessment of impacts to Murray crayfish in Talbingo Reservoir and development of avoidance, mitigation and offset measures following the targeted survey. The process will initially involve a process of data gathering to further develop Murray crayfish habitat mapping, including:

- targeted crayfish survey in accordance with the method agreed with DPI. This will inform presence/absence and abundance at different depth ranges in Talbingo Reservoir, primarily within the proposed disturbance footprint and at a limited number of reference locations;
- information from previous studies (ie Zukowski et al. 2013 and unpublished data provided by DPI) on Murray crayfish catches in Talbingo Reservoir (location, depth, abundance);
- bathymetric profiles of the impact areas; and
- mapping of the likely presence of submerged timber using current and historic aerial imagery, and interpretation of vegetation presence prior to reservoir inundation.

The above information will be used to estimate the habitat suitability for crayfish in the impact areas including:

- identification of high/medium/low suitability crayfish habitat in the impact areas (as described above);
- revised assessment of significance of impacts to Murray crayfish in Talbingo Reservoir;
- where feasible, identification of avoidance measures in the high/medium suitability areas;
- potential additional mitigation measures to minimise impacts; and

- if offsets or compensatory measures are required to address residual impacts, a process and timeframes for the securing offsets and/or compensatory measures.

The additional survey, habitat mapping, revised assessment of significance and process to develop strategy to avoid, minimise and offset residual impacts will be submitted to DPI Fisheries and DPE in October 2018.

The AEA should be further developed to include an establishment of a baseline for Murray crayfish populations and an improved assessment of the likely impacts on both the populations themselves and their habitats. If these impacts are found to significant, consideration should be given to available mitigation options within existing project design, including alternatives to the subaqueous rock placement or an offsetting agreement to account for any impacts that cannot be sufficiently mitigated.

Refer to response above.

Page 42-43 Section 4.3.2.2 Subaqueous Placement - This section states that there is unlikely to be any direct loss of Key Fish Habitat and or key habitat for threatened species. These assumptions are made regarding the lack of the surveys to detect any Murray Crayfish in Talbingo Reservoir and the conclusion that they are unlikely to occur in the reservoir. However there is an abundant population of Murray Crayfish known to exist within Talbingo Reservoir and known to utilise habitat to significant depths (greater the 10-15 meters). Therefore the subaqueous placement has the potential to significantly impact on large areas of known habitat of Murray Crayfish and potentially smother animals and/or their burrows in the placement of material. Murray Crayfish are known to burrow to depths greater than those currently proposed for the subaqueous placement, therefore there is a high probability that the subaqueous placement will smother Murray Crayfish burrows.

Refer to response above.

Recommendations to Minimise Residual Risks [Page iv. Of the AEA]·- Additional information is required on the proposed aquatic habitat mapping methodology, particularly with the relation to Murray Crayfish burrows in the deeper sections (10-15m) of the proposed works.

Refer to response above. The aquatic habitat mapping will be completed using a combination of survey data, bathymetry and presence of submerged timber inferred from historical aerial imagery.

At the time of preparation of the AEA, Murray crayfish burrows were not known to be in deeper sections of the reservoir; therefore mapping of crayfish burrows was proposed to be undertaken in shallow areas only where they would be visible from a visual inspection at the water surface. Mapping of burrows in the deeper sections of the reservoir is not proposed. The presence of burrows would be inferred based on the habitat mapping which would identify high/medium/low suitability habitat, as described in the response above.

DPI Fisheries would not consider the assessment in its current form acceptable within the existing policy context. The consideration of impacts on threatened species is not sufficient.

It is acknowledged that there is literature available (Zukowski et al. 2013) which identifies the presence of Murray crayfish in Talbingo Reservoir which the authors of the AEA were not aware of. Therefore, the presence of this species was only considered to be likely in the Yarrangobilly Arm of Talbingo Reservoir and further upstream in the Yarrangobilly River and Wallaces Creek.

As described in the response above, additional targeted survey is scheduled for early October 2018 for Murray crayfish in the reservoir. As agreed with DPI Fisheries, based on the data provided by DPI Fisheries and the planned surveys in Talbingo Reservoir, the assessment of significance presented in the AEA will be updated to account for the potential impacts to Murray crayfish and its habitat arising as a result of the proposed activities within Talbingo Reservoir including the SERP program, dredging activities and the construction of the two barge ramps.

Given the ongoing work agreed with DPI Fisheries, including targeted surveys for Murray crayfish in October 2018 and habitat mapping of the impact areas within the reservoir, DPI Fisheries agreed that it would be appropriate for the revised assessment of significance to consider additional information that will become available in October 2018. Therefore, a revised assessment of significance for Murray crayfish is not included in the RTS, but will be provided to DPI Fisheries as part of the process described in the response above.

The disturbance footprint in the SERP locations is presented in the table below. It is important to note that these placement areas are expected to be enough to accommodate the total volume of all excavated material from Snowy 2.0 Main Works (should Snowy 2.0 proceed), including up to 750,000 m^3 from Exploratory Works.

The estimates are based on the bathymetry of the reservoir bed (ie areas include the shape of the bed). There is a total of 79 ha of reservoir bed within the three SERP locations. This represents approximately 5% of the total reservoir bed (ie 5% of the total area of 1,675 ha below MOL). Approval is sought for the full area of impact (ie 79 ha) as placement may occur in all three locations as part of Exploratory Works. However, it is acknowledged that placement as part of Exploratory Works would only use a portion (up to 750,000 m^3) of the total available volume of around 7.5 million m^3 available in these three locations.

All material placed in the reservoir as part of Exploratory Works will be placed so that the material settles at least 3 m below the MOL of the reservoir. The MOL is 7 m below the average water level in the reservoir. Therefore, material will typically be placed at least 10 m below the current average water level. Table 4.12 summarises the placement footprints within the three nominated locations.

Table 4.13 Disturbance footprint in the SERP locations – Plain Creek, Ravine and Cascade bays

Location	Total estimated disturbance area	Area below MOL by depth (m^2 unless otherwise stated)		
		3–5 m depth below MOL	5–10 m depth below MOL	>10 m depth below MOL
Plain Creek Bay	89,454 m^2	31,943 m^2	22,941 m^2	34,571 m^2
Ravine Bay	304,664 m^2	55,333 m^2	54,691 m^2	194,639 m^2
Cascade Bay	399,324 m^2	87,373 m^2	73,944 m^2	238,007 m^2
Total (m^2)	**793,442 m^2**	**174,649 m^2**	**151,576 m^2**	**467,217 m^2**
Total (hectares, ha)	**79**	**18**	**15**	**47**

As described in the *Technical Report: Subaqueous Excavated Rock Placement Program* (RHDHV 2018), the proposed location for the subaqueous placement of 50,000m^3 of excavated rock in the initial phase for Exploratory Works in Plain Creek Bay. Section 4.4.2 of RHDHV (2018) stated that the area of the reservoir that would be displaced beneath the initial phase placement of excavated rock material (5.0 ha) is a very small proportion (0.3 %) of the total area of reservoir bed (note that the calculation was based on the proportion of reservoir impacted compared to FSL). This assessment related to the placement of excavated rock from the initial phase of the SERP program (50,000m^3 of excavated rock).

RHDHV (2018) stated that if the volume of rock in the initial phase was distributed evenly over the available area within Plain Creek Bay, it would be approximately 1 m thick. In practice, the intent is to vary the thickness of placement with the aim of assessing the efficacy of placement techniques which would achieve outcomes likely to be important to inform the excavated rock management program for the Snowy 2.0 Main Works. For Exploratory Works, the thickness of the placement of excavated rock above the reservoir bed would exceed 1 m in places but would not be expected to exceed 5 m. In all cases the top surface level of the placed rock would not encroach within 3 m below MOL.

Should the initial phase of subaqueous placement be successful (as agreed with relevant agencies), Snowy Hydro would proceed with placement of additional excavated rock as a continuation within Plain Creek Bay and also at Cascade Bay and Ravine Bay as part of Exploratory Works.

As shown in the table above, in the order of 79 ha of reservoir bed may be impacted within the three placement locations, which represents around 5% of the total area of the reservoir bed measured below the MOL. These placement areas are expected to be enough to accommodate the total volume of all excavated material from Snowy 2.0 Main Works (should Snowy 2.0 proceed).

Page 53 Table 5.4 Potential Impact – The section on Displacement of Aquatic Habitat and Biota, should be updated to include the likelihood that there will be the smothering and displacement of Murray Crayfish and their burrows.

Refer to responses above. A revised assessment of significance will be prepared for Murray crayfish.

Page 57 Conclusion – Given the inadequacies of the sampling methodology to detect crayfish and potentially other fish species, DPI considers that the conclusions drawn, particularly with relation to the impacts of the dredging and subaqueous placement of dredged material and rock have been made without sufficient supporting evidence. DPI request that further detailed and targeted sampling needs to occur, particularly for Murray Crayfish, before an informed conclusion can be drawn upon the impacts of the proposed works on Murray Crayfish and other aquatic species generally.

Refer to responses above. Additional targeted survey is scheduled for 2-4 October 2018. This will inform a revised assessment of significance for Murray crayfish.

Page 86 Murray Crayfish Assessment of Significance – The assessment of significance should include the proposed works within Talbingo Reservoir (dredging and subaqueous placement) and the potential impacts on the known Murray Crayfish population with the reservoir. This assessment cannot be undertaken until such time that an adequate and thorough survey of the impacted area has been undertaken.

Refer to responses above. Additional targeted survey is scheduled for 2-4 October 2018. This will inform a revised assessment of significance for Murray crayfish.

Controls – The controls should include:

Targeted surveys for the identification of presence and distribution of Murray Crayfish and to what depths they are present, these surveys should be designed to incorporate accepted sampling methods and developed in consultation with DPI.

The mapping of aquatic habitats should include the mapping of crayfish burrows and extend into depths to which Murray Crayfish are identified to be present via the targeted surveys and not be restricted to the shoreline as suggested.

The deployment of crayfish traps should include all areas where rock placement will occur, and not be restricted to the shoreline.

Refer to responses above.

4.3.3 Subaqueous placement

The justification for subaqueous rock placement is not sufficiently developed given it is contrary to the Policy and guidelines for fish habitat conservation and management (2013 update) and the general guidance provided to developers regarding the placement of spoil within waterways.

The subaqueous placement of dredged material will be subjected to the same environmental controls, monitoring and water quality criteria as the subaqueous placement of excavated rock. Subaqueous placement of rock is summarised in response to a matter raised by the EPA (refer to Section 4.2.3).

The proposed dredging program in Middle Bay is described in the *Middle Bay Dredging and Dredge Impact Assessment* (Appendix C of the *Barge Access Infrastructure* report (EIS Appendix L)) (the 'Dredging Report'). This includes:

- dredging about 1,500 m^3 of Talbingo Reservoir bed material at the toe of the barge access ramp (see Section 1.3.1 of the Dredging Report);
- dredging about 35,000 m^3 of bed material to form a channel so that the barge access ramp can be reached when the water level in the reservoir is low; and
- placement of the dredged material a) in the on-land rock emplacements, or b) in the reservoir.

If placed in the reservoir, Section 3.1 of the Dredging Report specifies that the dredged material would settle to the bed of the reservoir via the well and fall pipe fitted to the discharge barge. The dredged material would be of similar composition (fine textured sediments) to that on the bed of Plain Creek Bay. The proposed quantity of dredged material of 35,000 m^3 is relatively minor compared to the potential placement volume in Plain Creek Bay. Water movement at depth within the side bay and the reservoir is generally low, as evidenced by the fine textured sediments on the bed. The sediment to be dredged from Middle Bay would therefore be placed on material with similar physical and chemical properties (ie like with like material). In general, the impacts of placement of dredged material are expected to be similar to the placement of excavated rock.

Concerns were raised by EPA regarding the placement of dredged material in the on-land rock emplacements, including the required dewatering of the dredged material to allow this to occur and by NPWS regarding the proposed permanent rock emplacements. In response to these concerns: a) placement of dredged material in the on-land rock emplacements is no longer proposed and b) these rock emplacements will be temporary, and the emplacements will be removed within five years of completion of Exploratory Works.

The dredged material cannot be placed elsewhere within the KNP. This leaves two potential methods for the placement of dredged material:

- on-land placement outside of the KNP; and
- subaqueous placement in the reservoir (which is not part of the KNP).

Consideration of on-land placement outside of the KNP has been undertaken. A key consideration for on-land placement is the volume of dredged material and its transport to an end location. Assuming that a truck and dog vehicle configuration can transport an average of up to 15 m^3 of dredged material, approximately 2,500 truck trips (5,000 movements) would be required between Lobs Hole and an on-land placement area outside of the KNP. If dredging occurred over 1 month this would be 715 truck movements per day or 1 truck movement every 2 minutes, 24 hours/day, 7 days per week. More trucks would be required if the large truck and dog configuration was unsuitable to access Lobs Hole. The truck trays would need to be sealed to prevent the water from the dredged material spilling along the transport route. The trucks would need to travel on public roads for at least 70 km (round trip) if the on-land placement area was immediately outside of the nearest park boundary; it would most likely be much further to a suitable placement location. There is a level of risk with all vehicle movements; such large numbers of closely-spaced truck movements on the public roads in the KNP is expected to be unacceptable. Furthermore, if an on-land option was pursued, the dredged material would need to be placed in an engineered containment structure that would have environmental impacts such as the requirement for clearing and would require a range of water seepage controls. The containment structure would need to be rehabilitated once full.

It is therefore proposed to transport the dredged material by barge to Plain Creek Bay for subaqueous placement. The transport barges will be fitted with bulwarks ('hungry boards'). These will be water tight to prevent loss of water and fines into the water column along the transport route to the placement area. Subaqueous placement will not require any truck movements on public roads.

As described in Section 3 of the Dredging Report, the sediment is largely homogeneous across the bed of the reservoir. Therefore, the dredged material from Middle Bay will be like the sediment in Plain Creek Bay and would not result in a long-term change to the sediments within the bay. Further, based on the testing of the material to be dredged and the proposed controls no significant water quality impacts are predicted during the placement of the dredged material.

Page 14 Section 1.3.3.5 Barge Access and Other Infrastructure in Talbingo Reservoir – DPI Fisheries does not support the disposal of this type of dredged material within Talbingo Reservoir In accordance with DPI Policy and guidelines for fish habitat conservation and management (2013 update) Section 6.3.3. DPI policy also requires the proponents to carefully monitor the impacts of extraction activities including Rates of sediments infilling post-works, upstream and downstream impacts and immediate habitat changes.

Justification is provided in the response above for the rational of in-reservoir disposal of dredged material. Dredging activities will be carefully monitored as described in Section 8 (Table 8.1). DPI Fisheries will be consulted during preparation of the relevant management plan.

Sediment material extracted should also be tested for contaminants prior to any works commencing, including for heavy metals, organochlorines, Acid Sulfate Soils and toxic dinoflagellates. Contaminated sediment must be disposed of in accordance with OEH guidelines.

The *Middle Bay Dredging and Dredging Impact Assessment* (RHDHV 2018) included in Appendix L of the EIS presents the results of sediment quality testing of the proposed dredge material (Section 2.4). A broad suite of organic and inorganic contaminants was tested and compared to the screening levels provided in the National Assessment Guidelines for Dredging (NAGD) 2009. The NAGD screening levels are generally the same values as the Interim Sediment Quality Guideline (ISQG) low values provided in ANZECC/ ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Sediment Quality Guidelines*.

In summary, the sediment testing showed concentrations of all parameters were below the screening level or below laboratory detection except for nickel and copper. To assess the bioavailability of these contaminants, acid soluble metal analysis (dilute acid extraction, DAE) was undertaken on three representative samples of the proposed dredge material. While the total concentrations of copper and nickel exceeded the NAGD screening level, DAE concentrations of copper and nickel were below the NAGD screening level indicating these that these metals are unlikely to be bioavailable.

Elutriate tests are widely used to assess the potential impacts of dredging on water quality, in particular the desorption of contaminants from suspended sediment particles to the water. As described in the NGAD, these laboratory tests consist of mixing the sediment to be dredged with water from the disposal location (in this case the southern end of Talbingo Reservoir), and then measuring the resulting potential contaminant concentrations in the water. The elutriate tests simulate the maximum concentrations released during placement of dredged material but also provides an indication of potential release of contaminants during dredging. The elutriate tests described in the Middle Bay Dredging and Dredge Impact Assessment used a 1:4 sediment:water dilution.

Results of the elutriate testing for the project, without allowance for dilution beyond the 1:4 test dilution, showed exceedances of the ANZECC/ARMCANZ (2000) default trigger values for the protection of slightly–moderately disturbed ecosystems for chromium, copper, lead, and zinc.

The concentrations of copper and zinc in Talbingo Reservoir exceed these default trigger values:

- the median copper concentration of 0.032 mg/L exceeded trigger value of 0.0014 mg/L for the protection of 95% of species by about 20 times; and
- the median zinc concentration of 0.024 mg/L exceeded trigger value of 0.0080 mg/L for the protection of 95% of species by about three times.

The NGAD state that the relevant trigger values should not be exceeded after allowing for initial dilution, defined as “that mixing which occurs within four hours of dumping”. A total initial dilution of 1:25 is required within four hours for the concentrations of these contaminants in the water column to be below the trigger values. Based on the dredge site and proposed subaqueous placement area (Plain Creek Bay), specifically the available water depth and allowance for a four-hour mixing period, an initial dilution of 1:25 is readily achievable. These dilutions will occur within the silt curtains that will surround the placement area. As the water quality will not meet all trigger values within the silt curtains, the water volume within the silt curtains will need to be a mixing zone.

Adverse water quality impacts due to the release of metals into the water column during placement within the reservoir are not expected.

Sediments will be dredged using a long-arm excavator. There will be some entrainment of sediment to the water column as the bucket is raised to the surface. The mass lost to the water column will be negligible compared to the amount in the bucket. The sediment entering the water column will increase the turbidity of the water within the silt curtain or moon pool surrounding the extraction area. Given the entrainment process, the 1:25 dilutions required to meet the default trigger values will be met almost immediately so no adverse water quality impacts due to the release of metals into the water column during dredging are expected. As the water quality will not meet all trigger values within the silt curtains (or moon pool), the water volume within the silt curtains will need to be a mixing zone.

The aquatic ecosystem water quality objectives will be met as the trigger values for the protection of aquatic ecosystems will not be exceeded outside of the silt curtains in the dredging and placement areas.

Page 14 Section 1.3.3.5 Barge Access and Other Infrastructure in Talbingo Reservoir – Excavated spoil should not be stockpiled within 50 m of TYPE 1 and 2 aquatic habitats. Sediment and erosion control measures must be put in place for the management of any spoil disposal sites which have the potential to contaminate nearby waterways. Sediment material extracted should also be tested for contaminants prior to any works commencing, including for heavy metals, organochlorines, Acid Sulfate Soils and toxic dinoflagellates. Contaminated sediment must be disposed of in accordance with OEH guidelines.

Section 3.3.2.2 of the AEA identifies Talbingo Reservoir, Yarrangobilly River and Wallaces Creek as Type 1 watercourses. No Type 2 watercourses are identified. A 50 m buffer has been applied to these watercourses and no stockpiling would occur within 50 m. These controls are already included in the AEA and EIS. As described in Section 3.2 of this RTS, on land emplacement area is now proposed to be temporary and will not include the disposal of any dredged material.

Page 14 Section 1.3.3.5 Barge Access and Other Infrastructure in Talbingo Reservoir – The area proposed to be dredged to allow an appropriate operating depth for the barge ramps in the Yarrangobilly Arm is highly likely to contain Murray Crayfish and/or their burrows, this has not been included in the assessment or any mitigation measures regarding impacts of this works to Murray Crayfish. Further targeted survey work is required to determine the presence, abundance and distribution of Murray Crayfish with the proposed dredging site.

Impacts to Murray crayfish within the area proposed to be dredged is assessed in Section 4.5.2 of the AEA, which states that total area from which material would be dredged (3 ha at the navigation channel/Middle arm barge and 0.7 ha at the Talbingo barge ramp) is very small compared with the total area of reservoir (RHDHV 2018c).

Such habitat is also abundant throughout the reservoir. Thus, the loss/alteration of the small amount of habitat due to dredging of the barge ramp locations and Middle Arm navigation channel is expected to have very low to negligible effect on the overall aquatic ecology of the reservoir. Mitigation measures for impacts associated with dredging are presented in Section 5.5 of the AEA, which include mitigation measures to specifically address Murray crayfish including habitat mapping, visual searches for burrows and crayfish trapping.

Notwithstanding, the targeted surveys will be included the dredging locations and the revised assessment of significance will incorporate impacts from dredging in the Yarrangobilly Arm.

Page 12 Section 1.3.3.3.1 On Land Placement – The AEA states that 'design and management of the emplacement areas have not yet been finalised due to the need for further investigations and that a management plan will be prepared and implemented' DPI Fisheries request the opportunity to review and provide comment on the proposed management plan, prior to it being implemented..

The on-land emplacement area is now proposed to be temporary and will not include the disposal of any dredged material. Any remaining materials will be removed from KNP following completion of Exploratory Works subject to further approvals obtained for the Snowy 2.0 Main Works. The draft management plan can be provided to DPI Fisheries for comment.

4.3.4 Other clarifications

Page 28 Section 3.1.8 Pest Species of the AEA states that 'Observations made by DPI research staff suggest that goldfish can be a food source for some predatory freshwater fish such as Murray Cod'. Whilst Murray Cod and other predatory species may eat goldfish, their value as a food source has not been validated. It is recommended that this statement be removed.

DPI Fisheries comments are noted, and it is acknowledged that the value of goldfish as a food source for predatory fish has not been validated.

Page 28 Section 3.1.8 Pest Species states that 'There has been no reported incidences of fish kills associated with EHNV in Talbingo Reservoir'. however this does not mean that the virus is not present. Given the close proximity to Blowering Dam and the fact that EHNV can be transported via birds (Whittington et al., 1996) and water (Whittington et al., 2011), it is highly likely that EHNV is present within Talbingo Reservoir. Whilst not of significant relevance to the proposed exploratory works it may have significant ramifications for the broader proposed Snowy 2.0 works should they proceed.

It is acknowledged that the presence of the virus cannot be discounted. The presence/absence of EHNV is not directly relevant for Exploratory Works (no water transfer between reservoirs is proposed). Section 5 of the AEA includes measures for plant hygiene to avoid the potential for movement of pests or pathogens between areas.

The AEA states that 'Talbingo Reservoir also supports large areas of non-native aquatic plants'. Details regarding the species of plants and their location should be provided as part of the AEA.

The species is noted as Elodea in Section 3 of the AEA and is widespread throughout the reservoir. If any other species are identified during further work, this information will be provided to DPI Fisheries.

Recommendations to Minimise Residual Risks [Page iv. Of the AEA]·- It is recommended that if any harmed or dead fish are observed during seismic survey works that works will immediately cease and DPI Fisheries will be notified. Works should not recommence until DPI Fisheries have had sufficient time to investigate and are satisfied it is safe for works to recommence.

A protocol for the management of adverse impacts including harm to fish or other biota will be developed in consultation with DPI Fisheries and included in relevant management plan. The draft management plan will be provided to DPI Fisheries for review.

4.3.5 Watercourse crossings

Page 14 Section 1.3.3.4.2 Watercourse Crossings – The existing crossing over the Yarrangobilly River will have the level raised and be used as a temporary crossing during construction of the new bridge. Information regarding the nature and level of the proposed raising of the existing crossing and the time frame that the crossing will be utilised for should be provided.

The existing crossing over the Yarrangobilly River consists of a natural cobble/gravel bed which is impassable when river levels rise. Continued access across the Yarrangobilly River during the construction of the permanent bridge is required. The EIS contemplated and assessed the construction of a splash crossing in this location. However, alternative design options have now been identified, which subject to detailed design, would result in the same or reduced environmental impact than the assessed splash crossing. These options include the installation of a pipe and culvert or a pre-fabricated 'Bailey bridge'. DPI Fisheries will be consulted regarding the design of the watercourse crossing once a detailed design has been confirmed.

4.4 NSW Department of Industry – Water Division

4.4.1 Surface water

The proponent is required to confirm an approach to account for the proposed surface water take from Talbingo Reservoir and any take requirements due to the eastern rock emplacement.

The Exploratory Works will include four types of water take/use/interception which are listed below:

- interception of rainfall/runoff into disturbed areas (ie for erosion and sediment control) - some of these areas are marked as third order streams or above –disturbed areas have diversions, but some capture of rainfall and runoff is inevitable;
- use for potable water in the accommodation camp;
- use for dust suppression on roads and disturbed areas; and
- use for concrete production.

The use component (ie dust suppression and concrete production will peak at 227 ML/yr during construction). This take is temporary and not ongoing.

Snowy Hydro will work with DoI Water to determine the appropriate path for water access and use required for the Exploratory Works.

Snowy Hydro currently holds the Snowy Water Licence granted under section 22 of the Snowy Hydro Corporatisation Act 1997. The Snowy Water Licence confers the right to collect all water from the rivers, streams and lakes within the Snowy Water Catchment and then to divert, store and use that water to generate electricity and for purposes which are incidental or related to the generation of electricity or to the management of that water in Snowy Hydro's works. Snowy Water must then release all water collected and stored by it to rivers and streams flowing from the Snowy Water Catchment except normal operating losses and consumption within its works1. Snowy Hydro will explore with DOI the scope for the Snowy Water Licence to be utilised by agreement to enable water to be used for limited purposes associated with the Exploratory Works.

As stated in the EIS, a licence for the interception and taking of groundwater will be applied for under the Water Management Act, 2000. It is understood that the next controlled allocation release which could be licensed within the Lachlan Fold Belt (MDB) Groundwater Source (other) is scheduled for late 2018.

Justification be provided as to how the eastern emplacement can comply with the rule in Section 62 (1A) of the Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial water sources.

The rule in section 62 (1A) of the *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources 2012* refers to approval for in-river dams on a third order or higher stream.

The eastern emplacement area is now a temporary stockpile, not a permanent dam, with any materials (that have not been subaqueously emplaced) that remain following the completion of Exploratory Works, should Snowy 2.0 Main Works not proceed, will be removed from KNP.

This material will be removed from KNP to nominated location(s) within five years of completion of Exploratory Works. The temporary stockpile will continue to be managed as per the design and descriptions within the EIS until all material is removed. Lick Hole Gully will then be rehabilitated.

The water management approach for the eastern emplacement seeks to:

- manage sediment laden runoff during establishment;
- manage ARD risks, through the selective placement of PAF material with AC material or acid neutralising material;
- capture and divert runoff from Lick Hole Gully around the emplacement;
- promote infiltration of direct rainfall onto the emplacement; and
- actively manage water quality risks by capturing all seepage from the emplacement. Captured water will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant at the portal construction pad.

[1] Clauses 7.1 and 7.3 of the Snowy Water Licence"

The eastern and western emplacement areas will be rehabilitated following removal of all material. Lick Hole Gully will be resinated as part of the rehabilitation works. Geomorphic and ecological characterisation of Lick Hole Gully will be undertaken prior to disturbance to record the existing conditions and values of Lick Hole Gully. The rehabilitation approach will seek to create a physically stable landform that reinstates or improves the existing values.

Based on the active management process outlined above, the temporary stockpile is not expected to result in any material water take.

Monitoring of stream flows upstream of the emplacement and seepage from the emplacement will be undertaken to assess and understand changes to the hydrologic regime due to the emplacement.

> A detailed assessment of the watercourse characteristics and the significance of impacts proposed by works to be constructed in or within close proximity to these watercourses.

A detailed assessment of the characteristics of the Yarrangobilly River and Wallaces Creek has not been undertaken as a 50 m offset or exclusion zone from the top of bank has been applied to both watercourses. This exceeds the 40 m buffer recommended in '*Guidelines for Controlled Activities on Waterfront Land* (NRAR 2018)'. The only works proposed within this buffer are the establishment of Camp Bridge (Yarrangobilly River) and Wallaces Bridge (Wallaces Creek). Section 7.2 of the SWA (EMM 2018c) contained in Appendix M of the EIS provides further information on impacts to smaller watercourses.

With regards to the third order stream immediately to the north of the accommodation camp, Figure 6.1 within the SWA (EMM 2018c) shows a water management concept for the accommodation camp. A 15 m vegetated riparian zone (equivalent to the inner vegetated riparian zone for a third order watercourse) is shown on the figure. This figure shows that fill batters are proposed within the inner vegetated riparian zone at several locations. The batter for the eastern water management basin is shown to extend into the watercourse channel. There is a note on the figure that commits to replacing the earthen batter with a retaining structure to avoid direct disturbance of the watercourse channel. Hence, no stream diversions are proposed.

The AEA report contained in Appendix G of the EIS also provided assessment of the proposed bridge works. This report found that there is unlikely to be direct loss of key fish habitat due to the bridge construction and access road works.

4.4.2 Groundwater

> An assessment of the potential fracture propagation from the drill and blast method of tunnelling and potential for subsequent increased fracture flow of groundwater and/or increased connectivity. The results would need to be considered in terms of changes to impact predictions and water take.

The numerical groundwater flow model does not explicitly simulate fracture propagation from blasting. That is, hydraulic properties of the rock are not changed with time as tunnelling progresses. It should be noted that any fracture propagation is expected to occur only because of blasting, not as a result of structural slumping/subsidence such as occurs when mining coal seams. In this project setting, it is expected that fractures resulting from blasting will extend typically only on the order of 2 m from the tunnel. The tunnel has design height and width of 8 m by 8 m.

The numerical groundwater flow model simulates the removal of water from the tunnel using MODFLOW Drain package boundary conditions assigned to model cells intersected by the proposed tunnel. These model cells are each 12.5 m by 12.5 m in the north-south and east-west directions and 12 m high. These dimensions result in the model draining a volume of rock larger than the proposed tunnel and sufficiently large to encompass both the tunnel and expected extent of blast-induced fracturing beyond it.

For comparison, each drain boundary condition drains a volume of 1,875 m^2 (12.5 m long x 12.5 m wide x 12 m high), compared to an excavated tunnel volume of 800 m^2 (12.5 m long x 8 m wide x 8 m high).

Therefore, the model predictions are expected to be conservative with regard to both tunnel inflows and propagation of drawdown into the regional groundwater system.

An assessment of the compression/compaction impacts of waste material stockpiling on soil and alluvial sediments and its potential impacts on groundwater.

It is recognised that significant waste emplacement has the potential for infill of fractures with low permeability waste rock material, or possibly smearing (‘blinding’) by the waste rock of the fracture network exposure at surface. These factors may act together with changes in effective stress due to loading via waste rock emplacement causing pore pressure changes, closure of fractures and a decrease in permeability.

However, given both the shallow soil and colluvial sediments are unsaturated, and only episodically recharged during flooding, rainfall events and the waste rock emplacement for both the eastern and western stockpiles is temporary and not expected to remain a permanent feature for more than four years, we do not consider this a risk to the environment.

4.4.3 Biodiversity

Further assessment and justification in regards to the use of the eastern rock emplacement is required. This is to confirm 1) the impacts on aquatic and riparian habitat from its physical construction, and 2) the ability to mitigate water quality impacts to the surface and groundwater resources and associated habitat from potential acid generation.

Figure 6.10 shows the eastern emplacement area and the Lick Hole Gully riparian habitat. It can be seen the nature of the habitat is varied but generally degraded. Lick Hole Gully is an intermittent third order tributary of Yarrangobilly River. It arises near Round Top Mountain and flows north joining Yarrangobilly River adjacent to historic mine workings. During site visits in late January/early February 2018, very minimal flow was observed at the current Mine Trial Road / Lick Hole Gully crossing.

The gully appears to have experienced past disturbance due to historic mining and examination of aerial imagery and photographs of its channel and adjacent banks indicate substantial riparian vegetation clearing has taken place previously. This extends from the current road crossing to its confluence with Yarrangobilly River. It may also experience disturbance due to elevated metal, particularly copper, concentrations due to inflow from historic mine workings. Such impacts, and its intermittent flow, is expected to limit the value of the aquatic habitat that it provides, compared with similar, relatively undisturbed watercourses to the immediate east and west. Nevertheless, while this watercourse may provide limited habitat of fish, it would likely provide more valuable refuge for aquatic macroinvertebrates and other aquatic flora and fauna. Some isolated riparian vegetation is also present adjacent to some sections of its channel downstream of the current road crossing.

Approximately 450 m of Lick Hole Gully is within the footprint of the proposed eastern emplacement. This length of watercourses would be displaced beneath the excavated material. As previously discussed, the eastern emplacement area will now be removed following Exploratory Works. Given the changed long-term goals for the emplacement area, a revised approach to water management is proposed to manage water quality from potential acid generation. These controls were described in Sections 3.2.1 and 4.4.1 above. The intent of this management approach is to manage the water quality encroaching the Yarrangobilly River which provides habitat to fauna.

Displacement of habitat would be temporary as the material within the eastern emplacement area would be removed and the area rehabilitated following construction. Lick Hole Gully will be reinstated as part of the rehabilitation works and more detailed geomorphic and ecological characterisation of Lick Hole Gully carried out before disturbance occurs to record the existing conditions and values of Lick Hole Gully. The rehabilitation approach will seek to create a physically stable landform that reinstates or improves the existing values. In particular, the rehabilitation process would provide the opportunity to substantially improve the condition of the riparian vegetation of Lick Hole Gully. This would also improve the value of the habitat provided by the gully for aquatic flora and fauna.

Such habitat is abundant in the local and regional area and the temporary loss of this section of watercourses is not expected to result in any cumulative impact to aquatic ecology in the local area. Thus, the temporary loss of this small area of aquatic habitat of limited value would have a localised and short-term impact to aquatic flora and fauna that is likely to have negligible consequences for aquatic ecology in the study area. The rehabilitation of the gully following removal of the emplacement provides an opportunity for overall improvement in aquatic habitat following construction.

Prior to constructing the eastern excavated rock emplacement, the former Lick Hole Gully Adit would be backfilled, and track rolled. Once this is completed the remaining eastern excavated rock emplacement would be stripped of its soil and vegetation to a depth of 0.5 m below ground level. The soil and vegetation would be placed on the western excavated rock emplacement.

Measures to avoid direct impacts to aquatic and riparian habitat are outlined in the BDAR (EMM 2018b) provided in Appendix F of the EIS. Both the western and eastern rock emplacement areas are outside of the 50 m buffer zone; thus, no direct impacts to aquatic habitat in the Yarrangobilly River, or riparian vegetation along the Yarrangobilly River will occur. It should be noted that currently the riparian zone of the Yarrangobilly River is significantly cleared.

Measures to mitigate water quality impacts to surface water resources and associated habitat from acid generation are also outlined in the AEA. These measures include testing of rock for acid forming potential, lining the emplacement area with a layer of acid consuming limestone, passive treatment of water, diversion of water and surface water monitoring program in the Yarrangobilly River. Further detail is provided in Section 7.5.2 of the BDAR (EMM 2018b).

These controls are expected to provide a high factor of safety, resulting in negligible risk of impacts to water quality in the Yarrangobilly River. As a contingency, should water quality monitoring be found to impact on aquatic habitat in the Yarrangobilly River, the rock emplacement areas will be removed and disposed of outside of KNP.

Justification to support the prediction that the three terrestrial plant community types (PCT's) identified as potential Groundwater Dependent Ecosystems will be able to adapt to changes to groundwater levels.

Conservatively, two plant community types (PCTs): PCTs 285 and 296, were found to have facultative dependency on groundwater, while one PCT: PCT 302 was found to have an entirely/obligate - proportional dependency on groundwater. These PCTs are associated with tributaries of the Yarrangobilly River or the River itself.

The two PCTs with a facultative dependence on groundwater are considered unlikely to be impacted given their location, no real predicted impacts in these areas and minimal dependence on groundwater baseflows. PCT 302 is associated with the Yarrangobilly River. Exploratory Works is predicted to result in a 0.4% to 3.8% reduction in baseflow during the lowest monthly stream flow, providing a conservative assessment of the potential impacts. This level is considered negligible and highly unlikely to impact on GDEs. Given upstream environments of the Yarrangobilly River will not be affected, this GDE will maintain a source of water even during drought events.

4.4.4 Post approval requirements

Develop a Water Management Plan (WMP) for review by Lands and Water prior to construction commencement.

A Water Management Plan will be prepared and implemented under the framework of a CEMP. It will be prepared in consultation with DoI Water.

Provide the final design and construction documentation before construction commences.

Snowy Hydro will provide the requisite information to relevant agencies prior to construction.

Install the proposed network of shallow monitoring bores across the Exploratory Works surface infrastructure area, including the tunnel portal area to characterise the shallow rock profile before the end of 2018. The data from this monitoring is to further inform modeling prior to final design and construction. The updated groundwater modeling is to be provided to Lands and Water for review.

A network of shallow monitoring bores will be installed across the proposed surface infrastructure area prior to construction. A drilling and completion report will be provided to DoI Water following implementation of the network. A strategy to incorporate the groundwater level information from the shallow network into the numerical groundwater flow model has been outlined in the Water Management Plan. A model update will likely be available for comment in February 2019 as part of the Snowy 2.0 Main Works EIS.

Design the water management system to ensure sufficient water holding capacity to hold and be able to treat volumes of tunnel and runoff water equating to several days of maximum outflow.

Section 6 of the SWA (EMM 2018c) provides detailed information on the proposed water management controls, which include controls for stormwater management and tunnel affected water. This information will also be provided in the Water Management Plan.

The ability to accurately meter and monitor water take from surface and groundwater sources will need to be developed with ongoing review of actual verses modeled predictions. This will be a key component to confirm impact predictions, the adequacy of mitigating measures and compliance for water take.

Section 8 of the SWA (EMM 2018c) outlines a monitoring plan. This plan includes monitoring of stream flows, water uses and discharges. The plan will be formalised in the Water Management Plan.

Detailed mitigation and management measures will be required and should address issues such as the potential of encountering zones of high flow groundwater ingress, short term and long term water quality impacts from placement and storage of waste rock, and sediment and erosion control.

This information, including a Trigger Action Response Plan will be outlined in the Water Management Plan. This document will be prepared in consultation with DoI Water.

The design, construction and management of works within waterfront land including watercourse crossings (temporary and permanent) and works in Talbingo Reservoir such as barge related infrastructure need to be in accordance with the "Guidelines for Controlled Activities on Waterfront Land (NRAR 2018)"

The '*Guidelines for Controlled Activities on Waterfront Land* (NRAR 2018)' will be considered during detailed design, where relevant. It is noted that Exploratory Works is categorised as CSSI under Section 89J (1) (g) of the EP&A Act. Should approval be granted, a controlled activity approval to undertake work on waterfront land will not be required.

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

KEY

- Photo locations
- On land rock management
- Watercourse
- Contour (10m)

Eastern emplacement area – Lick Hole Gully

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 4.10

\\Emmsvr1\emm\Jobs\2017\J17188 - Snowy Hydro 2.0\GIS\02_Maps_EIS_EWRtSIRtSEW004_LickHoleGully_20180928_03.mxd 28/09/2018

4.4.5 Other matters

It is recognised the proponent proposes to use measures such as shotcreting to negate groundwater inflows where encountered. Lands and Water advises that more substantial measures may be required such as pressure cement grouting, cement curtain grouting, membrane curtain installation or combinations of such methods.

As stated in the EIS, the Exploratory Works design, operation and rapid rehabilitation and applied mitigation strategies will considerably minimise groundwater inflow and overall groundwater impacts. Snowy Hydro will progressively line the exploratory tunnel with shotcrete to limit groundwater inflow as tunnelling progresses.

Snowy Hydro will consider the application of more substantial measures for mitigating groundwater inflows if groundwater inflow occurs at rates substantially higher than anticipated. Potential measures that may be considered include but are not limited to: pressure cement grouting; cement curtain grouting; membrane curtain installation; or a combination of two or more measures. The measures will be determined by the contractors commissioned by Snowy Hydro to construct the exploratory tunnel.

The proposed increase in shallow monitoring of groundwater level and quality specifically from the area of the proposed portal and initial tunnel alignment prior to start of construction is supported. This will further inform the modelling outputs and refine the impact prediction and licence requirements. A minimum two years of baseline data is required to support the assessment of significant aquifer interference activities.

The existing comprehensive baseline water monitoring network has been developed through ongoing consultation with DoI Water. Baseline data will continue to be collected from this network throughout the life of the Exploratory Works. Expansion of the network, including the installation of additional shallow monitoring bores, and review of water quality analytical suites and frequency of monitoring will be considered where justified.

The ongoing development and expansion of the water monitoring network will occur in consultation with DoI Water and WaterNSW.

4.5 Department of Industry – Lands

The Tumut River (downstream of Talbingo Reservoir) is a Crown Waterway. Any work within the Tumut River will require a tenure from the Department.

No work is proposed to occur in the Tumut River, downstream of Talbingo Reservoir.

The Crown Road within Lot 5 DP 235380 is likely to be impacted as part of the access road upgrade. This Crown Road has an enclosure permit, currently held by Snowy Hydro Limited. It is recommended that Snowy Hydro Limited make application to close and purchase this road.

This comment is noted and Snowy Hydro will follow the required process.

4.6 NSW Heritage Council

The Heritage Council notes the potential of the proposal to impact some items of historical archaeological significance, but that it includes recommended mitigation measures for sites that may not have archaeological value. Changes to the Heritage Act 1977 mandate that the management of archaeological sites and relics is now by significance, not a date threshold. The assessment's approach is therefore inconsistent with current Heritage Council's Guidelines: Assessing Significance 2001 and Assessing Significance for Historical Archaeological Sites and Relics 2009. Where an archaeological site has been demonstrated to have a local or state value and a specific research potential, then measures should be put in place to manage the loss of the resource upon impact.

Accordingly, areas or sites with identified archaeological potential which will satisfy a local or state significance should be subject to a reassessment of significance. On that basis, appropriate management actions should be identified.

It is also recommended that any archaeological excavation should be undertaken in accordance with an archaeological research design and excavation methodology, prepared by a suitably qualified historical archaeologist, and in accordance with Heritage Council of NSWs guideline Archaeological Assessments 1996. This should be prepared and subject to the review of the Heritage Council of NSW or its delegate and agreed archaeological activities tied to the Cultural Heritage Management Plan (CHMP) for the project.

Lobs Hole and its associated mine is part of a locally significant landscape and it is pleasing to see that this area has been assessed as a group. It is noted however that the proposed mitigation measures should also consider the interconnectedness of this area and it may be appropriate to archivally record the whole area in greater detail, even aspects which will not be subject to harm, to ensure the landscape is recorded as a coherent group. This is an appropriate heritage mitigation measure, rather than focusing on the specific impact zones in isolation. Options for this action should be presented in the CHMP.

The assessment of significance was undertaken in accordance with current Heritage Council's *Guidelines: Assessing Significance* (2001) and *Assessing Significance for Historical Archaeological Sites and Relics* (2009), as noted in the HCHAR (NSW Archaeology Pty Ltd 2018b: 2). The assessment of significance of the potential items and archaeological sites and potential relics has been undertaken in accordance with the NSW Heritage Criteria as set out in *Assessing Significance for Historical Archaeological Sites and Relics* (2009:3) and not a date threshold.

In the HCHAR the NSW Heritage Criteria for heritage assessment is set out clearly in Table 16 (NSW Archaeology Pty Ltd 2018b: 156). Each of the potential historical items and archaeological sites and potential relics have been formally assessed against the NSW Heritage Criteria in Appendix 3 of the HCHAR (NSW Archaeology Pty Ltd 2018b, Appendix 3).

Mitigation measures have been presented in Table 19 of the HCHAR for all historical items and potential archaeological sites and relics, including those which do not satisfy local or State heritage significance criteria. Notwithstanding, a revised table is provided in Appendix C. The revision has groups a number of items related to Lobs Hole historic landscape into complexes to that individual items can be managed in the context of being contributory to broader, coherent groups.

The majority of the historical items recorded during the assessment are a part of the Lobs Hole historical landscape. On their own, many of the items do not appear to satisfy local or State significance criteria, but collectively have archaeological potential to be considered relics of local significance, which will be realised through the archaeological test excavation.

In addition, the Lobs Hole historic landscape includes a number of complexes such as the West Pinbeyan Station Homestead, the Lobs Hole Copper Mine and the Ravine Township (refer to Appendix C). The complexes within this area combine to make the Lobs Hole historical landscape, a place of local significance for its historical, technological, social and research values.

Appendix C presents revised management measures and mitigation for the Lobs Hole historic landscape, including the various elements of which it is comprised.

A research design and excavation method will be prepared to support and guide archaeological test excavation. A research design and excavation method report will be prepared based on the historical complexes presented in Appendix C rather than individual items. Accordingly, the management measures set out in Appendix C acknowledge that although an individual item (eg R2 – metal water pipe) would be considered as part of the archaeological research design and excavation method for a broader complex, that specific item (eg the water pipe) may not be included in the test excavation program.

> Should the Department consider approval of this application; the Heritage Council therefore suggests the following conditions:
> 1. In addition to the commitments in the historic cultural heritage assessment, the Cultural
>
> Heritage Management Plan (CHMP) for the project should include:
>
> a). A reassessment of the archaeological potential and significance of the study area to provide management measures for those items assessed as having archaeological significance and research potential, which will be impacted by the project.
>
> b). An archaeological research design and excavation methodology for all items of archaeological heritage significance requiring management.
>
> c). The nomination of a suitably qualified and experienced historical archaeologist as Excavation Director for the project. This person shall satisfactorily address the Heritage Council of NSW Excavation Director Criteria for the level of significance and activity proposed.
>
> d). At the completion of the archaeological program the Excavation Director prepare a final excavation report, to publication standard, within one year of the completion of the field-based archaeological activity. This report shall document the results of the archaeological program and identify where the artefacts recovered from the program will be stored. A copy should be lodged with the DPE, the Heritage Council of NSW and the relevant local studies library for the area in which the site is located.
>
> 2. Options for the recording of the entire Lobs Hole area should be provided to ensure the broader cultural landscape is appropriately documented.

Snowy Hydro will prepare a CHMP to manage relevant historic heritage values, including the information requested by OEH Heritage Council in its submission, as above. Furthermore, the recommendations presented in the HCHAR would form the basis for the development of the CHMP.

In respect of historic heritage, the CHMP would:

1. Set out procedures to manage impacts, avoidance of impacts and impact mitigation in accordance with the HCHAR recommendations.

2. Set out an unexpected finds protocol and the procedure to be followed for monitoring to undertaken for the purposes of inspecting areas for unrecorded heritage, when preliminary clearance of vegetation is made.

3. Outline a protocol for the management of potential unmarked graves in the project area.

4. Set out guidelines for the management of movable heritage anywhere in or near the project areas, to ensure that it is not inadvertently impacted or removed.

Revised management measures are provided in Appendix C.

Archaeological management, including the preparation of a research design and excavation method would be presented as part of the CHMP after approval. The following management measures would be included in the CHMP:

- archival recording of the entire Lobs Hole historic landscape to capture the industrial, residential and agricultural features at the site. The recording would use photographic techniques and topographic survey. Drone photography will also be taken. A photographic record will be produced that is in accordance with NSW Heritage Council guidelines for digital capture;

- a research design and excavation method will be prepared to support and guide archaeological test excavation. This will determine how the Lobs Hole historic landscape is managed to ensure that the project aims and positive heritage outcomes are achieved. This will also include provisions for archaeological salvage excavation, if warranted for particular items and / or complexes.

Ensuing from the above, a comprehensive historic document would be produced which would include, but not be limited to, the results of the archival recording and archaeological investigations, and the on-going oral and historical research.

4.7 Roads and Maritime Services – Maritime

4.7.1 Construction environmental management

The NSW Maritime Division of RMS will and can advise relevant parties (eg: contractors engaged to complete the works) on the formulation of a Waterway Traffic Management plan, which may include enacting an 'Exclusion Zone' (which NSW Maritime has the statutory delegation to declare) to ensure the safety of vessel traffic and to establish safe working zone/s.

Any vessel or structure occupying waters must display appropriate shapes and lights in accordance with the Marine Safety (Domestic Commercial Vessel) National Law Act 2012. Of particular note is the requirement to display an all-round white whilst at anchor light between the hours of sunset and sunrise.

It is important to note that all operators and vessels (including the barges and punts) used in this operation must comply with the Marine Safety (Domestic Commercial Vessel) National Law Act 2012, and that no agent shall be exempted from the provisions of the Marine Safety Act 1998 and relevant subordinate legislation.

A Waterway Traffic Management Plan will be prepared and implemented prior to any waterway traffic movements associated with Exploratory Works. This plan will contain management measures to ensure the safety of vessel traffic and to establish safe working zone(s) during Exploratory Works. It will be prepared in consultation with and to the satisfaction of the NSW Maritime Division of RMS.

All commercial vessels and structures within Talbingo Reservoir associated with Exploratory Works will comply with the requirements of the Commonwealth *Marine Safety (Domestic Commercial Vessel) National Law Act 2012*.

4.8 Roads and Maritime Services – Roads

The TTR commits to the preparation of a Construction Traffic Management Plan (CTMP) as part of the Construction Environmental Management Plan (CEMP). The CTMP is proposed to set out the strategy and procedures to manage the impacts of the Exploratory Works construction on the local road network and traffic systems. The CTMP would include guidelines, general requirements and procedures to be used when construction activities would have a potential impact on existing traffic arrangements. Implementation of the measures in the CTMP would ensure that delays and disruptions are managed with appropriate measures and identify/respond to any changes in road safety as a result of construction works.

A Construction Traffic Management Plan (CTMP) will be contained within the CEMP for the Exploratory Works.

The TTR proposes that upon confirmation of the haulage route(s) for construction vehicles associated with Exploratory Works, and prior to construction commencing, an independent and qualified expert should survey and prepare a Road Dilapidation Report. The report would assess the current condition of the road surfaces the construction vehicles would traverse, including the external road network, and describe mechanisms to restore any damage that may result due to its use by traffic and transport related to the project. The Road Dilapidation Report will be submitted to the relevant road authority for review prior to the commencement of heavy vehicle movements. In addition to this Roads and Maritime would require regular reviews to be undertaken of this report and meetings with the proponent representative to discuss the findings of the review. Initially this should occur at least at 6 monthly intervals but this period may be varied based on the findings of the initial review and the activity levels of haulage on the public road network. These meetings should also include all relevant road authorities.

Further discussions on this item are proposed to be held between Roads and Maritime and the Snowy 2.0 team in due course.

It is noted that Oversize and Overmass deliveries will be required however the size and number of such deliveries is currently unknown. Such loads will impact on the public road network used to transport these loads to Talbingo Reservoir. Where required, the applicant will need to obtain special permits for any oversized and over-mass load from the Special Permits Unit.

When confirmation is available regarding these loads a program shall be prepared and forwarded to Roads and Maritime Services for review, particularly for the site establishment phase of the project. For the haulage of the larger components to the site along the proposed route the need for measures to allow the following vehicle queue to pass should also be considered and addressed.

Further discussions on this item will be carried out between Roads and Maritime and Snowy Hydro. All permits will be obtained as requested for any impacted road alignment.

The proposal to use of Talbingo Reservoir for the transportation of materials and components, particularly the Oversize and Overmass loads to the developments site is supported for road safety reasons. The use of the reservoir will require the preparation of a Waterways Management Plan to be prepared in consultation with Roads and Maritime Services. This proposal may also include the implementation of navigational aids and markers as required. This will be further clarified in a separate submission from Maritime.

The CTMP will identify the volume of heavy vehicles along Miles Franklin Drive for use of barges along Talbingo Reservoir as well as any navigational protocols required for Talbingo Reservoir.

Whilst the loads required for the transportation of the large components may present issues, it is the frequency and volumes of the smaller construction vehicles such as trucks hauling ancillary materials such as sand and gravel for cement, etc to the development site that can represent issues for the road network.

These issues need to be finalised to allow for the proper assessment of the impacts on the road network. A program for such traffic including number of trips, volumes, the origins of the materials etc needs to be prepared to allow for an informed assessment of the potential impacts on the road network by the relevant road authorities including Roads and Maritime Services and the Councils.

This item will be addressed as part of the CTMP. The volumes forecast for the project is relatively low, even for smaller construction vehicles, and it is highly unlikely that the projected volumes would impact on the road network.

If any parts of the proposed transport routes are not suitable to cater for the project related traffic and transport, the proponent shall be required to improve such part of the road to safely cater for the length, size and volume of vehicles and their loads, and to protect the integrity of the road network.

This may include the proponent upgrading the road geometry or pavement on the haulage route determined by the relevant road authority. The potential need for modification or removal of road structures or furniture to allow for the movement of the larger components needs to be addressed. These issues will need to be authorised by the relevant road authority (Council or the Roads and Maritime Services).

The CTMP will identify locations, if any, where modification of road geometry, speed limit or clearance of vegetation is required. This will be undertaken in consultation with relevant road authorities.

Roads and Maritime is mainly concerned with the provision of safe access to and from the subject site along the public road network and the impact of the development on the safety and efficiency of the road network. Roads and Maritime emphasises the need, particularly during the construction phase of this development, to minimise the impacts on the existing road network.

The EIS found the impact of additional traffic volumes generated by Exploratory Works on the external road network will not lead to any noticeable change in the existing roadway level of service performance standards for the affected roads.

Similarly the Exploratory Works traffic and transport impacts are not predicted to have any negative impacts on the internal road network, public transport, traffic crashes or emergency vehicles.

Notwithstanding this, several measures will be implemented to mitigate traffic and transport impacts from Exploratory Works. These mitigation measures are summarised in Table 5.16 of the EIS. These measures will be incorporated into the CTMP.

Whilst Roads and Maritime Services does not object to the concept of the development as proposed there is a number of items relating to traffic and impacts on the road network that need further discussion and development between the proponent and the relevant road authorities. Further to issues raised above should consent be granted to the development as proposed Roads and Maritime Services provides the following items as the basis for conditions for the consideration of the consent authority in relation to the current proposal.

1. A Traffic Management Plan shall be prepared in consultation with the relevant road authorities (including Roads and Maritime Services and Council) to outline measures to manage traffic related issues associated with the development, particularly during the construction and decommission processes. The appointed transport contractor shall be involved in the preparation of this plan. The plan shall address all light and heavy traffic generation to the development site and detail the potential impacts associated with the development, the mitigation measures to be implemented, and the procedures to monitor and ensure compliance. This plan shall address, but not necessarily be limited to the following;

i-Details of traffic routes to be used by heavy and light vehicles, and any associated impacts and any road-specific mitigation measures. Details of any associated impacts and any required changes to the existing road environment along the proposed routes such as intersection upgrade, road widening, temporary street closures, removal and replacement of road infrastructure, etc required in order for the necessary materials and machinery to be delivered to site.

ii- Details of measures to be employed to ensure safety of road users and minimise potential conflict with haulage vehicles such as necessary route or time restrictions for oversized vehicles, use of traffic diversions, changes to speed zones, potential extended delay periods for motorists due to haulage vehicles etc,

iii -Proposed hours for construction activities, as night time construction presents additional traffic related issues to be considered.

iv-The management and coordination of the movement of vehicles for construction and worker related access to the site and to limit disruption to other motorists, emergency vehicles, school bus timetables and school zone operating times,

v- Scheduling of heavy vehicles movement to deny the need for access through school zones during school zone operating times,

vi- Scheduling of haulage vehicle movement to minimise convoy length or platoons,

vii- loads, weights and lengths of haulage and construction related vehicles and the number of movements of such vehicles,

viii- Details of measures to be employed to ensure safety of road users and minimise potential conflict with project generated traffic, including any proposed precautionary measures such as signage to warn road users such as motorists about the construction activities for the project.

ix- a Driver Code of Conduct to address such items as; appropriate driver behaviour including adherence to all traffic regulations and speed limits, safe overtaking and maintaining appropriate distances between vehicles, etc and appropriate penalties for infringements of the Code,

x- details of procedures for receiving and addressing complaints from the community concerning traffic issues associated with truck movements to and from the site,

2. A full and independent risk analysis and inspection of the transport route will be required to be undertaken by an appropriately qualified person and a copy provided to the relevant road authority. Further analysis and reporting to assess possible damage to, and repair of the route will be required on a regular basis.

The above requirements are noted.

The CTMP will document the above items and will be prepared in consultation with RMS, where practical. The CTMP will document the transport routes and describe management measures to be implemented. However, based on the peak volume, type and duration of traffic movements required for Exploratory Works, a full and independent risk analysis and inspection of the transport route is not required.

Snowy Hydro will discuss this matter with RMS during the preparation of the CTMP.

The Proponent must engage an appropriately qualified person to prepare a Road Dilapidation Report for all road routes to be used during the construction (and decommissioning) activities, in consultation with the relevant road authority (Roads and Maritime Services and Council). This report is to address all road related infrastructure, including pavements, bridge/culvert structures traffic islands, etc. Reports must be prepared prior to commencement of, and after completion of, construction (and decommissioning) and at 6 monthly intervals during the project timeframe. A program of review is to be implemented by the proponent and discussed with the road authorities on a regularly basis at 6 monthly intervals.

The EIS refers to the issue of road dilapidation during the project and states that road maintenance will be managed through the following measures:

- a Road Dilapidation Report will be prepared and approved prior to and following Exploratory Works;
- routine defect identification and rectification of the internal road network will be managed as part of the project maintenance procedure; and
- internal access roads will be designed in accordance with the relevant vehicle loadings.

Roads and Maritime comments will be addressed within a Dilapidation Report, which would be referred to within the CTMP.

The Proponent shall commit to restore all relevant roads to a state, described in the original Road Dilapidation Report where the dilapidation is attributable to construction activity. The cost of any restorative work described in the subsequent report or recommended by the relevant road authorities after review of the subsequent report, shall be funded by the Proponent. The applicant is accountable for this process, rather than the proposed haulage contractor. Such work shall be undertaken at a time as agreed to by the relevant road authorities.

This requirement is noted and will be documented in the CTMP.

Prior to the commencement of construction on-site, the Proponent must undertake all works to upgrade any road, its associated road reserve and any public infrastructure in that road reserve, to a standard suitable for use by heavy vehicles to meet any reasonable requirements that may be specified by the relevant roads authority. The design and specifications, and construction, of these works must be completed and certified by an appropriately qualified person to be to a standard to accommodate the traffic generating requirements of the project. On Classified Roads the geometric road design and pavement design must be to the satisfaction of the Roads and Maritime Services

This requirement is noted. Snowy Hydro would be responsible for costs incurred for proposed road safety amendments at locations approaching the Miles Franklin Drive and Snowy Mountains Highway intersection.

As a minimum the intersections of Miles Franklin Drive and Link Road with the Snowy Mountains Highway shall be constructed and the roadside maintained to the satisfaction of Roads and Maritime Services to provide for the required Sight Distance requirements for the intersections for a reaction time of 2.5 seconds in accordance with the Austroads Publications as amended by the supplements adopted by Roads and Maritime Services for the posted speed limit. Compliance with this requirement is to be certified by an appropriately qualified person prior to construction of the vehicular access.

The intersection of Link Road/Snowy Mountains Highway currently provides substantial sight distance in its current design configuration to cater for existing and expected traffic volumes and meet the stated sight distance requirement (Safe Intersection Sight Distance (SISD)).

The intersection of Miles Franklin Drive/Snowy Mountains Highway currently does not meet SISD standards. It is proposed that the existing 60 km/h speed zone is extended to the north of the intersection. A reduction in speed limit to 60 km/h would result in a conforming SISD for all motorists, including heavy vehicles, based on the current intersection design.

Potential minor trimming of shrubs could also be undertaken at the intersection itself between the left turn slip lane and Miles Franklin Drive approach to further improve visibility.

The low traffic volumes on the network during times of construction are unlikely to result in increased safety concerns and, for Miles Franklin Drive, the proposed improvement would result in improvements to existing sight distance issues for motorists and provide a legacy benefit to local residents and visitors to the area.

Additional reviews of the speed limit at these locations are proposed to occur as part of the CTMP.

> Details for any signage associated with the proposed development along the classified road network are to be developed and erected to the satisfaction of the Roads and Maritime Services.

This requirement is noted and will be documented in the CTMP.

> All works associated with the project shall be at no cost to the Roads and Maritime Services.

Snowy Hydro would be responsible for costs incurred for proposed road safety amendments at locations approaching the Miles Franklin Drive and Snowy Mountains Highway intersection.

> Any works within the road reserve of the Snowy Mountains Highway requires approval under Section 138 of the Roads Act, 1993 from the road authority (Council) and concurrence from Roads and Maritime Services prior to commencement of any such works. The developer is responsible for all public utility adjustment/relocation works, necessitated by the development and as required by the various public utility authorities and/or their agents.

This requirement is noted and will be documented in the CTMP.

> It is understood from the submitted documentation that the current proposal is potentially a precursor to the proposal for the construction of the power station that will need further approval under the provisions of the Environmental Planning & Assessment Act. As this proposal has the potential to have similar impacts to the current proposal works and management plans to address this current application may prove beneficial for this future development.

The assessment carried out for the Snowy 2.0 Exploratory Works proposal and Exploratory Works management plans will inform the environmental assessment process for Snowy 2.0 Main Works.

4.9 Fire and Rescue NSW

FRNSW were unable to identify any part of the EIS that directly assessed the risk to public safety arising from structure fire incidents involving the camp and its ancillary infrastructure (nb public safety being interpreted by FRNSW as including occupants of the accommodation camp).

FRNSW recommendations below are intended to ensure that an appropriate minimum level of fire and life safety is provided to occupants of the accommodation camp and also to works engaged in activities associated with construction of the tunnel. Comments are provided in the context of potential fire events that may inadvertently arise from the actions of occupants of buildings or from malfunctioning equipment/systems within the accommodation camp and the tunnel. In addition, FRNSW comments are provided with the location of the facility and the associated delay to emergency services intervention being considered.

1.To maximise the safety of the camp's occupants, the accommodation camp's buildings or parts of buildings that are classified as Class 1 a, 1 b, 2, 3, 4 or 9b under the provisions of Volume One of the National Construction Code are recommended to be provided with a smoke alarm system or detection system (as applicable). The applicable system complying with the relevant requirements of Part E2 and Specification E2.2a of the NCC.

The detailed design of the proposed structures for the Exploratory Works was beyond the scope of the BFRHA. Therefore, the BFRHA did not provide detail on smoke alarm systems or detection systems (as applicable) for the buildings classified as Class 1a, 1b, 2, 3, 4 or 9b under the National Construction Code at the accommodation camp. The recommendation of smoke alarm and detection systems (as applicable) to maximise the safety of the camp's occupants has been included within revised management measures documented within Chapter 8 of this RTS.

It should be noted that RFS has jurisdiction regarding fire management within KNP.

2. To maximise the safety of the camp's occupants, it is recommended that the facility's occupants and employees are comprehensively and regularly trained to undertake safe first attack fire fighting operations. Training is recommended to specifically include the extent of first attack fire operations that can be undertaken without endangering the safety of persons engaged in fire-fighting activities. The requirement and extent of training is also recommended to be specifically addressed in the site's emergency response plan (ERP).

Section 6 of the BFRHA outlines the specific management actions proposed to ensure suitable bush fire preparedness is undertaken as part of the Exploratory Works and ahead of the bush fire season, as well as specific procedures to limit the risk of ignition of surrounding bush land resulting from the Exploratory Works. The BFRHA has provisions for fire-fighting equipment to be kept on active sites at all times. The BFRHA states that equipment should include (but not be limited to) a 4WD Striker with slip on water unit equipped with diesel pump, hoses, extinguishers, knap sacks and hand tools as well as the availability of a 10,000 L water tanker (eg NPWS tanker). Table 8.1 of the BFRHA provides a summary of the management measures that will be included within the Bush Fire Management Plan for the Exploratory Works.

The FRNSW recommendation that the facility's occupants and employees are comprehensively and regularly trained to undertake safe first attack fire-fighting operations, including the use of fire reel systems within or adjacent to structures has been included within revised management measures documented within Chapter 8 of this RTS.

The requirement and extent of training will be incorporated into the *Snowy 2.0 Exploratory Works Bush Fire Management Plan* and the *Snowy 2.0 Exploratory Works Bush Fire Emergency Response and Evacuation Plan*, as applicable to each plan.

3. To facilitate the activities recommended in Point 2 above, it is recommended that all buildings of the accommodation camp are served by a fire hose reel system. Regardless of any floor area thresholds or other exclusions permitted in Clause E1.4 of the NCC, the fire hose reel system is recommended to serve all buildings (irrespective of occupancy classification) and comply with all other requirements of Clause E 1.4 of the NCC and Australian Standard (AS) 2441.

Section 5.3.1 of the BFRHA (EMM 2018f) identifies that at the detailed design of the accommodation camp, fire hose reels should be constructed in accordance with the standard *AS/NZS 1221:1997 Fire hose reels* and installed in accordance with *AS 2441:2005 Installation of fire hose reels*.

These FRNSW recommendations have been incorporated into revised management measures documented within Chapter 8 of this RTS.

4. That all buildings are provided with portable fire extinguishers that are suitable for the fire hazard protected and in accordance with the requirements of AS 2444.

The detailed design of the proposed structures for the Exploratory Works was beyond the scope of the BFRHA (EMM 2018f). Therefore, the BFRHA (EMM 2018f) did not provide detail on portable fire extinguishers for the buildings proposed for the Exploratory Works.

These FRNSW recommendations have been incorporated into revised management measures documented within Chapter 8 of this RTS.

5. To minimise the consequences of fire incidents involving vehicles engaged in tunnel construction and excavation, it is recommended that all vehicles that are required to enter the tunnel are fitted with onboard automatic engine fire suppression systems that comply with AS 5602 - 2016. In addition, that all vehicles are provided with portable fire extinguishers that comply with AS2444.

EMM notes that FRNSW has unintentionally referred to AS 5602, which is an unrelated standard, and it has been assumed that FRNSW refer to *AS 5062 – 2016 Fire protection for mobile and transportable equipment* (AS 5062 - 2016).

These FRNSW recommendations have been incorporated into revised management measures documented within Chapter 8 of this RTS.

4.10 NSW Rural Fire Service

Any approval issued by the Department shall include the following recommended conditions:

1. Compliance with the mitigation measures identified in the Bushfire Risk and Hazard Assessment Report prepared by EEM consulting dated 13 July 2018, as amended by conditions of this letter.

Sections 5, 6 and 7 of the BFRHA (EMM 2018f) detail the mitigation measures that have been included in the design process or that are recommended at the detailed design stage or as management measures to minimise the impacts of bush fire at the Exploratory Works. Section 8 and Table 8.1 of the BFRHA provides a summary of the mitigation measures. The following sections provide responses to the amended conditions, recommended by the RFS in their letter dated 28 August 2018.

Access:

2. All critical access roads which provide access and egress to the site shall be upgraded to ensure there are sufficient passing bays provided. While it is acknowledged that some areas of the access road will be constrained in terms of width, the roads should be upgraded to meet the minimum specifications with regards to passing bays as defined in section 4.1.3(3) of Planning for bush fire protection 2006.

This comment is noted.

The BFHRA (EMM 2018f) included several recommendations to be incorporated into the detailed design of Exploratory Works. The recommendation listed below is consistent with the matter raised by NSW Rural Fire Service.

Consideration should be given to the implementation of passing bays or reversing bays (as per PBP fire trail standards) at regular intervals in the upgrade of Upper and Lower Lobs Hole Ravine Road. This will improve the access and egress constraints along this section of road.

Onsite Refuge:

3. The proposed development shall provide suitable open air space(s) and building(s) for onsite refuges. All locations identified for places of refuge shall comply with the acceptable solutions for site criteria as outlined in section 7 of the NSW Rural Fire Service (RFS) document Guidelines for the Identification and Inspection of Neighbourhood Safer Places in NSW dated April 2017. In addition, all places of refuge shall comply with the following:

- Be clearly identified on the Bush Fire Emergency Management and Evacuation Plan;
- Be clearly signposted as 'Bushfire Refuge';
- Provide for the maximum capacity of the site (being the total number of all staff, contractors and visitors etc);
- Buildings identified as a refuge shall comply with the occupancy levels permissible for a Class 9b Assembly Building ('Public Hall') and 'area per person' requirements (being 1sq metre per person) as specified under the Building Code of Australia; and
- Buildings identified as a refuge shall be constructed in accordance with Sections 3 and 5 (BAL 12.5). Australian Standard AS3959-2009 Construction of buildings in bush fire-prone areas or NASH Standard (1.7.14 updated) National Standard Steel Framed Construction in Bushfire Areas - 2014 as appropriate and section A3.7 Addendum Appendix 3 of 'Planning for Bush Fire Protection, 2006'.

Section 5.6 of the BFRHA provides a list of location and design considerations for a community bushfire refuge and Table 8.1 of the BFRHA provides a summary of the mitigation measures.

These recommendations have been incorporated into revised management measures documented within Chapter 8 of this RTS.

Emergency Response Team:

4. In recognition of the isolated nature of the proposal, constraints associated with emergency service response, and the fact the proposal has been declared a Critical State Significant Infrastructure, the bush fire risk management strategy shall incorporate the provision of a full time, onsite emergency response team (ERT).

While the NSW RFS is the principal response authority for all bush fire events within the locality, access constraints may inhibit effective response times. The ERT should be fully trained and equipped to deal with all potential bush fire events. Snowy Hydro should liaise with the RFS District offices of Riverina Highlands and Monaro to determine the appropriate level of training and equipment required to fulfil this task.

Section 7 of the BFRHA outlines the bush fire emergency management procedures for the Exploratory Works including bush fire response and evacuation, bush fire awareness, a community bush fire refuge place with associated procedures in the case that offsite evacuation cannot occur, monitoring and review procedures.

Table 8.1 of the BFRHA provides a summary of the mitigation measures that will be included within the Bush Fire Emergency Response and Evacuation Plan for the Exploratory Works. EMM agrees that the mitigation measures identified within the BFRHA, as related to bush fire emergency management procedures, be conditions of approval. EMM also agree with the addition of the above commitments as identified by the RFS, related to the provision of a full time, onsite emergency response team (ERT) that will be fully trained and equipped to deal with all potential bush fire events.

The provision, training, equipment required and suitable liaison with RFS District offices as related to the ERT will be incorporated within the *Snowy 2.0 Exploratory Works Bush Fire Emergency Response and Evacuation Plan*. EMM acknowledge that the provision, training and equipment of an ERT, as conditioned by RFS, will overlap with recommendation 2 from FRNSW, training of staff in first attack fire operations.

These recommendations have been incorporated into revised management measures documented within Chapter 8 of this RTS.

Snowy 2.0 Bush Fire Management Plan:

5. A copy of the proposed Snowy 2.0 Bush Fire Management Plan should be submitted to the NSW RFS District offices of Riverina Highlands and Monaro for comment. Any comments provided by the District offices shall be incorporated into an amended plan. The proposed Snowy 2.0 Bush Fire Management Plan shall also include the provision of a suitable communication network. Snowy Hydro should liaise with the NSW RFS District offices of Riverina Highlands and Monaro to determine the appropriate network requirements for connecting to both internal and external response agencies.

Section 6 of the BFRHA outlines the specific management actions proposed to ensure suitable bush fire preparedness is undertaken as part of the Exploratory Works and ahead of the bush fire season, as well as specific procedures to limit the risk of ignition of surrounding bush land resulting from the Exploratory Works. Section 7 of the BFRHA outlines the bush fire emergency management procedures for the Exploratory Works including bush fire response and evacuation, bush fire awareness, a community bush fire refuge place with associated procedures in the case that offsite evacuation cannot occur, monitoring and review procedures. Table 8.1 of the BFRHA provides a summary of the management measures that will be included within the Bush Fire Management Plan and Bush Fire Emergency Response and Evacuation Plan for the Exploratory Works.

The following commitments will be made:

- the Snowy 2.0 Exploratory Works Bush Fire Management Plan will be submitted to the NSW RFS District offices;
- the Snowy 2.0 Exploratory Works Bush Fire Emergency Response and Evacuation Plan will be submitted to the NSW RFS District offices; and
- Snowy Hydro will liaise with the NSW RFS District offices on appropriate network requirements and the provision of a suitable communication network.

These recommendations have been incorporated into revised management measures documented within Chapter 8 of this RTS.

Bush Fire Risk Management Plan and Local Emergency Management Committee:

6. Snowy Hydro shall liaise with the relevant Bush Fire Management Committees and Local Emergency Management Committees to ensure the committees are aware of the proposal and all assets associated with the proposal are incorporated into future risk management plans.

As stated within the BFRHA, the Exploratory Works is within the Riverina Highlands Bush Fire Management Committee (BFMC) area and adjacent to the Snowy Monaro BFMC area. Assets associated with the current Snowy Hydro Scheme are listed within the existing draft Bush Fire Risk Management Plans (BFRMP) for both BFMC areas. The Exploratory Works is within the Snowy Valleys Local Government Area (LGA) and adjacent to the Snowy Monaro Regional LGA. The Snowy Valleys Local Emergency Management Committee (LEMC) and the Snowy Monaro Regional LEMC are therefore relevant to the Exploratory Works.

Snowy Hydro will liaise with the appropriate BFMCs and LEMCs to ensure the committees are aware of the proposal and all assets associated with the proposal are incorporated into future risk management plans.

These recommendations have been incorporated into revised management measures documented within Chapter 8 of this RTS.

4.11 Snowy Monaro Regional Council

4.11.1 Rock emplacement areas

Excavation Spoil - there is a possibility that Council could use some quantities of excavation spoil materials for road works and/or landfill cover depending on quality of material. This might provide further options to those referenced in the EIS. If the material is classified as being suitable for landfill cover (Virgin Excavated Natural Material) there is currently no disposal fee at Council landfill facilities.

Transportation of such materials to our facilities material would need to be met by the contractor, or negotiated with Council.

This comment is noted.

Page 11 - Traffic and Transport Report - 2.4.1 On land placement states:

"The design and management of the emplacement areas have not yet been finalised due to the need for further investigations to determine the likely geochemical characteristics of the excavated material. Following further investigation and prior to construction of Exploratory Works a management plan will be prepared and implemented". If the placement of excavated material has not yet been finalised and there exists a possibility of that material NOT being stored on-site due to the "geochemical characteristics"; what effect does this have on Table ES1 (Construction Traffic Peak Hour Volume) and comments made on page i (Executive Summary)? What are the predicted traffic volumes if excavated material is stored off-site?

As described in Sections 3.2 and 6.1.2 of this report, the eastern emplacement area is now a temporary stockpile. It will be constructed as per the design and descriptions within the EIS. Suitable excavated rock will be sourced from this location for the subaqueous emplacement trial program.

In response to matters raised by OEH and in detailed discussions, any materials within the eastern emplacement area (that have not been subaqueously emplaced) that remain following the completion of Exploratory Works, should Snowy 2.0 Main Works not proceed, will be removed from KNP.

This material will be removed from KNP to nominated location(s) over within five years of completion of Exploratory Works. The temporary stockpile will continue to be managed as per the design and descriptions within the EIS until all the material is removed. Lick Hole Gully will then be rehabilitated.

Removal of the remaining material will require traffic movements outside of KNP to locations that are currently not known. These traffic movements, should they be required, would be additional to those assessed within the EIS. Should any remaining material require transport outside of KNP and once destinations are known, it is expected that transport routes would be determined in consultation with the relevant roads authorities, such as Snowy Valleys Council. It is not anticipated that daily or peak hourly traffic movements associated with the removal of this material would result a material change in the performance of the local and regional road network.

4.11.2 Waste

Bio-solids from sewerage treatment plant – details of how bio-solids will be managed has not been clarified.

Bio-solids produced from the wastewater treatment plant will be removed from Exploratory Works by a licensed contractor. Options for disposal include (but are not limited to):

- blending with bio-solids produced at other regional wastewater treatment plant (such as the Snowy Hydro operated wastewater treatment plant at Cabramurra) and disposal via the existing arrangements; or
- disposal to a licensed landfill.

Appropriate arrangements will be made following consultation with relevant stakeholders.

Waste and recycling from construction - it is considered to be highly important to minimise the amount of waste and recycling generated at the site, as there is likely to be a direct impact to Council due to disposal at Council's transfer station at Adaminaby. Arrangements for transportation of waste and recyclables, including expected volumes of materials, should be advised to Council if our facilities are to be utilised. This will ensure Council has adequate receptacles available to transport the materials off-site for disposal and processing.

Snowy Hydro supports Snowy Monaro Regional Council's position that waste should be minimised during Exploratory Works. Minimising waste not only reduces the environmental impact of its disposing, but also substantially reduces project costs. Notwithstanding this, the following construction related waste streams from Exploratory Works have been identified:

- excavation and tunnelling wastes;
- timber and green wastes;
- construction wastes including;
    - wastes generated from concrete batching plant;

- waste generated from chemicals and or spill clean-up or remediation;
- waste generated from remediation of contaminated sites;
- sediment and or sludge from sediment basin de-silting;

- packaging materials;
- waste produced from the maintenance of construction vehicles and plant, which might include oils, fluids, fuels, tyres;
- sewage and general waste from the accommodation camp and other site facilities; and
- general waste from offices, accommodation camp and other facilities.

Waste separation and segregation will be promoted on-site to facilitate reuse and recycling as a priority of the waste management program as follows:

- waste segregation onsite – waste materials, including spoil and demolition waste, will be separated onsite into dedicated bins/areas for either reuse onsite or collection by a waste contractor and transport to offsite facilities;
- waste separation offsite – wastes to be deposited into one bin where space is not available for placement of multiple bins, and the waste is to be sorted offsite by a waste contractor.

Where materials cannot be reused and recycled, all waste would be handled and disposed in accordance with the NSW *Protection of the Environment Operations Act 1997* at a licensed waste facility. Waste facilities that may be used during Exploratory Works include:

- Cooma landfill (EPL limits of 20,000 tonnes per annum general solid waste), approximately one hour and 45 minutes drive (100 km);
- Adaminaby waste transfer station, approximately one hour and 10 minutes drive (50 km);
- Tumut waste and recycling centre, approximately one hour and 45 minutes drive (100 km);
- Talbingo waste depot, approximately one hour and 20 minutes drive (75 km); and
- Tumbarumba waste transfer station, approximately one hour and 45 minutes drive (90 km).

Other landfills and waste transfer stations in the vicinity include Jindabyne waste management facility which has an annual limit of 5,000 tonnes and Tumut – Bellettes landfill which has an annual limit of 10,000 tonnes.

The location of the waste facility or facilities for the disposal of waste generated by Exploratory Works has yet to be determined. This will be undertaken by the contractor(s) in consultation with Snowy Hydro and Snowy Valleys and Snowy Monaro Regional councils. However, the volume of waste requiring deposition at a landfill is relatively minor and within local waste receipt limits. Consultation will be undertaken with councils regarding these requirements ensuring there is enough capacity to receive and process this waste.

The management of waste and recycling will be detailed in the Waste management Plan being prepared for Exploratory Works.

4.11.3 Traffic and transport

Traffic including transportation of equipment and materials - there are concerns about the effect of heavy/oversize vehicles and combinations transporting large items of machinery and equipment along Monaro Highway between Canberra and Cooma and on the Snowy Mountains Highway between Cooma and the site. The onus for road repairs will be borne by Snowy 2.0, not by Council. The two existing roundabouts in Cooma's CBD might be problematic depending on the size and length of vehicles. This matter might also be of interest to the RMS.

The EIS notes the issue of road dilapidation during the project and states that road maintenance will be managed through the following measures:

- a Road Dilapidation Report will be prepared and approved prior to and following Exploratory Works;
- routine defect identification and rectification of the internal road network will be managed as part of the project maintenance procedure; and
- internal access roads will be designed in accordance with the relevant vehicle loadings.

The CTMP will include assessments of the two roundabouts within Cooma, if relevant, once details of vehicles types as well as vehicle origination and destination sites are confirmed. At this stage of the project it is probable that oversized vehicle heavy movements will originate from the Hume Highway via Tumut therefore, there will be no need for road repair costs between Canberra and Cooma to be borne by Snowy Hydro.

Page 15 - Traffic and Transport Report - 2.6.1 Access road works states "It is expected that the majority of materials and equipment will travel along the Snowy Mountains Highway, Link Road and Lobs Hole Ravine Road". Where is the traffic originating from prior to entering Snowy Mountains Highway?

Deliveries of materials and equipment required for Exploratory Works have been accounted for within the Traffic and Transport Assessment report (SCT 2018). The primary transport route to Lobs Hole is via Snowy Mountains Highway and Link Road.

The origin of these traffic movements prior to accessing the Snowy Mountains Highway is unable to be confirmed as construction contractors have yet to be appointed. However it is probable that oversized vehicle heavy movements will originate from the Hume Highway via Tumut (ie passing through Snowy Valleys LGA). Expected volumes outlined in the EIS are small (eg a maximum of 44 trucks per day) relative to baseline regional traffic volumes and will have a negligible increase regarding the capacity of the road network.

What are the main road corridors for movement of transport, materials and staff during all phases of this project?

Confirmation of vehicle origin and destination for Exploratory Works is unknown at this stage however it is probable that oversized vehicle heavy movements will originate from the Hume Highway via Tumut. Expected volumes outlined in the EIS are small relative to baseline regional traffic volumes and the theoretical capacity of the surrounding road network. As such there would be a negligible increase regarding the impact on the road network.

What is the plan for movement of transport, materials and staff through Cooma?

Accommodation will be on site with fly-in / fly-out (FIFO) staffing. Drive-in / drive-out (DIDO) staffing movements are expected to be minimal.

Detailed movement of transport and materials will be identified in the CTMP which will include haulage routes showing the extent of oversized and heavy vehicle movements north and south of the project site.

No mention of any road through the Cooma township or consideration of increased traffic volumes/noise through Nimmitabel.

It is not proposed that construction vehicles would travel further south than Cooma. In the event that an alteration was made to the anticipated origin and destination of project-related vehicles this will be captured within the CTMP and relevant authorities notified.

Possible use of Bobeyan Road - as an alternate route, e.g. for transportation of FIFO workers if Canberra airport is used, as a more direct route to Adaminaby. This would require upgrading of Bobeyan Road in both NSW and the ACT.

Bobeyan Road is not proposed to be utilised by project-related vehicles.

4.11.4 Weeds

Weeds - it is noted that management plans will be put in place, and wash-down areas for plant and equipment are to be provided at the site. There are concerns that some weeds species could be introduced to the site, particularly from transportation of raw materials (sands, gravels etc), and concern about some species being transported off-site from site activities. Council will be interested to see the details contained within the proposed weed management plans. There is heightened concern regarding Orange Hawkweed, which has been identified as a high priority weed within the KNP, although Council is not aware that it has been found in the area of works.

Council's concerns regarding weed management, particularly Orange hawkweed (*Hieracium aurantiacum*), are noted. These concerns will be considered and addressed in the *Weed and Feral Animals Management Plan* being prepared for Exploratory Works.

4.11.5 Social

Economic development opportunities - we support the suggestion that local businesses will be given the opportunity of providing goods and services to the construction contractor. This will be an important factor in creating good-will and positivity about the project at a local level.

The Exploratory Works are also expected to provide economic benefits to the local region due to opportunities to supply non-labour inputs to Exploratory Works and in the form of expenditure of wages by labour. As stated in Section 5.7.3(iv) of the EIS the predicted direct and indirect jobs (from wage expenditure) to existing residents in the local economy are estimated to be 37.

4.11.6 Licensing

Future impacts - water releases from Tantangara - although not directly linked to the Exploratory Works EIS, Council seeks assurance that there will be no alteration to the current license requirements regarding releases from the Tantangara reservoir into the Murrumbidgee River.

As Council notes in its submission, no work is proposed to be undertaken at Tantangara Reservoir as part of Exploratory Works. As such, there are no proposed changes to Snowy Hydro's water licensing arrangements regarding Tantangara Reservoir water releases.

The management of water within Tantangara Reservoir, including releases to the Murrumbidgee Reservoir, will be considered in the EIS for the Main Works. Notwithstanding this, no changes to licence requirements regarding water releases to the Murrumbidgee River will be contemplated as part of Main Works for Snowy 2.0.

4.12 Snowy Valleys Council

4.12.1 Public access

EIS Ref: 2.7.3 - If additional barge access was installed at the southern end of Talbingo access at the southern end of Talbingo Reservoir at O'Hares Campsite. Some materials and equipment could be transported via the Elliott's Way. This would:

1. Reduce the use of the Talbingo barge ramp

2. Reduce barge travel times as O'Hares to Middle bay is substantially shorter in distance.

Recommended Action - Install additional barge access at the southern end of Talbingo Reservoir at O'Hares Campsite

Snowy Hydro appreciates Snowy Valleys Council's recommendation on this matter, and the reasons supporting it. However, the installation of additional barge access at O'Hares Campsite is not required as part of the Exploratory Works. This matter will be considered and addressed at part of the EIS for the Main Works for Snowy 2.0.

EIS Ref: 2.9.3(ii) - Talbingo residents have expressed concerns that the laid down area has not been clearly defined and would restrict any access to the spillway.
Recommended Action:

1. The lay down area needs to be clearly defined;

2. If the southern end of the spillway is restricted for public use, other alternative recreation solutions are created including:

a. Extending the southern end of the spillway to create additional recreational area;

b. Create additional recreational areas on the foreshore in close proximity to the boat ramp;

c. Additional community infrastructure in Talbingo including walking/cycleway between Talbingo and T3 power station

Subsequent to the preparation and publication of the EIS, shortlisted contractors have advised that access to whole spillway is required for the duration of Exploratory Works for public safety reasons. In addition, during consultation after publication of the EIS, the NSW Maritime Division of RMS raised safety concerns regarding the likely interaction of recreational and commercial vessels at the spillway during Exploratory Works.

As noted by Snowy Valleys Council a key concern raised in submissions from residents of Talbingo (permanent and part-time residents) on the Exploratory Works EIS was the access restrictions for the spillway.

New measures are now proposed to mitigate impacts regarding restrictions to access to the spillway. These include:

- provision of a jetty for the mooring of boats near the boat ramp;
- consideration of the provision a swimming pontoon off the picnic area to the south of the boat ramp;
- provision of an exclusive swimming area around the picnic area and potential swimming pontoon; and
- upgrading of picnic facilities and amenities at the picnic area including additional picnic tables and BBQs.

Section 3.3 of this RTS provides a description and an assessment of the construction of the proposed upgrade to the Talbingo boat ramp recreation area. The proposed measures to upgrade the boat ramp were presented to a meeting with residents of Talbingo and a representative from the NSW Maritime Division of RMS on 6 September 2018.

Plans of these mitigation measures are contained in Section 3.3 of this RTS. Further consultation will be carried out with the local community regarding the final concept to be constructed as part of the mitigation measures for Exploratory Works. It is considered that these new mitigation measures will adequately compensate for the loss of access and use of the spillway during the Exploratory Works.

A walkway/cycleway between Talbingo and T3 power station is not proposed as part of Exploratory Works.

EIS Ref: 2.9.3 - There are concerns in relation to the location of signage:

1. Signage is required on the Miles Franklin Drive adjacent to the Snowy Mountains intersection;

2. An up to date website would be beneficial to advise tourist of restriction prior to visiting Talbingo.

Recommended Action:

1. Install signage at Miles Franklin Drive adjacent to the Snowy Mountains intersection;

2. Snowy Hydro create/maintain a website advising of proposed closures/restrictions.

As stated in Section 2.9.3 of the EIS, information regarding public access restrictions to Talbingo boat ramp will be provided by signage on Miles Franklin Drive near Tumut 3 power station. This information will also be made available online on the Snowy Hydro website.

EIS ref: Clause 2.13 Decommissioning, figure 2.9, Proposed Exploratory Works Chapter 2, p2-54

Council would like to express an interest in the accommodation camp to remain at the completion of the project to be used as a tourism accommodation.

Options/actions: Explore further impacts with relevant stakeholders in relation to the retention of the accommodation facility.

The final decommissioning and rehabilitation outcomes for the Exploratory Works are yet to be determined and are subject to ongoing consultation with NPWS, as the landowner. It is likely that the accommodation camp will be removed following works.

4.12.2 Traffic and transport

EIS Ref: 2.10.5)i) - There are concerns that the majority of materials and equipment will be conveyed by barge to site, instead of Link Road, Lobs Hole Ravine Road. This will have additional impact on Miles Franklin Drive and the township of Talbingo.

The road pavement of Miles Franklin Drive is not constructed to a structural capacity that will withstand Higher Mass Loading. Strengthening of road pavement is a necessity prior to commencement of being subjected to deliveries via the barge option.

Given that the increase of heavy vehicles to the township of Tumut, reassessment of major intersections in the Tumut township must be undertaken, including the Snowy Mountains Hwy/Gocup Road intersection and Snowy Mountains Hwy/Wynyard Street.

Recommended Action:

1. Review the amount of traffic using the Miles Franklin Drive;

2. Strengthening of Miles Franklin Drive road pavement from Snowy Mountains Highway to Spillway Road;

3. Reassessment of major intersections in the Tumut township;

4. Upgrade of Yellowin Access Road between Batlow and the Snowy Mountains Highway to facilitate use by the general public.

The EIS notes the issue of road dilapidation during the project and states that road maintenance will be managed through the following measures:

- a Road Dilapidation Report will be prepared and approved prior to and following Exploratory Works;
- routine defect identification and rectification of the internal road network will be managed as part of the project maintenance procedure; and
- internal access roads will be designed in accordance with the relevant vehicle loadings

The CTMP will address the provided comments, if required, once details of vehicle haulage routes and heavy vehicle size/loads are determined.

i Miles Franklin Drive access review

a. Miles Franklin Drive capacity

Whilst the majority of traffic associated with Exploratory Works will access Lobs Hole via Link Road and Lobs Holes Ravine Road, the following information provides an assessment of the capacity of Miles Franklin Drive should it be used as the main access.

If all construction vehicles are proposed to access Miles Franklin Drive to use the barge option at Talbingo Reservoir, the likely increase of traffic volumes along Miles Franklin Drive is summarised in the following Table 4.14.

It is noted that there is no publicised capacity for local roads. Roads and Maritime has in the past recognised that local roads typically accommodate up to 500 vehicles during a two-hour AM peak period as part of their road classification review (*Road Classification Review Information Paper and Invitation for Submissions*, 2004, RMS). If this value is assumed to be a typical capacity of a local road, an indicative vehicle / capacity ratio for Miles Franklin Drive can be determined.

Table 4.14 Miles Franklin Drive Construction Traffic

Time period	Traffic volumes					
	Motorcycles	**Light vehicles**	**Heavy vehicles**	**Total**	**Total (PCU)**	**V/C ratio**
Existing conditions						
11AM – 12PM*	1 | 1	25 | 24	4 | 1	30 | 26	37 | 27	0.15 | 0.11
9AM – 10AM^	1 | 0	23 | 19	3 | 1	18 | 25	32 | 21	0.13 | 0.09
Peak construction period						
9AM – 10AM^	1 | 0	25 | 19	25 | 21	51 | 40	97 | 79	0.39 | 0.32
Difference between existing peak period and construction peak	0 | -1	0 | -5	21 | 20	21 | 14	60 | 52	0.24 | 0.21

Notes: *Eastbound traffic volume | Westbound traffic volume*

** = Network traffic volumes during overall peak period*

^ = Network traffic volumes during construction traffic peak period

 # = Network traffic volumes during construction traffic peak period in July school holidays (estimate)

= Assume no motorcycles during snow season

Source: CFE Information Technologies, modified by SCT Consulting; 2018

Table 4.14 shows that with the increased traffic along Miles Franklin Drive, totalling less than 200 vehicles in both directions of travel, the capacity of Miles Franklin Drive would be impacted during Exploratory Works.

b. Miles Franklin Drive / Snowy Mountains Drive Intersection Review

The intersection of Miles Franklin Drive and Snowy Mountains Highway is along widened segment of Snowy Mountains Highway, which would accommodate passing of vehicles turning right into Miles Franklin Drive. However there is currently no line marking to suggest this is arrangement. The intersection is within a speed transition zone whereby the signposted speed reduces from 100km/h to 40km/h, for heavy vehicles, and 60km/h for all other vehicles.

According to AUSTROADS *Guide to Road Design – Part 4A Unsignalised and Signalised Intersections*, a Safe Intersection Sight Distance (SISD) of approximately 261 m for cars and 330 m for trucks is required for vehicles travelling at 100 km/hr, such is the case for vehicles travelling southbound along Snowy Mountain Highway on approach to Miles Franklin Drive. However, the current road alignment does not conform to this sight distance due to the curvature of the road alignment and road side vegetation, which currently only permits approximately 170 m sight distance to the intersection.

Extension of the existing 60km/hr speed zone further north of the intersection by approximately 500 m, with minor trimming of shrubs within the road reserve, would allow the existing intersection of Miles Franklin Drive and Snowy Mountains Highway to conform to the recommended SISD of 130 m for cars and 160 m for trucks within a 60km/hr speed zone.

EIS Ref: 2.10.6 - Travel time and description of site incorrect. Travel time more in the order of 1 hour and 45 mins (90kms). Tumbarumba has a waste transfer station.

Recommended Action - Amend travel time and description.

This comment is noted.

EIS ref: Clause 5.6.5(iii) Assessment of impacts, Transport Chapter 5.6, p5.6-4

There are concerns that the majority of materials and equipment will be conveyed by barge to site, instead of the Link Road, Lobs Hole Ravine Road. Hauling materials and equipment up Talbingo Mountain and through the snow during winter periods will be problematic. No provisions have been made for the use of heavy rigid vehicle that will be required for the haulage of cement and bulk fuel. The predicted fuel use for the duration of Exploratory Works is approximately 8,690,000L of diesel fuel. (Proposed Exploratory Works Chapter 2, p.2-49) depending on how this is transported (16,000L in heavy rigid or 57,000L in B-Double) will equate to 543 heavy rigid and 152 B-Double movements. This will have additional impacted on Miles Franklin Drive and the township of Talbingo.

Drive.

The EIS considered both the vehicle type and number of vehicles include delivery of materials and equipment for the construction of Exploratory Works. The Traffic and Transport Report (Appendix Q of the EIS) assessed that heavy vehicles would consist of a mixture of rigid and articulated multi-axle types.

Construction of the project is anticipated to commence at the end of 2018 with substantive works commencing in early 2019 and to continue for an estimated 34 months. During peak construction the highest number of peak hourly deliveries to site will be 44 two-way truck movements. Most of these vehicles will travel via Lobs Hole Ravine Road.

It is anticipated that approximately 8.69 million litres of diesel fuel would be required for Exploratory Works. Delivery of this fuel would occur progressively over the duration of the works. These vehicle movements have been considered in the Traffic and Transport Report. Notwithstanding, the primary transport route to Lobs Hole is via Link Road and Lobs Hole Ravine Road, not Miles Franklin Drive.

4.12.3 Social

EIS ref: Table 6.1, Chapter 6, p 6-16

Social & Economic impacts to the township of Talbingo mitigation measures - Council endorses this approach.

Options/actions: Possibly set as a condition of consent.

These mitigation measures will be incorporated into the relevant management plans for the Exploratory Works.

EIS ref: N/A - The existing Tumut Hospital is inadequate to meeting the emergency needs for the development.

Options/Actions: Expedite the upgrade of the hospital.

Exploratory Works will comprise self-contained emergency services at Lobs Hole. It is highly unlikely that Tumut Hospital will experience capacity issues due to Exploratory Works.

4.12.4 Waste

EIS ref: Clause 4.11, Regulatory Framework report Appendix C, p57

The approval for a sewerage treatment plant (STP) of this size falls out of the scope Section 68 approval Council would require advice and guidance from the EPA in relation to the approval system. Although the sewerage treatment plant is below the scheduled licencing threshold of:

a) 2,500 persons equivalent, as determined in accordance with guidelines established by EPA Gazettal notice, or

b) 750 kilolitres per day.

It would be more appropriate for the STP to be approved and licenced under the EPA, given the location within a National Park. This is the case for the Cabramurra STP.

Options/Actions: Further consultation with EPA.

Snowy Hydro and EPA are in discussions regarding the specifications of the waste water treatment plant to be established for Exploratory Works. Discharge criteria is discussed in Section 4.2 of this RTS.

The waste water treatment plant will be licensed by the EPA and be included on the EPL for Exploratory Works should it be approved.

EIS Ref: 2.10.6 - Talbingo and Tumbarumba as waste facilities options will not accommodate significant levels of waste.

Recommended Action - remove reference to Talbingo and Tumbarumba waste facilities.

This matter was addressed at Section 4.10.2.

The location of the waste facility or facilities for the disposal of waste generated by Exploratory Works has yet to be determined. This will be undertaken by the contractor(s) in consultation with Snowy Hydro and Snowy Valleys and Snowy Monaro Regional councils. However, the volume of waste requiring deposition at a landfill is relatively minor and within local waste receipt limits. Consultation will be undertaken with councils regarding these requirements ensuring there is enough capacity to receive and process this waste.

The management of waste and recycling will be detailed in the Waste management Plan being prepared for Exploratory Works.

CHAPTER 5

RESPONSE TO SPECIAL INTEREST GROUP SUBMISSIONS

5 Response to special interest group submissions

5.1 Overview of responses

As discussed in Section 2.5.2, the most commonly raised themes in special interest group submissions were biodiversity, the approval process and water. Other matters that were raised were the project elements, project justification, impacts to KNP and impacts to land. This section summarises special interest group submissions and provides responses. Special interest group submissions were received from:

- National Parks Association of NSW (NPA);
- Australian Cave and Karst Management Association (ACKMA);
- Nature Conservation Council (NCC); and
- The Colong Foundation for Wilderness.

5.2 Project need

5.2.1 Alternatives and options considered

> Three submissions identified that the decision to proceed with Snowy 2.0 was made without a proper assessment of alternative options, including other combinations of pumped storage options using different Snowy Hydro reservoirs, options in other areas of the State with potentially less impact on the environment and natural heritage, or options for other clean energy technologies. The need to proceed with Snowy 2.0 has not been justified, particularly given the significant impacts it will have on KNP.

The matter raised is concerned with Snowy 2.0 Main Works, rather than Exploratory Works. Nonetheless, information is provided in response.

The need for Exploratory Works is described in Section 1.4, which identifies that the purpose of Exploratory Works is to undertake investigative works to gather important technical and environmental information for the Main Works of Snowy 2.0. Specifically, Exploratory Works involves horizontal drilling in situ, and at depth so detailed geological data can be collected about the rock types, conditions, ground temperature and stress conditions. This information will inform the design and construction of the cavern for the underground power station. In the event that Snowy 2.0 does not proceed following the commencement or completion of Exploratory Works, Section 2.13 of the EIS describes decommissioning of Exploratory Works disturbance areas.

The need for pumped hydro-electric capabilities is discussed in Section 1.3 of the EIS. Section 1.3 establishes that the NSW energy system (and broader NEM) is facing major and unprecedented challenges through rising energy costs, deterioration in energy system security and reliability, and a transition in the generation mix away from coal-fired, dispatchable, base-load power to intermittent renewable wind and solar power (also known as variable renewable energy or VRE, meaning energy sources that are non-dispatchable and fluctuating in nature like solar and wind).

As stated in Section 1.3.3 of the EIS, Snowy 2.0 would provide energy security and reliability to the NSW energy system and the NEM through its energy storage capacity and quick-start dispatchable generation delivery. The strategic need for Snowy 2.0 is due to its potential to play a key role in helping NSW and the broader NEM achieve energy system reliability and security with relatively low costs and emissions.

Section 3.2.1 of the EIS set out the strategic context for Snowy 2.0 and its place within the NEM. Pumped hydro-electric storage is accepted as a necessary component of a secure power system with a reliable supply of electricity to consumers (Finkel et al 2017). Snowy 2.0 would deliver 2,000 MW of electricity generation, with quick-start capabilities for delivery of about 175 hours of storage (350,000 MWh). Snowy 2.0 would be capable of delivering generation within minutes in times when variable renewable energy is not operating. In this regard, it is well-positioned to ensure the reliable and secure electricity needed for NSW's continued economic strength.

The EIS provided consideration to the 'do nothing' alternative to Exploratory Works in Section 1.4.2. In relation to consideration of alternative technologies or alternative projects, Section 1.3.3 of the EIS provides information on the benefits that would be provided by the pumped hydro-electric energy storage technology used in Snowy 2.0. In particular Snowy 2.0 would have high full cycle energy efficiency, a long lifespan and would provide a 350,000 MWh of energy storage, which is significant storage capacity. These benefits are considered to justify the use of pumped hydro energy storage to complement over other smaller scale energy storage technologies.

The development of pumped hydro-electric storage requires significant lead time for planning, engineering and design. Snowy 2.0 utilises existing assets under the control of Snowy Hydro. A feasibility study for Snowy 2.0 was completed in 2017, and the connection of Talbingo and Tantangara reservoirs to deliver pumped hydro-electric capability has been considered at a conceptual level since the original construction of the Snowy Scheme.

The Feasibility Study (Snowy Hydro 2017) identified that a key study regarding the connection of the two reservoirs was a study completed in 1991, *titled Snowy Mountains Scheme Augmentation Ranking Study* (Dunn 1991), which included a summary of studies undertaken before 1991, and stated that augmentation studies of pumped storage schemes were first considered in 1966 during the design and construction phase of the Snowy Mountains Hydroelectric Scheme. Further studies concerned with energy reserve capability and mostly of pumped storage schemes were undertaken from 1980-1986 and a study of a mini hydro development at Khancoban Dam was completed in 1990.

While other opportunities have been identified in NSW and throughout Australia for pumped hydro-electric storage, notably the atlas of pumped hydro-electric storage released in 2017 (Blakers et al. 2017), the lead time and planning for such projects is extremely complex. In this regard, Snowy Hydro is uniquely positioned to be able to deliver a project of the magnitude of Snowy 2.0 that will provide significant benefits to NSW and the NEM utilising its existing reservoirs.

One submission questioned what analysis had been undertaken for the proposed capacity of 2,000 MW, stating that a lesser capacity would require smaller diameter tunnels and generation/pumping equipment at lower costs and lesser environmental impact, and conversely a larger capacity would potentially have greater environmental impact but would produce more power.

The matter raised is concerned with Snowy 2.0 Main Works, rather than Exploratory Works. Nonetheless, information is provided in response.

The Feasibility Study (Snowy Hydro 2017) included consideration of alternative electrical generation capacities and configuration of power station electrical and mechanical equipment. The proposed capacity of 2,000 MW is achieved through a combination of six pump/turbines. The analysis of costs and environmental impacts do not directly correlate with the capacity of the project – the environmental impact assessment includes a complex balance of biophysical, social and economic impacts weighed up against the benefits of the project.

As stated above, the Snowy 2.0 power station is not proposed as part of Exploratory Works and therefore is not a part of this application. Further details regarding the proposed electrical generation capacities and configuration of the power station would be provided in a separate EIS for the Main Works for Snowy 2.0.

5.3 Approvals process

5.3.1 Adequacy of the EIS

Two submissions stated concerns regarding the general adequacy of the Exploratory Works EIS, with general statements that the EIS fails to adequately address the impacts of the project and that there will be significant environmental impacts.

The Exploratory Works for Snowy 2.0 EIS provides technically accurate and robust information. The EIS provided consideration of the Secretary's Environmental Assessment Requirements (SEARs) and demonstrated the measures taken to avoid, minimise and mitigate the potential impacts of Exploratory Works.

As stated on the EIS certification page the EIS provided all available information relevant to the environmental assessment of Exploratory Works and no information contained in the EIS was false or misleading. The EIS and supporting technical reports were prepared by technical experts in their respective fields as shown in the EIS study team provided as Appendix B to the EIS.

As stated in Section 7.5 of the EIS, Exploratory Works has been designed to avoid and minimise impacts where possible. The residual impacts have been identified and assessed. The key impacts of Exploratory Works are associated with direct and indirect impacts from vegetation clearance and ground disturbance, such as loss of native habitat for threatened species and potential changes to water quality from construction activities. During construction, a number of roads and walking tracks will need to be closed off to the public. On completion of Exploratory Works, most sites will be reopened, subject to the requirements of the Snowy 2.0 main project, currently in a design phase.

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

5.3.2 Commonwealth approvals

Two submissions stated their disagreement with the determination that Exploratory Works are not a controlled action under the EPBC Act, and that the Exploratory Works will have a significant impact on matters of national environmental significance.

The matter raised relates to a separate planning process to the NSW planning system and is not relevant to the application. Nonetheless, information is provided below in response.

A referral for Exploratory Works was lodged with the Commonwealth Department of Environment and Energy (DEE) on 28 May 2018. The referral was subsequently publicly notified from 2 June to 20 June 2018 where comments from the community and special interest groups could be prepared and lodged with DEE.

As part of the referral assessments of potential impacts of Exploratory Works on matters of national environmental significance (MNES) were submitted to DEE. This included the following reports which were submitted as part of the EPBC referral:

- Matters of National Environmental Significance Report – Species and Communities; and
- Assessment of Impacts on National Heritage Places.

The Exploratory Works EPBC referral concluded that overall there is a low risk of direct or indirect impacts to threatened species listed under the EPBC Act and Exploratory Works are unlikely to result in a significant impact to these species. The referral also stated that the proposed action will not have a significant impact on National Heritage Places. The DEE provided their decision on the referral for Exploratory Works on 12 July 2018 finding the Exploratory Works to be 'not a controlled action' under the EPBC Act.

5.3.3 Staged approvals process

Several submissions raised concerns that a staged approvals process is not appropriate for Snowy 2.0 and argued that the Exploratory Works stage of the project should not be assessed separate to an application for all other stages and elements of Snowy 2.0.

In NSW staged applications for state significant infrastructure (SSI) projects are common practice and consistent with the requirements for SSI stated in Division 5.2 of the EP&A Act. As stated in Section 3.3.1 of the EIS on 7 March 2018 the NSW Minister for Planning declared Snowy 2.0 to be CSSI and thereby confirmed that a staged SSI application process as a permissible approvals pathway for Snowy 2.0.

As a component of Snowy 2.0, the Exploratory Works is declared to be CSSI for the purposes of the EP&A Act. Therefore the application for Exploratory Works as a first stage of Snowy 2.0 with later stages of the project to be assessed in separate applications is permissible in accordance with Division 5.2 of the EP&A Act. The environmental assessment carried out for Exploratory Works was thereby consistent with the relevant requirements of the NSW planning legislation.

As stated in Section 7.5 of the EIS, Exploratory Works is considered to be justified and in the public interest because:

- it seeks to promote the management and conservation of resources, while also permitting appropriate development to occur which is in line with the objects of the EP&A Act;
- the benefits of Snowy 2.0 are in the public interest and will provide long term reliable energy, environmental and economic benefits;
- it is a necessary precursor to finalising the detailed design for Snowy 2.0. The exploratory tunnel is needed to understand the geotechnical conditions of the site for the underground power station;

- the design of Exploratory Works has been an iterative design and environmental assessment process to ensure impacts have been avoided and minimised as much as possible. This has included refining the design in consultation with NPWS and OEH;

- the environmental impact assessment has identified that residual impacts can be appropriately managed and offset in consultation with NPWS and OEH;

- consultation with NPWS, OEH and other key stakeholders has been undertaken to ensure appropriate management objectives are identified and incorporated into the construction and long term management framework for Exploratory Works; and

- Snowy Hydro has committed to the long term environmental management and rehabilitation of impacted sites, including removal, decommissioning and rehabilitation if needed. Therefore, should Snowy 2.0 not proceed, long term negative environmental issues can be reasonably avoided.

5.3.4 Development within KNP

Several submissions stated that the project should not be allowed to proceed due to its location within the KNP. These submissions argued that the Exploratory Works should not be approved on the principle that development within a national park is unacceptable.

The generation of hydro-electric power within KNP forms part of the origins of the national park, which was originally established as Kosciusko State Park, legislated in 1944 under the *Kosciusko State Park Act 1944* resulting in the creation of a reserve of 518,229 ha. The motivations of the then Premier, William McKell, for creating the park were his interests in soil and water conservation, and his ambitions for developing the hydro-electric potential of the mountains (Department of Environment and Conservation 2006).

As discussed in Section 3.3.3 of the EIS Part 6, Section 37(2) of the *Snowy Hydro Corporatisation Act 1997* (SHC Act) entitles Snowy Hydro to the grant of a lease, licence, easement or right of way over KNP, for the purposes of the existing Snowy Scheme development. The Snowy Park Lease was granted in 2002 and has a term of 75 years. Section 41(5) of the SHC Act provides that development that is for a purpose for which a lease has been granted under Part 6 of the Act, is taken to be authorised under the NPW Act.

New surface infrastructure works within KNP associated with Exploratory Works are not covered by the existing Snowy Park Lease. Therefore, minor amendments will be required to the SHC Act to enable the grant of a Snowy Park Lease to include the areas that will be accessed and occupied by Snowy Hydro during Exploratory Works. The proposed amendments to the SHC Act and subsequent Snowy Park Lease together with management plans and the Minister's approval, if granted, will provide a regulatory framework that permits the Exploratory Works to be carried out within the KNP.

Snowy Hydro is committed to maintaining its excellent environmental track record of work within the KNP. The environmental management framework that will govern the avoidance, minimisation and management of impacts during the Exploratory Works has been set out to ensure responsibilities and accountabilities for environmental performance are clear (see Chapter 6 of the EIS).

Snowy Hydro's consultation with key stakeholders and the community is ongoing. Working together with NPWS is fundamental to achieving long term management objectives, and has been important in the development of Exploratory Works. Snowy Hydro has set out in its commitments, the ability for the Exploratory Works to be reversible (ie decommissioned and suitably rehabilitated) should unacceptable impacts occur or if Snowy 2.0 does not proceed. Snowy Hydro has also been working with NPWS to develop appropriate offsets for biodiversity and recreational uses, for predicted impacts.

One submission stated that Snowy Hydro must pay NPWS fair rent for what is leasehold occupation of the entire area over which it will claim exclusive possession, and that the small offset payment proposed in the EIS is demonstrably unfair.

As stated in the section above Snowy Hydro's occupation of the KNP is currently subject to the Snowy Park Lease which includes the payment of rent to NPWS. The extension to the Snowy Park Lease required for the development of Exploratory Works within KNP will be subject to an agreed commensurate adjustment in the rent paid to NPWS for Snowy Hydro's occupation of KNP in accordance with the Snowy Park Lease. It should also be noted that rent paid under the Snowy Park Lease is separate to and additional to any biodiversity offset payments which may be required to meet obligations under the *Biodiversity Conservation Act 2016*. The proposed biodiversity offset strategy is set out in Appendix B.

5.3.5 Public exhibition

The submissions raised concerns with the public exhibition of the EIS. These concerns included that the public exhibition period was too short and that the format the EIS was available in was not adequate.

The Exploratory Works for Snowy 2.0 EIS was placed on public exhibition from 23 July to 20 August 2018. This is consistent with the requirements stated in Schedule 1, Division 2, Clause 12 of the EP&A Act that specifies that the minimum public exhibition period for an SSI project EIS is 28 days.

In relation to the format of the EIS, a range of methods were used to reach a wide audience. The EIS was made available electronically on the DPE major projects website, as well as via the Snowy Hydro website. In addition, an online web portal was created to communicate the EIS to the public and stakeholders in an accessible and interactive way. The EIS was also exhibited in hard copy at several locations.

During the exhibition period the EIS was provided in multiple formats and geographies and was made readily available to a wide audience. The public exhibition also met the requirements of the relevant NSW planning legislation and is therefore considered to have been adequate.

5.4 Project elements

5.4.1 Interactions with Snowy 2.0

One submission identified that the EIS did not include a description of the likely interactions with other existing, approved or proposed development in the vicinity of the site, and in particular, likely interactions with the broader Snowy 2.0 project.

Section 1.4 of the EIS discussed the need for Exploratory Works and provides details of the interactions between Exploratory Works and Snowy 2.0. The relationship between Snowy 2.0, Exploratory and the existing Snowy Scheme is also discussed in Section 1.2 of the EIS. This section provides information on Exploratory Works and Snowy 2.0 and where they fit within the history and infrastructure of the existing Snowy Scheme.

Chapter 2 of the EIS includes references throughout to how the Exploratory Works elements integrate with the broader Main Works for Snowy 2.0; for example, Section 2.2.2 states that (subject to obtaining the necessary approvals if Snowy 2.0 proceeds) the exploratory tunnel proposed for Exploratory Works could be utilised to form the main access tunnel to the underground power station for Snowy 2.0, and Section 2.13 describes decommissioning of Exploratory Works in the event that Snowy 2.0 does not proceed.

5.4.2 Site layout

One submission stated that insufficient reasoning was provided for the layout of infrastructure at Lobs Hole, stating insufficient information to assess alternative site layout options considered.

The site layout presented in the EIS was developed through an iterative design process involving a team of engineers and designers, shortlisted contractors and a range of environmental specialists. The final site layout was developed over a period of time with incorporation of key environmental considerations as information became available throughout the preparation of the EIS.

A key driver for the layout of infrastructure was the location of the exploratory tunnel portal, which was based on a complex range of geotechnical and other considerations. This then influenced the proximity of other project elements, such as the portal construction pad, which contains infrastructure to support the construction of the exploratory tunnel (eg concrete batching plant, stockpiles, equipment laydown areas) and would ideally be within close proximity to the tunnel portal to minimise the distance and transport of materials to and from the construction pad and tunnel.

The site layout was also substantially influenced by environmental considerations, such as:

- setbacks to the Yarrangobilly River to avoid riparian habitat for key threatened species and water quality impacts;
- minimisation of impacts to existing vegetation;
- potential for Aboriginal and non-Aboriginal heritage significance;
- maximum probable flood levels; and
- bushfire risk.

Many different alternative options were considered throughout the design process and considered against a range of criteria to achieve an outcome that minimised environmental impacts as far as practicable.

5.4.3 Excavated rock management

One submission raised a number of questions regarding excavated rock management including reuse of excavated rock by NPWS and whether the use of 40,000 m^3 by NPWS for road base is realistic, alternative options considered for rock emplacement (at Lobs Hole and elsewhere), and volume and management of excavated rock from the broader Snowy 2.0 project.

Section 2.5.2 of the EIS stated that that up to 40,000 m^3 of suitable excavated material from the Exploratory Works program will be made available to NPWS for use in road maintenance and upgrades. This volume was determined in consultation with NPWS and represents an upper limit of the volume of material that may be required. Snowy Hydro would consult with NPWS regarding required volumes of excavated for reuse.

The sites chosen for on land excavated rock emplacement areas were selected based on several criteria including:

- proximity to the exploratory tunnel;
- suitable topography for development of emplacement area landforms;
- use of previously disturbed sites where possible; and
- avoidance of environmental sensitivities including avoidance of all areas within 50 m of the Yarrangobilly River.

The removal and management of rock for the power station cavern and main tunnel is not part of Exploratory Works and will be addressed in a separate EIS for Main Works for Snowy 2.0. The volume of rock from the Main Works estimated in the Feasibility Study (Snowy Hydro 2017) is in the order of 6.5 million bank cubic metres. However, further engineering and design is ongoing and this estimate will be updated as part of further detailed design.

The method of disposal will be dependent on the characteristics of the material, which will be subject to detailed analysis and assessment. The primary option being considered for management of most of the suitable excavated rock is subaqueous emplacement within Talbingo and Tantangara reservoirs; however, the management of excavated material from the main tunnel and power station cavern will be subject to further detailed investigation and environmental impact assessment as part of the EIS for Main Works.

5.4.4 Rehabilitation

One submission stated that the rehabilitation strategy for Exploratory Works does not take into account rehabilitation for the broader Snowy 2.0 project, in particular at Lobs Hole, noting that Lobs Hole would be a major access point for the main Snowy 2.0 project and therefore subject to impacts at a greater scale.

Section 2.12 and 2.13 of the EIS describe how the areas disturbed by Exploratory Works would be rehabilitated if the Snowy 2.0 project was not to proceed. The EIS for Snowy 2.0 Main Works will describe rehabilitation for the broader project, including areas disturbed by Exploratory Works in the longer term if Snowy 2.0 was to proceed.

One submission stated that rehabilitation of the former mine workings and mine waste stockpiles should be completed to improve the Ravine area.

A Phase 1 Contamination Assessment was included as Appendix J of the EIS, and identifies the existing contamination associated with the former mine workings and mine waste stockpiles remaining at Lobs Hole. The disturbance footprint has avoided most of these areas for Exploratory Works; no specific actions are proposed to address rehabilitation of these areas as part of Exploratory Works.

Should the broader Snowy 2.0 project proceed, use of Lobs Hole would be ongoing beyond Exploratory Works. Evaluation of options for rehabilitation of former mine workings and waste rock stockpiles would be undertaken in consultation with NPWS as part of Snowy 2.0 Main Works.

5.5 Biodiversity

5.5.1 Terrestrial ecology

Two submissions raised concerns regarding impacts to the Booroolong frog, including degradation of habitat from discharge of sewage and placement of excavated rock, including acid forming material, stating that the 50 m buffer applied to the Yarrangobilly River is inadequate, especially given frogs were observed up to 130 m away from the river. The concrete batching plant at the portal construction pad also poses risks to frog habitat during periods of high rainfall or industrial mishap, with mitigation measures inadequately addressed in the EIS.

Impacts to the Booroolong Frog have been extensively considered as a part of the biodiversity assessment, and relevant species experts consulted in development of appropriate mitigation measures. As discussed in Section 7.2.2 of the BDAR (EMM 2018b) (Appendix F of the EIS) the 50 m buffer applied to the Yarrangobilly River was developed in consultation with species experts from OEH and was determined to provide a buffer that would avoid direct impacts along with most indirect impacts to Booroolong Frog habitat.

Sewage will not be discharged into the Yarrangobilly River, but rather treated before disposal of clean water into the reservoir and trucking of waste off-site. As described in Section 3.2, the eastern emplacement area will comprise an active water management regime to divert clean water around the stockpile and treat runoff through the process water management system, avoiding runoff from entering the Yarrangobilly River. Stormwater controls are in place to ensure water entering the Yarrangobilly River does not present a risk to the biodiversity values of the river (or reservoir). A monitoring program is being developed to ensure assumed impacts in the EIS are met.

One submission noted the importance of periglacial blockstreams along Lobs Hole Ravine Road in providing habitat for small mammals such as the Mountain Pigmy Possum and the Broad Toothed Rat, and that care was required in upgrading the road to avoid collapse of the blockstreams was required.

Surveys of the periglacial blockstreams were undertaken as a part of the biodiversity assessment; no threatened species were recorded using these blockstreams, but a precautionary approach has been undertaken and presence has been assumed. As discussed in Section 3.5 and the expert geoheritage report provided in Appendix D, road widening has been designed to avoid impacts to these blockstreams wherever possible. Impacts will be further minimised through the method of construction where road widening is required. These works will ensure there is no collapse of the blockstreams.

5.5.2 Aquatic ecology

One submission noted that joining Talbingo and Tantangara Reservoirs is likely to result in transporting noxious and non-native fish from Talbingo Reservoir into Tantangara Reservoir and its downstream rivers, and that this is not addressed in the EIS.

The matter raised is concerned with the Main Works for Snowy 2.0, rather than Exploratory Works. Nonetheless, information is provided in response.

Exploratory Works does not involve connection of the two reservoirs or transfer of water between the waterbodies, and therefore is not required to be assessed in the EIS.

It is acknowledged that the broader Snowy 2.0 project would connect Talbingo and Tantangara reservoirs, and that there is potential for the transport of fish between the two reservoirs, including noxious and non-native species. This will be comprehensively assessed as part of an EIS for Snowy 2.0 Main Works.

One submission stated that there is no mention of offset credits for residual impacts to aquatic ecology.

Offset credits for residual impacts to aquatic ecology were not required based on the findings of the aquatic ecology assessment presented in Appendix G of the EIS.

As discussed in Section 4.3.2 an approach to assessment for impacts on Murray Crayfish in Talbingo Reservoir has been discussed with DPI Fisheries. The process will involve a process of data gathering to further develop Murray crayfish habitat mapping followed by the identification of additional avoidance and mitigation measures if required. The additional survey, habitat mapping, revised assessment of significance and process to develop strategy to avoid, minimise and offset residual impacts for Murray Crayfish in Talbingo Reservoir will be submitted to DPI Fisheries and DPE in October 2018.

5.5.3 Adequacy of survey and assessment

One submission identified that six to eight species of forest bats occur at Yarrangobilly, and that some of these species would exist and forage in the Ravine area, questioning whether a bat survey was carried out in the Ravine area. In regards to the Eastern bent-wing bat, the submission noted that the BDAR stated there were no suitable roosting structures for this species, however an adit will be impacted by rock emplacement which potentially provides suitable roosting habitat.

The biodiversity assessment was undertaken in accordance with the requirements of the *Biodiversity Conservation Act 2016* (BC Act) and Biodiversity Assessment Method (OEH 2017) (the BAM). Under the BAM, many species of bats are considered ecosystem credit species, with their habitat considered to be reliably predicted to occur based on plant community types (PCTs). Targeted surveys are not required for this species. Breeding habitat for the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) is a species credit species, and if impacted surveys are required. A number of adits in Lobs Hole are known to provide roosting habitat for the species; however, no breeding was recorded in these adits during surveys for vegetation mapping and habitat assessment.

5.5.4 Offsets and management measures

One submission identified concerns that a biodiversity offset package has not yet been developed for the project, stating that a proper assessment of biodiversity cannot be done without an understanding of how offsets will be offset, and requests exhibition of a biodiversity offset strategy prior to determination of the project. Two submissions raised concerns that there is no explanation of how the ecosystem and species credits identified in the BDAR will be met. One submission also raised concerns with the broader biodiversity offset framework set out in NSW government policy.

A biodiversity offset strategy has been prepared for Exploratory Works, in consultation with OEH and NPWS. The biodiversity offset strategy is presented in Appendix B.

Biodiversity offsets for Exploratory Works will achieve a direct conservation benefit for the KNP through the undertaking of management actions in KNP. Snowy Hydro will make a payment, equivalent to what would be required if payment was made into the Biodiversity Conservation Fund (BCF), to be used to fund these management measures. The biodiversity offset strategy in Appendix B provides further detail on the management measures proposed, with NPWS to develop detailed plans.

One submission identified that the project will promote the introduction of weed species and that measures should be included to reduce impacts. This submission identified opportunities to address the broader issue of non-native species at Ravine as part of the project.

Impacts of introduction of weed species into KNP were assessed as a part of the biodiversity assessment, and measures to minimise and mitigate these impacts recommended. These measures will be further developed in the management plans currently being developed for the project. In addition to wash down procedures for all vehicles entering the works area, regular monitoring will be undertaken, and controls implemented if weeds are found to increase from the Exploratory Works.

In addition to the project specific mitigation measures proposed, the Exploratory Works will also be subject to the Snowy Management Plan Environmental Management Plan (SMP EMP) which outlines Snowy Hydro's obligations about the protection of the environment and public health and includes weed management measures.

Two submissions stated that in-principle offset agreements made between the proponent, the Office of Environment and Heritage and the National Parks and Wildlife Service should be made public to allow all stakeholders the opportunity to comment on whether these are sufficient and appropriate.

The biodiversity offset strategy is attached at Appendix B. Snowy Hydro will make payment to fund these management measures equivalent to the payment required into the BCF. NPWS will be developing further details on management actions.

One submission stated that there is no references offset credits for other environmental damage from the Exploratory Works, including the expanded road network (18.5 km of road widening, 7.5 km of road upgrades, 2 km of new roads and two watercourse crossings.

All impacts arising from the project, including an expanded road network and watercourse crossings, have been considered and residual impacts will be offset.

5.6 Kosciuszko National Park

5.6.1 Continued park operations

Submissions raised concerns with the loss of access to Lobs Hole Ravine and areas within KNP more broadly in the longer term if Snowy 2.0 was to proceed, noting important research, historical and recreational values of these areas including the campground at Lobs Hole Ravine. One submission noted the possibility of occasional open days if Snowy 2.0 was to proceed.

As stated in Section 2.9.3 of the EIS there will be public access restrictions imposed during Exploratory Works. The public access restrictions are proposed for safety reasons to minimise interactions between the public and Exploratory Works construction and will exclude the public from all construction sites. The following areas of KNP will be closed to the public for the duration of Exploratory Works:

- Ravine campground;
- Lobs Hole Ravine Road from the intersection of Link Road (in the south) and Blue Creek Trail (in the north);
- Lobs Hole Ravine Road from the intersection with Tolbar firetrail; and
- Middle Bay hand-launching boat ramp.

Should the Main Works component of Snowy 2.0 proceed it is likely that public access to these areas would continue to be restricted for safety reasons. Any future restrictions to public access will be subject to ongoing consultation with NPWS and assessment in a separate EIS.

Following Exploratory Works (and Snowy 2.0, should it proceed) access to these areas would be reopened to the public. If Snowy 2.0 proceeds, access arrangements to operational infrastructure would be determined in consultation with NPWS. Public visitation to any future Snowy 2.0 infrastructure would be considered once operations were established.

In the long term it is expected that Exploratory Works will improve public access to Lobs Hole. These improvements principally relate to access and internal roads around Lobs Hole and Ravine campground, which will contribute to the future public enjoyment and use of the KNP.

One submission stated that KNP continues to face unabated pressure from infrastructure developments, tourism and invasive species, and that the proposal to build Snowy 2.0 must be viewed and considered within the context of continual incremental encroachment and damage to KNP's environment, and not as a standalone project.

All technical environmental assessments completed as part of the EIS have considered the existing baseline conditions of the project area which include the impacts of other nearby projects, industries and existing environmental conditions. For example the impacts of Exploratory Works on invasive species were considered as part of the BDAR (EMM 2018b) and AEA (Cardno 2018) (Appendix F and G respectively).

Other nearby developments within the KNP include the Mt Selwyn Ski Resort and other elements of the Snowy Scheme. There are no other projects within the KNP that are expected to undertake significant construction works at the same time as Exploratory Works. Therefore no additional impacts are expected to occur due to the cumulative effects of other nearby projects being undertaken.

One submission stated that no significant infrastructure should be permitted within a national park, and that the project is inconsistent with KNP operations.

As previously discussed in Section 7.3.4 the development of Exploratory Works within the KNP will be permissible in accordance with the SHC Act which will be amended to facilitate the carrying out of any approved Exploratory Works within the park. Snowy Hydro is committed to maintaining its excellent environmental track record of work within the KNP.

As stated in Section 2.9.3 of the EIS there will be some public access restrictions imposed during Exploratory Works to exclude park users and staff from active construction sites. Despite these access restrictions the majority of the KNP will continue to operate and be open to the public for the duration of Exploratory Works.

Management of impacts within KNP will be aligned to the management objectives identified in the KNP PoM administered by NPWS. Snowy Hydro has been working with NPWS to ensure opportunities for contributory measures are identified where needed. The final landform and rehabilitation outcomes to be achieved following Exploratory Works will be designed to meet the land use goals of NPWS and the KNP PoM.

5.6.2 Impacts to recreational values

One submission raised a number of issues regarding the description of Ravine campground and its values for recreational users presented in the EIS, including:

- references in the EIS to recreational values of ski resorts and other facilities are irrelevant to visitors who use Ravine campground;
- it is inappropriate for the EIS to suggest that other parts of KNP be opened up to 4WD vehicle users as a mitigation measure for impacts to accessibility of the Ravine area;
- statements in the recreation section of the EIS (Section 5.2.2iii) are misleading as there is a focus on snow sports, rather than 4WD recreational vehicle use and water-based summer recreation on the waterways;
- Figure 5.4 of the EIS is misleading as it presents the Ravine campground as being located on one of the two proposed rock emplacement areas – the figure should be consistent with the KNP Plan of Management and show more detail regarding the Ravine areas locality, including public access roads to the campground;

The EIS states that the Ravine campground is little used and closure will not affect public access, which is incorrect.

Section 5.2 of the EIS details the predicted impacts to KNP including a discussion of the park's values. This section provides specific consideration to snow tourism as the KNP PoM identifies the KNP's status as Australia's pre-eminent skiing destination as one of its key values.

The recreational value of Ravine campground was considered as part of the social impact assessment which is detailed in Section 5.7 of the EIS and provided in Appendix R of the EIS. Section 5.7.3(v) of the EIS states the following:

Potential impacts to recreation users resulting from Exploratory Works include the closure of Lobs Hole Ravine Road and the Ravine campground within KNP – restricting access to Lobs Hole for the duration of the Exploratory Works will impact current and potential users of the road and site including campers, drive tourers, fishers and those who visit the area with an interest in its heritage;

The recreational uses and values of Ravine Campground are also characterised in other sections of the EIS including Section 1.5.2 which states 'Lobs Hole is currently used as a remote campground (known as Ravine campground) within KNP and provides space for recreational activities including camping, fishing, and 4WD'.

As stated in Section 2.9.3 of the EIS there will be restrictions to public access to some areas of KNP during Exploratory Works. The following areas of KNP will be closed to the public for the duration of Exploratory Works:

- Ravine campground;
- Lobs Hole Ravine Road from the intersection of Link Road (in the south) and Blue Creek Trail (in the north);
- Lobs Hole Ravine Road from the intersection with Tolbar firetrail; and
- Middle Bay hand-launching boat ramp.

An assessment of recreational impacts was included as part of the social impact assessment which is detailed in Section 5.7 of the EIS and provided in Appendix R of the EIS. This provided consideration of the recreational impacts of restricted public access to recreational areas within KNP. It is expected that other recreational areas within KNP offer similar activities and will be able to absorb some of the displaced recreational users. At the completion of Exploratory Works public access to these areas of the KNP will be reinstated.

One submission stated that reinstatement of the campground atop the rehabilitated rock emplacement area would not be a positive outcome, and would provide reduced amenity for campers and reduced access to the river, which is a main point of interest for campers accessing the area.

As stated in Section 3.1.1 and 6.1.2, following additional consultation with NPWS any materials within the eastern emplacement area (that have not been subaqueously emplaced) that remain following the completion of Exploratory Works, should Snowy 2.0 Main Works not proceed, will be removed from KNP. The final decommissioning and rehabilitation outcomes for Exploratory Works will be subject to further consultation with NPWS regarding the end land use of the area.

One submission states that it is wrong to state that recreational facilities or users will not be close enough for modelled infrastructure to be seen, and incorrect to state that users will have no access to existing tracks and a campground. If the campground and access tracks are to be replaced by a waste rock emplacement for the duration of the project, then visitors shall be denied access. References to the proximity of infrastructure are misleading when impacts will include denial of access to the national park.

As stated in Section 2.9.3 of the EIS there will be public access restrictions imposed during Exploratory Works. The public access restrictions are proposed for safety reasons to minimise interactions between the public and Exploratory Works construction and will exclude the public from all construction sites. The following areas of KNP will be closed to the public for the duration of Exploratory Works:

- Ravine campground;
- Lobs Hole Ravine Road from the intersection of Link Road (in the south) and Blue Creek Trail (in the north);
- Lobs Hole Ravine Road from the intersection with Tolbar firetrail; and
- Middle Bay hand-launching boat ramp.

An assessment of recreational impacts was included as part of the social impact assessment which is detailed in Section 5.7 of the EIS and provided in Appendix R of the EIS. This provided consideration of the recreational impacts of restricted public access to recreational areas within KNP.

In the long term it is expected that Exploratory Works will improve public access to Lobs Hole. These improvements principally relate to access and internal roads around Lobs Hole and Ravine campground, which will contribute to the future public enjoyment and use of the KNP.

Snowy Hydro is committed to maintaining its excellent environmental track record of work within the KNP. Snowy Hydro is committed to ongoing consultation with NPWS regarding Exploratory Works and Snowy 2.0 including the decommissioning and rehabilitation of Exploratory Works and the development of appropriate offsets for predicted impacts including recreational uses.

5.7 Land

5.7.1 Geodiversity

One submission raised issues regarding the impacts to low-angle tufa deposits including terraces, which may be impacted by roadworks and other operations, noting that the small caves in the tufa deposits support bats and contain important sub-fossil materials.

One submission stated that Lobs Hole Road crosses the important fossiliferous Lick Hole Limestone and lies within the catchments which supply the dissolved limestone that produces much of the tufa deposits characteristic of the Ravine area. The submission states that the interests of the fossils will need attention and the issue of excess sediment supply must be considered. Road upgrades in these areas require careful planning.

An assessment of potential impacts to geodiversity features in the project area was provided in the Geodiversity Review (Appendix I of the EIS) and further consideration has been given to the significance of predicted geodiversity impacts and detailed in expert reports provided in Appendix D. As stated in Section 4.1 of the geodiversity review the main areas of disturbance associated with the Exploratory Works that have potential to impact geodiversity features within the KNP are along Lower Lobs Hole Ravine Road.

The tufa deposits referenced in this submission were identified during the geodiversity review. No construction is proposed near vertical walls/cliff faces where tufa deposits usually occur. Works associated with the Exploratory Works program will avoid any identified tufa deposits where possible. The fossiliferous outcrop raised in submissions was also identified as part of the geodiversity review. Although the Lobs Hole Ravine Road upgrade will impact a small section of the Lick Hole formation outcrop, the predicted impacts are considered to be minimal and can be adequately managed as stated in Appendix D.

Impacts to geodiversity will be able to be kept to minimal levels, subject to construction requirements, environmental controls (such as erosion and sediment controls), and options for further minimising disturbance through design refinement. Where possible, the design of Lobs Hole Ravine Road and the required disturbance footprint have been reduced as much as possible to minimise impacts to geodiversity.

The CEMP developed for Exploratory Works will consider the management objectives and implementation actions identified in the KNP PoM and *KNP Geodiversity Action Plan 2012-2017* (KGAP). The rocks, landforms and geological processes are to be managed within the bounds of acceptable limits of disturbance. An Surface Water Management Plan will be prepared as a sub-plan to the overarching CEMP. The document will outline risk mitigation measures to prevent and control sediment runoff in disturbance areas and measures to protect geological features.

5.7.2 Naturally occurring asbestos

One submission raised a number of matters regarding the disturbance of naturally occurring asbestos (NOA), including:

- inadequate consideration of the potential impact of asbestos on workers and park visitors;
- regional geology indicates that the rock waste will be dumped upon rocks with high asbestos potential. The possibility of mobilising asbestos sediments in Talbingo Dam and the risk of asbestos fibres in the waste rock extracted from the tunnel requires further consideration;
- it is not appropriate to cover the naturally occurring asbestos outcropping on the Upper Lobs Hole Ravine Road with gravel only. The asbestos must be sealed off from the environment so that it cannot generate dust;
- the EIS should have mapped the areas with naturally occurring asbestos so that these may be avoided;
- the tunnel's geological cross-section must consider the potential to intersect serpentinised rock which has asbestos fibre potential; and
- the EIS does not mention Worksafe NSW advice that activities that will generate dust from NOA areas be avoided.

A Phase 1 Contamination Assessment was included as Appendix J of the EIS and identifies the potential for naturally occurring asbestos. Section 3.3 of the contamination assessment identifies that a 600 m section of the Lobs Hole Ravine Road Lobs Hole road aligns with an area identified as having a low potential for naturally occurring asbestos. The potential for naturally occurring asbestos has been interpreted based on NSW mapping of naturally occurring asbestos. Section 6.2.3 of the contamination assessment stated that the risk of exposure to asbestos is considered to be low throughout the project area. Minimal upgrade works are proposed along the 600 m section of Lobs Hole Ravine Road.

While the risk to encounter asbestiform mineral is low and all samples collected to date (21 samples) have not identified the presence of the asbestiform mineral, works which would intersect or excavate potential asbestos occurring areas and formations will require specific management strategies that would be outlined in a site-specific asbestos management plan (AMP) for the identified 600 m section of Lobs Hole Ravine Road where there is potential for asbestos to occur.

5.8 Water

5.8.1 Impacts to water quality

One submission stated that potential risks associated with acid rock drainage should be avoided or mitigated.

Section 2.5.1 of the EIS states that a small volume of tunnel rock may be potentially acid forming (PAF), requiring suitable management and design techniques for emplacement and disposal. Subject to geochemical testing of the rock material, excavated rock will either be re-used or placed subaqueously within Talbingo Reservoir.

As described in Section 3.2, the eastern rock emplacement will comprise an active water management regime by diverting clean water around the emplacement area and collecting and treating stockpile runoff within the process water management system, avoiding discharges into the Yarrangobilly River.

One submission noted that there are potential changes in underground water flows along the route of the tunnels, which could lead to surface water retention and flows, and the potential for far more frequent and much larger fluctuations in the water levels of both Talbingo and Tantangara Reservoirs, which will impact on flora, fauna and aquatic species, and also on recreational usage and amenity, noting that these risks must be appropriately avoided or mitigated.

The comments in this submission relate to impacts that may occur as a result of the operation of Snowy 2.0, and are not relevant to Exploratory Works.

5.8.2 Groundwater

One submission raised concerns for the potential of issues with groundwater at Yarrangobilly, and specifically how drainage of the machinery hall and access tunnels will affect regional groundwater.

Potential impacts associated with the construction and operation of Exploratory Works components on Snowy 2.0 has been assessed in detail in the Groundwater Assessment in Appendix N of the EIS. This includes an assessment (including numerical modelling) of regional impacts on known sensitive receivers, including the Yarrangobilly Caves. The assessment determined that the caves are highly unlikely to be impacted by the Exploratory Works due to low permeability rocks, local groundwater recharge supporting the caves, and the distance to the caves from the proposed exploratory tunnel. Ongoing monitoring at the caves and will be described in a Surface and Groundwater Monitoring Plan.

5.8.3 Subaqueous emplacement

One submission raised concerns regarding the disposal of tunnel spoil, including the excavated material to contain pyrites and other oxidisable minerals that may impact water quality of the Yarrangobilly River and Talbingo Reservoir, noting that subaqueous emplacement of waste rock is inappropriate if there is a risk of acid formation.

Section 2.5.4 of the EIS describes the approach to subaqueous emplacement of excavated rock. The EIS describes the process for testing of excavated rock for establishing acid generating material. Material that is acid generating (ie reactive) will not be placed with Talbingo Reservoir, unless it can be established that the risk of acid formation is low or that there is sufficient neutralizing capacity in the surrounding excavated rock. This process would be described in the Excavated Rock Management Plan.

One submission sought clarification on whether subaqueous placement of 50,000m^3 within Talbingo Reservoir is a realistic possibility, and what the ultimate potential for subaqueous placement for the full Snowy Hydro 2.0 project may be.

The Feasibility Study (Snowy Hydro 2017) identified significant storage capacity in Talbingo Reservoir, well in excess of the trial placement volume of 50,000 m^3, and the volume of up 750,000 m^3 that could be subaqueously emplaced as part of Exploratory Works for which approval is sought in the Exploratory Works EIS. Further, there is significant capacity in Talbingo Reservoir to emplace excavated material for the broader Snowy 2.0 project; however this would be subject to detailed assessment as part of the Main Works EIS.

5.9 Transport

One submission raised that issue of transport of limestone to the project area for use in the rock emplacement area, and questions the source of the limestone and whether traffic movements have been assessed for in the order of 58,000 m^3.

The volume of limestone required for the eastern emplacement area will depend on multiple factors including the volume of PAF material identified during tunnelling and the volume of excavated material identified as suitable for subaqueous placement. Therefore the total quantity of limestone required may vary. The estimate provided in the Excavated Rock Emplacement Area Assessment (Appendix K to the EIS) was based on the full capacity of the emplacement area being used and as a permanent landform using the limestone as a passive management technique.

The traffic volumes used for the traffic and transport assessment (Appendix Q of the EIS) were estimated based on predicted quantities of materials and equipment required for Exploratory Works. As stated in Section 5.6.4 of the EIS, the impact of additional traffic volumes generated by Exploratory Works on the external road network will not lead to any noticeable change in the existing roadway level of service performance standard for the affected roads.

As discussed in Section 3.2 of this RTS, the eastern emplacement area is now a temporarily stockpile with active management, the volumes of limestone required will be substantially less. This will result in a lower volume of traffic transporting limestone from sources outside KNP.

5.10 Social and economic

One submission raised a number of matters regarding the economic assessment for the Exploratory Works, stating it should be revised to comply with international best practice by including full pricing of environmental resources (ecosystem services, biodiversity, water, social and recreational values, etc) and the use of time-declining discount rates as used by the OECD. The discount rate currently stipulated under NSW Treasury Guidelines is 7%, which is strongly at odds with the prevailing 2-3% government bond rate. International best practice by OECD, Stern Report on climate change and others is to use time-declining discount rates.

The economic assessment used a cost benefit analysis framework in keeping with best practice. Where material environmental impacts were identified by specialist assessments these were valued in dollar terms and included in the cost benefit analysis.

As identified in this submission, the economic assessment used the discount rate specified by NSW Treasury Guidelines, which was considered appropriate for a project being assessed under the NSW environmental planning and assessment regime.

Notwithstanding, it is incorrect to say that it is international best practice to use a declining (or low) discount rate - refer to European Commissions (2014) *Guide to Cost-Benefit Analysis of Investment Projects: Economic appraisal tool for Cohesion Policy 2014-2020*. As identified by Harrison, M. 2010, *Valuing the Future: the social discount rate in cost-benefit analysis*, Visiting Researcher Paper, Productivity Commission, Canberra, the marginal return to private capital in Australia over the past four decades, has averaged almost 9% real. Market rates reflect the opportunity cost of investing in public projects, and there is no case for allocating resources to low return investments when higher returns are available. Using an artificially low discount rate for project evaluation can make future generations worse off.

CHAPTER 6

RESPONSE TO COMMUNITY SUBMISSIONS

6 Response to community submissions

6.1 Overview of responses

As discussed in Section 2.2, the most common matters raised in the community submissions were classified as 'social and economic' which included public access to recreational areas (particularly the Talbingo spillway), economic impacts to Talbingo township and the adequacy of baseline surveys for the recreational user impact assessment. Other key matters raised included the level of stakeholder engagement, the approvals process, project justification and consideration of alternatives. The community submissions also raised transport, biodiversity, the project description, land, water, heritage, environmental management and mitigation, KNP and other matters.

This section summarises community submissions received and provides responses. The section is structured to present matters in order of how frequently they were raised by community submissions.

6.2 Social and economic

Social and economic matters were raised in 44 (94%) of the community submissions. These are addressed in the sections below.

6.2.1 Public access to recreational areas

Public access to recreational areas was raised in 77% of community submissions – predominately with regard to restrictions to public access at the Talbingo spillway and Talbingo boat ramp. Several submissions proposed alternative barge access options to avoid restricting access to these areas. Some submissions also recommended additional recreational facilities are established to mitigate impacts to public access to recreational areas.

Snowy Hydro acknowledges community concerns from restricted public access to the Talbingo spillway and boat ramp and, in response, additional measures are proposed to further mitigate impacts of restricted access to the spillway and boat ramp. These include:

- provision of pontoons for the mooring of boats to the north of the boat ramp;
- provision of 'beach' area immediately south of boat ramp;
- provision a swimming pontoon off the 'beach' area;
- provision of an exclusive swimming area around the 'beach' area; and
- provision of picnic facilities and amenities at 'beach' area including picnic tables and BBQs.

The design and assessment of the proposed additional recreational facilities at Talbingo boat ramp are provided in Section 3.3.

Subsequent to the publication of the Exploratory Works for Snowy 2.0 EIS, it has been determined that construction access to the entire spillway is required during the project, requiring its closure to the public.

Occasional temporary access restrictions may apply to the boat ramp. As stated in Section 2.9.3(ii) of the EIS, the boat ramp will be used intermittently only, primarily at the start of Exploratory Works. During use the boat ramp will be closed to the public. This will be for periods of typically one to two hours. The following peak visitor use periods will be avoided:

- for the duration of Exploratory Works 7am–9am on weekends and weekdays on school holidays between October and April; and
- all day during the Christmas and Easter holiday periods.

Any restrictions to the boat ramp access and the timetable for operation of the barge will be communicated to reservoir users online and by signage posted near Tumut 3 power station.

In the long-term, it is expected that the Exploratory Works will provide benefits of improved public access to recreational areas from implementation of the measures listed above and once full access to the Talbingo spillway and Talbingo boat ramp is reinstated.

6.2.2 Economic impacts to Talbingo township

Economic impacts on Talbingo township were raised in 47% of community submissions. Several submissions suggested that the Exploratory Works are likely to have a negative impact on the Talbingo economy due to impacts on tourism from proposed restrictions to public access to recreational areas such as the Talbingo spillway and Talbingo boat ramp.

As noted in the section above, in response to community concerns from restricted public access to the Talbingo spillway and boat ramp and, additional measures are proposed to further mitigate impacts of the restricted access. These additional facilities will enable continued recreational use of Talbingo Reservoir and support tourism in the surrounding area including Talbingo township.

The economic benefits of undertaking Exploratory Works relate to reduced direct construction costs, reduced delays, and avoiding substantial investment in a technically infeasible project with the associated impacts. The Exploratory Works are also expected to provide economic benefits to the local region including Talbingo due to opportunities to supply non-labour inputs to Exploratory Works and in the form of expenditure of wages by labour. As stated in Section 5.7.3(iv) of the EIS the predicted direct and indirect jobs (from wage expenditure) to existing residents in the local economy are estimated at 37.

As stated in the EIS Section 5.7.3(v) the Exploratory Works are expected to directly impact only a low number of users of the KNP. The surrounding area also provides numerous alternative recreational areas with capacity to absorb the recreational users displaced by Exploratory Works.

6.2.3 Adequacy of surveys

Several community submissions raised the adequacy of the social impact assessment, recreational user impact assessment and surveys of Talbingo township; stating that surveys were undertaken over a short period, for a limited number of participants and not during the peak visitor periods. Some submissions also stated that the social assessment did not satisfactorily establish the baseline conditions for Talbingo township.

The social impact assessment and recreational user impact assessment were prepared in accordance with the SEARs for Exploratory Works, as well as relevant guidelines and policies, and in consultation with the relevant government agencies. The assessments were determined as adequate by the technical specialists that prepared the reports and through a review of the EIS by DPE enabling the EIS to be publicly exhibited.

Various surveys were completed and data sources reviewed as part of the above assessments, which enabled relevant and robust information on the baseline socio-economic conditions of the region including Talbingo township.

Surveys undertaken in Talbingo that informed the social impact assessment were:

- community surveys as part of two community consultation sessions held in Talbingo in November 2017;
- an interview with a tourist accommodation provider in March 2018;
- visitor surveys at Talbingo spillway and Talbingo Caravan Park on 31 March and 1 April (Easter Saturday and Sunday); and
- online surveys distributed to customers at Talbingo Caravan Park in April 2018.

Other information used to understand the baseline socio-economic conditions and recreational uses near Talbingo township were:

- traffic count data on Miles Franklin Drive collected between March and April 2018 (including the Easter Weekend); and
- Australian Bureau of Statistics (ABS) census data.

It is noted that recreational user surveys and traffic counts indicating boat use of Talbingo Reservoir were undertaken over a peak use period (Easter weekend 2018).

6.2.4 Impacts to services

Several submissions raised the impact of Exploratory Works on community services, including impacts to local emergency services such as Tumut Hospital. Similarly, several submissions questioned whether the requirements of the Exploratory Works workforce would exceed the capacity of existing communications infrastructure.

The project will not adversely impact community services or communications infrastructure. Whilst on swing, the construction workforce will be housed on site at Lobs Hole within an accommodation camp, with workers being driven in by bus from designated locations (eg airport).

As stated in Section 5.7.3(ii) of the Exploratory Works for Snowy 2.0 EIS the population changes in the local area will be negligible. Exploratory Works will comprise self-contained emergency services at Lobs Hole. Snowy Hydro also has these services at nearby Cabramurra. Similarly, communications infrastructure will be established to meet the service needs of Exploratory Works. This will include a submarine communications cable linking the accommodation camp and portal construction pad to Tumut 3 power station.

6.2.5 Workforce

The make-up of the Exploratory Works workforce was raised in several submissions. Some submissions suggested that opportunities for local employment would provide economic benefits to the local region. One submission raised concerns that the workforce would largely be sourced from outside the local region.

The Exploratory Works are expected to provide employment opportunities within the local region. The estimated workforce composition includes 40% workers sourced from the local region and over 95% of the workforce being Australian (see Section 2.11 of the EIS). The Exploratory Works will also provide 37 direct and indirect jobs (from wage expenditure) to existing residents in the local economy as discussed in Section 5.7.3(iv) of the EIS.

6.3 Engagement

The adequacy of the stakeholder engagement undertaken for the EIS was raised in 30% of community submissions. A number of submissions questioned the level of stakeholder engagement within the Talbingo township. Some submissions stated that the frequency, format and timing of engagement activities and materials provided were inadequate. Some submissions also stated that they did not feel the stakeholder engagement process provided trustworthy information.

Extensive community engagement was undertaken as part of the Exploratory Works project planning through the Snowy 2.0 community engagement program. Feedback from the community and government stakeholders was considered as part of the design process as discussed in Chapter 4 of the EIS.

Snowy Hydro has an existing highly effective communications program. In addition, an extensive program for stakeholder engagement has been developed for Snowy 2.0 as detailed in Chapter 4 of the EIS. This program included community engagement across a wide area and providing information in several formats including community information sessions, community information booklets and through the Snowy Hydro website.

As discussed in Section 4.4.2(i) of the EIS community consultation sessions were held in November 2017 and April to June 2018. Community consultation sessions were held in Tumut, Talbingo, Tumbarumba, Adaminaby, Cooma and Jindabyne. Community information booklets were also prepared and distributed to accompany the community consultation sessions. The community information booklets are provided in the social impact assessment (Appendix R of the EIS). Information on Snowy 2.0 and the Exploratory Works was also made available through the Snowy Hydro website. Community engagement was also undertaken as part of the social assessment and recreational user impact assessment through several surveys.

Community engagement activities relevant to Talbingo township carried out prior to the Exploratory Works for Snowy 2.0 EIS being submitted are listed below.

- two community consultation sessions held in Talbingo in November 2017;
- an interview with a tourist accommodation provider in March 2018;
- visitor surveys at Talbingo spillway and Talbingo Caravan Park on 31 March and 1 April 2018 (Easter Saturday and Sunday); and

- online surveys distributed to customers at Talbingo Caravan Park in April 2018.

As previously discussed in Chapter 1 additional community consultation has been undertaken in Talbingo township during the public exhibition of the EIS.

All community information sessions and materials have aimed to provide helpful and informative materials to the community. Information was provided in several formats and across a wide geographic area to reach as many community members as possible. No misleading information was provided during community engagement.

6.4 Approvals process

The approvals process was raised in 15 (32%) of the community submissions received. Matters raised are addressed in the sections below.

6.4.1 Adequacy of the EIS

The adequacy of the Exploratory Works for Snowy 2.0 EIS was raised in several community submissions.

The Exploratory Works for Snowy 2.0 EIS was prepared in accordance with the SEARs for Exploratory Works, as well as relevant guidelines and policies, and in consultation with the relevant government agencies. The EIS including all technical studies was subject to adequacy review by the DPE and relevant government departments.

As per the EIS certification page, the EIS provided all available information relevant to the environmental assessment of Exploratory Works and no information contained in the EIS was false or misleading.

6.4.2 Staged approvals process

The appropriateness of a staged approvals process was raised in several community submissions. It was contended that the Exploratory Works stage of the project should not be assessed separate to an application for all other stages and elements of Snowy 2.0.

The staged approvals process for Snowy 2.0 is consistent with NSW planning laws.

In NSW, staged applications for SSI projects are common practice and consistent with the requirements for SSI stated in Division 5.2 of the EP&A Act.

On 7 March 2018 the NSW Minister for Planning declared Snowy 2.0 to be CSSI and thereby confirmed that a staged SSI application process as an appropriate approvals pathway for Snowy 2.0. As a component of Snowy 2.0, the Exploratory Works is declared to be CSSI for the purposes of the EP&A Act. Therefore, the application for Exploratory Works as a first stage of Snowy 2.0 with later stages of the project to be assessed in separate applications is permissible in accordance with Division 5.2 of the EP&A Act.

6.4.3 Development within KNP

Several community submissions contended that the project should not be approved due to its location within the KNP, as development within a national park is unacceptable.

Snowy Hydro is committed to maintaining its excellent environmental track record of work within the KNP. This is demonstrated through the high level of engagement achieved with NPWS through the design and planning of Exploratory Works.

Development of Exploratory Works within the KNP is permissible in accordance with the SHC Act provided minor amendments are made to enable an extension to the Snowy Park Lease.

The environmental management framework and responsibilities for Exploratory Works within KNP are clearly set out in Chapter 6 of the EIS. Snowy Hydro is committed to ongoing consultation with NPWS regarding Exploratory Works and Snowy 2.0, including the decommissioning and rehabilitation of Exploratory Works and the development of appropriate offsets for predicted impacts to biodiversity and recreational users.

6.4.4 Public exhibition

Concerns on the length of the EIS exhibition period and EIS accessibility were raised in 11% of community submissions. Several submissions stated that community members in remote areas with limited internet access struggled to download and access the EIS files.

The EIS exhibition period was consistent with the requirements stated in Schedule 1, Division 2, Clause 12 of the EP&A Act that prescribe the minimum public exhibition period for an SSI project EIS as 28 days.

Significant effort was invested in providing the EIS in a form that was accessible to all stakeholders.

The EIS was made available electronically on the DPE major projects website, as well as via the Snowy Hydro website. The EIS was also made available in hard copy at several locations for the entire exhibition period. The locations where hard copies were made available are listed in Section 8.3 of this report.

As described in Section 8.3, this included the development of an online publicly accessible web portal summary for the EIS.

The web portal was designed to summarise the EIS in an innovative way by presenting information in an interactive and accessible format. The provision of the EIS web portal was a new and innovative method for presenting environmental impact assessment documents in NSW and is testament to Snowy Hydro's efforts to go above and beyond to make information accessible to stakeholders.

6.5 Project need

The project need was raised as a concern in 11 (23%) of the community submissions. Matters raised are addressed in the sections below.

6.5.1 Alternative and options considered

Several community submissions questioned the consideration of alternatives to the Exploratory Works and Snowy 2.0. Several submissions questioned why projects other than Snowy 2.0 had not been considered, including alternative technologies and sites.

As discussed in Section 7.2.1, Snowy 2.0 will provide energy security and reliability to the NSW energy system and the NEM. The NSW energy system (and broader NEM) is facing major and unprecedented challenges through rising energy costs, deterioration in energy system security and reliability, and a transition in the generation mix away from coal-fired, dispatchable, base-load power to intermittent renewable wind and solar power (also known as variable renewable energy or VRE, meaning energy sources that are non-dispatchable and fluctuating in nature like solar and wind). The principal drivers of these challenges are:

- a requirement for replacement capacity due to the retirement of base-load coal-fired power stations (eg proposed retirement of Liddell power station in 2022);
- reducing costs of intermittent renewable generation; and
- carbon emission reduction policies, including the *NSW Climate Change Policy Framework* and *NSW Renewable Energy Action Plan*.

The growth of renewable generation from wind and solar across the NEM has displaced some traditional coal-fired generating capacity, leading to reduced capacity to respond to network disturbances. This means the power system is less secure during some operating conditions, which has led to system blackouts (the most recent notable example occurred in South Australia in September 2016). In this regard, the *Independent Review into the Future Security of the National Electricity Market - Blueprint for the Future* (Finkel et al 2017) (also known as the Finkel review) concluded that a secure power system is a necessary condition for a reliable supply of electricity to consumers and recommended options for improving security, including large scale pumped hydro-electric storage.

As stated in Section 1.3.3 of the EIS, Snowy 2.0 would provide energy security and reliability to the NSW energy system and the NEM through its energy storage capacity and quick-start dispatchable generation delivery. The strategic need for Snowy 2.0 is due to its potential to play a key role in helping NSW and the broader NEM achieve energy system reliability and security with relatively low costs and emissions.

The EIS provided consideration to the do nothing alternative to Exploratory Works in Section 1.4.2. The Exploratory Works are considered justified as they will enable Snowy 2.0 to provide timely security and reliability to the NEM whilst meeting high standards for quality, safety, efficiency and the environment.

In relation to consideration of alternative technologies or alternative projects, Section 1.3.3 of the EIS provides information on the benefits that would be provided by the pumped hydro energy storage technology used in Snowy 2.0. In particular, Snowy 2.0 would have high full cycle energy efficiency, a long lifespan and would provide a massive 350,000 MWh of energy storage. These benefits are considered to justify the use of pumped hydro energy storage over other energy storage technologies.

The site chosen for Snowy 2.0 is considered to be the optimal location for the project as it utilises two existing reservoirs and would be integrated within the existing Snowy Scheme. By using existing water storages Snowy 2.0 would minimise the project's environmental footprint (by avoiding building new dams) and subsequently reduce the project costs. By integrating Snowy 2.0 within the existing Snowy Scheme the project will benefit from being able to utilise the existing mature management systems and technology being used across the Snowy Scheme. There are very clear advantages over establishing the project elsewhere including increased project certainty, cost and efficiency.

6.5.2 Planning policies

One submission argued that Snowy 2.0 and Exploratory Works are not consistent with the objectives of the NSW renewable energy action plan due to the Commonwealth ownership of Snowy Hydro.

The Snowy 2.0 and Exploratory Works are consistent with the objectives of the NSW renewable energy action plan.

As stated in Section 3.2.1(iii) of the EIS, the NSW Renewable Energy Action Plan positions NSW to increase the use of energy from renewable sources at least cost to the energy customer and with maximum benefits to NSW.

While NSW is well-placed to meet the State's current energy needs, major traditional energy generators will reach the end of their lives and are likely to be retired over the coming decades. This has the potential to lead to energy supply shortfalls and rising prices for consumers. Reliable, affordable energy is fundamental to the future economic well-being of NSW. With the planned retirement of a substantial proportion of existing generation capacity, there is an unavoidable need to provide replacement generating capacity and improve energy security.

Snowy 2.0, with its 2,000 MW of electricity generation and quick-start capabilities for delivery of about 175 hours of storage (350,000 MWh), is well-positioned to ensure the reliable and secure electricity needed for NSW's continued economic strength.

6.6 Transport

Matters related to transport were raised in 15 (32%) of the community submissions. These matters are addressed below.

6.6.1 Miles Franklin Drive

Traffic impacts to Miles Franklin Drive were most commonly raised in community submissions. Concerns included the predicted volume of heavy traffic on Miles Franklin Drive, safety impacts to other road users, such as walkers and cyclists, and impacts to the road condition due to heavy vehicle traffic.

The traffic and transport assessment presented in Appendix Q of the EIS concluded that the impact of additional traffic volumes generated by Exploratory Works on Miles Franklin Drive not lead to any noticeable change in the existing roadway level of service performance standard. The maximum peak hour volume observed along Miles Franklin Drive was less than 60, which is significantly less than the environmental goal of 300 (refer to *RMS Guide to Traffic Generation Developments* (2002)).

The construction period for Exploratory Works is approximately 34 months (ie close to 3 years). Construction inputs will be required across this construction period and will be transported to site progressively. Importantly, the primary haulage route to site will be via Link Road and Lobs Hole Road not Miles Franklin Drive. During peak construction the highest number of peak hourly deliveries to site will be 44 two-way truck movements. These volumes include the required construction inputs (eg materials such as aggregates) with the majority of these vehicles travelling via Lobs Hole Ravine Road.

6.6.2 Adequacy of assessment

The adequacy of the traffic impact assessment was raised in several submissions. Aspects raised were predicted traffic volumes, safety impacts on road users and impacts of traffic generated by the Exploratory Works on the condition of existing roads.

The traffic and transport assessment presented in Appendix Q of the EIS considered additional traffic volumes generated by Exploratory Works, safety impacts on road users and impacts to the condition of existing roads.

The traffic and transport assessment concluded that the impact of additional traffic volumes generated by Exploratory Works on the external road network would not lead to any noticeable change in the existing roadway level of service performance standards on the affected roads. Therefore, impacts to road users and road safety will not exceed the existing road performance standards. Mitigation measures were proposed to manage the impacts of Exploratory Works on the condition of existing road including the preparation of a road dilapidation report prior to and then following the construction of Exploratory Works.

6.6.3 Impacts on road maintenance

One submission raised concerns regarding the impacts of traffic from Exploratory Works on the condition of road surfaces in general and questioned whether pavement repairs would be paid for by the proponent.

A road dilapidation report will be prepared for roads accessed by Exploratory Works heavy vehicles prior to construction and submitted to the relevant road authority. This will determine the existing condition of the road network in the project area.

Following construction, a subsequent road dilapidation report will be prepared for the same roads to determine any damage that may have resulted from the project.

As per the commitments made in Section 5.6.4 of the EIS, Snowy Hydro will mitigate any impacts to road surfaces caused by the project's construction traffic.

6.6.4 Public access

Access to the road network during Exploratory Works was raised in several community submissions. One submission questioned whether access to Buddong Falls would still be available during closure of the Talbingo boat ramp or spillway. Another submission questioned whether closure of the spillway will prohibit movement of cattle on the road.

As discussed earlier in Section 3.3 access to Talbingo spillway will be closed to the public during Exploratory Works. Public access to the spillway will be restricted from the intersection of Spillway Road and will not prevent traffic travelling west of Tumut 3 power station. Public access to other areas west of Tumut 3 power station, including Buddong Falls will remain open to the public. Public access to areas west of Tumut 3 power station may be temporarily affected by road upgrade works on Spillway Road. All impacts to traffic access due to the upgrade works on Spillway Road will be temporary only and will be managed in accordance with a traffic management plan prepared prior to works.

6.7 Biodiversity

Matters related to biodiversity were raised in five (11%) of the community submissions. These matters are addressed in the sections below.

6.7.1 Threatened terrestrial fauna

Impacts of the Exploratory Works to the threatened Smoky Mouse, Booroolong Frog and Eastern Bent-wing Bats were raised in two community submissions.

Impacts to threatened terrestrial fauna were discussed in Section 5.1 of the EIS. The biodiversity assessment was undertaken in accordance with the requirements of the *Biodiversity Conservation Act 2016* (BC Act) and *Biodiversity Assessment Method* (OEH 2017) and was provided as Appendix F of the EIS.

Nineteen species of threatened fauna were identified as having potential to occur within the project area based on background research. Ten threatened fauna species were recorded during targeted surveys within or adjacent to the project area; five ecosystem credit species and five species credit species (as defined under the BAM). The five ecosystem credit species included Smoky Mouse and Booroolong Frog. Numerous design changes and measures were adopted through the design process to avoid and minimise impacts to threatened species and their habitats including Smoky Mouse and Booroolong Frog.

Under the BAM, many species of bats are considered ecosystem credit species. Their habitat can be reliably predicted to occur based on plant community types (PCTs) and targeted surveys are not required for these species, as is the case for many species of forest bats. Breeding habitat for the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) is a species credit species, and if impacted, surveys are required. A number of adits in Lobs Hole are known to provide roosting habitat for the species; however, no breeding has been recorded in these adits.

Residual impacts following implementation of avoidance and minimisation measures include:

- clearing of 95 ha of native vegetation; and
- impacts to 70.64 ha of threatened species habitat for five species credit species.

Direct impacts on 2.04 ha of Booroolong Frog habitat and 0.2 ha of Smoky Mouse habitat require offsetting. Other threatened species habitat requiring offsets is given in Section 5.1 of the EIS.

As discussed in Section 5.1.4(i) of the EIS, offsets will be provided in line with the biodiversity offset framework. Extensive consultation has been undertaken with NPWS and OEH, and other government agencies regarding the biodiversity offset for Exploratory Works. Throughout this process, the objective of the offset framework has been to ensure any offsets payment from the Exploratory Works achieve best value for the management of biodiversity values in KNP. As discussed earlier in Section 6.1 the biodiversity offset strategy has now been finalised and is provided in Appendix B.

6.7.2 Aquatic ecology

Impacts from subaqueous excavated material placement, dredging works during barge ramp establishment and sediment and erosion impacts to water quality during construction to aquatic ecology were raised in three community submissions.

Reference was provided to the threatened Murray Crayfish, Trout Cod, Murray Cod, Silver Perch and Macquarie Perch and their habitats. Potential impacts to Rainbow and Brown Trout were also raised.

An aquatic ecology assessment was prepared and provided in Appendix G of the EIS. The aquatic ecology assessment concluded that impacts would not significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within assemblages of biota beyond the small affected areas. Most impacts would be temporary. The potential for impacts to the threatened Murray crayfish in Talbingo Reservoir through subaqueous placement of excavated material was identified through the response to submissions and was addressed in Section 4.3.1.

Targeted surveys will be undertaken to identify Murray crayfish habitat, occurrence and frequency in Talbingo Reservoir. The survey results will be used to develop likelihood of occurrence mapping within Talbingo Reservoir. Once likelihood of occurrence mapping is completed the subaqueous placement program and placement areas will be reviewed and measures to avoid and minimise impacts to Murray crayfish will be taken to inform revised assessments of significance which will be provided to DPI Fisheries and DPE. Any residual impacts to Murray crayfish will be offset in consultation with DPI Fisheries.

6.7.3 Biodiversity offsets

One submission requested further details of the biodiversity offset strategy including information on the purpose of the offsets, consultation on the offsets strategy, details of the in-principle approach and what the benefits would be to the KNP.

As discussed in Section 6.1 and 8.7, the biodiversity offset strategy has now been completed and is provided in Appendix B. This contains information on the matters raised in the submission.

6.8 Heritage

Matters related to heritage were raised in five (11%) of the community submissions. These matters are addressed in the sections below.

6.8.1 Impacts to historic heritage items

Several submissions requested additional consideration of historic heritage items including the Ravine Public School, Ravine Village, a brick kiln, several sites associated with historic mining at Lobs Hole, a stone irrigation channel and historic fruit trees.

An assessment of all the historic heritage items referenced by the community submissions formed part of the historic heritage assessment provided in Appendix P of the EIS.

It is noted that the assessments of significance and proposed mitigation measures for historic heritage items have been updated and are included in Appendix C of this report.

6.8.2 Engagement with Aboriginal groups

The adequacy of consultation with the Ngarigo Aboriginal Corporation was raised in one community submission. This submission stated that representatives of the Ngarigo Aboriginal Corporation made contact with Snowy Hydro regarding the consultation process but were not subsequently involved. The submission also objected to Exploratory Works and stated that the works would impact on areas that have cultural significance to the Ngarigo people.

This comment is noted. However, the ACHA was undertaken in accordance with the process of Aboriginal community consultation in the OEH *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010). This process was documented in Section 4.4.2v of the engagement chapter (Chapter 4) of the Exploratory Works EIS (EMM 2018).

6.9 Project elements

Matters related to the project elements were raised in five (11%) of the community submissions. These matters are addressed in the sections below.

6.9.1 Excavated rock management

The design of the rock emplacement areas, the volume of rock to be placed in each emplacement, contingency measures for subaqueous placement and the appropriateness of emplacement areas within the KNP were raised in several community submissions.

One submission stated that the design of the east emplacement area did not adequately consider the design of Mine Trail Road

Section 2.5.1 of the EIS provides information on the proposed excavated rock management.

Up to 750,000 m^3 of bulk materials will be excavated during Exploratory Works. Subject to geochemical testing of the rock material, excavated rock will either be re-used, temporarily placed on land or placed subaqueously within Talbingo Reservoir.

As described in Section 4.2.1, any materials within the eastern emplacement area that remain following the completion of Exploratory Works (and not subaqueously emplaced) will be removed from KNP.

This material will be removed from KNP to nominated location(s) within 5 years of completion of Exploratory Works. The temporary stockpile will continue to be managed as per the design and descriptions within the EIS until all material is removed. Lick Hole Gully will then be rehabilitated.

The eastern and western emplacement areas will be rehabilitated following removal of all material. Lick Hole Gully will be resinated as part of the rehabilitation works. Geomorphic and ecological characterisation of Lick Hole Gully will be undertaken prior to disturbance to record the existing conditions and values of Lick Hole Gully. The rehabilitation approach will seek to create a physically stable landform that reinstates or improves the existing values.

6.9.2 Exploratory tunnel

One submission questioned whether the exploratory tunnel could reasonably be referred to as 'exploratory'.

The exploratory tunnel is referred to as exploratory as its purpose is to optimise the location, design and construction method of the power station cavern. An exploratory tunnel of approximately 3.1 km is proposed to provide access to the location of the largest cavern (the cavern for the machine hall) for the underground power station. This will enable horizontal drilling at the cavern location and help gain a greater understanding of underground conditions at the cavern location which, in turn, is required to finalise the design of Snowy 2.0.

The use of the exploratory tunnel as the main access tunnel for Snowy 2.0 would be subject to a separate approval process. The construction of the power station cavern is not proposed as part of Exploratory Works and would be subject to a separate application for Snowy 2.0.

6.10 Land

Matters related to land were raised in three (6%) of the community submissions. These matters are addressed in the sections below.

6.10.1 Geodiversity

Impacts to geodiversity, specifically tufa deposits and fossiliferous rock, were raised in several community submissions.

No construction is proposed near vertical walls/cliff faces where tufa deposits usually occur. The additional tufa features identified in the Lobs Hole area (Cave Gully and Lick Hole tufa deposits) are in avoidance areas of the project and will not be disturbed as part of Exploratory Works.

Potential impacts to geodiversity, including tufa deposits and fossiliferous rock, were outlined in the Geodiversity Assessment memo dated 13 July which was included in Appendix I of the EIS. Since the publication of the EIS, required road improvements to allow for safe and reliable access have been identified.

These works may require some removal of fossiliferous rock and rock streams in some sections of Lobs Hole Ravine Road, and construction works and associated increased heavy vehicle traffic may result in indirect vibration impacts. As discussed in Section 3.5 expert assessments of significance were prepared to assess the proposed road designs which found that the proposed impacts were acceptable.

Management and mitigation measures will be implemented to minimise potential impacts. The measures outlined in the additional geodiversity studies have been added to the environmental management measures to be implemented and are within Chapter 8 of this RTS.

6.10.2 Adequacy of assessment

A number of submissions raised the final landform remaining after the project. These submissions stated that the eastern emplacement area proposed as a permanent landform would not be an appropriate feature within the KNP. Several submissions also stated that the proposed rehabilitation would not meet the land use goals of the KNP.

As noted in Section 3.2.1, the project design has been revised so that excavated materials placed in the on-land emplacement areas would be removed following completion of the Exploratory Works. Should any excavated material not be able to be placed in either the on-land emplacement areas or within the reservoir via subaqueous placement it will be removed for disposal to an approved location outside of the KNP.

The final decommissioning and rehabilitation outcomes for the Exploratory Works are yet to be determined and are subject to ongoing consultation with NPWS. The final landform and rehabilitation outcomes to be achieved following Exploratory Works will be designed to meet the land use goals of NPWS and the KNP PoM.

6.11 Water

Matters related to water were raised in ten (21%) of the community submissions. These matters are addressed in the sections below.

6.11.1 Impacts to water quality

Impacts to the water quality of Yarrangobilly River, Talbingo Reservoir and downstream waters were the most frequently raised matter in the community submissions. The main concern was the discharge of treated waste water to Talbingo Reservoir and subaqueous placement of excavated material within Talbingo Reservoir.

The surface water assessment was prepared in accordance with the SEARs for Exploratory Works, as well as relevant guidelines and policies, and in consultation with the relevant government agencies, and included consideration of water quality impacts from treated sewage discharge and subaqueous placement of excavated material. This surface water assessment was revised as part of this RTS to respond to matters raised during the exhibition of the EIS (see Appendix E for revised assessment).

All wastewater will be treated in a wastewater (sewage) treatment plant prior to being discharged into Talbingo Reservoir. Table 6.1 below summarises the controls that will be implemented to manage the impacts of wastewater (as described in Section 6.8.3 of the surface water assessment (Appendix E).

Table 6.1 Water management controls: waste water management system

Control	Description
WM_7.1	Waste water from the accommodation camp will be reticulated to a waste water treatment plant via a sewer system. The sewer system will be designed to restrict stormwater ingress into the waste water system.

Table 6.1 Water management controls: waste water management system

Control	Description
WM_7.2	Water efficient fittings will be used to minimise waste water loads.
WM_7.3	Low phosphorus products are to be used for washing activities controlled by site management (ie laundry services and mess hall) and encouraged (via education) for general use.
WM_7.4	The waste water storage system will include emergency storage of untreated waste water. The storage volume will be calculated at detailed design based on analysis of response times from regional waste management contractors to provide emergency trucking and offsite disposal options.
WM_7.5	A waste water treatment plant will meet the required water quality specifications provided in Table 4.4 of this RTS (Table 6.25 of the SWA) .
WM_7.6	Treated waste water will be disposed to Talbingo Reservoir via the controlled discharge pipeline.

Treated wastewater (including treated sewage) will be discharged into the Yarrangobilly River arm of Talbingo Reservoir. During drought conditions, this discharge may result in the near-field concentration of phosphorus exceeding the trigger value for physical and chemical stressors that is provided in ANZECC 2000. No measurable near-field impacts are expected during non-drought conditions due to higher river inflows and in the greater reservoir due to the high inflows associated with the existing operation of the Snowy Scheme.

As stated in Section 5.4.3(viii) of the EIS, potential impacts associated with controlled discharge to Talbingo Reservoir would be managed through the appropriate treatment of process water prior to discharge. Accordingly, no material receiving water impacts are expected.

A range of measures would be implemented to avoid or minimise water quality impacts from subaqueous placement of excavated material. Examples of these measures are provided below.

The transport barge will include watertight bulwarks and excavated material will be kept wet during transport to and on barges for placement. The discharge barge will be fitted with a receiving well and discharge pipe. These barge fittings will minimise mobility of sediments during transport and reduce potential impacts to water quality. Several environmental controls are embedded into the method for transport and placement, including a silt curtain surrounding the works. Based on this method, adverse impacts to surface water quality are not expected.

Further, only suitable (non-reactive) material will be placed in the reservoir. This, combined with the method of placement, reduces the risk of adverse impacts at the reservoir bed which are low and localised. Elevated turbidity is expected near the reservoir bed during placement because of disturbance, but this is expected to be localised and short term due to the very low currents and intermittent nature of placement activities (ie individual barge loads will be separated in time). As impacts are localised, regional impacts to downstream water users of Talbingo Reservoir (Tumut River catchment) are not expected. Continual monitoring will be implemented to ensure settlement of both coarse and fine sediments after placement.

6.11.2 Flooding

Several community submissions raised flooding. One expressed concern that the assessment of flooding impacts did not consider climate change impacts on future flooding; another stated concern regarding flooding risks to construction materials placed at Talbingo spillway in the laydown area for the proposed Talbingo barge ramp.

Flood potential was considered during the design of the project with avoidance of flood prone land wherever possible.

The surface water assessment was prepared in accordance with the SEARs for Exploratory Works, as well as relevant guidelines and policies, and in consultation with the relevant government agencies, and included six flood levels, which reflect a variety of climate scenarios.

The bridge crossings over the Yarrangobilly River and Wallaces Creek, parts of the western emplacement area, and the water management basin for the portal construction pad will unavoidably need to be constructed on flood prone land. Flood modelling concluded that the predicted changes to flood regimes will not impact infrastructure or items of heritage significance.

In relation to flood risks to construction materials, the CEMP and supporting construction water management plan will provide measures for managing surface water and flood risks during construction, including requirements for the placement and storage of construction equipment and materials.

6.11.3 Site water management

One community submission questioned the site water management of the east emplacement area. Specifically the submission questioned the length of time the ephemeral basin is likely to hold water and what the subsequent impacts to vegetation would be.

The eastern emplacement area will be a modified landform whilst material is stockpiled temporarily. The ephemeral basin will be vegetated with species that are suitable for ephemeral conditions and, therefore, vegetation will not be 'adversely' impacted due to the length of time that water is held in the basin.

The active water management of this area has been described in Section 6.3 of this RTS.

As described in Section 4.2.1, any materials within the eastern emplacement area that remain following the completion of Exploratory Works (and not subaqueously emplaced) will be removed from KNP.

This material will be removed from KNP to nominated location(s) within 5 years of completion of Exploratory Works. The temporary stockpile will continue to be managed as per the design and descriptions within the EIS until all material is removed. Lick Hole Gully will then be rehabilitated.

The water management approach for the eastern emplacement seeks to:

- manage sediment laden runoff during establishment;
- manage ARD risks, through the selective placement of PAF material with AC material or acid neutralising material;
- capture and divert runoff from Lick Hole Gully around the emplacement;
- promote infiltration of direct rainfall onto the emplacement; and
- actively manage water quality risks by capturing all seepage from the emplacement. Captured water will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant at the portal construction pad.

The eastern and western emplacement areas will be rehabilitated following removal of all material. Lick Hole Gully will be resinated as part of the rehabilitation works. Geomorphic and ecological characterisation of Lick Hole Gully will be undertaken prior to disturbance to record the existing conditions and values of Lick Hole Gully. The rehabilitation approach will seek to create a physically stable landform that reinstates or improves the existing values.

6.12 Environmental management and mitigation

Five (11%) of the community submissions sought further information or had concerns regarding the Exploratory Works framework for environmental management and mitigation. Matters raised were: what authority would monitor the environmental performance of Exploratory Works; the committed funding for the Exploratory Works environmental management and mitigations; and whether funding would be available for additional community services.

Snowy Hydro as the owner and proponent of Exploratory Works will be responsible for overseeing the construction of Exploratory Works to ensure they are delivered in line with the conditions of approval, if granted. Full account of the cost of any environmental and mitigation for the Exploratory Works will be taken account of in the capital works budget for the project. The community benefits of the project are discussed in Chapter 5.7 of the EIS.

Public authorities that will be involved in monitoring the environmental performance of Exploratory Works following approval include DPE, with jurisdiction over the conditions of approval, the EPA, with responsibility for the EPL and NPWS with responsibility for monitoring compliance with the management plan for KNP (SMP EMP).

Snowy Hydro will appoint a construction contractor(s) to carry out Exploratory Works in compliance with the EIS and the conditions of approval, if granted. This includes the implementation of a CEMP and all other activities relevant to managing construction impacts. All mitigation measures identified in the EIS will be captured by the CEMP and associated sub-plans, as well as in standalone strategies associated with long-term management commitments.

Snowy Hydro will be responsible for obtaining and implementing the requirements of the EPL, including relevant monitoring requirements and auditing of contractor(s) activities. Following the construction of Exploratory Works all ongoing maintenance and management of permanent infrastructure will be the responsibility of Snowy Hydro and will be incorporated into relevant operating management procedures where required. The conditions of consent will include requirements for environmental performance monitoring and regular reporting as well as independent environmental auditing.

As well as the requirements set out in the EIS and the conditions of approval Snowy Hydro will also need to manage Exploratory Works in accordance with their existing obligations within the KNP. Snowy Hydro currently manages around 6,400 ha of land within KNP. As part of Snowy Hydro's occupation of KNP, all work is carried out in accordance with a management plan. The environmental management framework proposed for Exploratory Works will complement the existing SMP EMP and ensure existing objectives continue to be met.

6.13 Kosciuszko National Park

Three (6%) of the community submissions raised concerns about impacts to the KNP; specifically; that the Exploratory Works would be inconsistent with the land use objectives of the KNP; and that the Exploratory Works would degrade the values of the KNP.

The project has been designed to minimise adverse impact on the KNP. An assessment of the impacts of Exploratory Works on the KNP and its values was provided in Section 5.2 of the EIS. The Exploratory Works will include short term and temporary impacts to KNP in addition to residual impacts that need to be considered as part of a longer term management strategy. Management of impacts within KNP will be aligned to the land use objectives identified in the KNP PoM administered by NPWS. Snowy Hydro has been working with NPWS to ensure opportunities for contributory measures are identified where needed.

The final decommissioning and rehabilitation outcomes for the Exploratory Works are yet to be determined and are subject to ongoing consultation with NPWS. The final landform and rehabilitation outcomes to be achieved following Exploratory Works will be designed to meet the land use goals of NPWS and the KNP PoM.

6.14 Other

6.14.1 Public safety

Three (6%) of the community submissions raised concerns regarding public safety and barge access on Talbingo Reservoir.

Interactions between the public and barges on Talbingo Reservoir have been considered further following submission of the EIS. Based on feedback from RMS (Maritime) Talbingo spillway will be closed to the public for the duration of Exploratory Works to limit interactions between the public and the barge access infrastructure.

Measures relating to the safe operation of barges on Talbingo Reservoir will be detailed prior to deployment of barges in the CEMP and relevant management plans.

6.14.2 Noise

Three (6%) of the community submissions raised concerns about noise impacts on Talbingo township, particularly road traffic noise from vehicle movements on Miles Franklin Drive.

Road traffic noise from Miles Franklin Drive was assessed as part of the noise and vibration assessment (Section 5.8.1 and Appendix T of the EIS). Road traffic noise levels will satisfy the relevant Road Noise Policy (RNP) assessment requirements on all roads, including for road traffic noise on Miles Franklin Drive.

Construction noise was also assessed for Exploratory Works for all sensitive receivers, including Talbingo township. The assessment results indicate that construction noise levels satisfy noise management levels (NMLs), in accordance with the *Interim Construction Noise Guideline (ICNG)*(DECC 2009), at all assessment locations with the exception of one property on Miles Franklin Drive (R2) where a 2 dB and 5 dB

exceedance is predicted for the standard out of hours period during calm and adverse weather conditions, respectively.

The predicted exceedance at location R2 is generated by Spillway Road construction activities (near Talbingo). Road construction for this activity is scheduled to occur for six weeks. Therefore the exceedance of NMLs at R2 will occur for less than six weeks.

Snowy Hydro will notify noise affected residents (including R2) of the scheduled construction works and the potential noise impacts. Noise monitoring during the initial stages of construction will be undertaken to determine if actual construction noise levels are above NMLs. If NMLs are exceeded, the proponent will:

- identify feasible and reasonable mitigation measures that reduce construction noise levels to at or below NMLs;
- limit road construction for areas where there are noise affected residents to ICNG standard hours only; or
- enter into a negotiated agreement with the property owners.

6.14.3 Cumulative impacts

There are no known current development applications within the project area, based on review of publically available databases. Therefore, no additional impacts are expected to occur due to the cumulative effects of other nearby projects beyond those contemplated in the EIS.

An assessment overview of the assessment on the impacts of Exploratory Works on the KNP is given in Section 8.13. All technical environmental assessments completed as part of the EIS have considered the existing baseline conditions of the project area which include the existing impacts of other projects in the area, including the original Snowy Scheme, Snowy Hydro cloud seeding and Mt Selwyn Ski Resort, where relevant. This included the biodiversity, bushfire and flooding assessments.

CHAPTER 7

UPDATED PROJECT DESCRIPTION

7 Updated project description

This chapter describes the elements, construction activities and method for Exploratory Works. The works described in this chapter form the basis of the environmental impact assessment undertaken and are based on the concept design for Exploratory Works. The final design will be the outcome of the detailed design process. In some cases, detailed design of the infrastructure may vary from the concept design assessed within the EIS. For example, the actual size, space and specific use of locations within the disturbance footprint may change as part of the detailed design and construction planning. However, the nature of such variations would be generally consistent with the concept design and its environmental outcomes. Any final design will be within the parameters of the impacts assessed in the EIS, and if not, a modification would need to be sought to the approval, if granted.

7.1 Exploratory Works elements

7.1.1 Overview

Exploratory Works will involve construction of an exploratory tunnel to enable exploratory drilling and provide a greater understanding of the underground conditions at the Snowy 2.0 power station cavern. Several supporting elements will be required to facilitate the construction of the exploratory tunnel, and these are summarised in Table 7.1 and shown in Figure 7.1.

An avoidance footprint has been defined for Exploratory Works and is shown in Figure 7.1 and several other figures throughout this section. The avoidance footprint is defined as all areas excluded from clearing and ground disturbance due to sensitive environmental and heritage constraints.

A disturbance footprint has been defined for Exploratory Works and is shown in Figure 7.1 and several other figures throughout this section. The Exploratory Works disturbance footprint is defined as all areas subject to clearing and ground disturbance.

Table 7.1 Summary of Exploratory Works elements

Project element	Overview
Exploratory tunnel	An exploratory tunnel approximately 3.1 km long
Horizontal and test drilling	Horizontal and other test drilling, investigations and analysis at the proposed cavern location and associated areas, and around the portal construction pad, access roads and excavated rock emplacement areas all within the disturbance footprint
Portal construction pad	An entrance structure at the western end of the exploratory tunnel, and an area for infrastructure, equipment and activities required for the construction of the exploratory tunnel
Accommodation camp	A fully serviced accommodation camp catering for a construction workforce of up to 152 personnel
Access roads	26 km of road upgrades and approximately 2 km of new roads to facilitate access to the project area
Barge access	The construction and use of two new barge ramps on Talbingo Reservoir at the existing Talbingo Spillway and Middle Bay
Supporting infrastructure	Provision of power, communications, water and waste infrastructure and services to the construction sites
Excavated rock management	Up to 750,000 m^3 of bulked excavated rock to be placed within temporary emplacement areas within Lobs Hole and/or subaqueous placement within Talbingo Reservoir subject to management and monitoring

Table 7.1 Summary of Exploratory Works elements

Project element	Overview
Revegetation and rehabilitation	Post-construction revegetation and rehabilitation of areas disturbed by construction elements and activities, including removal and decommissioning of construction facilities (should Snowy 2.0 not proceed).

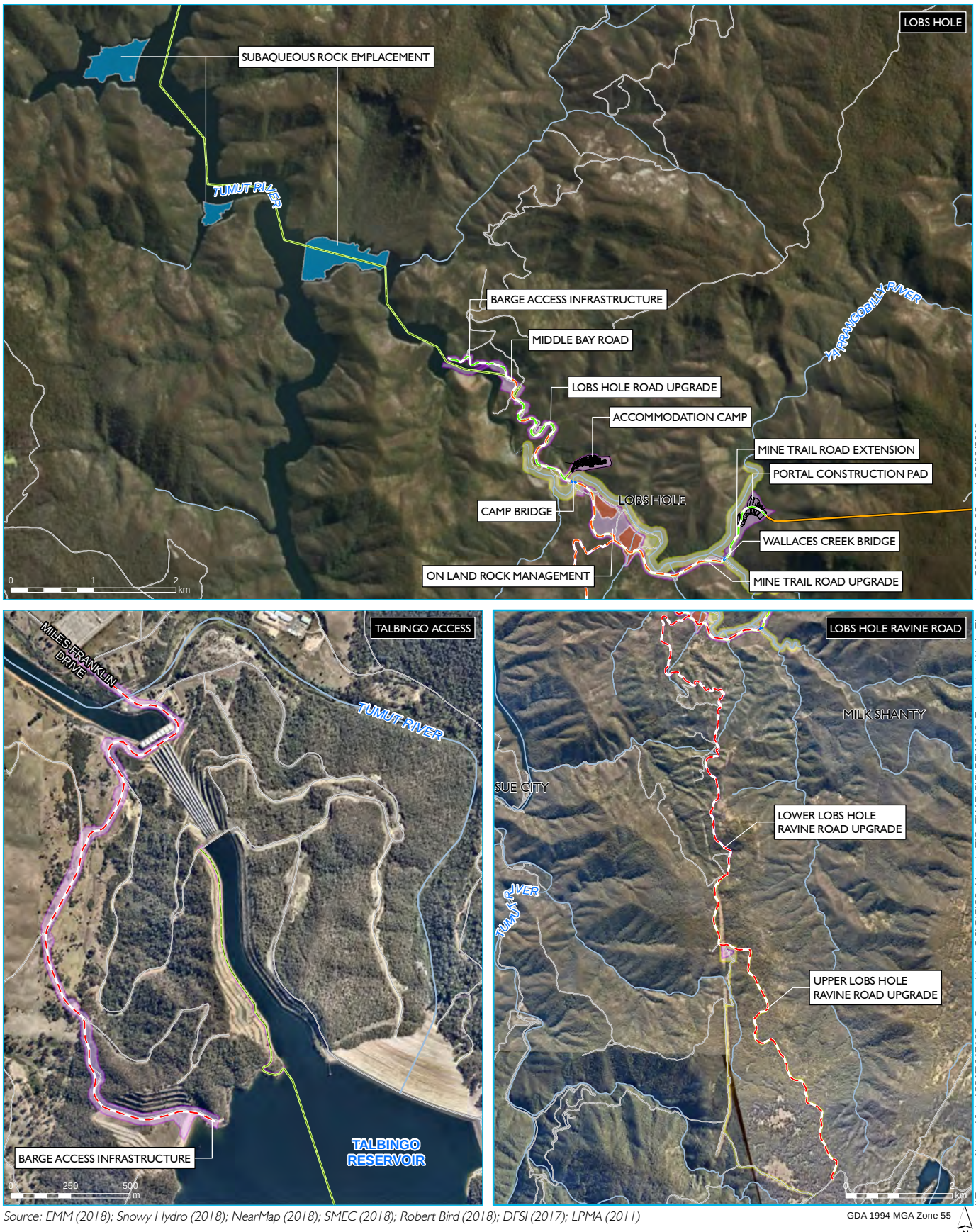
As mentioned in Chapter 1 of the EIS, Exploratory Works is a separate application to the construction and operation of Snowy 2.0. Therefore, decisions regarding whether Snowy 2.0 proceeds are separate to Exploratory Works. Should Snowy 2.0 not proceed, constructed elements of Exploratory Works would be decommissioned and rehabilitated in consultation with NPWS, ensuring the values of KNP are maintained.

7.1.2 Guiding design principles and approach

Given the complexities of Exploratory Works, its scale and schedule, an iterative and risk-based design and assessment process was adopted in identifying and assessing potential environmental impacts. This iterative process to develop the design and construction methods for Exploratory Works was undertaken with the guiding principles of avoiding and minimising environmental impacts where possible. This EIS has been prepared with consideration of impacts commensurate with the levels of risk identified through the iterative design and assessment process.

The challenges for the design team included the need to develop solutions that balance the need for ensuring a safe working environment for the construction of Exploratory Works, including the safe movement of plant, equipment, materials and workforce across the site, with the need to preserve and protect the values of the KNP and the environmental constraints of the location. Throughout the design process, the objective was to identify and avoid sensitive locations, to minimise the construction footprint and maintain as much of the existing natural environment as is feasible. For this reason, Lobs Hole was selected as a works area because it has historically been subject to disturbance associated with the former town, grazing, cultivation and mining.

This means that the facilities and infrastructure proposed in this EIS are sufficient for Exploratory Works only, but if the main Snowy 2.0 project is approved to proceed, they may need to be augmented to accommodate further development for this purpose. For example the accommodation camp has been designed to accommodate the Exploratory Works workforce only and has been sited in a cleared area with low value vegetation.



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Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017); LPMA (2011)

GDA 1994 MGA Zone 55

N

KEY

- Exploratory tunnel
- Access road upgrade
- Access road extension
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Communications cable
- Local road or track
- Watercourse
- On land rock management
- Subaqueous excavated rock placement
- Disturbance footprint
- Avoidance footprint

Exploratory Works elements

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.1

snowy2.0

EMM creating opportunities

7.2 Exploratory tunnel

7.2.1 Purpose and location

The purpose of the exploratory tunnel is to optimise the location, design and construction method of the power station cavern. An exploratory tunnel of approximately 3.1 km is proposed to provide access to the location of the largest cavern (the cavern for the machine hall) for the underground power station. This will enable horizontal drilling at the cavern location and help gain a greater understanding of underground conditions at the cavern location which, in turn, is required to finalise the design of Snowy 2.0. A minor variation of an additional approximately 500 m may be required if the exploratory drilling indicates poor ground conditions in the nominated cavern location.

The exploratory tunnel is proposed in the north-east section of Lobs Hole and will extend in an east-west direction with the portal and portal construction pad to be outside the western end of the tunnel at a site east of the Yarrangobilly River and is shown on Figure 7.1.

7.2.2 Infrastructure and design

The exploratory tunnel will have a finished clearance of approximately 8 m by 8 m with a D-shaped cross section. The proposed tunnel cross-section is provided in Figure 7.2. The cross-section shape and dimensions are designed to allow two-lane traffic for the removal of excavated material along with ventilation and drainage of groundwater. Minor expansions (niches) within the tunnel will be required to allow for material crushing and turning bays during construction.

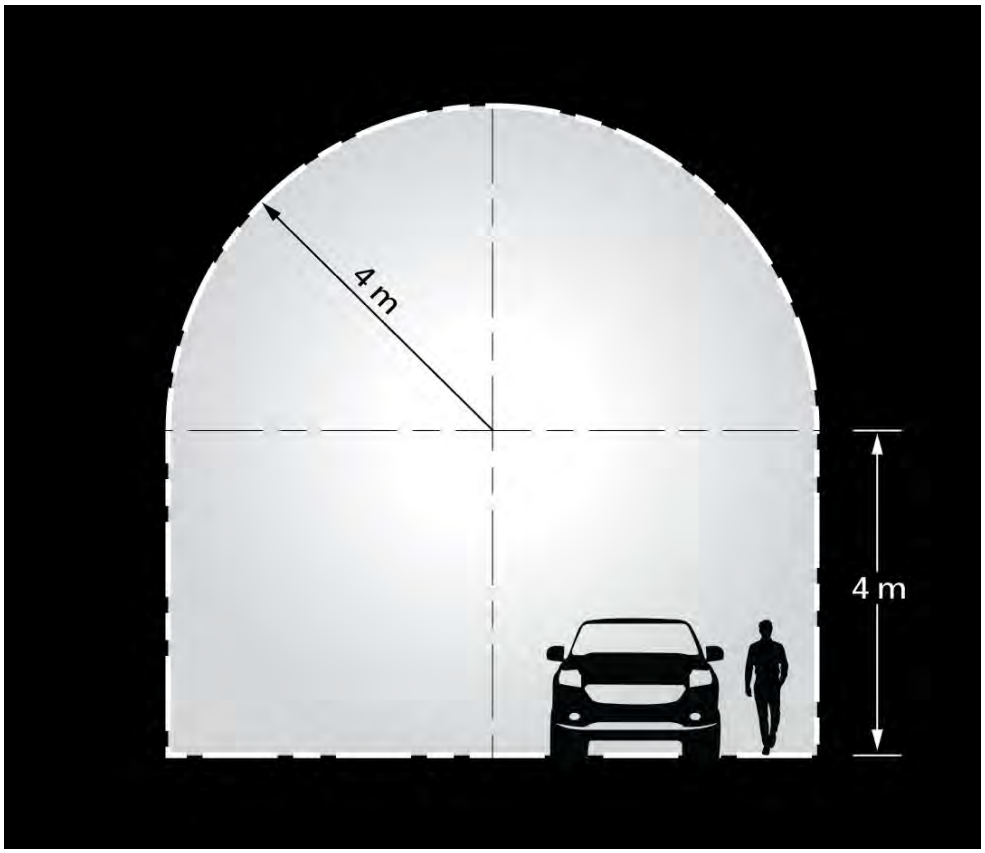


Figure 7.2 Exploratory tunnel cross section

The exploratory tunnel will have the following functions:

- plant, equipment and personnel access and egress to the cavern location to conduct geological testing;
- spoil removal;
- ventilation;
- routing of services; and
- dewatering.

Subject to obtaining the necessary approvals if Snowy 2.0 proceeds, the exploratory tunnel could be utilised to form the main access tunnel (MAT) to the underground power station for Snowy 2.0.

i Tunnel lining

The exploratory tunnel will be shotcrete-lined with permanent anchor support, and incorporate a groundwater management system.

ii Lighting and ventilation

The exploratory tunnel will have adequate lighting installed to enable workers to carry out work safely and effectively. Lighting will be designed in accordance with relevant tunnelling and construction standards. All underground work fronts will be ventilated. Ventilation will be designed in accordance with relevant design principles for underground ventilation systems.

iii Dewatering, treatment and disposal

Groundwater intersected during tunnelling will be contained and transferred to the portal for treatment and management. Construction pits with submersible pumps will be provided with interconnected hoses that discharge to the tunnelling affected water sedimentation pond at the tunnel portal. Areas identified during forward probing with the potential for high groundwater flows may require management through a detailed grouting program or similar.

iv Tunnel portal

The portal will provide a safe and stable entrance to the exploratory tunnel. The location of the tunnel portal is shown on Figure 7.3. The tunnel portal will be established at the western end of the exploratory tunnel and provide access and utilities to the exploratory tunnel during construction and operations. The portal will house diesel-generated power, communications, ventilation and water infrastructure. An example of a finished portal structure is shown in Photograph 2.1.

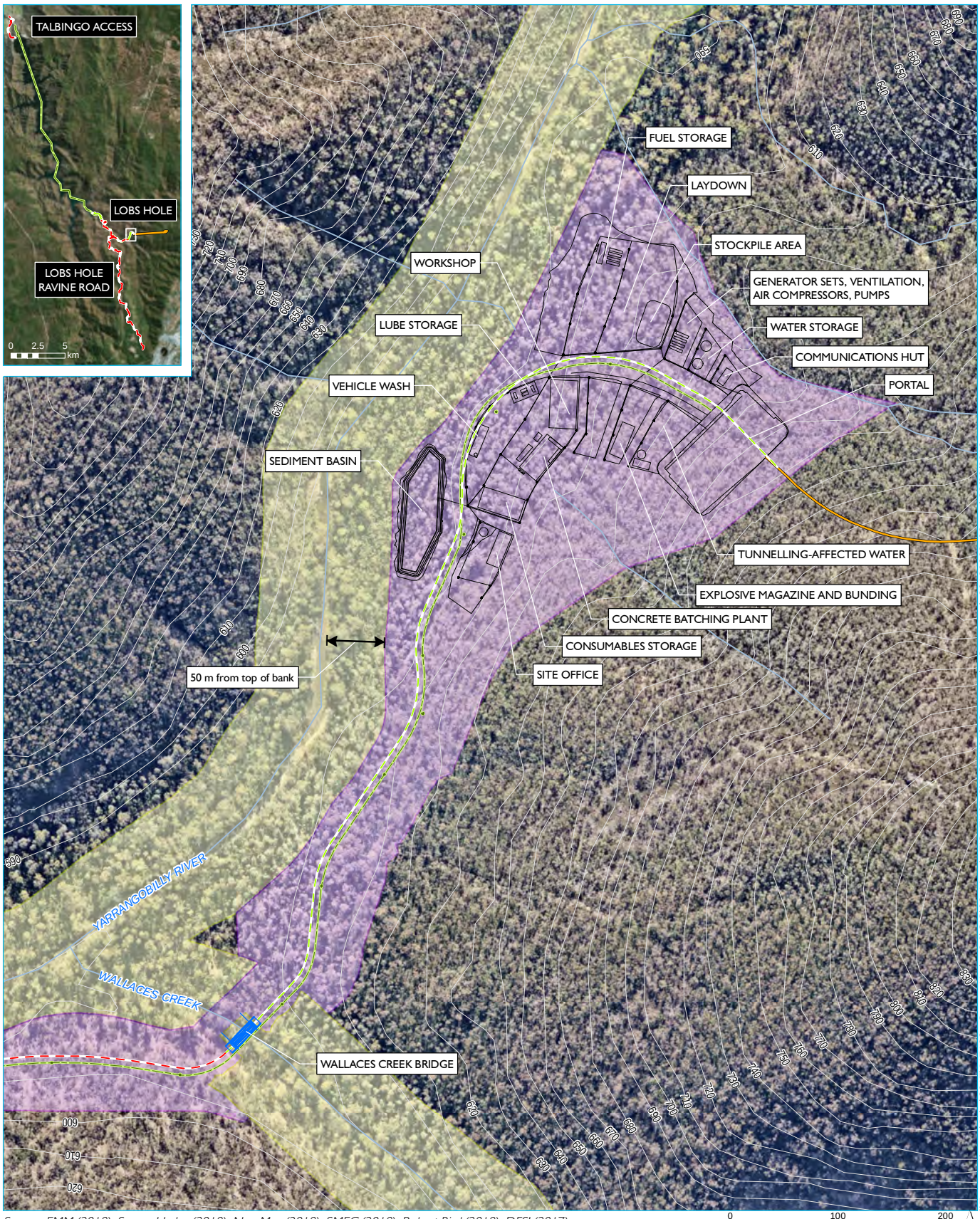
Photograph 7.1 Finished Tumut 2 power station tunnel portal

7.3 Portal construction pad

7.3.1 Purpose and location

A portal construction pad for the exploratory tunnel will provide a secure area for construction activities. Infrastructure at the portal construction pad will primarily support tunnelling activities and include a concrete batching plant (CBP) and associated stockpiles, site offices, maintenance workshops, construction support infrastructure, car parking and equipment laydown areas. A temporary excavated rock stockpile area is also required to stockpile material excavated during tunnel construction before its transfer to the larger excavated material management areas at Lobs Hole.

The portal construction pad will be excavated to provide a level construction area with a near vertical face for the construction of the portal and tunnelling. The layout of the portal construction pad is shown in Figure 7.3. The portal construction pad will be adjacent to the tunnel portal at the western end of the exploratory tunnel. The area required for the portal construction pad is approximately 100,000 m^2. A description of the key facilities and equipment to be sited at the portal construction pad is provided in this section.



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

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Portal construction pad conceptual layout
- Exploratory tunnel
- Communications cable
- Watercourse
- Contour (10m)
- Disturbance footprint
- Avoidance footprint

Conceptual layout – portal construction pad

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.3

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7.3.2 Infrastructure and design

i Site offices and workshops

A site office will provide the primary base for personnel and contractors working during construction. A dedicated workshop is also required for the servicing of heavy plant and equipment as well as pre-fabrication. The workshop will comprise a covered area of approximately 1,125 m^2. The indicative site office and workshop locations are shown in Figure 7.3.

ii Concrete batching plant

A CBP will be required to support the tunnel construction, tunnel shotcreting, portal construction and construction of footings, base slabs for structures and other applications that require pre-cast concrete segments or concrete cast in-situ. Stockpiles providing around two to three months of CBP feedstock (aggregate and sand) are expected to be needed, and will be stored within the portal construction pad footprint.

A CBP design capacity of 250 cubic metres (m^3) per day is expected to be sufficient to service the Exploratory Works construction schedule. There is also sufficient space to enable an increase in capacity of the CBP if required within the assessed footprint of the portal construction pad. The predicted total concrete production required for Exploratory Works is approximately 50,000 m^3.

iii Fuel storage facility

The main fuel storage facility for Exploratory Works will be north-west of the tunnel portal as shown in Figure 7.3. The fuel storage facility will have capacity to store approximately 275,000 litres (L) of fuel and have an area of around 122 m^2. Fuel storage facilities will also be provided at ancillary construction areas as described in Section 7.10.6.

Environmental controls will include:

- an asset protection zone (APZ) to minimise bushfire risks; and
- fully bunded enclosure to minimise the risks of spills and loss of containment.

iv Vehicle and equipment storage and maintenance

A laydown area for vehicle, equipment and materials storage will be established at the portal construction pad near the temporary excavated material stockpile. The laydown area will have an area of approximately 9,000 m^2. Engineering and manufacturing plant and materials will also be stored in the workshop which will be near the CBP. A vehicle and equipment wash down facility will also be established on the west side of the portal construction pad.

A dedicated covered area of approximately 800 m^2 is proposed for storage of consumables associated with the tunnelling and activities at the portal construction pad. The vehicle and equipment storage locations are provided in Figure 7.3.

Vehicle and equipment storage and maintenance will also be provided at ancillary construction areas as described in Section 7.10.6.

v Magazine (explosives)

To facilitate the drill and blast method for tunnel construction, an explosives magazine will be required, and will be near the tunnel portal at the portal construction pad. The location of the explosives magazine is provided in Figure 7.3. The magazine will be designed in accordance with relevant legislation, standards and codes of practice for the storage and handling of explosives in NSW. This will include the implementation of all required emergency, security and safety plans required by SafeWork NSW and under relevant legislation. To minimise hazards associated with the storage of explosives the magazine has a minimum setback distance of 18.11 m to nearby structures and vegetation.

vi Materials stockpiles

Materials stockpiles are required at the portal construction pad for temporary storage of building materials and excavated rock. These materials will be stockpiled at the CBP. A temporary excavated rock stockpile area is also required for material excavated during tunnel construction before its transfer to the larger excavated material management areas. The excavated rock will be transported by truck from the portal construction pad to the emplacement areas by road. Building materials may also be stored in this area as required.

7.3.3 Impact avoidance and minimisation

Key considerations of environmental impacts during the design of the portal construction pad included establishing a 50 m setback from the Yarrangobilly River to avoid impacts to riparian habitat from vegetation clearance and stormwater runoff. The arrangement of the portal construction area was designed to incorporate sufficient APZs without impacting the 50 m Yarrangobilly buffer.

7.4 Accommodation camp

7.4.1 Purpose and location

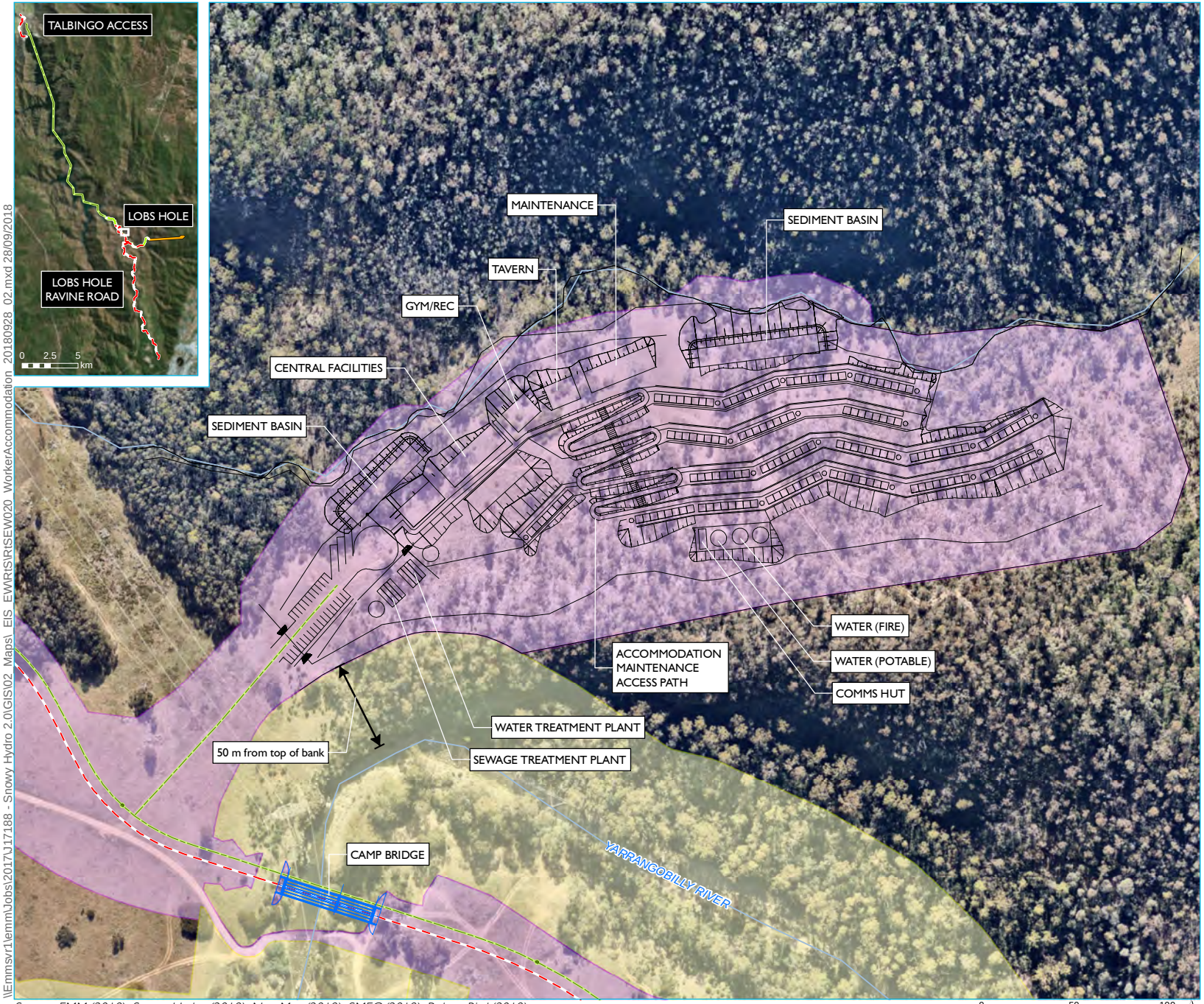
An accommodation camp will provide accommodation and supporting services for workers near the exploratory tunnel.

7.4.2 Infrastructure and design

The accommodation camp will comprise up to 152 single rooms with private ensuites. The accommodation camp layout includes ensuite rooms surrounding central facilities including a kitchen, gym, administration office, laundry, maintenance building, sewage and water treatment plants and parking that will service the Exploratory Works workforce. The conceptual layout of the accommodation camp is shown on Figure 7.4.

The accommodation camp will provide food and beverage services to the Exploratory Works workforce in the dedicated kitchen. Laundry facilities will be provided in the central facilities building. A gym and recreation facility will be provided for use by the workforce during stays at the accommodation camp.

Access to the accommodation camp will be via an access road connecting to the north side of Lobs Hole Road at Lobs Hole. Car and bus parking facilities will be provided for the workforce.



KEY

- Exploratory tunnel
- Access road upgrade
- Access road extension
- Permanent bridge
- Accommodation camp conceptual layout
- Communications cable
- Watercourse
- Disturbance footprint
- Avoidance footprint

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

0 50 100 m

GDA 1994 MGA Zone 55

N

Conceptual layout – accommodation camp

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.4

7.4.3 Impact avoidance and minimisation

Key considerations of environmental impacts during the design of the accommodation camp are listed below:

- siting the camp in an area largely devoid of vegetation with only small areas of low value vegetation remaining;
- establishing a 50 m setback from the Yarrangobilly River to avoid impacts to riparian habitat from vegetation clearance and stormwater runoff; and
- arranging the site layout so that adequate bushfire APZs can be established without impacting the 50 m Yarrangobilly River buffer.

7.5 Excavated rock management

7.5.1 Purpose and location

It is estimated that up to 750,000 m^3 of bulked materials will be excavated, mostly from the exploratory tunnel and portal construction pad with additional quantities from road upgrade works. Initial information suggests a small volume of tunnel rock may be potentially acid forming (PAF), requiring suitable management and design techniques for emplacement and disposal. Subject to geochemical testing of the rock material, excavated rock will either be re-used, placed on land or placed subaqueously within Talbingo Reservoir. The proposed on land and subaqueous placement areas are described further in this section.

A flow chart showing the proposed process for excavated rock management is provided in Figure 7.5. As shown in this figure excavated material will be managed for either re-use, on land or subaqueous placement.

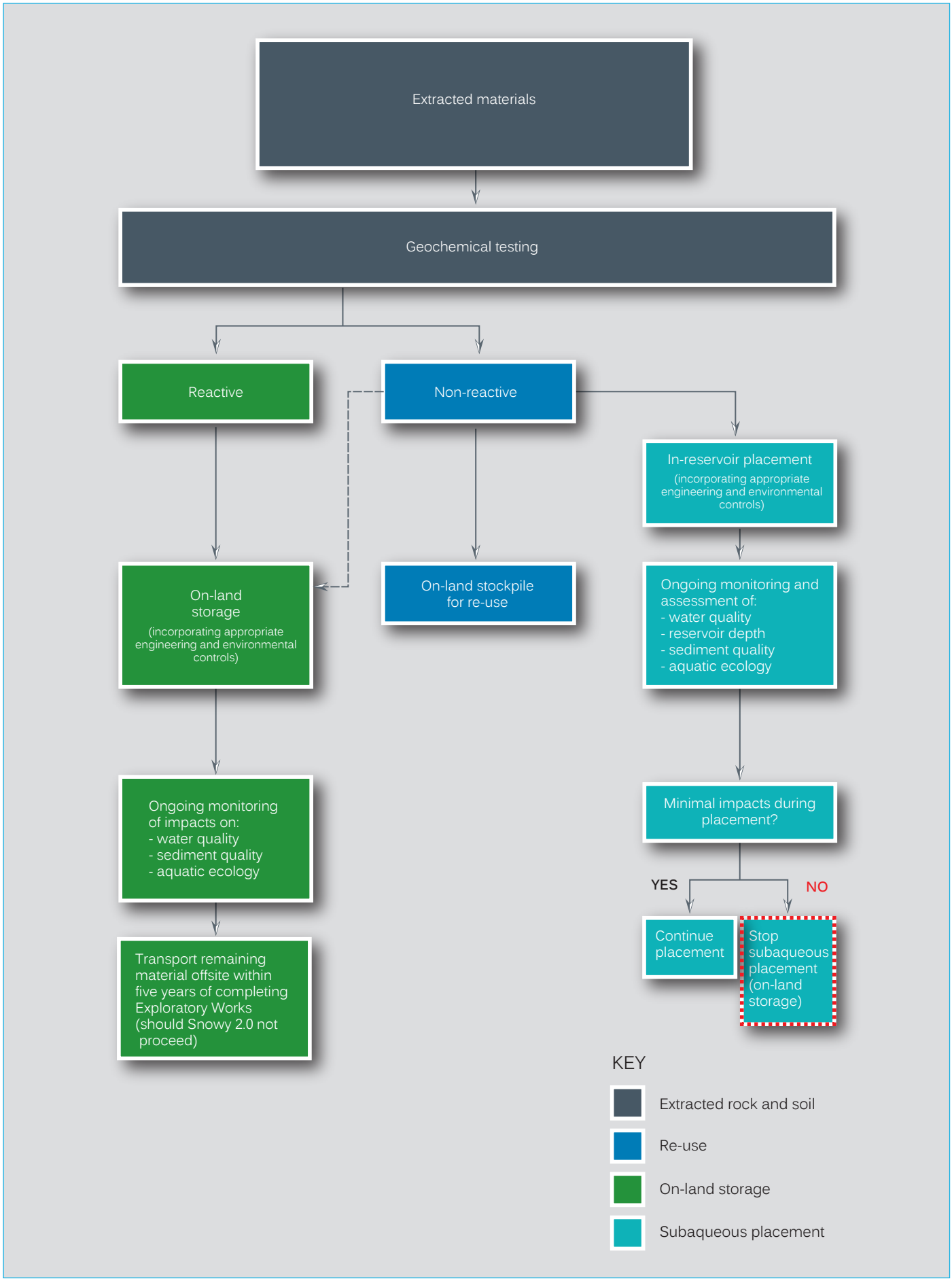
7.5.2 Re-use of materials

i Management

Excavated material identified as suitable for re-use will be re-used within the construction of Exploratory Works or made available to NPWS for road-base materials within KNP. Excavated material will be identified as suitable for re-use based on geochemical testing and particle size. It is expected that up to 40,000 m^3 of suitable excavated material will be made available to NPWS for use in road maintenance and upgrades. Transportation and re-use of materials by NPWS will be subject to a separate approvals process. Material identified as reactive and unsuitable for re-use will be managed as per the on land rock placement detailed in Section 7.5.3.

ii Storage

Excavated material identified as suitable for re-use will be placed in the western emplacement area. The western emplacement area is shown on Figure 7.6. All remaining material placed in this emplacement area will be removed following the completion of Exploratory Works.



Excavated rock management flow chart

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.5

7.5.3 On land rock placement

i Management

Excavated materials for on land placement will be placed in one of two temporary rock emplacement areas at Lobs Hole as described in Figure 7.5 and shown on Figure 7.6, the eastern and western emplacement areas. On land placement of excavated rock will be placed within one of the two on land emplacement areas for temporary storage through the duration of Exploratory Works. Following Exploratory Works the excavated material placed in the on land emplacement areas will be disposed of via one of the following options:

- Disposal with the Main Works excavated material – should Snowy 2.0 proceed, any excavated material from the on land emplacement areas will be disposed of with the excavated material from the Snowy 2.0 Main Works. This will involve either subaqueous placement within an existing reservoir or disposal to a suitable location outside the KNP. The placement of excavated material for Snowy 2.0 Main Works will be subject to further assessment and approvals.

- Disposal outside the KNP – if the main Snowy 2.0 project does not proceed, any excavated material not able to be re-used will be disposed of to a suitable location outside the KNP within five years of the completion of Exploratory Works subject to consultation with NPWS and further assessment and approvals.

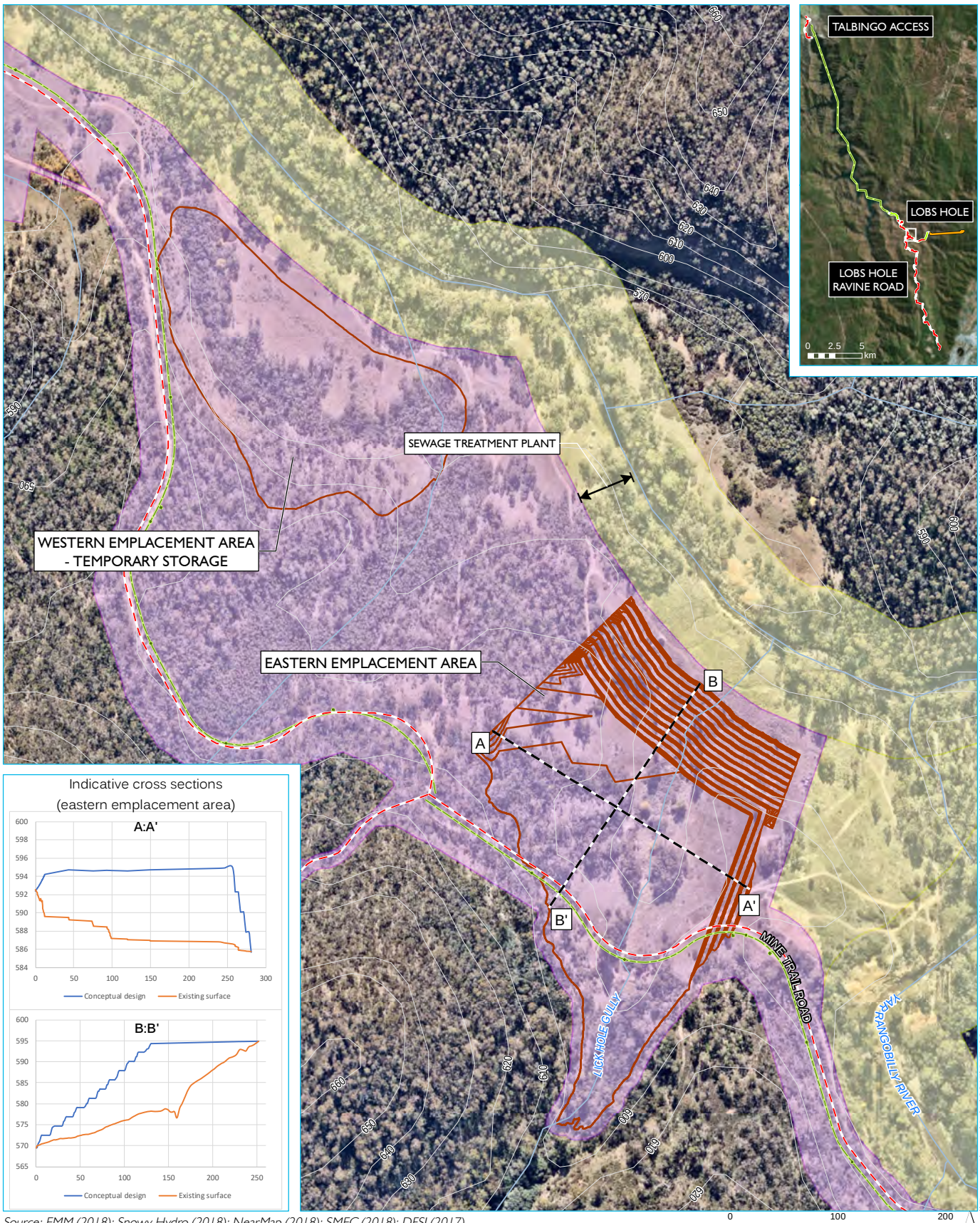
ii Eastern emplacement area

The eastern emplacement area is within Lick Hole Gully at Lobs Hole and is shown in Figure 7.6. This emplacement area will be a temporary landform and will be removed from the KNP following completion of Exploratory Works.

The emplacement area has a capacity of up to 600,000 m^3 for temporary storage of excavated material. The northern edge of the emplacement will be setback more than 50 m from the Yarrangobilly River.

a. Landform design

The eastern emplacement will be constructed within Lick Hole Gully. The landform will have a large ‘flat top’ at a level of 595 m AHD. The stockpile will interface with existing topography at the 595 m AHD contour along the western, southern and some portions of the eastern boundary. Benching is proposed along the northern and some portions of the eastern boundary. The benching will comprise 2 m lifts separated by 4 m benches. The benches will be top soiled and revegetated and will grade back towards the emplacement so any runoff from direct rainfall onto the benches and upslope lift will temporarily pond against the toe of the above lift prior to infiltration.



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

KEY

- Cross-section
- Exploratory tunnel
- Access road upgrade
- Access road extension
- Communications cable
- On land rock management
- Watercourse
- Contour (10m)
- Disturbance footprint
- Avoidance footprint

Conceptual layout – excavated material emplacement areas

Snowy 2.0
Resonse to Submissions
Exploratory Works
Figure 7.6

b. Geochemistry risks and management approach

Some geochemistry analysis of rock samples from a drill hole near the exploratory tunnel. Some rock samples identified that some material may be potentially acid forming (PAF), while other rock samples had excess acid neutralising capacity (ANC) and therefore have acid consuming (AC) potential (SGM environmental 2018).

To avoid the uncontrolled placement of PAF rock, excavated material will be geochemically characterised prior to placement. If any potentially acid forming material is encountered, it will be placed in a select area of the emplacement. The potential for acid rock drainage will be treated by placing and compacting layers of limestone (or other suitable AC material) between each rock and soil layer as required. The volume of limestone (or other suitable AC material) in each layer will be determined stoichiometrically so that the maximum potential acidity from the overlying layer of rock and soil is treated. This approach will neutralise AMD within the stockpile.

c. Water management approach

Water quality risks associated with emplacement seepage will be actively managed by capturing all seepage. Captured seepage (water) will be either irrigated to the emplacement (to promote evaporation losses) or treated in the process water treatment plant. Lick Hole Gully will be diverted around the emplacement to minimise the volume of emplacement seepage.

iii Western emplacement area

The western emplacement area will be used to store excavated materials suitable for re-use as described in Section 7.5.2. All remaining material placed in this emplacement area will be removed following the completion of Exploratory Works.

7.5.4 Subaqueous rock placement

Suitable excavated material will be placed within Talbingo Reservoir as part of Exploratory Works. An initial program of up to 50,000 m^3 will be carried out. The program will be implemented in a section of Talbingo Reservoir in accordance with a detailed management plan based on an engineering method informed through the materials' geochemistry and reservoir's characteristics. The purpose of the program is to confirm the suitability of the emplacement method for future excavated rock material from the remainder of the Exploratory Works program and construction of Snowy 2.0, should it proceed.

Should the initial phase show that there are minimal impacts to the reservoir from the subaqueous rock placement, the subaqueous rock placement program may be continued to include subaqueous placement of a greater proportion of excavated rock (ie up to 750,000 m^3) subject to further consultation with relevant authorities.

The rock for subaqueous placement will be taken from the excavated rock emplacement areas as described above. Testing of the excavated material would be conducted during excavation to assess geochemical properties. Any rock assessed as unsuitable for subaqueous placement based on the prior geochemical and leachability testing would be temporarily emplaced on-land and not used in the program (refer to Figure 7.5). Suitable (ie non-reactive material) would be stored at the on-land rock emplacement areas and then transported and loaded to a barge, for subaqueous placement.

All placement within the reservoir would occur within silt curtains and be subject to a detailed monitoring regime before, during, and after placement that will be included in the subaqueous rock trial management plan. Suitable placement areas have been identified for Exploratory Works and are described in the section below. Further detailed information is also provided in Appendix L of the EIS.

i Subaqueous rock placement areas

The selection of subaqueous rock placement locations considered several criteria including aquatic ecology, environmental and social considerations, available water depth, potential for resuspension, distance from load-out point in Middle Bay, Snowy Hydro operations and ability to implement environmental controls during placement. The following three potential locations for subaqueous rock placement have been identified:

- Plain Creek Bay;
- Cascade Bay; and
- Ravine Bay.

The indicative subaqueous rock placement areas are provided in Figure 7.7.

The initial phase will place up to 50,000 m^3 of excavated material within the Plain Creek Bay subaqueous rock placement area. Should the trial show that impacts to the reservoir from the subaqueous rock placement at Plain Creek Bay can be adequately managed, the subaqueous rock placement program may be expanded to include subaqueous placement at Cascade Bay and/or Ravine Bay.

ii Management and monitoring

A specific water quality monitoring program would be developed for subaqueous placement together with a management action plan. The following will be carefully monitored and assessed during the program:

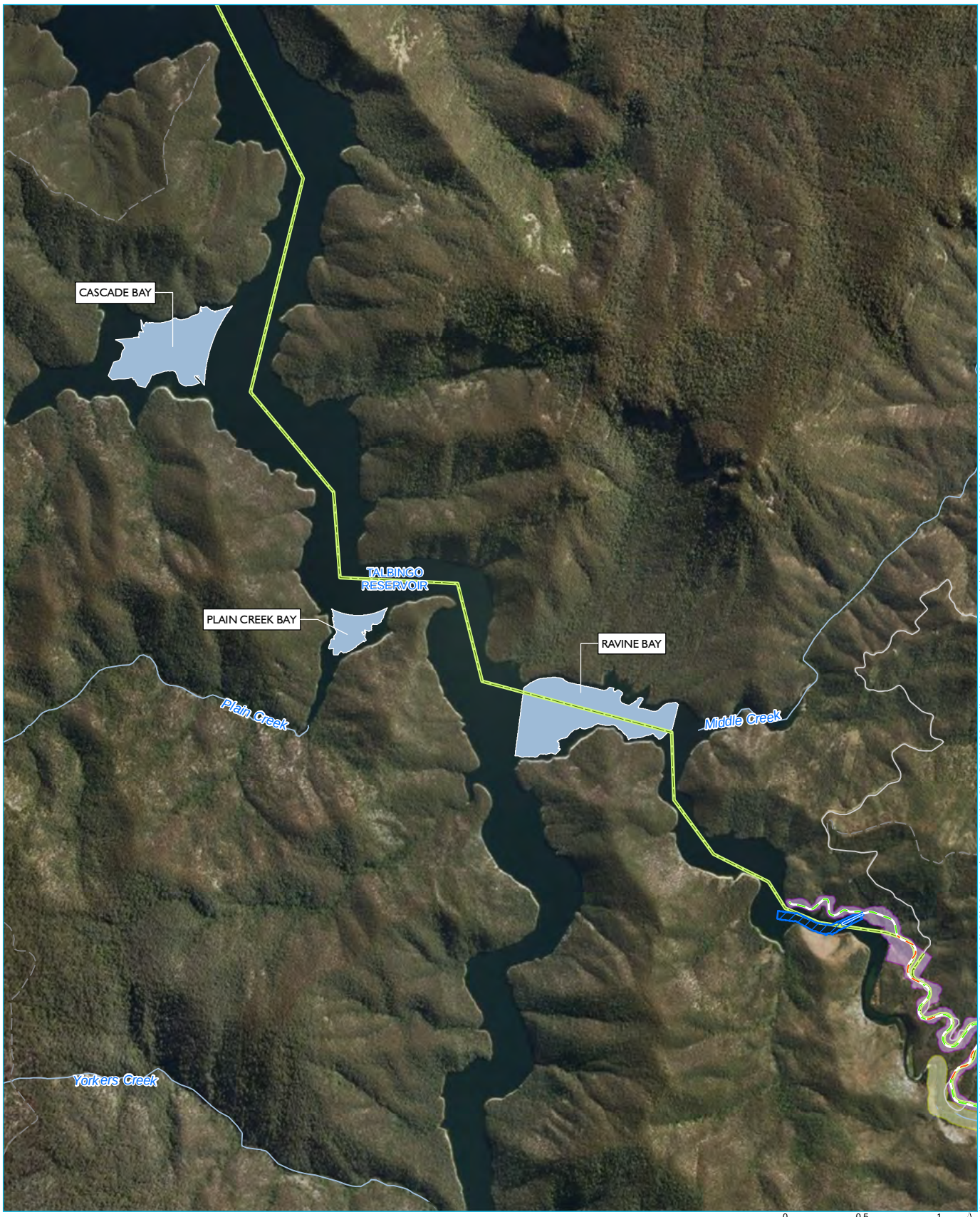
- water quality monitoring to establish the effectiveness of control measures during subaqueous placement;
- physical and chemical testing of excavated material every 5,000 m^3 before placement to assess the potential for geochemical reactivity; and
- the bathymetry of the subaqueous placement areas before and after placement.

The management, mitigation and monitoring measures would be refined following ongoing investigations. Mitigation measures to be implemented during the program are detailed in Chapter 6 and Appendix L of the EIS.

iii Management response

In the event that monitoring of the subaqueous rock placement identifies likely unacceptable environmental impacts, management responses will be executed. The management responses would include:

- investigate the issue;
- modify work practices if required; and
- stop placement if required.



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

0 0.5 1 km
GDA 1994 MGA Zone 55
N

KEY

- Access road upgrade
- Access road extension
- Communications cable
- Subaqueous rock placement area
- Major watercourse
- Local road
- Track
- Middle Bay barge access
- Disturbance area - barge infrastructure
- Disturbance footprint
- Avoidance footprint

Subaqueous excavated rock placement

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.7

snowy2.0

EMM creating opportunities

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iv Continuation of subaqueous rock placement

Should the initial phase show that there are minimal impacts to the reservoir from the subaqueous rock placement, the subaqueous rock placement program may be continued to include subaqueous placement of a greater proportion of suitable excavated material (ie over 50,000 m^3) subject to further consultation with relevant authorities.

7.6 Road access and transport

7.6.1 Purpose and location

Access and transport works are required to:

- provide for the transport of excavated material between the exploratory tunnel and the excavated rock emplacement areas;
- accommodate the transport of oversized loads as required; and
- facilitate the safe movement of plant, equipment, materials and construction workers onto and across the construction sites.

The access roads will be upgraded or established to provide access for a truck and dog trailer. The access road upgrades and establishment are provided in Figure 7.8.

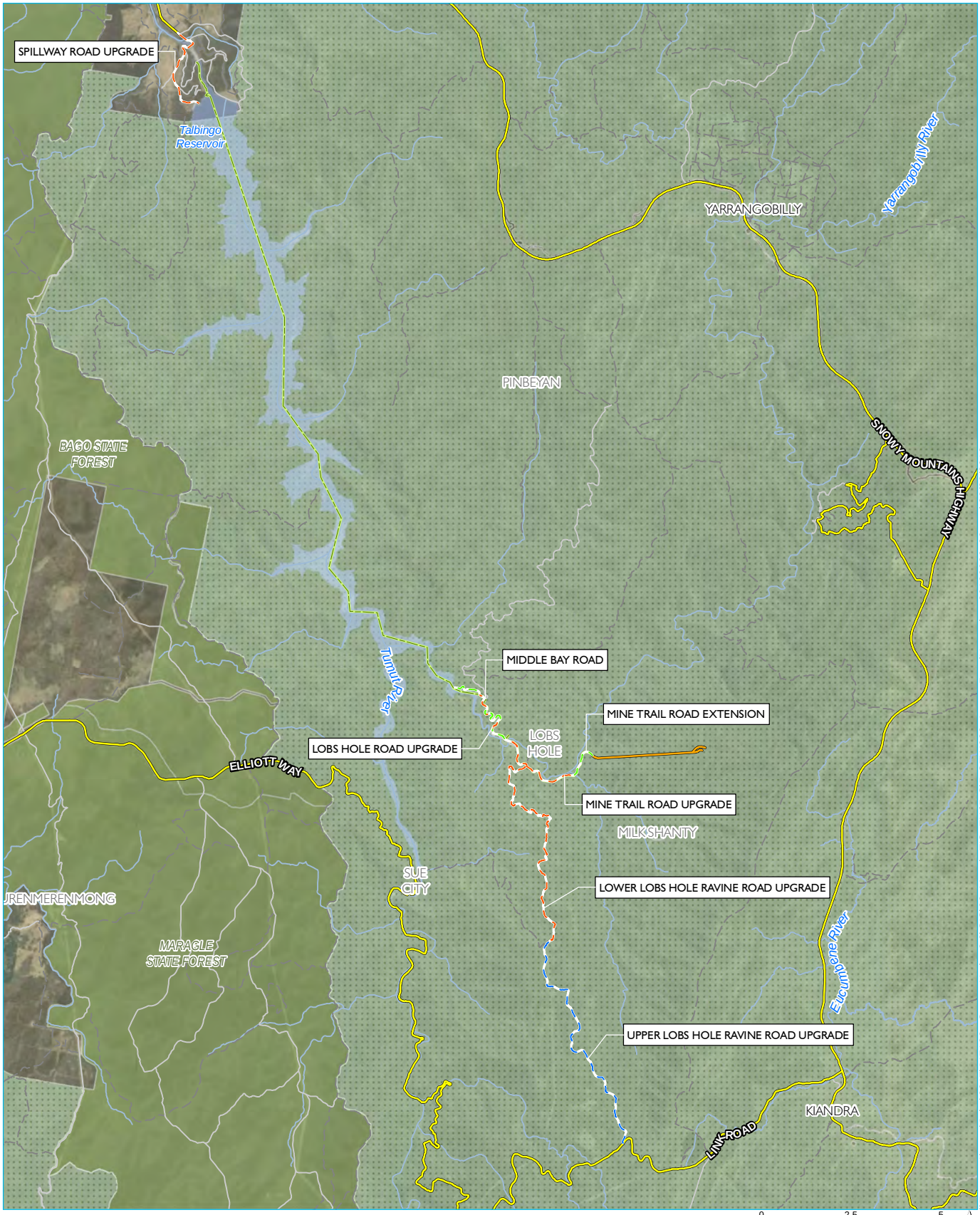
Barge access to the project area is also proposed and is detailed in Section 7.7. Barge access will be provided for roll-on roll-off barges via barge ramps near the Talbingo Spillway (at the northern end of Talbingo Reservoir) and Middle Bay (at the southern end of the reservoir).

Helicopter access to the project area will also be provided by an existing helipad at Lobs Hole near the eastern rock emplacement area.

7.6.2 Access roads

The access road works are summarised into the following categories:

- upgrades to existing roads that do not require widening (eg surface works);
- access road upgrades including track widening;
- construction of new roads; and
- watercourse crossings.



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

0 2.5 5 km

GDA 1994 MGA Zone 55

N

KEY

- Access road upgrade - without widening
- Access road upgrade - with widening
- Access road extension
- Exploratory tunnel
- Communications cable
- Main road
- Local road
- Vehicular track
- Perennial watercourse
- Scheme storage
- Kosciuszko National Park
- State forest

Access road upgrades and establishment

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.8

snowy2.0

EMM creating opportunities

In total, 17.3 km of road widening, 8.7 km of road upgrades that do not include widening, 2 km of new roads and two watercourse crossings are proposed for Exploratory Works. A summary of the access road works required is provided in Table 4.2 below and further described in this section.

Table 7.2 Access road works summary

Roadwork area	Overview
Road upgrades without widening	
Upper Lobs Hole Ravine Road	Minor upgrades to 7.5 km section of existing road. Generally only single lane access will be provided. No cut and fill earthworks or vegetation clearing will be undertaken
Road upgrades with widening	
Lower Lobs Hole Ravine Road	Upgrades to 6 km section of existing road involving cut and fill earthworks in some sections, with two-way access provided
Lobs Hole Road	Upgrade to 5.7 km section of existing road and establishment of 1.6 km of new road providing two-way access
Mine Trail Road	Upgrade to 2.2 km section of existing track to two-way access
Spillway Road	Upgrade of a 3 km section of existing road to provide two-way access to the proposed Talbingo barge ramp
New roads	
Mine Trail Road extension	Establishment of a new two-way road providing access to the exploratory tunnel portal
Middle Bay Road	Establishment of a two-way road to the proposed Middle Bay barge ramp including 0.4 km of road upgrades and 0.9 km of new road
Watercourse crossings	
Wallaces Creek Bridge	Establishment of a new bridge at Wallaces Creek as part of the Mine Trail Road extension
Camp Bridge	Establishment of a new bridge across Yarrangobilly River as part of Lobs Hole Road upgrade

For public safety reasons, public access to Lobs Hole Ravine Road will be restricted from both the Blue Creek Trail intersection (in the north) and Link Road (in the south) for the duration of Exploratory Works.

i Road upgrades without widening

The upper section of Lobs Hole Ravine Road requires minor upgrades to a 7.5 km section of existing flat to undulating track referred to as Upper Lobs Hole Ravine Road. Due to identified sensitive biodiversity values within the surrounding vegetation, only minor upgrades are proposed to provide for generally one-way traffic. This section of Ravine Road will have maintenance activities to rehabilitate gravel pavement to 4 m lane width, maintain drainage paths, installation of guideposts and snow poles above the snow line. The existing roadway provides adequate space for passing bays in several sections and no vegetation clearing will be required. The Upper Lobs Hole Ravine Road upgrade is provided in Figure 7.9 with inset photos showing the condition of the existing road.

ii Road upgrades with widening

Several access roads will be upgraded and widened to provide two lane access. These road upgrades include upgrades to Lower Lobs Hole Ravine Road, Lobs Hole Road, Mine Trail Road and Spillway Road. These road works will include culvert and drainage, road widening, retaining walls, gravel pavement overlay, installation of guideposts, guard fences and snow poles above the snow line. The Lower Lobs Hole Ravine Road upgrade is provided in Figure 7.9 with inset photos showing the condition of the existing road. Mine Trail Road, Lobs Hole Road and Middle Bay Road are provided in Figure 7.10 with inset photos showing the condition of the existing roads.

iii New roads

Two new roads will be established at Middle Bay Road and an extension to Mine Trail Road and are shown in Figure 7.10. Some sections of Lobs Hole Road will also require new road establishment. New road establishment works will include clearing and grubbing, installation of several culverts, drainage channels and outlet protection works, road construction, gravel pavement, installation of guideposts and guard fence.

iv Temporary construction access road works

A temporary construction road is required between Wallaces Creek and the exploratory tunnel portal until Mine Trail Road extension is complete and is shown in Figure 7.11. This temporary road will enable haulage of excavated material from the exploratory tunnel, portal and portal construction pad during the initial stages of Exploratory Works, while the permanent access road works are constructed.

7.6.3 Watercourse crossings

Bridge construction works will be required at two locations for Exploratory Works as described in Table 2.3. The locations of bridge works are shown in Figure 7.11.

Table 7.3 Watercourse crossing summary

Bridge works area	Overview
Camp Bridge	An existing crossing on Yarrangobilly River will be used as a temporary crossing while a new permanent bridge is built as part of Lobs Hole Road upgrade. The temporary crossing to be used will be selected during detailed design and may require construction of a pre-fabricated 'Bailey bridge', a pipe culvert or raising the crossing level with rocks to facilitate vehicle passage. The temporary crossing will be removed and the crossing no longer used once the permanent bridge has been constructed. The new bridge (Camp Bridge) will be a permanent crossing and used for both Exploratory Works and Snowy 2.0 main works (if it proceeds).
Wallaces Creek Bridge	Establishment of a new permanent bridge at Wallaces Creek as part of the Mine Trail Road extension. Establishment of this bridge will require an initial temporary pre-fabricated 'Bailey bridge' to be constructed, which will be removed before the end of Exploratory Works.

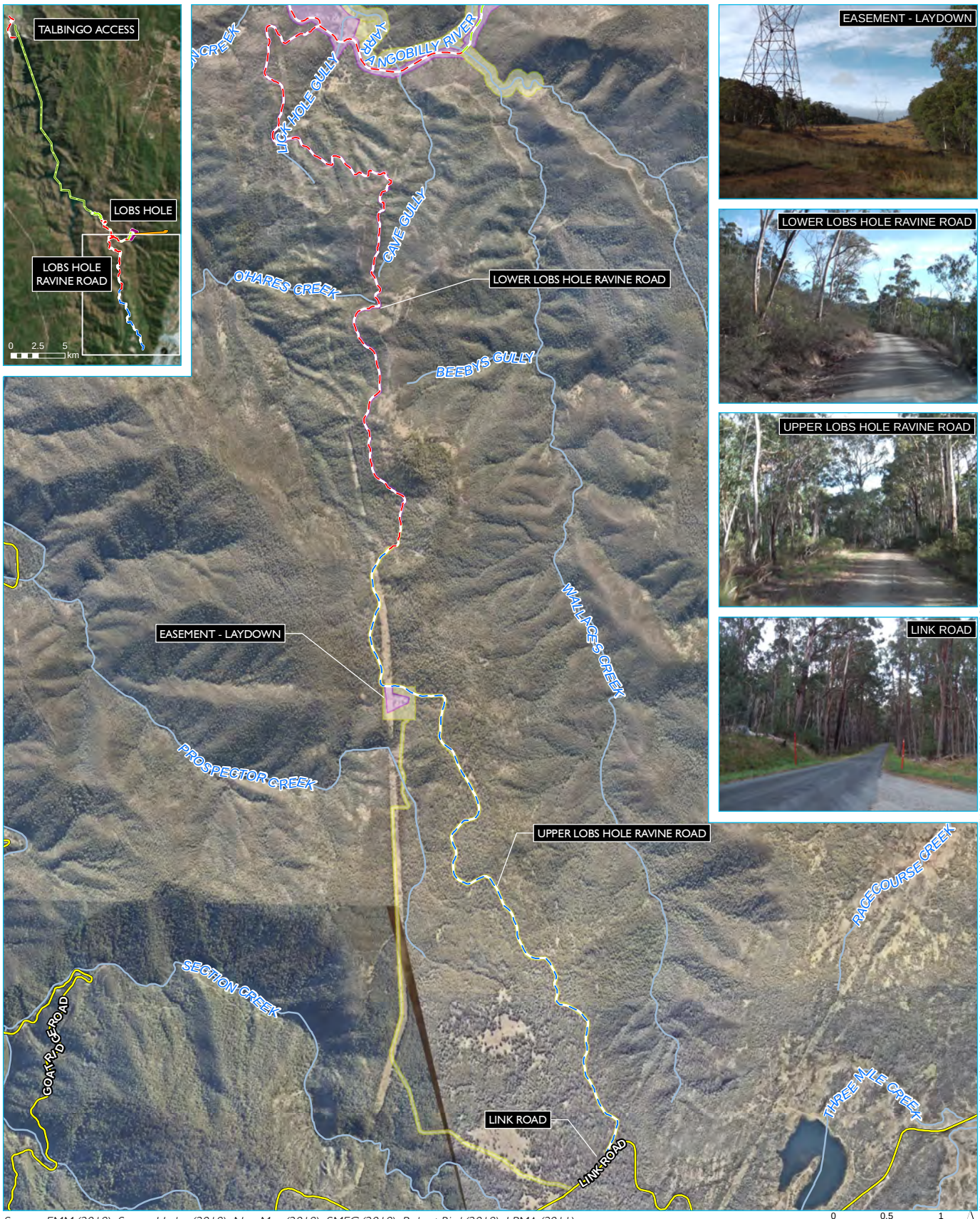
The design for permanent bridges at both crossings will consist of steel girders with a composite deck. This is the most common type of permanent bridge constructed in and around the existing Snowy Scheme.

The construction works for the temporary and permanent watercourse crossings will be undertaken incorporating controls to minimise mobilisation of sediments into the Yarrangobilly River. In addition, the design of both the temporary and permanent structures has incorporated appropriate aquatic ecology controls to allow for fish passage.

7.6.4 Impact avoidance and minimisation

Key considerations of environmental impacts during the design of the access and transport infrastructure are listed below:

- establishing a 50 m setback from the Yarrangobilly River to avoid impacts to riparian habitat;
- establishing an avoidance area and minimising upgrade works along the upper section of Lobs Hole Ravine Road to avoid impacts to identified habitat for Smoky Mouse;
- investigating use of the existing transmission line easement as an alternative access route to the Upper Lobs Hole Ravine Road, however further biodiversity surveys identified Smoky Mouse habitat within vegetation along the edges of the easement and this alternative was discounted;
- establishing an alternative access option via barge to minimise upgrades to Lobs Hole Ravine Road and avoid impacts to Smoky Mouse;
- avoiding heritage items including the Washington Hotel;
- avoiding disturbance to known contaminated areas including the former Lobs Hole mine;
- using of existing roads and cleared areas at Lobs Hole; and
- minimising disturbance of potential aquatic habitat and fish passage through design of temporary bridge crossings.



Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); LPMA (2011)

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KEY

- Access road upgrade - without widening
- Access road upgrade - with widening
- Access road extension
- Main road
- Watercourse
- Disturbance footprint
- Avoidance footprint

Lobs Hole Ravine Road upgrades

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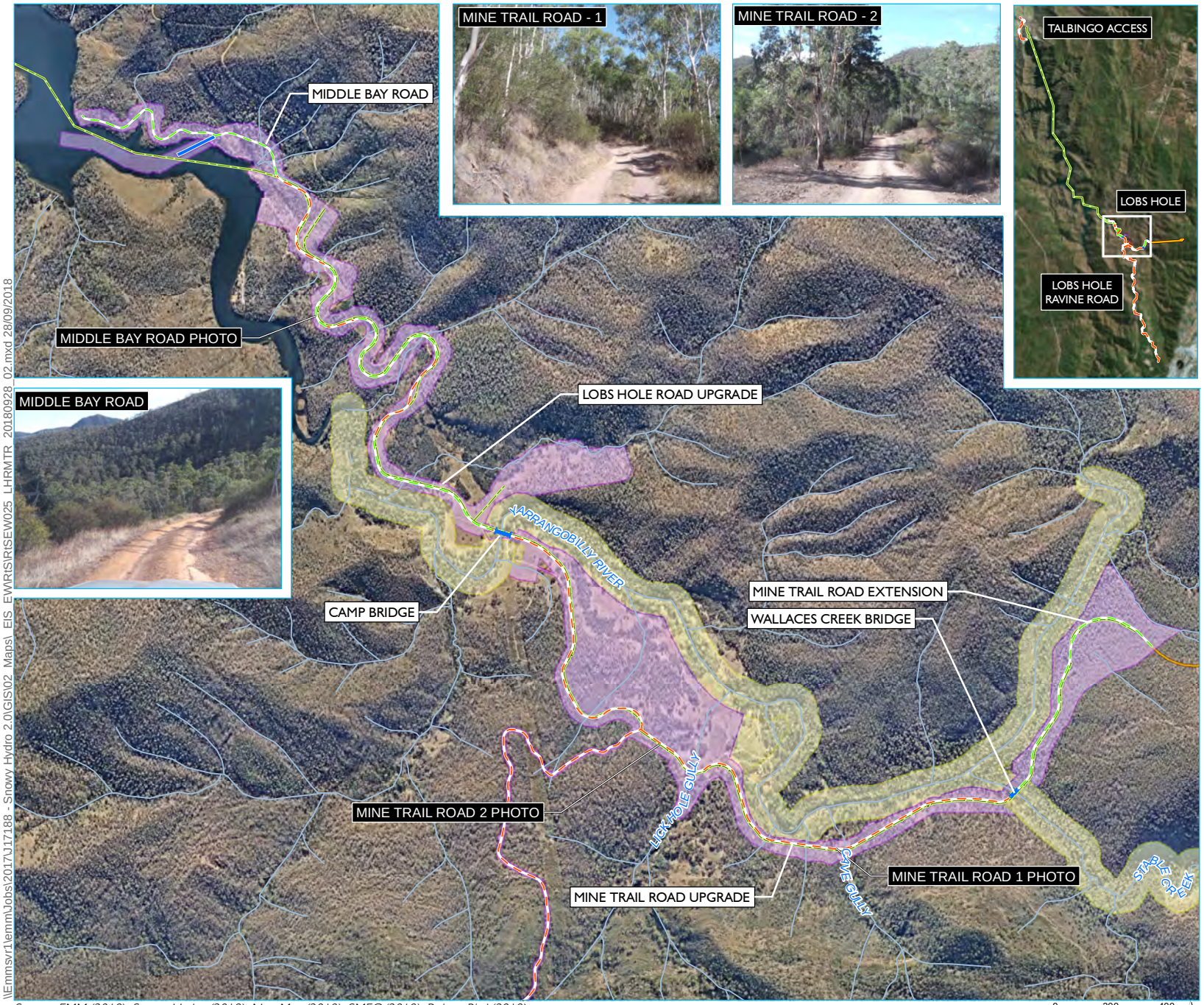
Response to Submissions
Exploratory Works
Figure 7.9

snowy2.0

EMM
creating opportunities



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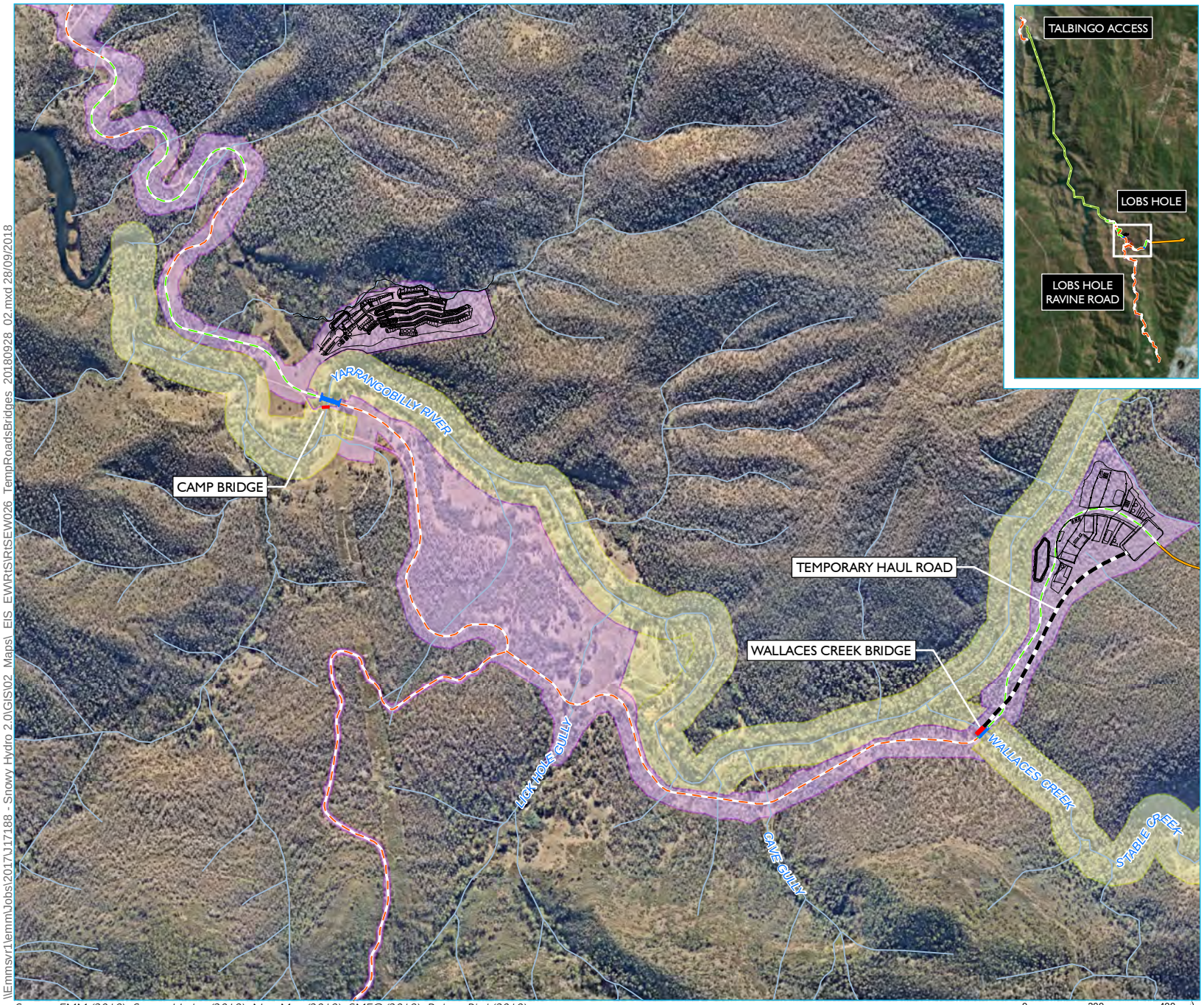
Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018)

Lobs Hole Road and Mine Trail Road upgrades and extension

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.10



KEY

- Temporary haul road
- Temporary bridge
- Permanent bridge
- Access road upgrade
- Access road extension
- Portal construction pad and accommodation camp conceptual layout
- Exploratory tunnel
- Watercourse
- Disturbance footprint
- Avoidance footprint

\\Emmsvr1\emmJobs\2017\J17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWRtS\RtSEW026 TempRoadsBridges 20180928 02.mxd 28/09/2018

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

0 200 400 m

GDA 1994 MGA Zone 55

N

Temporary roads and bridges

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.11

7.7 Barge access and transport

7.7.1 Purpose and location

Given the avoidance measures implemented on Lobs Hole Ravine Road to maintain Smoky Mouse habitat, an alternative to road access through use of barge access to the project area, is proposed. The barge access infrastructure will enable transport of bulky and heavy equipment and provide alternative access in case of emergency. Heavy equipment for barge transport may include drilling jumbos, haul trucks and large excavators for portal construction and establishment of work sites. Materials including cement, aggregates, sand and steel could also be delivered by barge. The barge access infrastructure includes:

- a new barge ramp near the Talbingo Spillway (Talbingo barge ramp);
- a new barge ramp at Middle Bay (Middle Bay barge ramp);
- occasional use of the existing Talbingo Reservoir boat ramp near the dam wall; and
- dredging to facilitate ramp construction and barge navigation.

A barge access infrastructure report was prepared by Royal HaskoningDHV which provides details of the conceptual design and construction methods for the barge access infrastructure and is provided in Appendix L of the EIS. This section provides a summary of construction and operation of the barge infrastructure.

7.7.2 Infrastructure and design

i Talbingo and Middle Bay barge ramps

The Talbingo barge ramp is on Snowy Hydro owned land at the north end of Talbingo near the existing Talbingo Spillway and will comprise a barge ramp and adjacent laydown area. The Talbingo barge ramp will be a concrete ramp at a grade of 1:10 (vertical:horizontal) approximately 10 m wide. The reservoir bed 20 m either side of the centreline of the barge ramp will be no higher than the barge ramp surface. The infrastructure for the Talbingo barge ramp is provided in Figure 7.12.

The Middle Bay barge ramp and access makes use of existing access and previously disturbed areas near the existing Middle Bay unformed boat launching area. The Middle Bay barge ramp will take the form of a concrete ramp at a grade of 1:10 (vertical:horizontal) and be approximately 15 m wide. The infrastructure proposed for Middle Bay barge ramp is provided in Figure 7.13.

The barge ramps will be constructed from cast in-situ concrete above the reservoir FSL and pre-cast concrete planks or slabs below FSL. The pre-cast planks will be laid on a pre-prepared flexible foundation comprising bedding material screed and compacted at the desired grade. The planks will be connected with stainless steel straps and pins. The barge's bow ramp will be lowered onto the concrete barge ramp to enable vehicles, plant and equipment to roll-on and roll-off the barges. The barges will be positioned using tugs and held against the concrete ramp by mooring lines attached to bollards near the crest of the ramp. The mooring lines will be tensioned using a winch to ensure the barges are held securely in place.

ii Middle Bay navigation channel

Dredging is required to establish a navigation channel on the approach to the Middle Bay barge ramp. The concept layout of the navigation channel is provided in Figure 7.13. The minimum channel depth would be 534.7m Australian Height Datum (AHD) for Exploratory Works.

Channel batters formed by dredging would be approximately 1:2 (vertical:horizontal). Acceptable dredge batters would be confirmed following review of the geotechnical investigation (refer to Section 7.10.2). The minimum width of the navigation channel would be 50 m. Turning basins would be 100 m. The width of the navigation channel may increase in the vicinity of bends in the channel to accommodate navigation.

The navigation channel alignment will also provide space for a pump intake, on the inside bend of the channel, approximately 80 m downstream from the toe of the ramp. The pump intake is proposed as part of Exploratory Works water services pipeline which is detailed further in Section 7.8.1.

7.7.3 Barge transport

During Exploratory Works, barges will be loaded at the Talbingo barge ramp, travel about 18 km along Talbingo Reservoir and be unloaded at the Middle Bay barge ramp before returning to the north. A round trip from Talbingo barge ramp to Middle Bay barge ramp and return would take approximately four hours. Some loads may also be transported in the reverse direction, for example when equipment is no longer required. Barges may be towed by a tug or self-propelled. There may also be the need for smaller, faster maintenance boats. There are expected to be up to 24 barge movements per day transporting equipment and materials between Talbingo barge ramp and Middle Bay barge ramp.

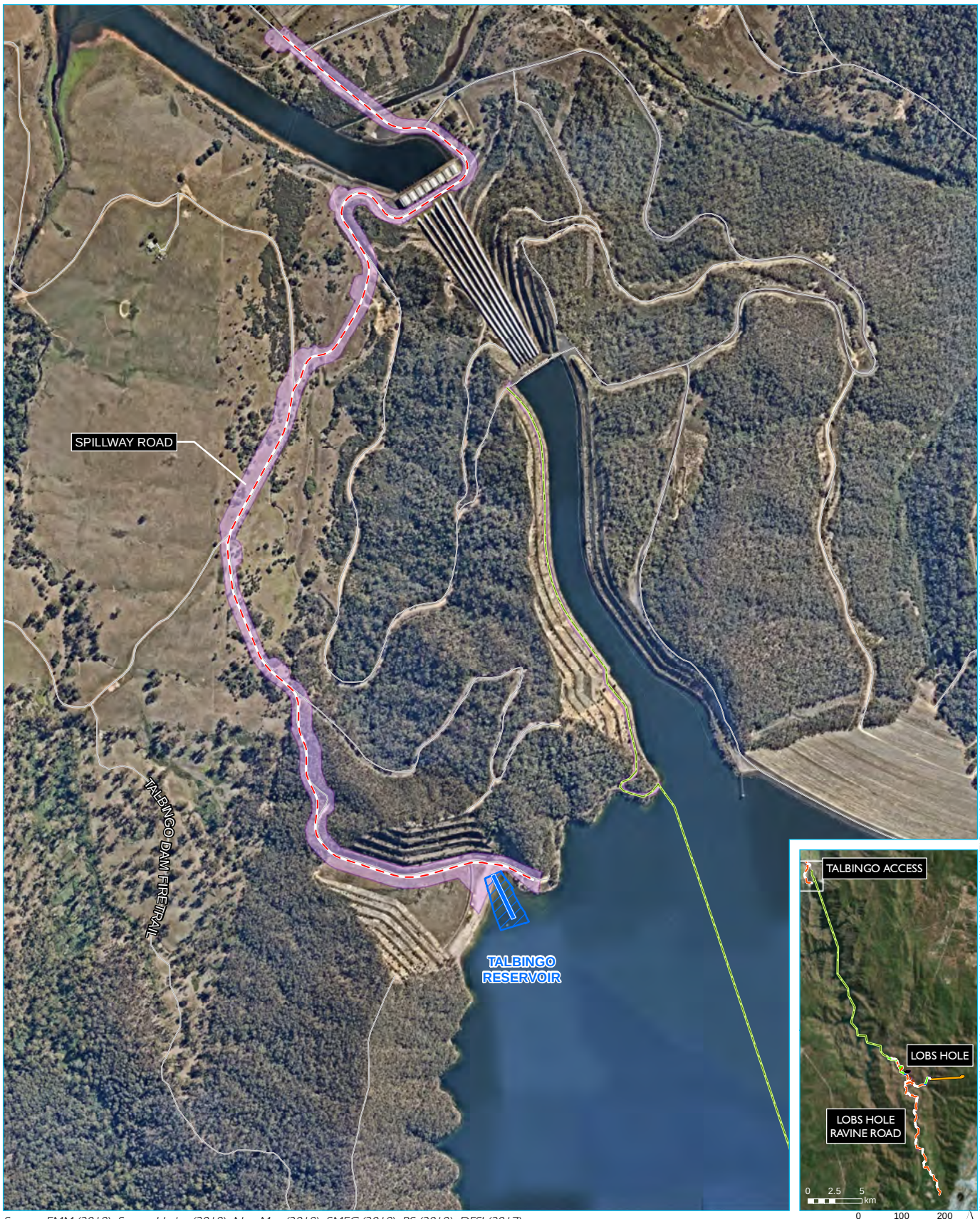
Barges at Middle Bay will also be used for transport and placement of excavated material as part of the sub-aqueous rock placement program (See Section 7.5.4).

Barging may occur 24 hours a day but is likely to be used predominantly during daylight hours.

7.7.4 Impact avoidance and minimisation

Key considerations of environmental impacts during the design of barge access infrastructure included:

- use of existing disturbed areas at the Talbingo Spillway and the Middle Bay unformed boat launching area;
- submerged timber (dead trees and wood debris) removed during construction will be replaced at a similar depth within the reservoir to minimise impacts to potential habitat for fish and other aquatic biota; and
- minimisation of impacts to recreational users of Talbingo Reservoir through avoidance of restricting access to Talbingo boat ramp during peak use times.



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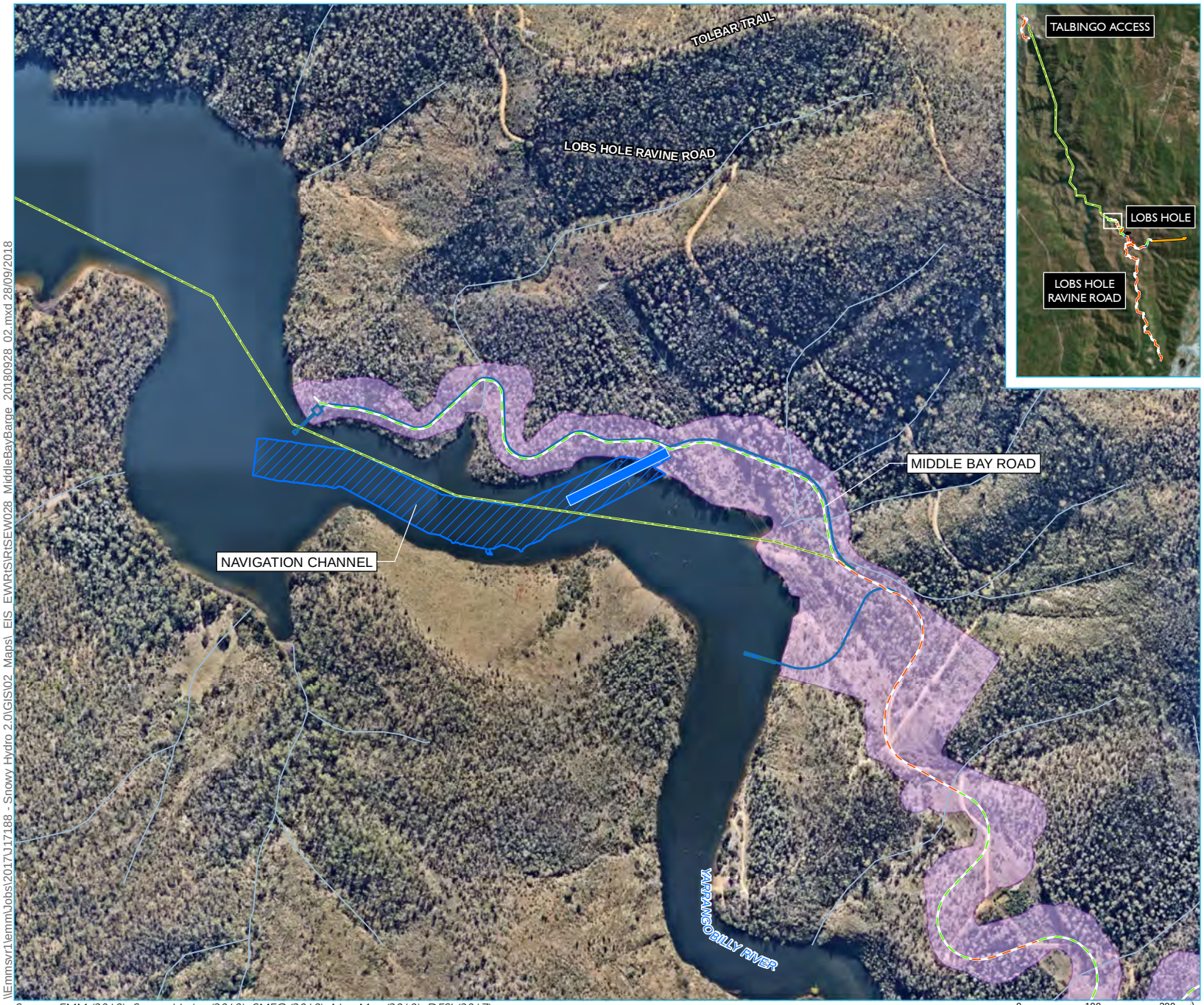
Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); PS (2018); DFSI (2017)

KEY

- Access road upgrade
- Access road extension
- Exploratory tunnel
- Communications cable
- Main road
- Local road or track
- Talbingo barge access
- Disturbance area - barge infrastructure
- Disturbance footprint

Talbingo barge access

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.12



KEY

- Communications cable
- Water services pipeline
- Access road upgrade
- Access road extension
- Watercourse
- Middle Bay barge access infrastructure/ramp
- Disturbance area - barge access
- Disturbance footprint

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

0 100 200 m

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Middle Bay barge access

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.13

snowy2.0

EMM creating opportunities

7.8 Supporting infrastructure

7.8.1 Water

i Water services pipeline

A services pipeline for the supply and discharge of water for Exploratory Works will pump water between Talbingo Reservoir and the exploratory tunnel portal and accommodation camp. The layout of the water services pipeline and associated water infrastructure is provided in Figure 7.14.

The services pipeline intake structure will be sited near the Middle Bay barge ramp. The intake structure will be in the form of a submersible pump station. An electrical control cabinet will be on the reservoir banks above the flood level. The discharge from the pump station will be via 300 mm high density polythene (HDPE) pipe and the pipeline will follow the alignment of the Middle Bay Road.

ii Water supply and use

The portal construction pad water supply will be pumped via a water services pipeline from Talbingo Reservoir near the Middle Bay barge ramp. Water will be pumped to the portal construction pad which is east of Middle Bay. The pipeline will be terminated at a storage tank at the portal construction pad. The raw water will be used for non-potable purposes such as dust suppression and for tunnel construction and concrete batching purposes. The water services pipeline will be sized to cater for all non-potable purposes and the demand will reduce overtime once the tunnel seepage water can be re-used on site.

A package water treatment plant is proposed at the accommodation camp to provide potable water to the accommodation camp and portal construction pad facilities and will be treated to a standard that complies with the *Australian Drinking Water Guidelines* (NHMRC 2011). The 100 kL potable water tank will provide a minimum of 24 hours storage. The potable water will be carted by truck from the accommodation camp to tanks at the portal construction pad facilities.

A dedicated 200 kL fire water supply tank will also be maintained at the portal construction pad. For fire fighting services at the portal construction pad a minimum storage based on 15 L/s for two hours will be provided.

The accommodation camp water supply will be pumped via the water services pipeline from Talbingo Reservoir at Middle Bay. Potable and non-potable water storage tanks will be at the accommodation camp. For fire services at the camp a minimum non-potable storage of 15 litres per second (L/s) for two hours will be provided. The potable water tank will provide a minimum of 24 hours storage.

iii Sewage and water treatment facilities

A sewage treatment plant (STP) is proposed at the accommodation camp to treat waste water. The STP will treat all waste water from the accommodation camp. The STP will produce effluent quality comparable to standard inland treatment facilities in the region (eg Cabramurra STP, or Thredbo STP). Following treatment waste water will be discharged to Talbingo Reservoir via the water services pipeline connecting the accommodation camp to Middle Bay.

The wastewater treatment system will incorporate a wastewater treatment plant at the accommodation camp. The wastewater treatment plant will treat water to a suitable quality for discharge to the Yarrangobilly River arm of Talbingo Reservoir via the controlled discharge pipeline, and will be treated to meet the required water quality criteria..

An emergency waste water storage tank with 25,000 L capacity will be provided at the accommodation camp based on 12 hours storage at daily sewage load.

The domestic sewage volume at the portal construction pad is not expected to be significant and hence it will be tanked from the portal construction pad to accommodation camp facilities for treatment in the STP.

During Exploratory Works tunnel seepage water will be pumped to a sediment basin near the tunnel portal as shown in Figure 7.3. The tunnel seepage water will undergo preliminary treatment at the portal construction pad before it is reused for non-potable purposes at the construction site. Any excess treated water will be conveyed to Talbingo Reservoir through the water services pipeline.

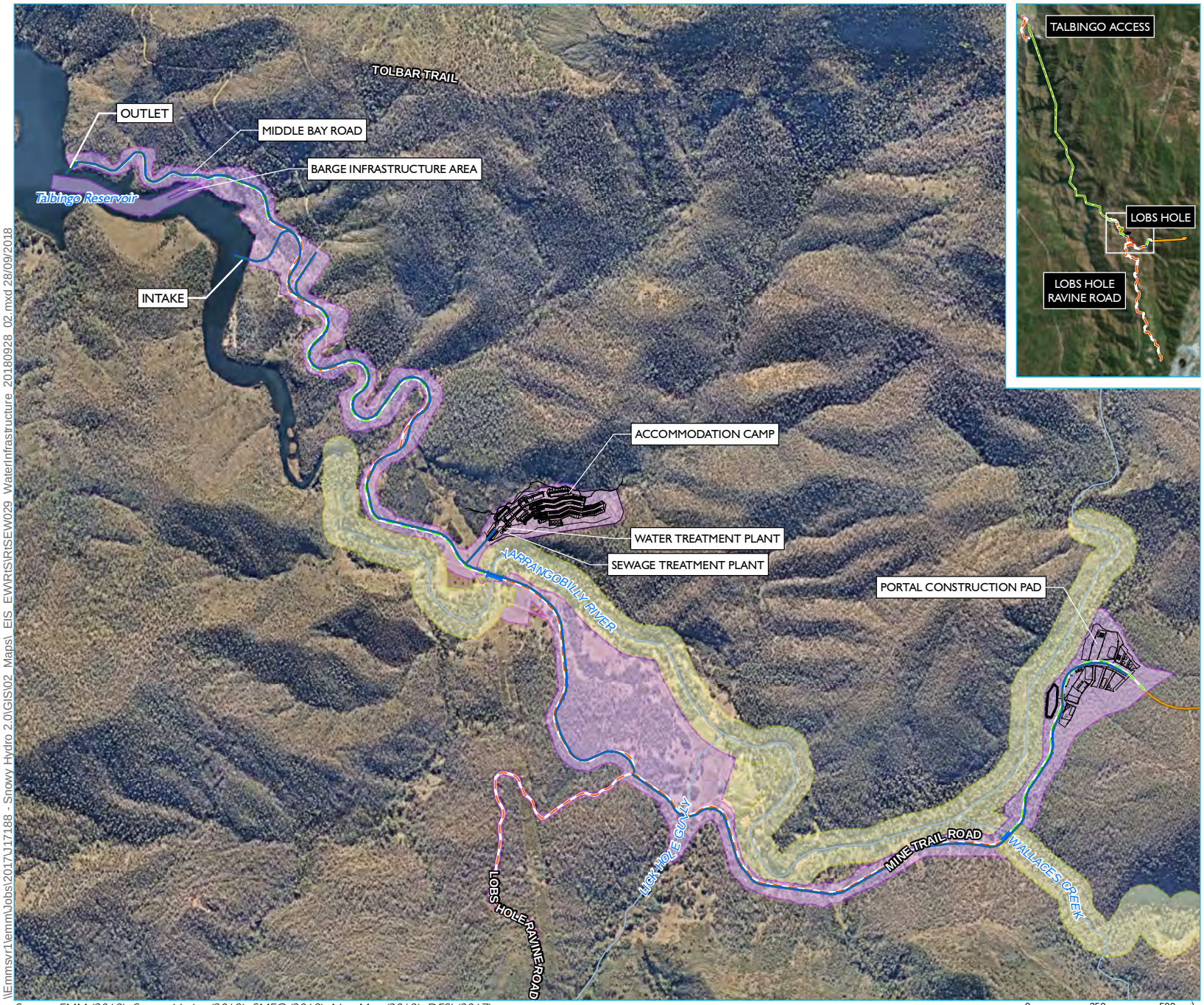
The process water system will incorporate a water treatment plant that will treat water to a suitable quality for its proposed use in construction activities. Additional treatment will be provided for any water that is to be discharged to Talbingo Reservoir via the controlled discharge pipeline, and treated to achieve the required water quality criteria.

7.8.2 Power

Power supply for Exploratory Works will be required at the accommodation camp, the portal construction pad and the Middle Bay barge ramp. Power requirements at these sites will be provided by diesel generator sets at the portal construction pad as shown in Figure 7.3. A temporary high voltage/low voltage reticulation network will connect the diesel generators to facilities throughout the project area via buried conduit within the Exploratory Works disturbance footprint. Diesel storage tanks will be at the portal construction pad. By using diesel-generated power instead of new or augmented transmission supply connections, the extent of ground disturbance and vegetation clearing needed to establish construction power has been significantly reduced.

7.8.3 Communications

Communication infrastructure servicing Exploratory Works will be provided via fibre optic link. The fibre optic service has been designed to incorporate a submarine cable from Tumut 3 power station to Middle Bay in Talbingo Reservoir at the barge ramp and then via a buried conduit to the accommodation camp and the portal construction pad. The route for the submarine fibre optic cable is provided in Figure 7.15.



KEY

- Water services pipeline
- Access road upgrade
- Access road extension
- Permanent bridge
- Watercourse
- Portal construction pad and accommodation camp conceptual layout
- Exploratory tunnel
- Disturbance footprint
- Avoidance footprint

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

0 250 500 m

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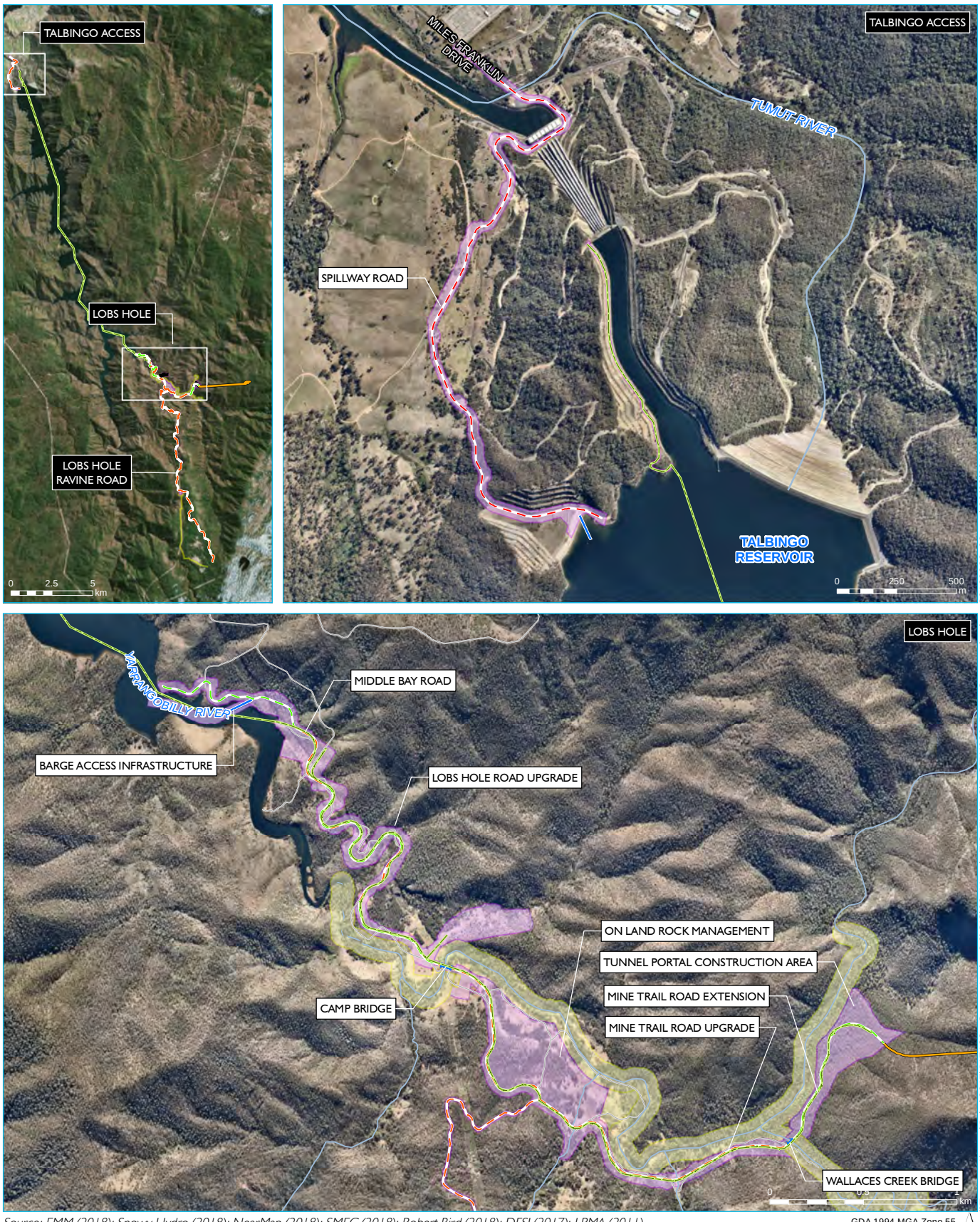
Proposed water infrastructure

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.14



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Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017); LPMA (2011)

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KEY

- Communications cable
- Access road upgrade
- Access road extension
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Exploratory tunnel
- Main road
- Local road or track
- Watercourse
- Barge access
- Disturbance footprint
- Avoidance footprint

Communications cable route

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.15

snowy2.0

EMM creating opportunities

7.9 Construction staging and timing

7.9.1 Construction timing

Construction of the project is anticipated to commence at the end of 2018 with substantive works commencing in early 2019 and to continue for an estimated 34 months. Timing for the main construction activities for Exploratory Works is set out in Figure 7.16 below.

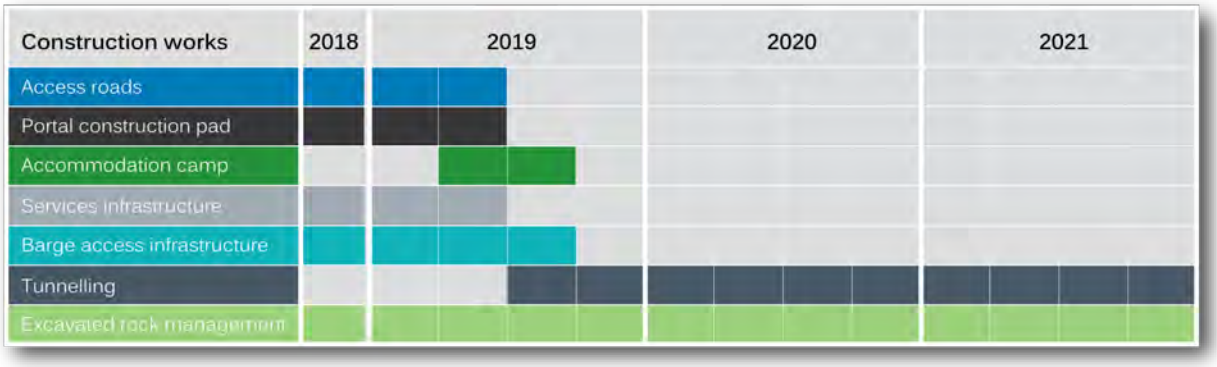


Figure 7.16 Indicative timing of Exploratory Works elements

This construction program should be treated as indicative only and may change based on:

- further work undertaken during the detailed design phase, and any further approvals for Snowy 2.0;
- unseasonal weather conditions; and
- field-based discovery, such as unexpected threatened biodiversity species or heritage items.

7.9.2 Construction staging

A detailed schedule will be prepared for the procurement, construction and commissioning of Exploratory Works. It is anticipated the schedule will include the following discrete but overlapping stages:

- **Management plans**: a number of management plans will be prepared in line with the conditions of approval and submitted to the relevant authority.
- **Geotechnical investigations and site establishment works**: To assist the detailed design of Exploratory Works further geotechnical investigations will be undertaken within the disturbance footprint. This will include a program of geophysical surveys, test pits, and borehole drilling. Site establishment works will be undertaken, such as preparation for road access.
- **Detailed design and permits**: Further input is required to the concept designs, as contained in this EIS, to produce detailed designs suitable for construction, followed by the preparation and lodgement of approval documentation required to allow surveyor activities, vegetation clearing, the construction of buildings and facilities and associated operational works.

- **Mobilisation**: Once initial approvals have been granted and agreement has been reached between Snowy Hydro and the successful contractor(s) the process of mobilising key design and construction staff and establishing a presence on-site can commence.

- **Construction works**: Once relevant designs are completed and approved construction works will commence including construction of road upgrades and extensions, the accommodation camp, the portal construction pad, barge facilities and the exploratory tunnel drill and blast program. The timing of the construction works is detailed further in Section 7.9.1.

- **Post-construction revegetation and rehabilitation, management and monitoring**: Following Exploratory Works the continued use of Exploratory Works infrastructure will be subject to whether Snowy 2.0 proceeds. Should Snowy 2.0 proceed the infrastructure established for Exploratory Works will be used as part of Snowy 2.0. Should Snowy 2.0 not proceed, all non-permanent infrastructure will be decommissioned and the disturbance area rehabilitated in accordance with an approved rehabilitation plan.

7.9.3 Changes to public access

i Duration of Exploratory Works

There will be public access restrictions imposed for the duration of Exploratory Works. Changes to public access include:

- the closure of public access to Lobs Hole Ravine Road from the intersection of Lobs Hole Ravine Road and Blue Creek Trail (in the north) and Link Road (in the south);

- the closure of public access to Ravine campground;

- the closure of public access to the Middle Bay hand-launching boat ramp; and

- the closure of public access to the spillway area.

There will be occasional temporary restrictions to public access to the Talbingo boat ramp. The occasional use of the Talbingo Reservoir public boat ramp near the dam wall is described further in Section 7.9.3 (ii) below.

ii Temporary/occasional

The existing Talbingo boat ramp will be temporarily closed during the upgrade of recreational facilities. The boat ramp will be used for barge access intermittently only, primarily at the start of Exploratory Works. During use for Exploratory Works, the boat ramp will be closed to the public. This will be for periods of typically one to two hours. Intermittent closure of the boat ramp will be avoided at the following peak visitor use periods:

- for the duration of Exploratory Works 7am–9am on weekends and weekdays on school holidays between October and April; and

- all day during the Christmas and Easter holiday periods.

Any restrictions to the boat ramp access and the timetable for operation of the barge will be communicated to reservoir users by signage posted within Talbingo, near Tumut 3 power station and on relevant websites.

There will also be some restricted boat access to the Yarrangobilly Arm upstream of the low water barge turning basin to prevent interactions between the public and barge operations.

To mitigate the closure of the spillway for public access, additional recreational facilities at the public boat ramp will be developed. This area is owned by Snowy Hydro and will continue to be made available to the public. These include:

- provision of pontoons for the mooring of boats to the north of the boat ramp;
- provision of 'beach' area immediately south of boat ramp;
- provision a swimming pontoon off the 'beach' area;
- provision of an exclusive swimming area around the 'beach' area; and
- provision of picnic facilities and amenities at 'beach' area including picnic tables and BBQs.

Three design options are under consideration for the additional recreational facilities and will be finalised following further consultation with the community and government agencies.

The options under consideration are listed below.

- Option 1: On-ramp pontoon – This option involves widening of the existing walkway alongside the boat ramp to provide a platform for an on-ramp pontoon. The on-ramp pontoon would be constructed on a rock fill foundation and comprise an insitu concrete slab (above water level) and precast concrete planks (below water level). A larger pontoon would be provided at the end of the on-ramp pontoon to facilitate boat berthing. The pontoon would provide boat berthing and assisted disabled access at water levels down to MOL.
- Option 2: Gangways linking pontoons A – This option involves the construction of several gangways to link with floating pontoons. The gangway linking to the foreshore would be hinged from an abutment formed behind the existing gabion wall. Pontoons would be restrained by piles that would incorporate pontoon stops. The pontoon stops would limit the downward movement of pontoons at low water levels to ensure that the gangway slope remains adequate for access. This option would provide assisted disabled access at water levels down to MOL.
- Option 3: Gangways linking pontoons B–This option is similar to Option 2 but extends further offshore with flatter maximum gangway slopes. This option includes a longer structure that provides disabled access that is consistent with best practice guidance for accessibility.

The design options for the additional recreational facilities at Talbingo boat ramp are provided in Figure 3.1, 3.2 and 3.3.

iii Following Exploratory Works

In the long term it is expected that Exploratory Works will improve public access to Lobs Hole. These improvements principally relate to access and internal roads around Lobs Hole and Ravine campground, which will contribute to the future public enjoyment and use of the KNP in the long term.

7.10 Construction method

7.10.1 Construction delivery

The current intended contract delivery method is to award two separate contracts to enable efficient construction of Exploratory Works following a competitive tender process. The initial Exploratory Works will be a construct-only contract comprising access roads and site establishment of the portal construction pad. A second contract requiring detailed design and construction for the remaining works will then be awarded.

The successful contractors will be contractually committed to delivering the defined Exploratory Works in compliance with the provisions of this EIS and the conditions of approval. Snowy Hydro, as principal, will be responsible for overseeing the construction of Exploratory Works. This will include periodic inspections, monitoring and auditing the work performed by the contractors.

7.10.2 Geotechnical investigation program

Further survey of ground conditions is required to inform detailed design for Exploratory Works. A program of geotechnical investigations including geophysical survey, construction of test pits, and borehole drilling, within the disturbance footprint will be undertaken.

The indicative geotechnical investigation sites are provided in Figure 7.17, and comprise a series of test pits, boreholes, geophysics surveys and horizontal drilling at the power station cavern on completion of the exploratory tunnel.

i Test pits

Test pits will be excavated to up to 3 m depth, unless prior refusal is reached. Bulk samples will be collected from the excavated material at various depths for laboratory soil testing. Dynamic cone penetrometers testing will also be carried out. At completion, test pits will be backfilled with the excavated material and compacted. Where works are undertaken within existing roads, test pits will not be positioned in wheel paths.

ii Borehole drilling

Borehole drilling is required to facilitate the detailed design of cuttings, bridge foundations, retaining wall foundations, and drainage structures. Borehole drilling will be carried out using a variety of truck and track mounted drilling rigs. The sequence for borehole drilling is listed below:

- drill pad establishment – including vegetation clearing, establishing a drill pad with compacted aggregate, installation of erosion and sediment controls, site delineation and installation of plastic sheeting to control hydrocarbon spills;
- borehole drilling – by augers, washboring or diamond coring techniques; and
- in-situ testing, measurement and collection of samples – including photographs, point load testing, measurement of the water level and soil sampling.

Several boreholes will also require additional works including borehole wall imaging and installation of standpipe piezometers. Where no standpipes are required, boreholes will be backfilled with a lean mix cement grout mixture.

iii Borehole drilling in water

Several boreholes are proposed over water in Talbingo Reservoir to inform the detailed design of the barge ramps and navigation channel. Over water drilling activities are to include activities listed below:

- mobilise and secure floating barge to reservoir floor and shoreline using concrete anchors that will be removed at completion of work;
- drill boreholes using auger and rotary wash bore drilling techniques;
- rock core drilling using triple tube diamond coring techniques to the target depth; and
- in-situ testing and surveys including water pressure tests and acoustic surveys.

iv Installation of standpipe piezometers

Several boreholes will include the installation of standpipe piezometers which will be used for groundwater monitoring. All standpipe piezometers will be constructed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (NUCDL 2012).

v Geophysics surveys

The geophysics surveys involve establishing temporary surface equipment that generates seismic energy and receives the resulting reflected/refracted seismic waves along an array of receivers. This seismic data involves establishing straight lines via a cable with geophones installed every 4–8 m and using small charges to generate seismic energy.

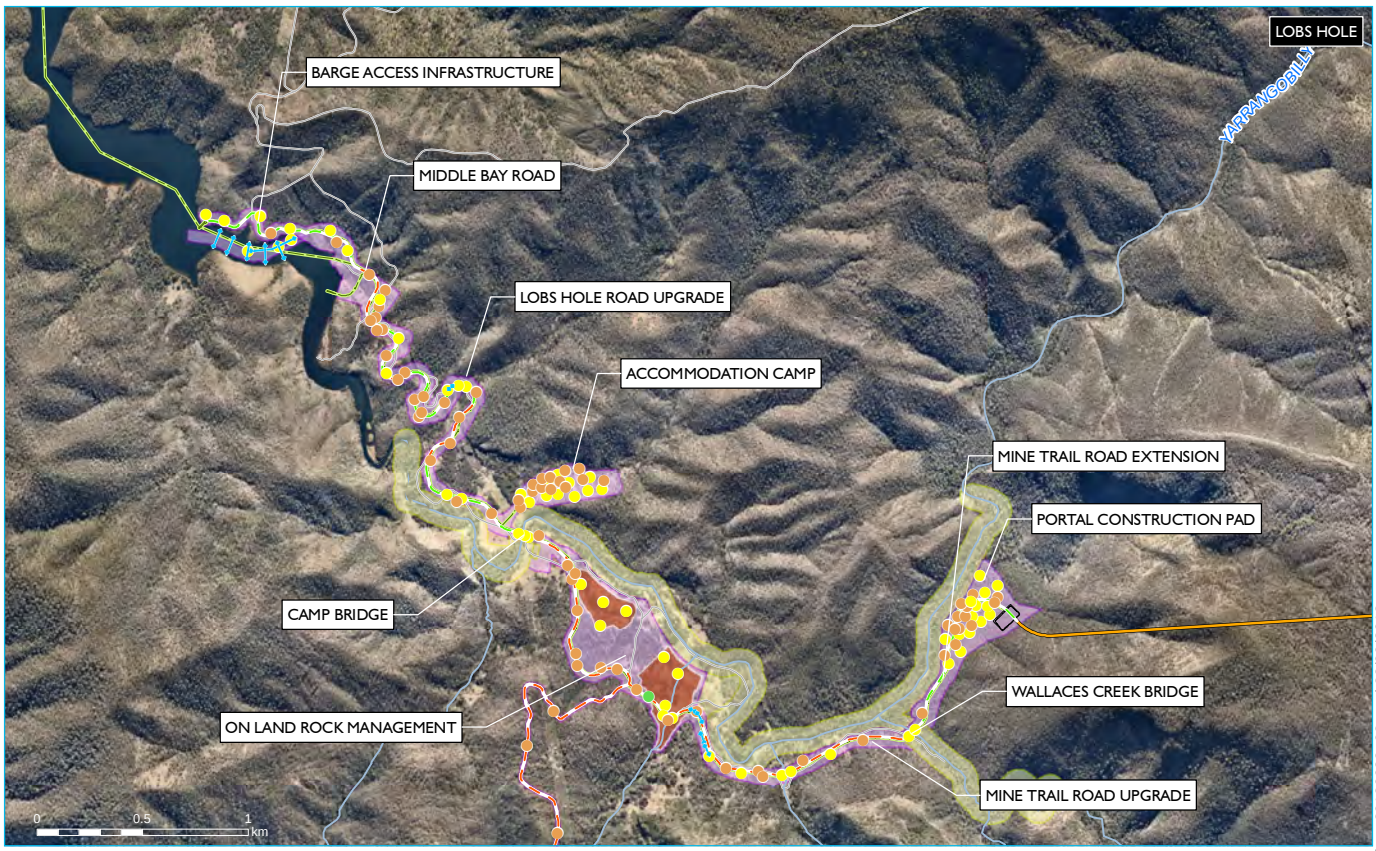
The geophysical survey activities will include the activities listed below:

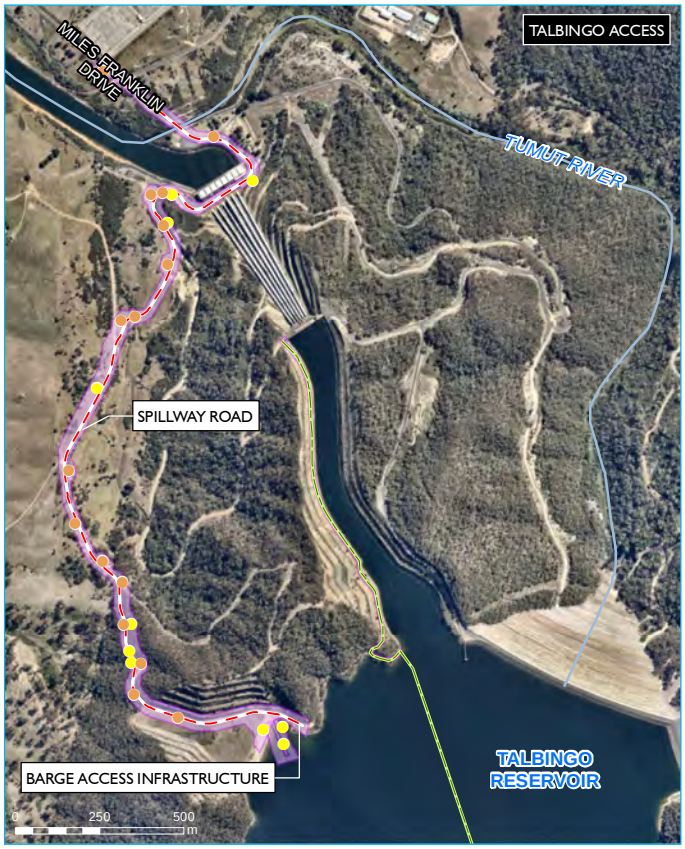
- the geophone cable will be placed along the survey line with geophones spaced every 4 m;
- survey holes will be established along the survey line every 8 m using a post hole digger or auger;
- small charge of 100 gram (g) will be positioned at the bottom of the holes and then backfilled. A geophysicist will determine the amount of explosives to be used to ensure the minimum possible quantity is used; and
- the seismic shots will be executed one at a time. The shot holes will be inspected by the licensed shot-firer after each shot and filled if necessary.

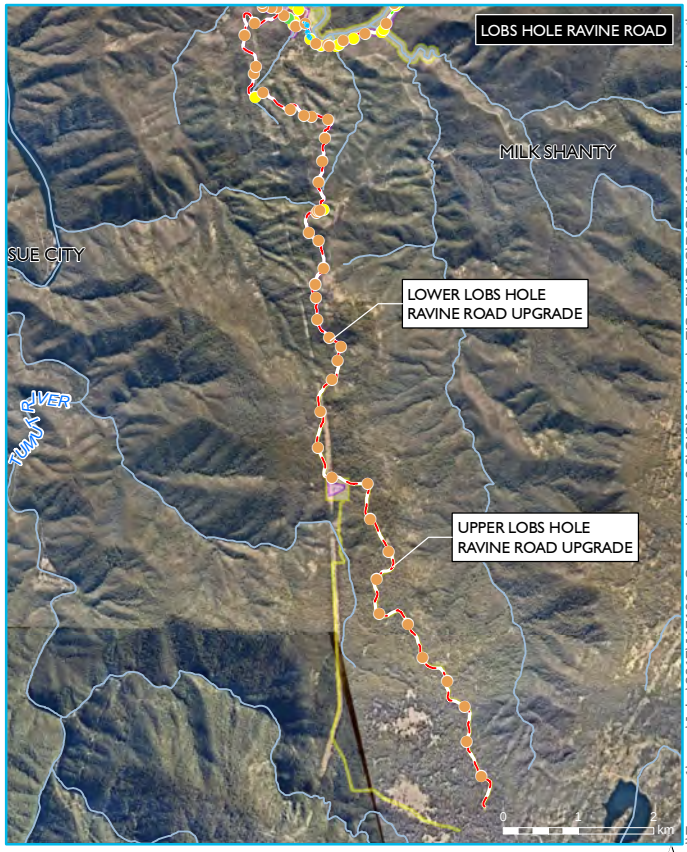
Marine geophysics surveys are required within Talbingo Reservoir to inform the design of Middle Bay barge ramp and navigation channel. Marine geophysics surveys will involve deploying a line of hydrophones along the reservoir floor and the generation of seismic energy by a small airgun. The airgun will be used to produce a controlled release of compressed gas at or near the reservoir floor, at approximately 8 m intervals along the geophysics line.

vi Horizontal drilling at power station cavern

The key aim for Exploratory Works is to acquire information about the underground conditions at the Machine Hall cavern for Snowy 2.0. To do this a program of horizontal investigation probes at depth is proposed. This program will be undertaken on the completion of the exploratory tunnel. The associated testing includes in-situ stress testing to confirm the precise underground power station complex location and suitable orientation for the stress conditions at depth.







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Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017); LPMA (2011)

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KEY

Geotechnical investigation sites

- Borehole
- Dynamic cone penetrometer
- Test pit
- Geophysical spread
- Access road upgrade
- Access road extension
- Exploratory tunnel
- Communications cable
- On land rock management
- Disturbance footprint
- Avoidance footprint

Geotechnical and geophysical investigation sites

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.17

snowy2.0

EMM creating opportunities

7.10.3 Typical construction methods

i Pre-construction methods

Prior to the construction of any of the Exploratory Works elements, site-based pre-construction activities will be undertaken as outlined below.

- each of the Exploratory Works elements will be surveyed and the extent of the approved disturbance footprint clearly identified and marked;
- environmental avoidance areas will be identified and marked within the approved disturbance footprint;
- any ground disturbance or vegetation clearing associated with the pre-construction activities will require the installation of appropriate stormwater and diversion drainage and erosion and sedimentation control works prior to works;
- all project personnel, vehicles and project equipment will be required to stay within the confines of approved work areas and to gain access to and from work areas via approved access routes; and
- users of KNP and Talbingo Reservoir will be informed of the construction activities, the extent of work areas and the locations of environmental exclusion areas with project notifications, including warning signs of construction activities and notifications of access restrictions at road junctions and trail crossings.

ii Road work methods

a. Existing tracks for upgrade without widening

Where road upgrades are proposed without widening, no works will occur beyond their current boundary, which will be defined by the growth of established vegetation at the edge of the track. There will be no vegetation clearing to upgrade these tracks, however in some instances minor trimming of overhanging branches may be required.

Tracks which have erosion features and rutting that prevent safe passing will have all or some of the following improvement works: removal of high points, infill of scours, blade levelling and compaction of the surface by rolling.

b. Track widening and construction of new roads

Where track widening or new roads are established a minimal disturbance footprint approach will be adopted. Before any widening works start, the following sequence of events will be carried out:

- drainage will be constructed;
- clearing and grubbing works will be undertaken including the removal of high points;
- bulk earthworks (ie cut and fill) will be carried out;
- earthworks may involve blasting in some sections where practical;
- road pavement material will be placed on the roadway;

- road safety furniture and signage will be installed as required; and
- site stabilisation and rehabilitation to happen as soon as practical.

iii Bridge construction and creek diversions

With respect to creek crossings and potential impacts on the bed and banks of waterways, Exploratory Works will require:

- the installation of Wallaces Creek Bridge;
- the installation of Camp Bridge across Yarrangobilly River; and
- potential, temporary water diversions within the watercourse to allow access during road and bridge construction.

For Wallaces Creek Bridge and Camp Bridge, bridge foundations and substructures (including piles, abutments and piers) will be constructed using standard techniques and provide the base for a steel girder bridge with composite deck that is consistent with the type of permanent bridge used in and around the existing Snowy Scheme.

Temporary water diversions within the watercourse may be required to facilitate works. Construction methods will include:

- installing erosion and sedimentation controls including scour protection;
- constructing temporary local diversions within the watercourse;
- replicating natural bed and bank profiles and install jute matting, geofabric and rock armouring as required;
- revegetating with endemic native species; and
- removing diversions once bed and banks are sufficiently stabilised.

Once the temporary diversions are no longer required all structures and materials will be removed and the watercourse returned to its previous state.

iv Portal construction pad, accommodation camp and laydown areas

The methods for site preparation and establishment will be similar at the portal construction pad, accommodation camp and laydown areas.

The construction methods will involve the steps outlined below.

- delineating and marking vegetation to be cleared;
- clearing designated vegetation, removing topsoil and transporting to dedicated location to use in rehabilitation;
- levelling and profiling of the works area will be undertaken including surface finishing;
- installing site drainage, soil erosion and other permanent environmental controls;

- compacting works areas and grading and contouring internal roads;
- marking the location of facilities upon completion of the earthworks and, where required, establishing concrete bases;
- assembling pre-fabricated facilities and setting up water utilities ;
- levelling and preparing bases and pavements for other amenities; and
- establishing and connecting power and communication services to the facilities.

v Supporting infrastructure

Construction of supporting infrastructure will include:

- establishing water and waste water infrastructure;
- establishing power infrastructure; and
- establishing communications infrastructure.

The typical methods for supporting infrastructure construction are summarised in Table 2.4 below.

Table 7.4 Supporting infrastructure construction methods

Supporting infrastructure	Typical methods
Water and waste water	Construction of water infrastructure will involve establishment of a STP and water treatment plant at the accommodation camp. The water services pipeline will be established between Middle Bay, the accommodation camp and the portal construction pad. Construction of the water services pipeline will involve trenching within proposed road alignments, placement of the water services pipeline and backfilling with excavated material.
Power	Construction of power infrastructure will involve establishment of diesel generators at the portal construction pad. Following establishment of diesel generators power services will be connected to the required equipment, facilities and accommodation via buried conduit. Establishment of the buried conduit will involve trenching within the proposed road alignments, placement of the conduit and backfilling with excavated material.
Communications	The communications cable will be installed as a buried conduit and as a submarine cable in some sections. The sequencing for communications cable construction is outlined below. i) Establish a buried conduit between Tumut 3 power station and Talbingo Reservoir. ii) Lay a submarine cable from Tumut 3 power station to Middle Bay. iii) Establish a buried conduit from Lobs Hole to Middle Bay and exploratory tunnel. iv) Establishment of the buried conduit will involve trenching within proposed road alignments, placement of the conduit and backfilling with excavated material. v) The submarine section of the communications cable will be laid via boat or barge with the cable weighted and placed along the floor of the reservoir.

vi Barge access construction

Construction of the barge ramps will involve excavation, backfilling, dredging, installation of, cast-in-situ concrete planks and bollards.

The required excavation above FSL could be completed with a range of equipment including excavators and dozers. Excavation and dredging below FSL will be undertaken with a long reach excavator either positioned on the land or mounted on a barge, depending on the water level at the time of construction. Dredging will take place within a silt curtain.

Submerged timber (dead trees) would need to be removed to provide safe navigation and enable construction of the barge facilities. Submerged timber may also need to be removed from the proposed locations for subaqueous excavated rock placement to provide safe navigation and ensure the placed material is stable. Submerged tree trunks and branches would be cut and removed to 3 m below MOL throughout the reservoir where navigation is required, unless sediment or rock is encountered above this level. If sediment or rock is encountered, dredging would be required and the stump and root system of the submerged vegetation would be removed. Following removal, the submerged vegetation would be placed along the shoreline in up to 10 m water depth. The placement will provide habitat for fish and other aquatic biota.

Dredge material will be disposed within Talbingo Reservoir as part of the subaqueous placement program as discussed in Section 7.5.4.

vii Exploratory tunnel construction

The major stage and primary activity of Exploratory Works is the extraction of rock to create the exploratory tunnel. Works will include the establishment of the portal and associated earthworks and batter protection, the drill and blast operation, rock coring, testing and cavern alignment confirmation to provide the completed exploratory tunnel. Tunnelling will be carried out via traditional methods, drill and blast being the most likely option. The exploratory tunnel will be shotcrete-lined. This method is summarised in Figure 7.18 and will involve the following steps:

- set out pre-support pattern and next advance blast pattern;
- install tunnel pre-support ahead of advancing tunnel face if required;
- drill next advance blast pattern;
- undertake charging and stemming of blast holes;
- conduct blasting;
- inspect blast area to ensure it is free of undetonated explosives;
- excavate blast spoil and scale the blasted zone;
- undertake geotechnical mapping of the tunnel face;
- set out rock bolt pattern and excavation performance monitoring locations where required;
- install tunnel support typically including rock bolts and steel fibre reinforced shotcrete and supplemented by steel ribs and lagging where required;

- install and monitor tunnel excavation performance monitoring instruments if required; and
- progressively repeat above sequence for the development of the exploratory tunnel.

The following supporting activities and methods will also be implemented during exploratory tunnel construction:

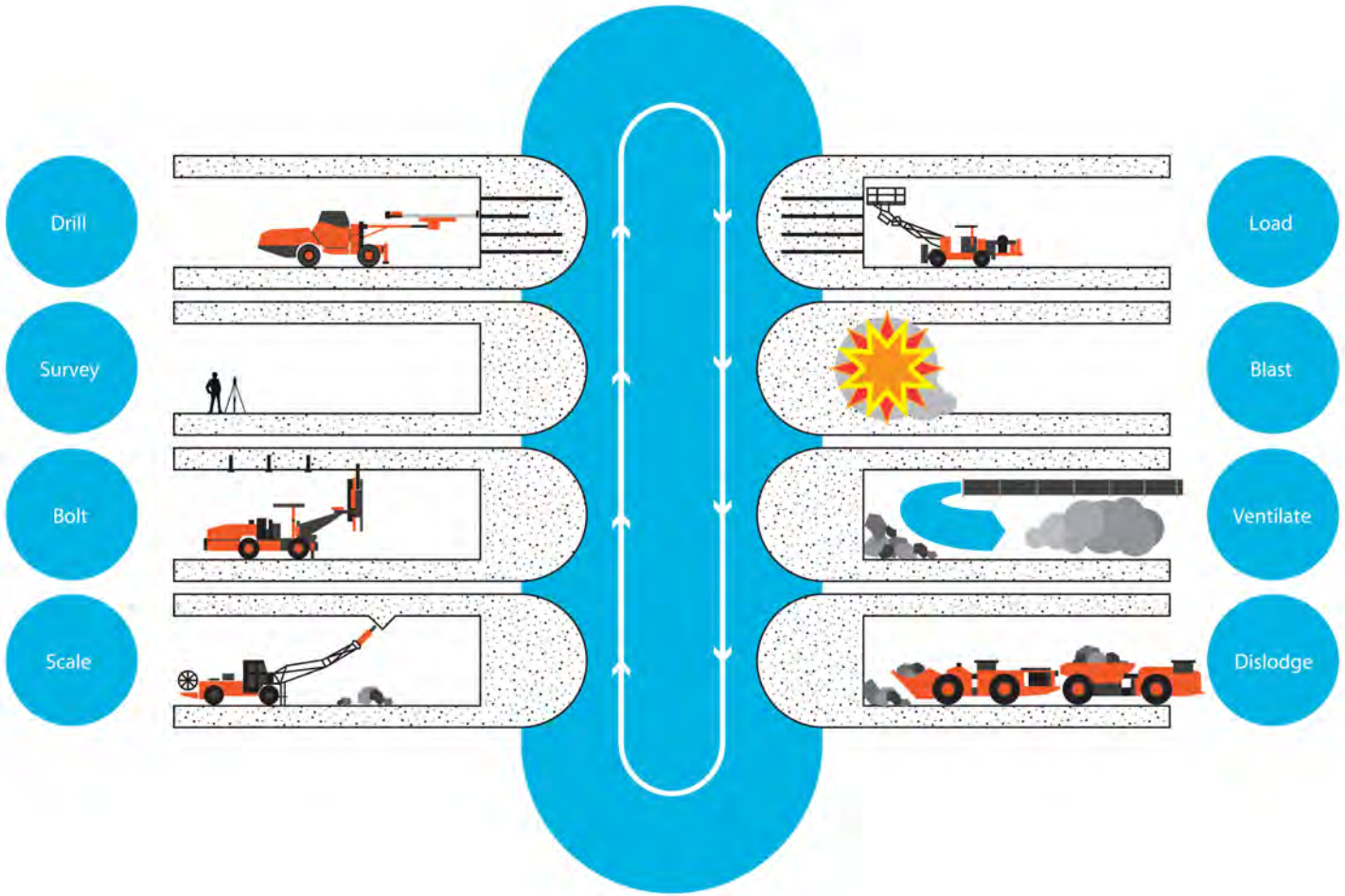
- forced ventilation of the tunnel excavation will commence once the tunnel has extended 20–30 m beyond the portal subject to the performance of the tunnel to self-ventilate;
- tunnel drainage systems will be progressively installed as tunnelling advances. This will typically consist of sumps constructed at 250–500 m intervals with the sumps connected to the tunnel portal and a sump at or near the tunnel face. The sump at the tunnel face will be equipped with a submersible pump and flexible discharge hose to feed tunnel water to the closest sump;
- bench excavation will follow as a complementary sequence 20–50 m behind heading construction following a similar drill and blast sequence;
- in-tunnel services such as water supply, power, lighting, air quality monitoring and communications will be progressively advanced around 20 m behind the tunnel face and away from blasting zone; and
- tunnel invert concreting will follow behind the bench development and may include under slab drainage system installation.

7.10.4 Plant and equipment

The indicative plant and equipment for each Exploratory Works element is provided in Table 2.5 below.

Table 7.5 Indicative plant and equipment

Exploratory Works element	Types of equipment
Exploratory tunnel	Excavator, dump truck, bulldozer, roller, grader, truck and dog, drilling rigs, grout pumps, agitator truck, shotcrete pump, semi trailer, water cart, light vehicles, compressor, generator, drills, jumbo, boomer, hydraulic breakers, air track, explosives transport vehicle, water bowser, 4WD telesco, stihl saw, forklift, light tower, compressor, gas monitor, rescue equipment, battery, ventilation fans, fuel truck, cement tanker, shotcrete robot, shotcrete pump, boom lift and water pump.
Portal construction pad	Excavator, dump truck, bulldozer, grader, truck and dog, crane, water cart, light vehicle, compressor, fuel vehicle, piling rig, agitator truck, concrete truck, semi trailer and roller.
Accommodation camp	Excavator, dump truck, bulldozer, grader, truck and dog, crane, water cart, light vehicle, compressor, fuel vehicle, piling rig, agitator truck, concrete truck, semi trailer and roller.
Access roads	Excavator, dump truck, bulldozer, grader, truck and dog, crane, water cart, light vehicle, compressor, fuel vehicle, piling rig, agitator truck, concrete truck, semi trailer and roller.
Barge access infrastructure	Bulldozer, excavator, roller, barge and skip truck.
Excavated rock management	Bulldozer, excavator, roller, barge and skip truck.



Source: http://www.railsystem.net/wp-content/uploads/2017/05/drill-and-blast-5.jpg

Drill and blast excavation process

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.18

7.10.5 Traffic movements

Through the duration of Exploratory Works, vehicle movements from the external road network will be required. The peak month for external traffic movements is predicted to occur in the sixth month of Exploratory Works with about 423 external traffic movements in this month. The peak hourly traffic generation has been estimated at 44 vehicle movements, which is expected to occur between 9–10am on a day during month six of Exploratory Works.

i Primary transport routes

It is expected that materials and equipment will travel along the Snowy Mountains Highway, Link Road and Lobs Hole Ravine Road. Materials and equipment may also travel via Talbingo to Talbingo Reservoir and transfer via a barge to site. It is expected that all heavy transport will be limited to daylight hours to limit noise impacts. The primary transport routes for construction material deliveries to site are provided in Figure 7.19.

ii Excavated rock haul route

Excavated material from the exploratory tunnel will be transported by truck from the portal construction pad to the excavated material emplacement area at Lobs Hole. The haul route for excavated material will use the Mine Trail Road extension and Mine Trail Road upgrade as shown in Figure 7.20. Excavated material haulage between the exploratory tunnel and the emplacement area will be undertaken 24 hours per day seven days per week.

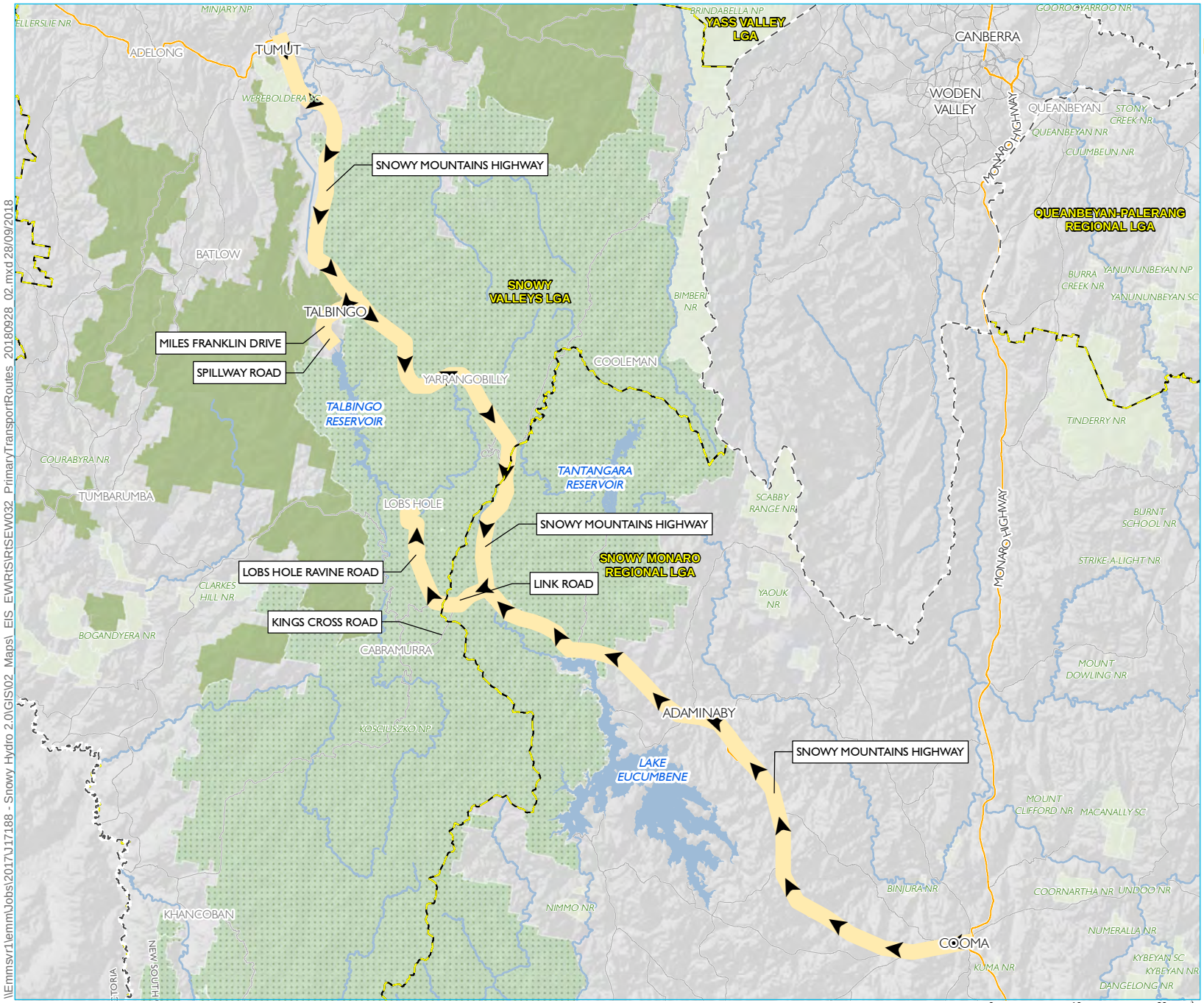
7.10.6 Construction resources

i Material quantities and sources

Construction materials required for Exploratory Works will indicatively include fuel, wood, building materials, scaffolding, explosives, reinforcing steel, wire and cable, tunnelling equipment, rock bolts, pre-cast concrete, electrical equipment, geotextiles, aggregate, cement, coated stone, concrete and guard rails. The sources of construction materials are yet to be determined. It is expected that construction materials will be sourced from several different locations including nearby towns such as Cooma and Tumut with some items and equipment being sourced from nearby cities such as Canberra, Sydney and Melbourne.

ii Water use

Total water consumption is estimated to be approximately 226 megalitres (ML) annually for the duration of Exploratory Works with the main quantities being used in the accommodation camp, CBP and site dust suppression. Table 2.6 provides a summary of estimated water consumption.



KEY

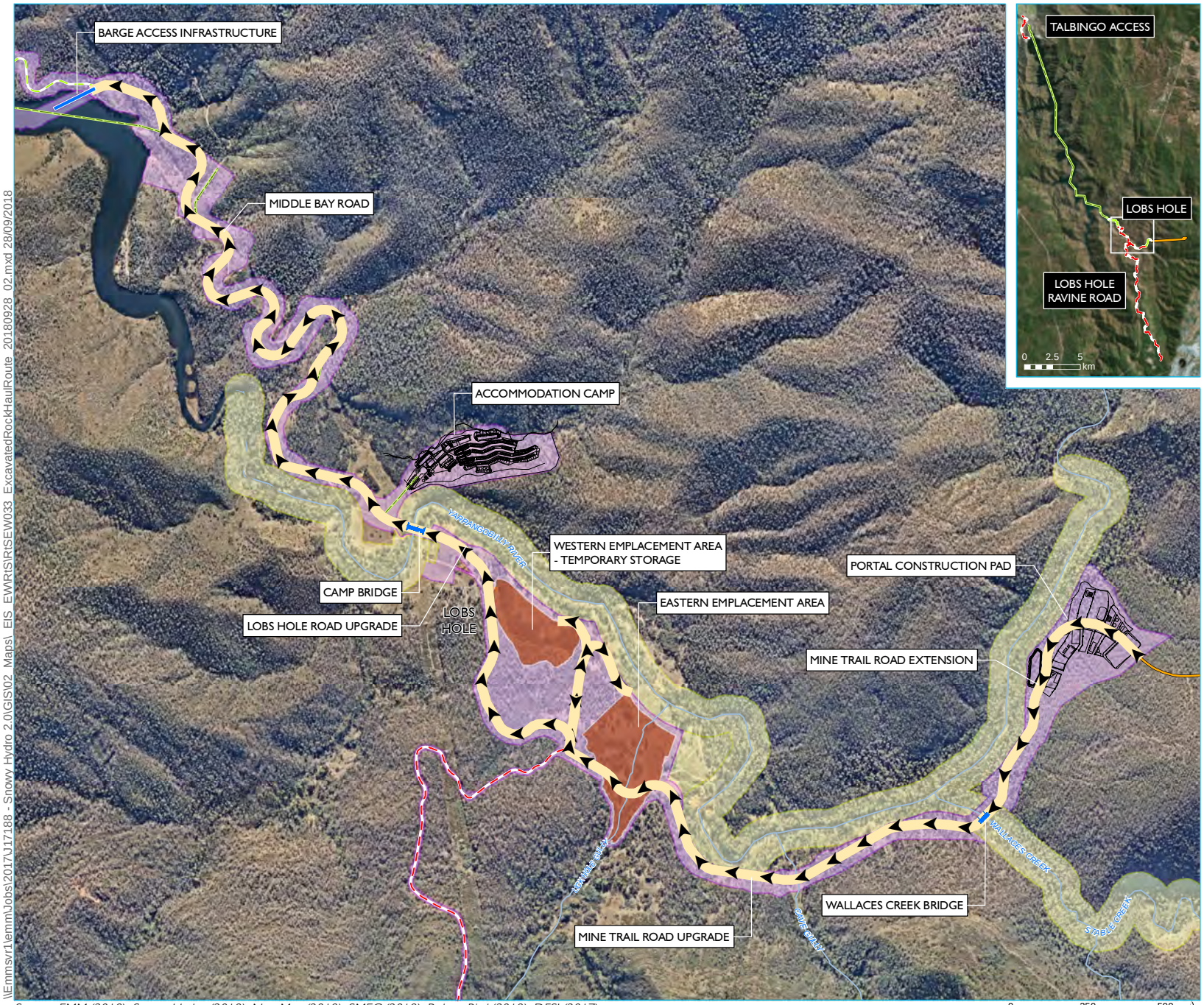
- Primary construction material transport routes
- Main road
- Local road
- Watercourse
- Waterbodies
- Kosciuszko National Park
- NPWS reserve
- State forest
- Local government area boundary
- State boundary

\\Emmsvr1\emmJobs\2017\J17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWRtS\RtSEW032 PrimaryTransportRoutes 20180928 02.mxd 28/09/2018

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

Primary transport routes

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.19



KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Exploratory tunnel
- Portal construction pad and accommodation camp conceptual layout
- Communications cable
- Excavated rock haul route
- Watercourse
- On land rock management
- Middle Bay barge access
- Disturbance footprint
- Avoidance footprint

\\Emmsvr1\emmJobs\2017\J17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWRtS\RtSEW033 ExcavatedRockHaulRoute 20180928 02.mxd 28/09/2018

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

Excavated material haul route

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 7.20

Table 7.6 Water consumption estimates

		Predicted water use	
Water use	**Source**	**kL per day**	**ML per year**
Potable water	Talbingo Reservoir	48	17.5
Dust suppression	Process water system[2]	Variable	201[1]
Concrete production	Process water system[2]	12	4.4
Tunnel construction	Process water system[2]	10	3.7
Total	-	-	**226.6[1]**

Notes: 1. Median value provided for dust suppression.

2. The process water system will manage water produced by and used by construction activities. The process water system will preferentially source water from the portal sump, the portal construction pad water management basin then Talbingo Reservoir.

iii Energy use

As stated in Section 7.8.2, Exploratory Works power supply will be provided by diesel generators at the portal construction pad. The predicted fuel use for the duration of Exploratory Works is approximately 8,690,000 L of diesel fuel.

iv Waste management

The management and disposal of waste water and excavated rock are described in Sections 2.8.1 and Section 7.5 respectively.

Construction waste such as used materials and packaging will be placed in dedicated waste containers at the accommodation camp or portal construction pad. Construction waste will be removed from the project area by truck and disposed of to a licensed facility. Waste facilities that may be used during Exploratory Works include:

- Cooma landfill, approximately one hour and 45 minutes drive (100 km);
- Adaminaby waste transfer station, approximately one hour and 10 minutes drive (50 km);
- Tumut waste and recycling centre, approximately one hour and 45 minutes drive (100 km); and
- Talbingo waste depot, approximately one hour and 20 minutes drive (75 km).
- Tumbarumba landfill, approximately 45 minutes drive (45km)

Any hazardous materials will be disposed of to an appropriately licensed facility.

v Ancillary construction areas

Ancillary facilities and laydown areas have been identified within the conceptual layout for the portal construction pad and accommodation camp. A number of other indicative construction and laydown areas have also been identified to support Exploratory Works. A summary of these sites are:

- Upper Lobs Hole Ravine Road laydown area within the transmission line easement;
- rock emplacement area laydown, storage and ancillary uses;

- a laydown area approximately adjacent to Talbingo barge ramp;
- two laydown areas adjacent to the Middle Bay barge ramp; and
- other minor laydown areas as needed during site establishment of watercourse crossings.

Ancillary construction areas may also include temporary site offices and fuel storage areas. All ancillary construction areas are within the project area and clearance footprint identified for Exploratory Works.

In addition, an area near Camp Bridge has been identified to be used for a plant nursery and organic stockpile area. No clearing of vegetation is required in this area.

7.11 Workforce

Exploratory Works is likely to take 34 months from initial mobilisation to completion of the exploratory tunnel. The estimated time to complete construction of the accommodation camp is up to 10 months. Workers constructing the accommodation camp will be accommodated within Cabramurra (existing Snowy Hydro town) until the accommodation camp is constructed and operational Some workers may also be accommodated at Snowy Hydro owned units at Talbingo during construction of the Talbingo barge ramp.

It has been estimated that Exploratory Works will have a total workforce of up to 201 people, comprising 181 employed for actual Exploratory Works and 20 employed in the accommodation camp. It has been estimated that at any one point in time there will be up to 164 people working on Exploratory Works on-swing, with the remaining 37 people off-swing. All of the workforce will work on 'swing'. This means that workers will likely work two weeks on and one week off.

Accommodation for 152 workers will be provided at the accommodation camp. Construction will be undertaken on a shift basis and accommodation will be shared between shifts. Once established, the accommodation camp is expected to provide sufficient accommodation for the duration of Exploratory Works.

It will take about 13 months to ramp up to 164 employees, and it is likely to remain reasonably constant at this level for the duration of Exploratory Works. The Exploratory Works employment curve is provided in Figure 4.22 below.

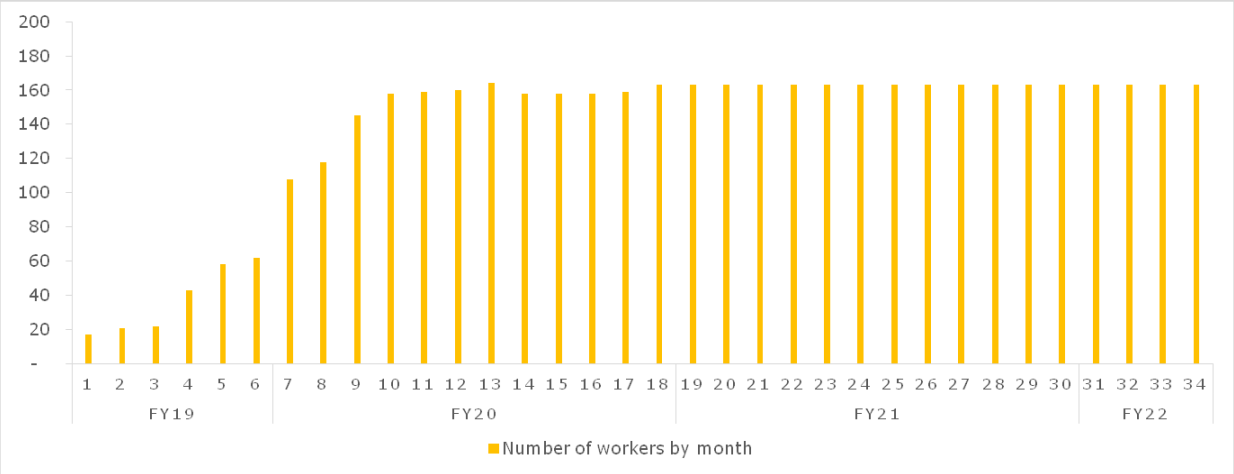


Figure 7.21 Exploratory Works employment curve

The average age of the workforce has been estimated to be 36 years. When on-swing, the workforce will work on shift. The shift times for the workforce are summarised in Table 2.7 below.

Table 7.7 Shift work summary

Work team	Shift summary
Tunnel	24 hours per day (2 shifts), 7 days per week
Roads	12 hours per day (1 shift), 7 days per week
Infrastructure	12 hours per day (1 shift), 7 days per week
Camp	16 hours per day (2 shifts), 7 days per week

The majority of the workforce will work on a fly-in fly-out (FIFO) and drive-in drive-out (DIDO) basis. Workforce access will be FIFO into Cooma or Canberra and then DIDO by bus to the project area. Access to the accommodation camp will be limited for workers on swing.

The approximate source geographies for the Exploratory Works construction workforce are provided in Table 2.8 below.

Table 7.8 Approximate construction workforce breakdown

Geography	Number	Percentage of workforce
Local area	23	11%
Local region	58	29%
Overseas	8	4%
Rest of Australia	112	56%

7.12 Rehabilitation and revegetation methods

The Exploratory Works rehabilitation strategy will consider the following phases:

- pre-development planning and design;
- site preparation;
- rehabilitation; and
- maintenance.

Rehabilitation will be considered during all phases of construction from design and site preparation, through to stabilisation and revegetation.

7.12.1 Pre-development planning and design

The core elements of the pre-development planning and design stage are:

- identify past, current and future land uses for the Exploratory Works project area;

- identify ecologically sensitive areas to protect (for example, the riparian zone of the Yarrangobilly River); and
- identify existing conditions and vegetation to preserve and specify for rehabilitation.

7.12.2 Site preparation

The rehabilitation activities to be undertaken during site preparation include:

- collection of indigenous/native seed and alpine sods for propagation;
- establishing an indigenous/native plant nursery within Lobs Hole to establish tube stock for revegetation;
- collecting and stockpiling organic matter from construction cuts and clearances, including topsoil, woodchip and organic matter for use in rehabilitation; and
- clearly define access routes for vehicles and machinery.

7.12.3 Stabilisation

Rehabilitation works to be undertaken alongside construction works include:

- rolling rehabilitation during construction to stabilise slopes and preparation of sites for revegetation including placement of organic matter and jute matting if required;
- mitigation of sediment runoff from rock emplacement areas and construction works including planting within swales and use of coir logs for sediment traps;
- hydroseeding soil slopes to assist stabilisation; and
- planting of higher risk slopes.

7.12.4 Maintenance and monitoring

Ongoing maintenance and monitoring of rehabilitation works will include:

- monitoring of slope stabilisation and revegetation;
- sedimentation ponds monitoring and maintenance;
- weed control;
- maintaining perimeter fencing to rehabilitation areas;
- replacement planting for seedlings that have not survived; and
- annual remulching of revegetation sites, until plants have sufficient mass to create their own biomass.

7.13 Decommissioning

Exploratory Works is construction works associated with further investigations to gather technical and environmental information for Snowy 2.0. Should Snowy 2.0 not proceed following the commencement or completion of Exploratory Works, elements constructed are able to be decommissioned and areas rehabilitated. Given works are within KNP, Snow Hydro will liaise closely with NPWS to determine the extent of decommissioning and types of rehabilitation to be undertaken. This approach will be taken to ensure that decommissioning allows for integration with future planned recreational use of these areas and to maintain the values of KNP.

These activities would be documented in a Decommissioning Plan, prepared in consultation with NPWS, and be implemented should Snowy 2.0 not proceed. Likely rehabilitation and decommissioning activities for Exploratory Works are shown in Table 2.9.

Table 7.9 Summary of likely decommissioning activities by site

Exploratory Works element	Rehabilitation and decommissioning activities
Accommodation camp	● removal of all accommodation facilities; ● some re-shaping of landform including fill to near pre-construction landform; ● rehabilitation of slopes through placement of organic matter and revegetation; and ● fencing and tree guards of revegetation areas to protect from grazing fauna.
Portal construction pad	● closure of exploratory tunnel entrance; ● removal of all construction infrastructure; ● re-shaping of batters by site-sourced fill material, with batters at 3H:1V with berms (4 m minimum), between each batter and to reshape to near pre-construction landform; ● rehabilitation of fill and cleared areas through addition of organic matter and revegetation; ● planted swales and sediment basins at the base of slope to assist in ongoing water quality treatment; and ● fencing and tree guards of revegetation areas to protect from grazing fauna.
Excavated rock emplacement areas	● removal of all construction infrastructure; ● final shaping of emplacement areas including finishing stockpiles surfaces; ● rehabilitation and revegetation or removal of emplacement areas in consultation with NPWS; ● fencing and tree guards of revegetation areas to protect from grazing fauna; and ● planted swales and sediment basins at the base of the stockpile to assist in ongoing water quality treatment.

During construction of Exploratory Works the maintenance and management of the project area will be the responsibility of the construction contractors. Throughout construction, the Exploratory Works will be carried out in accordance with a construction environmental management plan (CEMP).

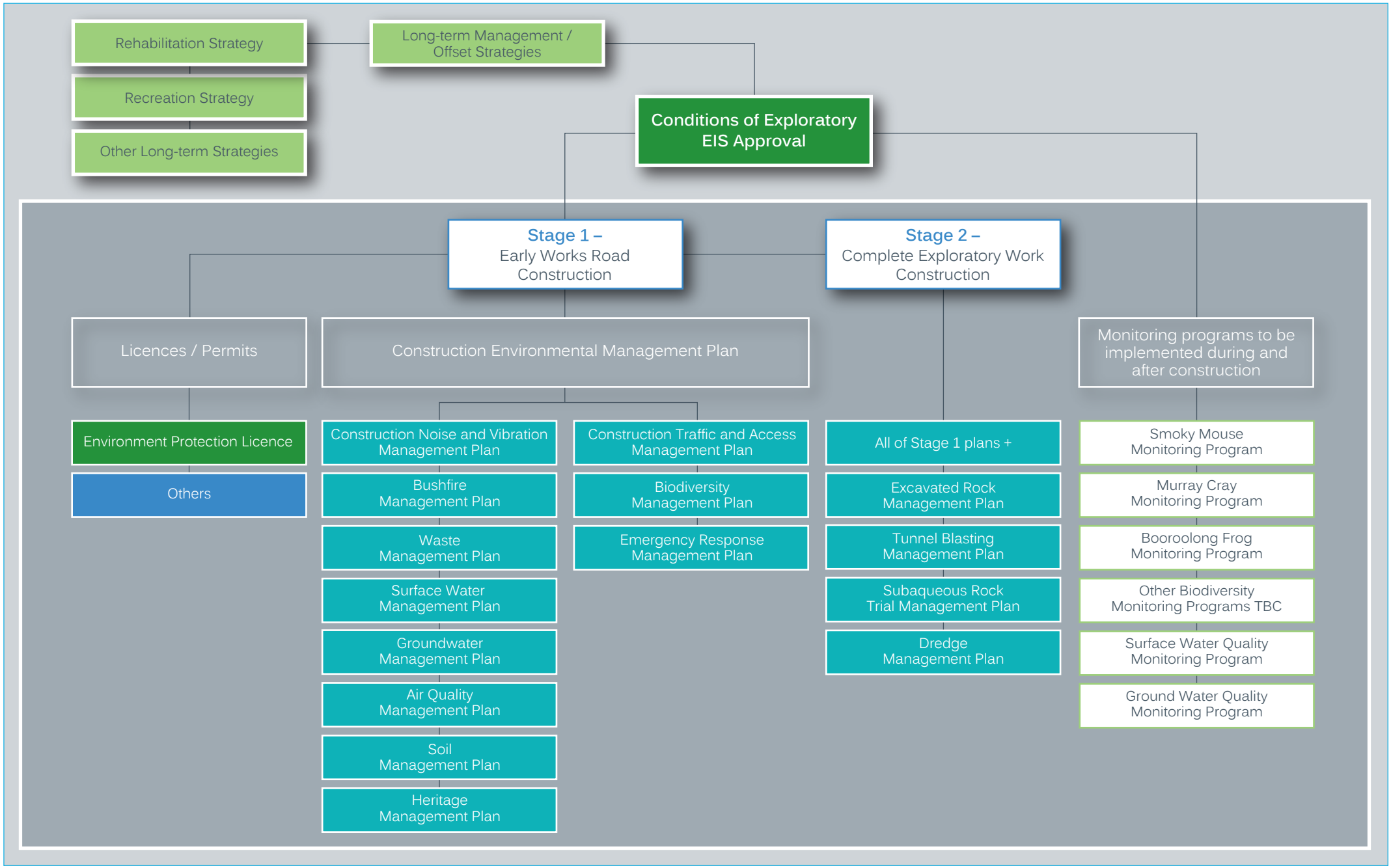
Following the construction of Exploratory Works all ongoing maintenance and management of permanent infrastructure will be the responsibility of Snowy Hydro. The Snowy Management Plan Environmental Management Plan (SMP EMP) outlines Snowy Hydro's obligations with regard to the protection of the environment and public health and will be updated to include the ongoing management and maintenance of permanent infrastructure developed through Exploratory Works. The SMP EMP will also be updated to include any additional permits, approvals or plans required for Exploratory Works.

CHAPTER 8

UPDATED MITIGATION MEASURES

8 Updated mitigation measures

Following public exhibition of the Exploratory Works EIS revisions to the mitigation measures included in the EIS have been identified. Mitigation measures have been revised in order to further minimise environmental impacts, improve the constructability of Exploratory Works and meet the expectations and requirements of stakeholders. A complete and comprehensive list of updated mitigation measures including mitigations that have been revised following public exhibition is provided in Table 8.1 below. The Exploratory Works environmental management framework is provided in Figure 8.1.



Exploratory Works Environmental Management Framework

Snowy 2.0
Response to Submissions
Exploratory Works
Figure 8.1

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Biodiversity			
Impacts to biodiversity	ECO01	The CEMP will include the following:	The Biodiversity Management Plan (BMP) will include the following:
		• identification of guidelines relevant to construction, the matters they apply to and what is required to ensure compliance;	• 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;	• pre-disturbance inspection requirements to identify features of conservation significance and select appropriate management measures and environmental controls which will include: – exclusion fencing around all areas of retained significant vegetation and fauna habitat adjacent to construction compounds and the camp; – where works are to be undertaken within the 50 m buffer zone, all vegetation, rocks, logs and other shelter are to be carefully inspected for frog species; and – vegetation clearing is to follow a two-staged process based on non-habitat and habitat vegetation.
		• standard precautions and mitigation measures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fisheries NSW 2013);	• standard precautions and mitigation measures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fisheries NSW 2013);
		• tree assessment and management protocols consistent with AS 4970-2009 Protection of trees on development sites; and	• tree assessment and management protocols consistent with AS 4970-2009 Protection of trees on development sites; and

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• terrestrial and aquatic weed, pest and pathogen prevention and management protocols, including washdown facilities at suitable locations.	• terrestrial and aquatic weed, pest and pathogen prevention and management protocols which will include; – construction of wash-down stations or the use of alternate hygiene protocols at suitable locations where practicable; – wash-down or alternate hygiene protocols will be applied to all vehicles prior to movement from Link Road to Lobs Hole Ravine and vice versa where practicable; – implementation of a weed and pathogen monitoring program; – implementation of a weed control program if weeds are identified within the site; – no food waste will be left outside in open areas accessible to feral animals and waste will be stored appropriately in lidded, inaccessible bins and disposed off-site; – remote camera monitoring for feral animals at the accommodation camp; – a predator control program will be implemented, in conjunction with OEH and NPWS, to control feral animals; – all equipment and vessel components, such as propellers, hulls, anchors and any other equipment used should be inspected for pest aquatic plants (particularly fragments of Canadian pondweed (Elodea canadensis) known to be present in Talbingo Reservoir) and pest fish; – vessels and vehicles should be washed down and cleaned prior to arriving at the boat ramp to be launched onto the reservoir and before travelling off-site from the reservoir; and – all personnel working within the waters should be instructed on how to identify potential pests.
			• pre-clearance procedures; and
			• an unexpected threatened species finds procedure.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	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.	Other than for Yarrangobilly River Bridge, Wallaces Creek Bridge and sections of Mine Trail Road and Lobs Hole Road required for permanent infrastructure ground disturbance within the avoidance footprint (Yarrangobilly River and Smoky Mouse habitat) will be prohibited, and marked with environmental controls as an exclusion area.
	ECO03		The accommodation camp will be sited in areas of lower quality vegetation where practicable.
Impacts on threatened species	~~ECO03~~ ECO04	A Threatened Species Management sub plan will be developed and implemented as part of the CEMP during construction. The sub plan will include:	Potential impacts to Threatened Species will be managed through the Biodiversity Management Plan during construction. The Biodiversity Management Plan will include:
		• pre-clearance procedures;	
		• an unexpected threatened species finds procedure;	
		• Murray Crayfish monitoring program (Talbingo Reservoir)	• Murray Crayfish monitoring program (Talbingo Reservoir);
		• Smoky Mouse monitoring program; and	• Smoky Mouse monitoring program; and
		• Booroolong Frog monitoring program.	• Booroolong Frog monitoring program.
	~~ECO04~~ ECO05	• Vehicle traffic movements along Upper Lobs Hole Ravine Road will be: • limited to day time hours only (except for emergencies); and • limited to 40km/h.	Vehicle traffic movements along Upper Lobs Hole Ravine Road will be: • limited to day time hours only (except for emergencies). Day time hours are to be taken as the time between First Light and Last Light; • limited to 40km/h; and • where practicable, reduced through the use of Talbingo Reservoir to barge heavy machinery, construction equipment and materials.
	ECO06		During Exploratory Works frog exclusion fencing will be installed in key areas where infrastructure is located in close proximity to Booroolong Frog primary habitats such as the bridge crossings. The fencing will be designed to minimise frogs from being able to access the road crossing.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	ECO07		Fauna spotters will check areas adjacent to Yarrangobilly River prior to clearing for Booroolong Frog and translocate them to adjacent habitats away from impacts.
	ECO08		During construction the Yarrangobilly River buffer zone will be revegetated and weed species removed, where practicable.
	ECO09		Where works are to be undertaken within the 50 m buffer zone of Yarrangobilly River, all vegetation, rocks, logs and other shelter are to be carefully inspected for frog species.
Impacts on fish eggs and larvae due to extraction of water from Talbingo Reservoir	~~ECO05~~	The water pipeline intake will be designed to:	The water pipeline intake will be designed to:
	ECO10	• prevent / discourage adult fish from approaching or entering the intake	• prevent adult fish from entering the intake and discourage adult fish from approaching the intake which may include: – incorporation of an enclosed, dark and long passage approach to the intake; – if feasible, screening of the intake with at least 5 mm 3 mm mesh screen; – if feasible, installation of a coarse mesh (e.g. cm aperture) screen / cage a few metres around the intake and removal and control of any aquatic vegetation and wood debris within and immediately adjacent to the intake location; and – if feasible, limiting the approach water velocity at the headwall during normal operation ideally to 0.1 m/s.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• locate the intake pump in deeper water where possible away from fish habitat such as woody debris and aquatic plants; and	• locate the intake pump in deeper water where possible; and
		• allow for pump start up procedures involving initial slow water velocity to reduce likelihood of aquatic biota being drawn into the pump.	• 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~~ ECO11	The permanent bridges at Yarrangobilly River and at Wallaces Creek will be designed with consideration of Policy and Guidelines for Fish Habitat Conservation Update 2013 (DPI 2013) and Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries 2003).	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~~ ECO12	The temporary bridges at Yarrangobilly River and at Wallaces Creek will be designed and constructed to:	The temporary bridges at Yarrangobilly River and at Wallaces Creek will be designed, constructed and removed to:
		• adhere to guidelines for temporary structures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (DPI 2013) and recommended crossing design considerations in Fairfull and Witheridge (2003); and	• where practicable implement measures in line with the guidelines for temporary structures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (DPI 2013) and recommended crossing design considerations in Fairfull and Witheridge (2003) which includes:
			– temporary in-stream structures will avoid spanning the full width of the waterway channel to ensure base flow conditions are maintained down the waterway where practicable; – maintaining some unmodified channel so that a weir effect or flow through rock interstices only is not created where practicable; and – temporary in-stream structures will be inserted during low-flow periods where practicable
		• ensure any build-up of debris potentially obstructing to fish passage will be removed.	• ensure any build-up of debris which potentially obstructs fish passage will be removed; and
			• the temporary structures will be removed and the river channel rehabilitated following construction of the permanent bridges.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	~~ECO08~~ ECO13	Construction of the temporary bridge at Yarrangobilly River will avoid or minimise works during the migration time of Macquarie Perch (October to January).	Construction and removal of the temporary bridge at Yarrangobilly River will avoid or minimise in stream works during the migration time of Macquarie Perch (October to January) where possible.
Impact to aquatic ecology from erosion and sedimentation	~~ECO09~~ ECO14	The water quality controls described in the Surface Water Assessment (Appendix M) and Aquatic Ecology Assessment (Appendix G) will be implemented.	The water quality controls described in in WAT01 to WAT05 and WM1.1 to WM 8.8 will be implemented.
Impacts to aquatic habitat and biota during dredging and subaqueous placement	~~ECO10~~ ECO15	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:	The subaqueous placement monitoring program for Talbingo Reservoir will be developed and implemented. Measures relevant to aquatic ecology will be implemented as described below 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;	• monitoring of water quality indicators including turbidity, pH and dissolved oxygen within and downstream of the construction area and, if a decline in water quality is detected as a result of the works, investigate potential causes and develop and implement an appropriate response;
			• the extent of the placement area will be minimised as far as practicable; • the extent of the dredge footprint will be minimised as far as practicable; • subaqueous placement would not occur shallower than 3 m below minimum operating level (i.e. where aquatic habitat, such as aquatic plants are less likely to occur); • placement of large rocks within the placement area will occur and is expected to enhance the value of this habitat for fish and mobile invertebrates by providing hard surface and refuges; • un-necessary noise and vibration disturbances should be kept to a minimum where practicable to avoid impacts to fish and other aquatic species;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management 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;	• 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	• where feasible, mapping/identification of aquatic habitats within and adjacent to the subaqueous placement areas and other reference areas to characterise the habitat and place this in context of that present throughout the entire reservoir; and
			• mapping of aquatic habitats would include searches for crayfish burrows along the shoreline, as these could indicate the presence of Murray crayfish and would inform the final placement area extent. Deployment of crayfish traps along the shorelines adjacent to the placement area and within the placement area could be used to re-locate any large mobile invertebrates (including any Murray crayfish) from these areas to nearby sections of the reservoir that would not be affected by placement;
			• prior to commencement of seismic surveys, smaller releases of compressed air will be undertaken just below the surface; • during seismic surveys, operators will be vigilant to potential harm to fish and invertebrates. If any harmed or dead biota are observed during works then this would result in the scaling back of works or review and adjustment of methodology (e.g. magnitude, frequency and/or duration of releases);
		• minimising suspension of sediment and turbidity by using the methods described in the Barge Access Infrastructure Report (Appendix L).	• minimising suspension of sediment and turbidity by implementing WAT14 and WAT15.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Kosciusko National Park			
Impacts to amenity	KNP01	Mitigation measures relevant to noise and air quality will be implemented as part of the CEMP, including:	Mitigation measures relevant to noise and air quality will be implemented as part of the Noise and Vibration Management Plan, including:
		• mitigation measures in Table 5.19 for noise impacts at Section 5.8.1.	• those referred to in NO01 to NO03;
		• mitigation measures in Table 5.20 for air quality at Section 5.8.2.	• those referred to in AIR01.
	KNP02	Construction contractor should minimise construction lighting and resulting glare to the maximum extent possible where it can be shown that to do so would not compromise safety.	Construction contractor should minimise construction lighting and resulting glare to the maximum extent practicable where it can be shown that to do so would not compromise safety.
	KNP03	All lighting should incorporate cut-off shields and be directed downward toward work activities, away from the night sky and away from known locations of light-sensitive habitat	All lighting should incorporate cut-off shields and be directed downward toward work activities, away from the night sky and away from known locations of light-sensitive habitat.
Recreational users	KNP04	Mitigation measures relevant to recreational users will be in line with the Recreational Users Study (Appendix C of Appendix R) and include: • mitigation measures in Table 5.18 for social impacts at Section 5.7.4.	Mitigation measures relevant to recreational users will implemented including: • those referred to in SEC01 to SEC08.
Visual impacts	KNP05	Consider potential visual impacts when determining disturbance footprint and consider amending design and reducing or modifying the extent of the clearing as appropriate.	Consider potential visual impacts when determining disturbance footprint and consider amending design and reducing or modifying the extent of the clearing as appropriate.
	KNP06	The landscape management plan (including rehabilitation and revegetation) should take into consideration of potential visual impacts.	The landscape management plan (including rehabilitation and revegetation) should take potential visual impacts into consideration.
Conservation impacts	KNP07	Mitigation measures relevant to conservation will be implemented as part of the CEMP, they are: • mitigation measures in Table 5.3 for biodiversity impacts at Section 5.1.4.	Mitigation measures relevant to conservation will be implemented as part of the Biodiversity Management Plan, including: • those referred to in ECO01 to ECO10.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Land			
Impacts to soil resources	SOIL01	Soil management procedures (including stripping, stockpiling and application) will be implemented as part of the CEMP. The objectives of soil management will be to:	Soil management procedures (including stripping, stockpiling and application) will be implemented as part of the CEMP. The objectives of soil management will be to:
		• preserve as much of the topsoil and subsoil as possible;	• preserve as much of the topsoil and subsoil as possible;
		• prevent contamination;	• minimise the risk of contamination;
		• ensure soil is not degraded or compacted during construction and following reinstatement;	• minimise the risk of any topsoil degradation or compaction during construction and following reinstatement;
		• avoid or ameliorate subsoil constraints immediately below topsoils;	• ameliorate subsoil where required for use in rehabilitation works;
		• ensure topsoil is not mixed with unsuitable soil and spoil materials; and	• minimise topsoil mixing with unsuitable soil and spoil materials during stripping and stockpiling; and
		• ensure reinstatement of soil horizons in the correct order and depths.	• ensure reinstatement of soil horizons in the correct order and required depths to allow for rehabilitation.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			Topsoil and subsoil will be stripped, stockpiled and handled during construction to avoid degradation. Management measures that will be implemented include: • the topsoil stripping procedure and stockpiling procedure will be developed and implemented to maximise the salvage of materials and minimise soil degradation; • structural decline of soil will be minimised by using suitable machinery, timing stripping where practicable, using correct stockpile development techniques and minimising handling of topsoil materials; • topsoil and subsoil will be stockpiled, with stockpiles designed and located to minimise contamination, development of anaerobic conditions, and to avoid erosion and dust generation; • nutrient decline will be minimised by managing stockpile methods and heights; • stockpiles will be regularly inspected for weeds; and • to minimise the risk of loss from wind and water erosion to stockpiled topsoil, a vegetative cover will be established or the stockpile covered.
Erosion and sediment transport	SOIL02	Erosion and sedimentation controls will be implemented as part of the Water Management Plan to minimise erosion potential, in particular in areas of dispersive soils, in accordance with the guideline Managing Urban Stormwater, Volume 2A Installation of Services, or equivalent.	Erosion and sedimentation controls will be implemented as part of the Water Management Plan to minimise erosion potential in accordance with the guideline Managing Urban Stormwater, Volumes 1 and 2, or equivalent.
Changes to landform and land use	SOIL03	A Landscape Management Plan will be prepared for the rehabilitation of disturbed areas: The Plan will include:	A Landscape Management Plan will be prepared for the rehabilitation of disturbed areas. The Plan and management controls will include:
		• objectives for landform rehabilitation at each site;	• objectives for landform rehabilitation at each site;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• measures to ensure successful rehabilitation and stabilisation of soils; and	• measures to ensure successful rehabilitation and stabilisation of soils which includes implementing the following: – collection of indigenous/native seed and alpine sods for propagation; – native species will be chosen that are representative of the surrounding area; – establishment of an indigenous/native plant nursery within Lobs Hole, to establish tube stock for revegetation; – only clean and contaminant-free soil materials will be bought to site and used in construction; – organic material from construction cuts and clearances will be stockpiled and reused in the works where practicable; – the topsoil application procedure will be developed and implemented; – soil will be applied to provide sufficient depth for plant growth and in a manner which minimises any degradation of soil characteristics; – soil nutrient decline will be amended at the time of rehabilitation by utilising fertilisers and amendment techniques (eg gypsum, organic matter or lime application); – disturbed areas would be re-vegetated progressively during construction of the Exploratory Works; and – erosion and sediment control measures will not be removed until the sites have been rehabilitated and suitably stabilised.
		• a soil balance to identify the depths and volume of soils to be reapplied in particular areas during rehabilitation.	• minimum depths of soils to be reapplied in particular areas during rehabilitation.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			• measures to ensure successful rehabilitation and stabilisation of disturbed riparian zones including: – revegetation of disturbed banks and areas cleared of vegetation with appropriate native species; – native species selected for planting beneath the bridge structures should be tolerant of shade; and – re-instatement of any wood debris and boulders removed during construction.
Compatibility of land use post-Exploratory Works	SOIL04	A Final Rehabilitation Strategy will be prepared to guide the long term rehabilitation of the site. Rehabilitation goals and objectives for the domains of the project area will be determined through the final land use.	A Final Rehabilitation Strategy will be prepared to guide the long term rehabilitation of the site. Rehabilitation goals and objectives for the domains of the project area will be determined through the final land use.
		This strategy will be developed in consultation with NPWS and other relevant government agencies.	This strategy will be developed in consultation with NPWS and other relevant government agencies.
Disturbance of existing contamination, including areas of naturally occurring asbestos	CON01	A Contaminated Land Management Plan will be prepared and implemented during construction. The Plan will include:	A Contaminated Land Management Plan will be prepared and implemented during construction. The Plan will include:
			• additional mitigation and remediation measures if confirmed during detailed design for areas of environmental concern which includes the adit South and Lobs Hole shallow groundwater;
		• management procedures to:	• management procedures to:
		– manage areas of known or potential contamination that would be impacted during Exploratory Works;	– manage areas of known or potential contamination that would be impacted during Exploratory Works;
		– manage unexpected finds in the event that unexpected contamination sources are identified. This would include steps to cease works in the affected area, undertake further investigation to assess the extent, magnitude and type of contaminants and identify appropriate remedial actions.	– manage unexpected finds in the event that unexpected contamination sources are identified. This would include steps to cease works in the affected area, undertake further investigation to assess the extent, magnitude and type of contaminants and identify appropriate remedial actions.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			• an outline of the control measures required to divert or capture and limit exposure of surface runoff to the contaminated area; • an outline of the qualifications and experience required of persons who will conduct contamination investigations in accordance with guidelines made or approved under the Contaminated Land Management Act 1997; • an outline of the remediation and rehabilitation techniques, the waste classification and disposal requirements, and the subsequent validation criteria that may be considered during construction.
		• Site specific asbestos management plan (AMP) for the identified 600 m section of Lobs Hole Ravine Road where there is potential for asbestos to occur. The plan would be prepared to satisfy the relevant legislative requirements and guidelines and include a procedure for the identification, testing and remediation of areas identified as containing asbestos. The AMP would also include procedures for air monitoring and clearance inspections and reports.	A site specific asbestos management plan (AMP) for the identified 600 m section of Lobs Hole Ravine Road where there is potential for asbestos to occur will be developed and implemented. The plan would be prepared to satisfy the relevant legislative requirements and guidelines and include a procedure for the identification, testing, and where required, remediation of areas identified as containing asbestos.
	~~CON03~~ CON02	An Excavated Rock Management Plan will be prepared and implemented during construction. The Plan will include:	An Excavated Rock Management Plan will be prepared prior to the commencement of tunnelling. The Plan will include:
		• protocols for handling, geochemical testing, classification, storage and disposal/placement of excavated rock will be implemented to ensure that excavated material is appropriately managed; and	• protocols for handling, geochemical testing, classification, storage and disposal/placement of excavated rock will be implemented to ensure that excavated material is appropriately managed; and
		• monitoring measures to be included as part of the Surface and Groundwater Monitoring Program, to monitor potential impacts from the placement of excavated rock material.	• monitoring measures to be included as part of the Surface and Groundwater Monitoring Program, to monitor potential impacts from the placement of excavated rock material.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			• management measures which include: – stockpile designs will incorporate benching and bunding to avoid mobilisation of sediment and rock; – controls to avoid the risk of acid or metal laden run off into the Yarrangobilly River; – progressive verification of the adequacy of controls; – minimisation of placement footprint where practicable; and – minimising the construction footprint and extent to which soil and vegetation within the riparian zone are disturbed.
Disposal of contaminated material	CON03		Excavated material which is classified as contaminated, which is not suitable for reuse on site or on onsite remediation, will be transported to a disposal facility that is legally able to accept the material for reuse or disposal. The material will be classified and disposed of to an appropriately licensed facility in accordance with the Waste Classification Guidelines (NSW EPA 2014).
Geodiversity – rock streams	GEO01	Measures to avoid and minimise impacts to geodiversity features will be implemented as part of the CEMP and include:	Measures to avoid and minimise impacts to geodiversity features will be implemented as part of the CEMP and include:
		• installing rock protection measures to protect identified features and limit direct and indirect impacts to the features as far as possible;	• digging the road deeper into the rock stream should be avoided where practical, and excavations that take place to widen the road should be undertaken on the upslope side of the road;
		• cataloguing any fossiliferous rock removed during upgrade of Lower Lobs Hole Ravine Road;	• appropriate drainage should be constructed under the road to ensure no build-up of water occurs above the road, within the rock stream, during heavy rain;
		• minimising surface water pollution within the Ravine karst catchment by installing erosion and sediment controls to manage water quantity and quality; and	• educational signage should be provided in a nearby suitably widened area to provide information on the periglacial rock stream geoheritage features;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• monitoring the effectiveness of environmental controls during Exploratory Works.	• if any works are required to stabilise upslope sections of rock stream it is recommended that open mesh wire fencing is used so the general public and scientists can see and appreciate the architecture of the deposit. Building a solid wall or spraying concrete on the upslope side should be avoided.
Geodiversity – fossiliferous beds	GEO02		Measures to avoid and minimise impacts to geodiversity features will be implemented as part of the CEMP and include: • representative excavated spoil is to be preserved off site so that palaeontologists (from various research organisations) can look through the fresh material and collect fossil specimens for scientific research and curation in their respective collections; and • depending on the option of road upgrades to be implemented, interpretive signs could be installed in an appropriate location near the cuttings to highlight features in the exposures, provided the fossils were protected from being easily collected.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Water			
Controls for construction disturbance areas Controls for all construction areas	WAT01 WM_2.1	Erosion and Sediment Control Plans (ESCP) will be prepared for all work sites in accordance with the Blue Book. The plans will consider local soil characteristics, clean water management and the proposed construction methods.	An Erosion and Sediment Control Plan (ESCP) will be prepared for each construction area. Each ESCP will: • consider local soil characteristics, clean water management and the proposed construction methods; • apply all practical source control and rehabilitation methods; and • be progressively amended as required during construction. A suitably qualified erosion and sediment control expert will be commissioned to develop and execute each ESCP. The expert will be responsible for overseeing the development of the ESCP and inspecting and auditing controls during implementation. Regular expert input will ensure that erosion and sediment control practices will be established and operated to a high standard and progressively improved. An ESCP will be prepared for each construction area. The plan will consider local soil characteristics, clean water management and the proposed construction methods.
	WAT02	The following controls will be applied to the design of the clean water management system:	The following controls will be applied to the design of the clean water management system:
	WM_1.1	• where possible, all clean water will be diverted around or through water management areas. Runoff from clean water areas than cannot be diverted must be accounted for in the design of water management systems;	• Where practical, all clean water will be diverted around or through water management areas. Runoff from clean water areas that cannot be diverted must be accounted for in the design of water management systems.;
	WM_1.2	• all clean water drainage will be designed and constructed to convey the 1% AEP peak flow and will have adequate scour protection;	• All permanent clean water drainage will be designed and constructed to convey the 1% AEP peak flow and will have adequate scour protection. Temporary clean water drainage will be designed to convey the 50% AEP peak flow;
	WM_1.3	• where possible, diversions will seek to avoid materially increasing flow rates in adjoining watercourses; and	• Where practical, diversions will seek to avoid materially increasing flow rates in adjoining watercourses.; and

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	WM_1.4	• where possible, the diversion of major drainage lines or watercourses using contour drains will be avoided.	• Where practical, the permanent diversion of drainage lines or watercourses using contour drains will be avoided. .
	WAT03 WM_2.7	Where construction areas are not constrained by terrain, sedimentation dams will be constructed in accordance with the methods recommended in Managing Urban Stormwater: Soils and Construction: Volume 1 (Landcom, 2004) and Volume 2D (DECC, 2008). Construction of sedimentation dams in steep terrain will be avoided.	Where appropriate, sedimentation basins will be constructed in accordance with the methods recommended in Managing Urban Stormwater: Soils and Construction: Volume 1 (Landcom 2004) and Volume 2D (DECC 2008). Water treatment chemicals will be applied to sedimentation basins with catchment areas greater than 2,500 m2 to enhance sedimentation and phosphorus and dissolved metal removal rates. Only water treatment chemicals that have a low risk of increasing the toxicity of treated stormwater will be used. Water treatment chemicals will be applied using an automated chemical dosing and mixing system. The design treatment rate will be the 1 year ARI peak flow.
	WM_2.1		An Erosion and Sediment Control Plan (ESCP) will be prepared for each construction area. Each ESCP will: • consider local soil characteristics, clean water management and the proposed construction methods; • apply all practical source control and rehabilitation methods; and • be progressively amended as required during construction. • A suitably qualified erosion and sediment control expert will be commissioned to develop and execute each ESCP. The expert will be responsible for overseeing the development of the ESCP and inspecting and auditing controls during implementation. Regular expert input will ensure that erosion and sediment control practices will be established and operated to a high standard and progressively improved.
	WM_2.2		The clean water management controls WM_1.1 to 1.4 apply to all ESCPs.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	WM_2.3		Stockpiles will be located where they are not exposed to concentrated or flood flow. Flood flow is defined as the 20% AEP flood extent. Monitoring for dispersion and erosion of soil stockpiles will be undertaken, particularly on moderately dispersive soils. Addition of ameliorants, such as gypsum and organic matter for dispersive soils will be undertaken as needed.
	WM_2.4		Soils will be lightly scarified on the contour to encourage rainfall infiltration and minimise run-off. As soon as practicable after respreading, a cover crop will be established to limit erosion and soil loss. This will also provide good mulch for native plant establishment.
	WM_2.5		Sediment traps or filters will be maintained at all discharge locations. The filters will only use non-toxic or materials which will not cause material harm to the environment, including biodegradable or natural materials where practicable. Sediment traps, filters and other appropriate sediment control devices will be installed to target the removal of coarse sediments.
Additional controls for construction areas that are constrained by terrain or the proposed disturbance boundary	WM_2.6		Runoff from construction areas that are constrained by terrain or the proposed disturbance boundary and are larger than 2,500 m^2 will be captured in a sump and pumped to a water treatment plant. The water treatment plant will use water treatment chemicals to enhance sedimentation and phosphorus and dissolved metal removal rates using an automated chemical dosing system. Only water treatment chemicals that have a low risk of increasing the toxicity of treated stormwater will be used. The design dewatering and treatment rate will be the 1 in 3 month average return interval (ARI) peak flow.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Additional controls for construction areas that are not constrained by terrain	WM_2.7		Where appropriate, sedimentation basins will be constructed in accordance with the methods recommended in *Managing Urban Stormwater: Soils and Construction: Volume 1* (Landcom 2004) and Volume 2D (DECC 2008). Water treatment chemicals will be applied to sedimentation basins with catchment areas greater than 2,500 m^2 to enhance sedimentation and phosphorus and dissolved metal removal rates. Only water treatment chemicals that have a low risk of increasing the toxicity of treated stormwater will be used. Water treatment chemicals will be applied using an automated chemical dosing and mixing system. The design treatment rate will be the 1 year ARI peak flow.
	WM_2.8		When practical, water captured in sedimentation basins will be used for dust suppression.
Water management controls for access roads Controls for all access roads	WM_3.1	Existing dirt tracks that will no longer be required following the construction of the new access roads will be removed and rehabilitated. This will reduce associated sediment loads.	• sections of Lobs Hole Road that will no longer be required following the construction of the new access roads will be removed and rehabilitated. This will reduce associated sediment loads;
	WM_3.2	All cut and fill batters will be stabilised in accordance with the Rehabilitation Strategy and Landscape Management Plan.	• all cut and fill batters will be stabilised as soon as practicable ;
	WM_3.3	The clean water management controls WM_1.1 to 1.4 will apply to the design of all access roads.	The clean water management controls WM_1.1 to 1.4 will apply to the design of all access roads.
	WM_3.4	Access road surfaces will be maintained with appropriate aggregate material to reduce sediment loads.	• access road surfaces will be maintained with appropriate aggregate material to reduce the risk of erosion;
	WM_3.5	Where practical, access roads will be single cross-fall and will grade to a table drain located against the toe of the cut batters. The drains will be stabilised by rock armouring as required.	• where practicable and safe to do so access roads will be single cross fall and will grade to a tables drain located against the toe of the cut batters. The drains will be stabilised by rock armouring as required;
	WM_3.6	Sediment traps or filters will be maintained at all discharge locations. The filters will only use biodegradable or natural materials. Sediment traps, filters and other appropriate sediment control devices will be installed to target the removal of coarse sediments.	• where appropriate, the sedimentation basins established to manage runoff during construction of the access roads will be maintained during the Exploratory Works to provide ongoing treatment of runoff from access roads;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Additional controls for access roads that are not constrained by terrain or the proposed disturbance footprint.	WM_3.7		The sedimentation basins established to manage runoff during construction of the access roads will be modified to be constructed wetland style basins where practicable. Constructed wetland style basins will maintain permanent water. An extended detention zone will be established above the permanent water. The extended detention zone will drain slowly through a low flow outlet control. Where practical, runoff from road embankments that have been stabilised by vegetation will be diverted into the clean water drainage system to minimise the contributing catchment area to the constructed wetlands. This will increase the effective size of the basin (in terms of depth of rainfall captured) and will result in a treatment volume that is greater than the 5 day 85th percentile volume that is proposed for sedimentation basins for construction areas.
Water management controls for the accommodation camp	WM_4.1	A stormwater management plan for the accommodation camp and portal construction pad will be prepared as part of the detailed design and will consider the design measures identified in the Surface Water Assessment (Appendix M).	A stormwater management plan will be prepared as part of the detailed design of the project. The plan will consider geotechnical constraints including shallow soils.
	WM_4.2		Clean water from upslope areas will be diverted around the accommodation camp.
	WM_4.3		A piped drainage system will be established to capture stormwater and convey it to the proposed water quality improvement ponds. The drainage system will have a 20% AEP capacity. Overland flow paths will be provided as required.
	WM_4.4		All pervious areas including batters will be vegetated with endemic native vegetation where practicable.
	WM_4.5		Runoff from roof areas will be collected in rainwater tanks where practicable. Captured water will be used for non-potable uses, reducing runoff volumes.
	WM_4.6		Source controls including permeable pavers and rain gardens will be used where practicable.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	WM_4.7		All runoff from the accommodation camp will be treated in water quality improvement basin(s). The basin(s) will be designed as constructed wetlands where practicable and will provide a water quality improvement function and attenuate peak runoff rates from the accommodation camp.
	WM_4.8	Collectively, the stormwater controls will be sized and configured to achieve the following pollution load reductions (as calculated using the MUSIC water quality model):	Collectively, the stormwater controls will be sized and configured to achieve the water quality specifications provided in SWA Table 6.12.
	WM_4.9	• 85% reduction in post development mean annual load of total suspended solids; • 60% reduction in the post development mean annual load of total phosphorus; and • 45% reduction in the post development mean annual load of total nitrogen	The water quality improvement pond batters will be established using retaining structures or other suitable measures to avoid disturbance of the Watercourse 3 channel.
Water management controls for the portal construction pad	WM_5.1		A stormwater management plan will be prepared as part of the detailed design of the project. The plan will be integrated with the process water system.
	WM_5.2	• Activities that have the potential to contaminate stormwater runoff will be isolated from the stormwater system through the use of covering (ie by a building or roof) and bunding.	Where practical, all activities that will occur on the portal construction pad with potential to contaminate stormwater runoff will be isolated from the stormwater system through the use of covering (ie by a building or roof) and bunding. Water produced within the covered and bunded areas will be either: • managed by the process water system; or • disposed as liquid waste to an appropriate facility.
	WM_5.3		Clean water from upslope areas will be diverted through or around the portal construction pad in a designated clean water drainage system.
	WM_5.4	• A stormwater management system will manage runoff from the portal construction pad. The system will include a 2,500 m3 water management basin. Captured water in the basin will be harvested for use in construction activities.	A piped drainage system will be established to capture stormwater and convey it to the water management basin. The drainage system will have a 1% AEP capacity. Overland flow paths will be provided as required.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	WM_5.5	• The stormwater management system will be designed to contain any leak, spill or fire water runoff from the portal construction pad.	All aggregate storage and stockpile areas will be bunded to minimise stormwater ingress. Runoff from these areas will be treated in sediment wedge pits or other sediment controls to remove all coarse material. Sediment wedge pits will overflow into the piped drainage system.
	WM_5.6		All runoff from the portal construction pad and adjoining access road will be conveyed to a water management basin with adequate capacity for at least a 5 day 95th percentile rainfall event, and include additional volume to accommodate required water quality treatments (ie. a total volume of at least 3,750 m^3) . The basin will provide a water quality improvement function. Water captured in the basin will be extracted to supply the process water system. Water treatment chemicals will be applied to the water management basin to enhance sedimentation and phosphorous and dissolved metal removal rates. Only water treatment chemicals that have a low risk of increasing the toxicity of treated stormwater will be used. Water treatment chemicals will be applied using an automated chemical dosing and mixing system. The system will be designed to meet the water quality specifications provided in SWA Table 6.16. The design treatment rate will be the 1 year ARI peak flow.
	WM_5.7		The water management basin will be designed to provide a freeboard between its overflow pipe and spillway. The freeboard volume will be calculated to contain probable leaks, spills and firewater runoff volumes. The overflow pipe will have a manual shutoff valve that will enable site management to shut off the overflow pipe to enable the basin to contain any leak, spill or fire water runoff.
Water management controls for the process water system	~~WAT06~~ WM_6.1	A process water system will be designed and implemented to manage any potentially contaminated water that may be produced by construction activities. The design of the process water system will:	A process water management system will be established to manage any potentially contaminated water that may be produced by the construction activities.
	WM_6.2	• be separated from the stormwater system to avoid uncontrolled overflows associated with stormwater ingress;	The process water management system will be separated from the stormwater system to avoid uncontrolled overflows associated with stormwater ingress.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	WM_6.3	• incorporate a water treatment plant that will treat water to a suitable quality for its proposed use in construction activities or discharge to Talbingo Reservoir (if required); and	The process water system will incorporate a water treatment plant that will treat water to a suitable quality for its proposed use in construction activities. If required to meet water quality criteria, additional treatment will be provided for any water that is discharged to Talbingo Reservoir via the controlled discharge pipeline. This treatment system will meet the water quality specifications provided in Table 4.5 of this RTS.
	WM_6.4	• have the ability to extract water from the construction pad's water management basin.	The process water management system will have the ability to extract water from the portal construction pad's water management basin. This will be done to top-up supply.
	WM_6.5		A reticulation system will be established to enable the process water system to: • extract water from Talbingo Reservoir (as required); and • discharge treated process water into Talbingo Reservoir (as required).
Water management controls for the waste water management system	~~WAT07~~ WM_7.1	A wastewater (sewage) treatment plant will be designed and implemented to treat all waste water produced by the Exploratory Works. The plant will treat wastewater to the water quality specifications provided in Appendix M.	Waste water from the accommodation camp will be reticulated to a waste water treatment plant via a sewer system. The sewer system will be designed to restrict stormwater ingress into the waste water system.
	WM_7.2		Water efficient fittings will be used to minimise waste water loads.
	WM_7.3		Low phosphorus products are to be used for washing activities controlled by site management (ie laundry services and mess hall) and encouraged (via education) for general use.
	WM_7.4		The waste water storage system will include emergency storage of untreated waste water. The storage volume will be calculated at detailed design based on analysis of response times from regional waste management contractors to provide emergency trucking and offsite disposal options.
	WM_7.5		A waste water treatment plant will meet the water quality specifications provided in Table 4.4 of this RTS.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	WM_7.6		Treated waste water will be disposed to Talbingo Reservoir via the controlled discharge pipeline.
Water quality impacts from rock emplacement areas	WM_8.1		The eastern and western rock and soil emplacement areas will be constructed as temporary landforms. The rock will be subject to the subaqueous emplacement program associated with Exploratory Works. Soil will be used for rehabilitation. Should any rock remain at these locations following the conclusion of Exploratory Works, it will be transported to a nominated location outside of Kosciuszko National Park within a timeframe agreed with NPWS.
	WM_8.2		During establishment, the water management controls for construction areas (WM_2.1 to 2.8) will be applied.
	WM_8.3		The western emplacement area will be used to store cuttings and other material that has a low geochemical risk. This landform will be built in a manner that limits compaction and will be top-soiled and vegetated to stabilise the landform.
	WM_8.4		Any remnant mine workings located within the eastern and western rock and soil emplacement areas will be rehabilitated (if necessary).
	WM_8.5		The eastern emplacement area will be used to store any material that that has higher geochemical risk. Excavated material will be geochemically characterised prior to placement. The potential for acid rock drainage will be treated by placing and compacting layers of limestone (or other suitable AC material) between each rock and sediment layer as required. The volume of limestone (or other suitable AC material) in each layer will be determined stoichiometrically so that the maximum potential acidity from the overlying layer of rock and sediment is treated. This approach will neutralise AMD within the stockpile. Once design levels are reached, the landform will be top-soiled and vegetated.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	WM_8.6		Runoff from Lick Hole Gully will be diverted around or through the eastern emplacement area. The diversion works will comprise a dam upstream of the diversion inlet and either a gravity or pump assisted diversion system. The diversion works will have a 1% AEP capacity. The dam upstream of the diversion inlet will be designed as a detention basin and will not permanently hold water. A high-flow diversion drain will be established to convey runoff from Lick Hole Gully around the emplacement area in a controlled manner, avoiding uncontrolled overflows through the emplacement area. This diversion drain will only be engaged if a flood greater than a 1%AEP event occurs.
	WM_8.7		Seepage from the eastern emplacement area will be collected in a water management dam. Collected water will either be irrigated to the emplacement (to promote evaporation) or treated in the process water treatment plant. Discharge of seepage water to the Yarrangobilly River will be avoided.
	WM_8.8		The eastern and western emplacement areas will be rehabilitated following removal of all material. Lick Hole Gully will be resinated as part of the rehabilitation works. Geomorphic and ecological characterisation of Lick Hole Gully will be undertaken prior to disturbance to record the existing conditions and values of Lick Hole Gully. The rehabilitation approach will seek to create a physically stable landform that reinstates or improves the existing values
Flood risks	FM_1.1	Camp and Wallaces Bridges will be designed in accordance with AustRoads bridge design standards which require the:	Camp and Wallaces Bridges will be designed in accordance with AustRoads bridge design standards which require the:
		• bridge deck soffit to be located above the 1% AEP flood level;	• bridge deck soffit to be located above the 1% Annual Exceedance Probability (AEP) flood level;
		• bridge structure to be designed to withstand a 0.05% AEP event; and	• bridge structure to be designed to withstand a 0.05% AEP event; and
		• abutments to be protected by appropriately designed scour protection.	• abutments to be protected by appropriately designed scour protection.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
	FM_1.2	The western emplacement will be designed to prevent the risk of emplacement material being entrained in flood waters during a 1 in 500 year flood event.	The western emplacement will be designed to minimise the risk of emplacement material being entrained in flood waters during a 0.2% AEP event. This may require a flood protection berm or rock armouring along the northern toe of the emplacement.
	FM_1.3	Flood emergency procedures will be prepared and implemented as part of the Emergency Response Plan.	A flood emergency response plan will be prepared as part of the project's emergency response plans.
Spills of hydrocarbons	WAT11	Procedures to address spills, leaks and tunnel washing will be developed and implemented as part of the CEMP.	Procedures to address spills and leaks will be developed and implemented as part of the CEMP.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
leaching/ running into groundwater/ creeks	WAT01		Management measures will be implemented to minimise potential environmental impacts to water and soil from hydrocarbon and chemical spills and leaks including: • minimizing direct access to the river by construction vehicles and mechanical plant; • regular inspection of construction vehicles and mechanical plant for leakage of fuel and /or oils;. • establishing a bunded area for storage of fuel and oils; • refuelling and maintenance of vehicles and mechanical plant at least 50 m from watercourses;. • avoiding as far as possible re-fuelling, washing and maintenance of land based vehicles and plant within 50 m of watercourses; • reporting spillages to the appropriate officer and immediately deploying spill containment and / or absorption kits as required to restrict its spread; • vehicles, vessels and plant would be properly maintained and regularly inspected for fluid leaks; • emergency spill kits will be kept onsite, at refueling areas and on all vessels at all times during the Exploratory Works. The spill kit will be appropriately sized for the volume of substances on the vessel. All staff would be made aware of the location of the spill kit and trained in its use; • if any hydrocarbon spills were to occur during soil stripping, the impact will be isolated and clean-up procedures implemented; • areas to be used for long-term storage and handling of hydrocarbons and chemicals will be enclosed with concrete bunds; • chemicals will be handled and stored as per manufacturer's instructions; and • below ground, refuelling will be undertaken in dry, enclosed, bunded areas;.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Surface and groundwater	~~WAT12~~ WAT02	A Surface and Groundwater Monitoring Program will be developed and implemented to monitor the effectiveness of water quality controls and compliance with licence conditions. The program will:	A Surface and Groundwater Monitoring Program will be developed and implemented to monitor the effectiveness of water quality controls. The program will include:
		• establish monitoring locations to provide suitable baseline and detection monitoring of surface and groundwater parameters;	• establish monitoring locations to provide suitable baseline and detection monitoring of surface and groundwater parameters;
		• monitor groundwater inflows in the tunnel and groundwater levels as well as groundwater quality during construction; and	• monitor groundwater inflows indirectly through the process water system and groundwater levels as well as groundwater quality during construction; and
		• set out annual monitoring requirements for Yarrangobilly Caves and PCTs potentially reliant on groundwater.	• set out annual monitoring requirements for Yarrangobilly Caves and plant community types potentially reliant on groundwater.
	~~WAT13~~ WAT03	Areas of groundwater inflow will be shotcreted to prevent further ingress.	Areas of groundwater inflow will be shotcreted or sealed by other methods to minimise further ingress.
			If groundwater is intercepted and unacceptable reductions to groundwater inflows to watercourses predicted, then groundwater should be discharged to waterways. This would occur following appropriate treatment of discharge water.
Impacts from barge access construction	~~WAT14~~ WAT04	A dredge environmental management plan (DEMP) will be implemented for dredging and construction of barge access infrastructure including:	A dredge environmental management plan (DEMP) and associated mitigation measures will be implemented for dredging and construction of barge access infrastructure including:
		• a water quality monitoring program at the dredge area prior to, during and following completion of dredging and barge access infrastructure construction works;	• a water quality monitoring program at the dredge area prior to, during and following completion of dredging and barge access infrastructure construction works;
		• installation of silt curtains around dredge and work areas.	• installation of silt curtains around dredging and active construction work areas within waterways;
		• selecting uncontaminated granular fill with less than 2% fines and selecting granular bedding material;	• selecting uncontaminated granular fill with less than 2% fines and selecting granular bedding material;
		• ensuring skip bins for land disposal of excavated material are watertight; and	• ensuring skip bins for land disposal of excavated material are watertight;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• all activities would be carried out in a manner that minimises the potential for leaks and spills and in compliance with waste handling and disposal procedures outlined in the DEMP.	• all activities would be carried out in a manner that minimises the potential for leaks and spills and in compliance with waste handling and disposal procedures outlined in the DEMP;
			• establishing a bunded area and sediment and erosion control measures around the land disposal area;
			• subaqueous placement of dredge spoil will include the mitigation measures described in WAT17; • subaqueous placement of any dredged material would be in a confined placement location rather than spreading the material across a wider section of the reservoir bed; • a silt curtain would be placed around the backhoe dredger or other suitable equipment at the dredge area; and • the dredged material once placed on barges would not be drained at the dredging site. Barges for subaqueous placement and skip bins for land placement would be watertight.
Water quality impacts from subaqueous placement in Talbingo Reservoir from dredging spoil and excavated rock placement	~~WAT15~~ WAT05	The subaqueous placement monitoring program for Talbingo Reservoir (described in Appendix D of Appendix L) will be implemented and include:	The subaqueous placement monitoring program for Talbingo Reservoir will be developed and implemented including:
		• survey monitoring of pre-placement and post-placement bathymetry at the placement location to assess the accuracy of subaqueous placement, batter slopes of placed material and any underwater spreading of the placed material;	• survey monitoring of pre-placement and post-placement bathymetry at the placement location to assess the accuracy of subaqueous placement, batter slopes of placed material and any underwater spreading of the placed material;
		• a water quality monitoring program at the subaqueous placement area prior to, during and following completion of works, including development of a total suspended solid (TSS) and turbidity (NTU) relationship and a structured management response to alerts and any exceedances of established triggers;	• a water quality monitoring program at the subaqueous placement area prior to, during and following completion of subaqueous placement works, including development of a total suspended solid (TSS) and turbidity (NTU) relationship and a structured management response to alerts and any exceedances of established triggers;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• confirmation of physical and chemical characteristics of the sediment at the subaqueous placement area prior to the placement of dredged material;	• confirmation of physical and chemical characteristics of the sediment at the subaqueous placement area prior to the placement of dredged material and excavated rock material;
		• installation of silt curtains around the discharge barge at the subaqueous placement area; and	Methods to minimise turbidity and sediment movement will be implemented during subaqueous placement of dredge spoil and excavated rock in Talbingo Reservoir including: • installation of silt curtains around the discharge barge at the subaqueous placement area;
		• design of the discharge barge and fall pipe arrangement at the subaqueous placement area to minimise surface turbidity.	• design of the discharge arrangement at the subaqueous placement area to minimise surface turbidity; • silt curtains should be inspected for integrity at least daily during placement of excavated material. Particular attention should be given to inspection and maintenance following heavy rainfall and high winds; • characterisation of the potential contaminant content and acid forming content of the placement material; • only suitable material would be selected for placement within the reservoir; • well maintained disposal equipment and barges will be used to minimise sediment loss/turbidity generation; • care should be taken when loading barges to reduce the potential for sediment spills and uncontrolled discharges. Overflowing/overloading of barges should be avoided;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			• subaqueous placement of excavated rock and dredge spoil would be localised in a side bay; • placement of material at least 3m below Minimum Operating Level to reduce the potential for resuspension by waves, currents or river flows; • barges would be fitted with bulwarks (hungry boards) made watertight to contain excavated rock and dredge spoil while in transit; • the placement location in a side bay would improve ability to incorporate environmental controls including silt curtains. An exterior silt curtain would be placed between the discharge barge and the main reservoir; • undertaking an tunnel excavated rock testing regime and screening of tunnel excavated rock material in stockpiles to demonstrate suitability for placement based on established criteria (possibly on a geological unit basis); • the exterior silt curtain will not be removed until satisfactory water quality criteria are met within placement area.
Heritage			
Impact to known and unknown heritage sites and items	HER01	A Cultural Heritage Management Plan (CHMP) will be prepared and implemented to guide the process for management and mitigation of impacts to Aboriginal cultural and historic heritage. The CHMP will:	An Aboriginal Heritage Management Plan (AHMP) will be prepared and implemented to guide the process for management and mitigation of impacts to Aboriginal cultural and heritage. The AHMP will:
		• be prepared in consultation with RAPs and OEH;	• be prepared in consultation with RAPs, NPWS Tumut Brungle Gundagai Aboriginal Community Executive Advisory Committee and OEH;
			• Set out guidelines for ongoing consultation and opportunities for cultural values assessment;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• include procedures relating to the conduct of additional archaeological assessment, including monitoring after clearance, if required;	• include procedures relating to the conduct of additional archaeological assessment, including monitoring and salvage excavations after clearance, if required. Should the additional archaeological assessment be required to occur prior to finalisation of the AHMP, the archaeological assessment will be prepared as a separate document, with any recommendations for monitoring incorporated into the AHMP;
		• set out guidelines for the management of movable heritage located anywhere in or near the project areas, to ensure that it is not inadvertently impacted or removed; and	
		• include an unexpected finds protocol for Aboriginal and European objects and sites, including reference to the management of the unknown locations of unmarked graves at Lobs Hole.	• set out an unexpected finds protocol for Aboriginal objects and sites and human skeletal material
			A 50 m buffer zone from the bank of the Yarrangobilly River will be established to protect the likely presence of Aboriginal cultural items, except for those areas required for creek or river crossings and road construction.
Loss of Aboriginal cultural heritage	HER02	Specific management and mitigation measures are listed for each individual heritage item in Table 21 of Appendix O and will be included in the CHMP.	Specific management and mitigation measures are listed for each individual heritage item below:
			• monitoring after vegetation clearance and salvage excavation will occur for sites – SU2, SU6, SU7 • salvage excavation will occur for sites– SU10, SU12, SU25
		Aboriginal cultural heritage management measures to be included in the CHMP are:	Aboriginal cultural heritage management measures to be included in the AHMP and implemented during construction include:
		• impacts to ground surfaces should be kept to an absolute minimum;	• impacts to ground surfaces should be kept to an absolute minimum;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• for Survey Units which are assessed to be of higher significance values mitigated impacts in the form of partial impacts only (i.e. conservation of part of an Aboriginal site or Survey Unit) and/or salvage in the form of further research and archaeological analysis prior to impacts;	• for Survey Units which are assessed to be of higher significance values, mitigated impacts in the form of partial impacts only (i.e. conservation of part of an Aboriginal site or Survey Unit) and/or salvage in the form of further research and archaeological analysis will occur prior to impacts. Should the additional archaeological analysis be required to occur prior to finalisation of the AHMP, the archaeological analysis will be prepared as a separate document, with any recommendations for monitoring incorporated into the AHMP;
		• salvage excavations in five Survey Units in order to mitigate impacts to the archaeological resource in the project area; and	• salvage excavations in the Survey Units in order to mitigate impacts to the archaeological resource in the project area; and
		• the CHMP is to include management measures of any further Aboriginal cultural heritage values which may be identified during construction.	• the AHMP is to include management measures of any further Aboriginal cultural heritage values which may be identified during construction.
Loss of historic heritage	HER03	Salvage and/or Archival recording of potential and known heritage items to be removed in the Lobs Hole Ravine area.	A Historic Heritage Management Plan (HHMP) will be prepared and implemented to guide the process for management and mitigation of impacts to historic cultural heritage. The HHMP will: • Set out procedures to manage impacts, avoidance of impacts and impact mitigation in accordance with the HCHAR recommendations; • Set out an unexpected finds protocol and the procedure to be followed for monitoring to undertaken for the purposes of inspecting areas for unrecorded heritage, when preliminary clearance of vegetation is made; • Outline a protocol for the management of potential unmarked graves and other human skeletal material in the project area; • Set out guidelines for the management of movable heritage located anywhere in or near the project areas, to ensure that it is not inadvertently impacted or removed.
	HER04	Specific management and mitigation measures are listed for each individual heritage item in Table 19 of Appendix P, and will be included in the CHMP. A series of management recommendations are	The following will occur to confirm the mitigation measures provided for the individual heritage items listed below where applicable:

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		presented. In some instances, no impact mitigation is required. For others a range of measures are recommended ranging from salvage of movable heritage to salvage excavation. In particular and where possible, further avoidance is recommended for the Ravine cemetery.	1. Archival recording of the entire Lobs Hole historic landscape to capture the industrial, residential and agricultural features at the site. The recording would use photographic techniques and topographic survey. Orthographically corrected photographs would be the most effective way of doing this as it combines both techniques (the methods for archival recording will be developed in the HHMP phase); 2. with the data obtained from '1' (above), an analysis of the site would be made of the areas of potential relics and determine what the research potential is and if test excavation is justified; 3. if the answer is yes for archaeological potential, a research design and excavation method would be prepared to support and guide archaeological test excavation; this will determine what and how much of the site can provide information that no other source can before it is removed by the project; and 4. ensuing from the above, a comprehensive historic document would be produced which would include, but not be limited to, the results of the archival recording and archaeological investigations, and the on-going oral and historical research. Specific management and mitigation measures are listed for each individual heritage items below. These shall be implemented prior to and during construction as applicable and include: – R1, R2 – archaeological research design, archival recording and archaeological test excavation within disturbance areas;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			– R3, R4, R5, R6, R7, R8, R10, R12, R13, R21, R23, R26, R30, R31, R33, R35, R36, R37, R43, R44, R46, R51, R52, R53, R54, R55, R56, R57, R58, R59, R62, R65, R67, R68, R70, R73, R75, R76, R77, R78, R79, R81, R82, R83, R84, R85, R86, R87, R94, R95, R97, R98, R101, R102, R103, R104, R105, R106, R107, R108, R110, R111, R112, R114, R115, R116, R117, R119, R120, R121 – archival recording; – R9, R74, R88 – archival recording and no-go buffer to be provided to avoid inadvertent impacts; – R11, R14, R49, R50, R100 – archival recording and implement measures to protect moveable heritage; – R15, R17, R22 – archival recording and include in the archaeological research design for the Pinbeyan Station Homestead; – R16, R18 – archival recording, implement measures to protect moveable heritage and include in the archaeological research design for the Pinbeyan Station Homestead; – R19 – avoid impacts; – R20 – archival recording, implement measures to protect fabric and moveable heritage, ensure no inadvertent impacts, determine curtilage around the item and prepare and archaeological research design to ascertain what, if any parts of the hotel complex are in the disturbance area and reassess the significance of component parts; – R24, R25, R27, R28, R29, R34, R38, R39, R40, R41, R42, R61, R63, R66, R69, R80, R90, R91, R92, R93, R96, R99, R122 – archival recording. Test excavation may be warranted; – R45 – archival recording and limit impacts as much as possible;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			– R47 – archival recording. Test excavation may be warranted. Avoid impacts as much as possible; – R48, R60 – archival recording. Test excavation may be warranted. Implement measures to protect moveable heritage; – R64 – archival recording program. Test excavation may be warranted. Ensure no inadvertent impacts; – R47 - archival recording. Test excavation may be warranted. Avoid impacts as much as possible; – R71, R72 - archival recording. Test excavation may be warranted. Avoid disturbance to the site if feasible; – R109, R118 – archival recording, avoid disturbance, ensure no inadvertent impacts; – R113 - archival recording. Avoid disturbance to the site if feasible; and – R128 – test excavation maybe warranted.
			A qualified heritage consultant is to undertake a pre-work condition assessment (including photographic records) for the Washington Hotel ruins. Following initial condition assessment, a monitoring regime is to be implemented to ensure vibration associated with the works avoid harm to pisé structure. Where possible, further avoidance is recommended for the Ravine cemetery.
		A comprehensive research project on the history and heritage of the area will be undertaken to fill in the gaps in the existing history of settlement and mining and the archival recording of heritage items in the Lobs Hole Ravine area.	A comprehensive research project on the history and heritage of the area will be undertaken to fill in the gaps in the existing history of settlement and mining and the archival recording of heritage items in the Lobs Hole Ravine area.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Transport			
Construction traffic management plan	TRA01	A Construction Traffic Management Plan (CTMP) will be prepared and implemented during construction. The CTMP will set out the strategy and procedures to manage the impacts of the Exploratory Works construction on the local road network and traffic systems, including:	A Construction Traffic Management Plan (CTMP) will be prepared and implemented during construction. The CTMP will set out the strategy and procedures to manage the impacts of the Exploratory Works construction on the local road network and traffic systems, including:
		• community and stakeholder notification processes for oversized vehicle movements and any planned disruptions to traffic and restriction of access to areas of KNP and Talbingo Reservoir	• community and stakeholder notification processes for oversized vehicle movements and any planned disruptions to traffic and restriction of access to areas of KNP and Talbingo Reservoir
		• traffic safety requirements, including appropriate signage, driver conduct and safety protocols.	• traffic safety requirements, including appropriate signage, driver conduct and safety protocols.
Road maintenance	TRA02	Road maintenance will be managed through the following measures:	Road maintenance will be managed through the following measures:
		• a Road Dilapidation Report will be prepared and approved prior to and following Exploratory Works;	• a Road Dilapidation Report will be prepared and submitted to the relevant road authority prior to and following Exploratory Works for: – Link Road; – all roads within KNP not upgraded as part of the exploratory works and which will potentially be used by Heavy Vehicles during construction; – local roads within Talbingo which will potentially be used by Heavy Vehicles during exploratory works; – Spillway Road; and – Miles Franklin Drive.
		• routine defect identification and rectification of the internal road network will be managed as part of the project maintenance procedure; and	• routine defect identification and rectification of the roads used by construction heavy vehicles within KNP and the Spillway Road will be managed as part of the project maintenance procedure; and
		• internal access roads will be designed in accordance with the relevant vehicle loading requirements.	• internal access roads upgraded or constructed as part of the Exploratory Works will be designed in accordance with the relevant vehicle loading requirements.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Signage	TRA03	Where changes to the traffic conditions are required, appropriate signage will be installed in accordance with the following:	Where changes to the traffic conditions are required, appropriate signage will be installed in accordance with the following:
		• Traffic Control Device for Works on Roads (AS1742.3; 2009); and	• Traffic Control Device for Works on Roads (AS1742.3; 2009); and
		• Traffic Control at Work Sites (Roads and Maritime Services; 2010).	• Traffic Control at Work Sites (Roads and Maritime Services; 2010).
Time of travel	TRA04	Standard hours of operation of heavy vehicles on public roads will observe the industry standard hours of 7 am to 6 pm during weekdays, excluding Lobs Hole Ravine Road where no heavy vehicle movements will occur before 8 am.	Standard hours of operation of heavy vehicles on local roads will be 7 am to 6 pm during weekdays and 8am to 1pm on Saturday, excluding upper Lobs Hole Ravine Road where no heavy vehicle movements will occur outside of day time hours (except in emergencies). Daytime hours being defined as First Light to Last Light. Access to the Barge Access Facility via Miles Franklin Drive, and Spillway Road will be permitted 24 hours a day and 7 days a week to all vehicles.
Traffic control	TRA05	Where temporary occupation of lanes is required traffic control measures specified in AS1742-2002 will be implemented. Where works require lane occupancy on RMS or council classified roads, a Road Occupancy Licence will be obtained.	Where temporary occupation of lanes is required traffic control measures specified in AS1742-2002 will be implemented. Where works require lane occupancy on RMS or council classified roads, a Road Occupancy Licence will be obtained.
Social and economic			
Impacts to long-term housing demand	SEC01	Develop and implement a program to track and monitor the demand for long-term housing in the local region by regularly consulting with workers, local real estate agents and the Snowy Monaro Regional and Snowy Valleys councils.	Develop and implement a program to track and monitor the demand for long-term housing in the local region by regularly consulting with workers, local real estate agents and the Snowy Monaro Regional and Snowy Valleys councils.
		The monitoring program will be prepared before construction starts and will be reviewed periodically to capture any relevant changes in the project and in the community. Monitoring would be undertaken every three months starting from the commencement of construction.	The monitoring program will be prepared before construction starts and will be reviewed periodically to capture any relevant changes in the project and in the community. Monitoring would be undertaken every three months starting from the commencement of construction.
		The results of the consultation would be reported back to DPE and the councils.	The results of the consultation would be reported back to DPE and the councils.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Costs incurred to NPWS to implement recreational user impact mitigation measures	SEC02	Snowy Hydro propose to enter into a heads of agreement with NPWS which will form the basis of a voluntary planning agreement (VPA) or similar between the two parties which will broadly set out the measures proposed to mitigate impacts to recreational users of KNP, and nominate the monetary contributions required to fund the mitigation and management measures.	Snowy Hydro propose to enter into a heads of agreement with NPWS which will form the basis of a voluntary planning agreement (VPA) or similar between the two parties which will broadly set out the measures proposed to mitigate impacts to recreational users of KNP, and nominate the monetary contributions required to fund the mitigation and management measures.
Higher levels of visitation to Lobs Hole post Exploratory Works due to improved access	SEC03	Master plan to be developed before the completion of works at Lobs Hole. Master plan to consider issues such as vehicle access and potential vehicle conflict, changing user dynamics and use of the area, planning for future camping groups and types, provision of amenities, weed and feral animal control.	Master plan to be developed before the completion of works at Lobs Hole. Master plan to consider issues such as vehicle access and potential vehicle conflict, changing user dynamics and use of the area, planning for future camping groups and types, provision of amenities, interpretive material outlining Aboriginal and European history, weed and feral animal control.
		Work on the rehabilitation of the site and the installation of visitor infrastructure would commence before the conclusion of the Exploratory Works (or Snowy 2.0) to enable visitor use of the area to recommence as soon as possible.	Work on the rehabilitation of the site and the installation of visitor infrastructure would commence before the conclusion of the Exploratory Works (or Snowy 2.0) to enable visitor use of the area to recommence as soon as practicable.
Loss of remote camping experience accessed by 4WD	SEC04	KNP PoM to be amended to consider potential sites that could offer a comparable experience to Lobs Hole Ravine such as those located on management trails that do not currently allow public access.	KNP PoM to be amended to consider potential sites that could offer a comparable experience to Lobs Hole Ravine such as those located on management trails that do not currently allow public access.
Increased visitation to other camping areas during Exploratory Works	SEC05	Site master planning be undertaken for busier areas, potentially affected by displacement of Lobs Hole Ravine users (Three Mile Dam, Yarrangobilly Village, Eucumbene River, Blowering campgrounds) and increased demand from Exploratory Works workers, to determine whether they will need any expansion, and how the current visitor experiences in those places will be maintained.	Site master planning be undertaken for busier areas, potentially affected by displacement of Lobs Hole Ravine users (Three Mile Dam, Yarrangobilly Village, Eucumbene River, Blowering campgrounds) and increased demand from Exploratory Works workers, to determine whether they will need any expansion, and how the current visitor experiences in those places will be maintained.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Restricted access to Talbingo Reservoir for recreational users	SEC06	Restrictions to access to Talbingo Reservoir at the spillway end for recreational users should be timed to avoid the peak visitor use periods (i.e. 7am-9am on weekends and school holidays between October and April).	Access to Talbingo spillway and boat ramp will be closed to the public for the period of the Exploratory Works.
			Additional recreational facilities will be provided to mitigate the impacts of the closure of public access to the spillway and boat ramp. These include: • provision of two pontoons for the mooring of boats to the north of the boat ramp; • provision of 'beach' area immediately south of boat ramp; • provision a swimming pontoon off the 'beach' area; • provision of an exclusive swimming area around the 'beach' area; and • provision of picnic facilities and amenities at 'beach' area including picnic tables and BBQs.
Impact of increased traffic in KNP on recreational users	SEC07	Traffic management arrangements will be put in place to minimise the amenity and safety risks for recreational users during periods of high traffic flow.	Traffic management arrangements will be put in place to minimise the amenity and safety risks for recreational users during periods of high traffic flow.
Maximising economic benefits	SEC08	Snowy Hydro would engage with the contractor(s) for Exploratory Works to ensure that its approach to employment embodies the following principles where possible:	Snowy Hydro would engage with the contractor(s) for Exploratory Works to ensure that its approach to employment embodies the following principles where possible:
		• a preference for local employment;	• a preference for local employment;
		• encouraging local contractors to tender for work; and	• encouraging local contractors to tender for work; and
		• use of local businesses.	• use of local businesses.
		In order to achieve this outcome, Snowy Hydro in consultation with the contractor(s) for Exploratory Works, proposes to:	In order to achieve this outcome, Snowy Hydro in consultation with the contractor(s) for Exploratory Works, proposes to:

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• provide advance information about the approach to workforce sourcing, recruitment policies of local people and work arrangements;	• provide advance information about the approach to workforce sourcing, recruitment policies of local people and work arrangements;
		• work with recruitment, education and training providers in the local area to encourage the provision (in advance of project commencement) of future employment and training opportunities for skills that would be directly and indirectly generated by Snowy 2.0, including Exploratory Works; and	• work with recruitment, education and training providers in the local area to encourage the provision (in advance of project commencement) of future employment and training opportunities for skills that would be directly and indirectly generated by Snowy 2.0, including Exploratory Works; and
		• participate, as appropriate, in business groups, events or programs, and/or provide training programs directly relevant to project needs or broader industry skills (including programs specifically designed to assist local companies to comply with likely pre-qualification and contractual requirements).	• participate, as appropriate, in business groups, events or programs, and/or provide training programs directly relevant to project needs or broader industry skills (including programs specifically designed to assist local companies to comply with likely pre-qualification and contractual requirements).
		The provision of these activities would be supported by the development of a local employment and business policy.	The provision of these activities would be supported by the development of a local employment and business policy.
Other matters			
Noise and vibration			
Construction noise and vibration	NOI01	A Construction Noise and Vibration Management Plan will be prepared and implemented during construction.	A Construction Noise and Vibration Management Plan will be prepared and implemented during construction.
		The main objective plan would be to manage construction activities to meet ICNG NMLs and applicable vibration criteria across the project.	The main objective of the plan would be to manage construction activities to meet ICNG NMLs and applicable vibration criteria across the project.
	NOI02	Snowy Hydro will notify noise affected residents (including R2) of the scheduled construction works and the potential noise impacts.	Snowy Hydro will notify noise affected residents (including R2) of the scheduled construction works and the potential noise impacts.
		Noise monitoring during the initial stages of construction will be undertaken to determine if actual construction noise levels are above NMLs. If NMLs are exceeded, the proponent will:	Noise monitoring during the initial stages of construction will be undertaken to determine if actual construction noise levels are above NMLs. If NMLs are exceeded, the proponent will:

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		• identify feasible and reasonable mitigation measures that reduce construction noise levels to at or below NMLs;	• identify feasible and reasonable mitigation measures that reduce construction noise levels to at or below NMLs;
		• limit road construction for areas where there are noise affected residents to ICNG standard hours only; or	• limit road construction for areas where there are noise affected residents to standard hours only; or
		• enter into a negotiated agreement with the property owners.	• enter into a negotiated agreement with the property owners.
		If the safe working distances outlined in the NVA are encroached, vibration monitoring will be carried out at selected nearby heritage or infrastructure structures.	If the safe working distances outlined in the NVA are encroached, vibration monitoring will be carried out at selected nearby heritage or infrastructure structures.
		If required, the monitoring system will be fitted with an auditory and visual alarm that triggers when vibration levels reach the nominated criteria. This would indicate if and when alternate work practices should be adopted (such as decrease vibratory intensity, alternate equipment selection, etc).	If required, the monitoring system will be fitted with an auditory and visual alarm that triggers when vibration levels reach the nominated criteria. This would indicate if and when alternate work practices should be adopted (such as decrease vibratory intensity, alternate equipment selection, etc).
Geophysics survey (blasting)	NOI03	A Blasting Procedure is to be developed and implemented during construction. Blast practices should be reviewed when blasting occurs in the vicinity of significant heritage items. This may include limiting the maximum instantaneous change (MIC) or re-assessing the significance and/or the sensitivity of these items to vibration prior to construction commencing in the area.	A Blasting Procedure or Blast Management Plan is to be developed and implemented prior to blasting. Blast practices should be reviewed when blasting occurs in the vicinity of significant heritage items. This may include limiting the maximum instantaneous charge (MIC) or re-assessing the significance and/or the sensitivity of these items to vibration prior to blasting commencing in the area.
			Practices will be reviewed and adapted where practicable if complaints are received from residents due to night blasting. A survey of heritage items and other potential vibration sensitive receivers will be undertaken in the blast offset zone identified around the tunnel excavation portal.
Air Quality			
Air quality impacts during construction	AIR01	Air quality management procedures to cover the proposed Exploratory Works will be developed in an Air Quality Management Plan prior to commencement.	Air quality management procedures to cover the proposed Exploratory Works will be developed in an Air Quality Management Plan prior to commencement.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
		The AQMP would provide procedures and measures to address the following activities:	The AQMP would provide procedures and measures to address the following activities:
		• hauling on unsealed roads;	• hauling on unsealed roads;
		• loading and unloading of excavated material;	• loading and unloading of excavated material;
		• dozer shaping excavated rock emplacement areas;	• shaping excavated rock emplacement areas;
		• excavated rock emplacement areas;	• excavated rock emplacement areas;
		• machinery exhaust and plant and equipment.	• machinery exhaust and plant and equipment.
Greenhouse gas emissions	AIR02		Greenhouse gas emissions will be reduced where practicable during construction through the implementation of the following measures: • energy efficiency can be considered during the design of mechanical and electrical systems such as the tunnel ventilation system and tunnel lighting. Energy efficient systems can be installed where reasonable and practicable; • options for the installation of renewable energy generation (small scale wind or solar photovoltaics) to power electronic equipment associated with ancillary and support facilities (e.g. communications locations, outlying works) can be considered; • opportunities to use low emission construction materials, such as recycled aggregates in road pavement and surfacing, steel with recycled content, and cement replacement materials, can be investigated and incorporated where feasible and cost effective; • construction plant and equipment can be operated and maintained to maximise efficiency and reduce emissions, with construction planning used to minimise vehicle wait times and idling onsite and machinery turned off when not in use; • locally produced goods and services can be procured where feasible and cost effective to reduce transport fuel emissions; and • cut and fill balances for earthworks can be reviewed to make sure that material is transported the least possible distances.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Worker and public safety			
Worker safety	PUS01	An Emergency Response Plan (ERP) will be prepared and implemented during construction. The ERP will contain all procedures relating to flood, bushfire and other emergencies.	An Emergency Response Management Plan (ERMP) will be prepared and implemented during construction. The ERMP will contain all procedures relating to flood and other emergencies.
	PUS02		A Bushfire Management Plan (BMP) including the bushfire emergency response and evacuation plan will be prepared and implemented during construction. The BMP will contain all procedures relating to bushfire. Including:
			• management actions proposed to ensure suitable bushfire preparedness is undertaken as part of the Exploratory Works and ahead of the bush fire season, as well as specific procedures to limit the risk of ignition of surrounding bush land resulting from the Exploratory Works; • the minimum requirements for a Village Protection Plan (as applicable to the Exploratory Works) as outlined within Section 3.4.9 of Kosciuszko National Park Fire Management Strategy 2008-2013 (NPWS, 2008). • bush fire awareness training; • a community bush fire refuge place in the case that offsite evacuation cannot occur; • bushfire maintenance measures and procedures; • work procedures, so as to limit the potential of ignition of surrounding bushland; • monitoring and review procedures; • Bushfire Emergency Response and Evacuation Plan which will include:

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			– developed to be consistent with, A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan (NSW RFS 2014), Australian Standard 3745-2010 Planning for emergencies in facilities and the relevant provisions of the KNP Fire Management Strategy (NPWS 2008); – the requirements for pre-bush fire season and continual bush fire awareness; – the requirements for immediate notification to the local NPWS of accidental ignition of surrounding vegetation; – mechanisms for notification of neighbouring communities (Yarrangobilly Caves village and the village of Talbingo) of accidental ignition of surrounding vegetation leading to bush fire that may impact upon them; – the circumstances under which different evacuation types are to be implemented, in response to a bush fire emergency; – mechanism for the early relocation of staff, noting that on days of catastrophic fire weather, the NSW RFS recommends leaving early as the only safe option; – detailed plans of all Emergency Assembly Areas including “onsite” and “offsite” arrangements; – the specific structure and role of emergency control for the site (e.g. fire wardens); – details of staff training consistent with their responsibilities within the emergency control organisational structure with the equipment provided; – the requirements for training in preparation for response to an emergency, including trial emergency evacuations via Lobs Hole Ravine Road and via the barge access route;

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			– the requirements for clarifying a safe egress route (via Lobs Hole Ravine Road or the barge access route) and an understanding of the extent/spread of local fires before allowing the evacuating persons to leave the site; – the requirements for egress and communication in the scenario that persons are leaving the Exploratory Works as emergency services are attending the Exploratory Works (noting that sections of Upper and Lower Lobs Hole Ravine Road are single lane only); and • mechanisms for communication with NPWS and neighbouring communities (Yarrangobilly Caves village and the village of Talbingo) on suitable egress routes and an understanding of the impacts that the egress of high numbers of project staff may have on the neighbouring communities ability to safely egress along the Snowy Mountains Highway.
			The Bush Fire Management Plan shall include the provision of a suitable communication network. Snowy Hydro should liaise with the NSW RFS District offices of Riverina Highlands and Monaro to determine the appropriate network requirements for connecting to both internal and external response agencies.
			To maximise the safety of the camp's occupants, the facility's occupants and employees are to be comprehensively and regularly trained to undertake safe first attack fire-fighting operations. Training is recommended to specifically include the extent of first attack fire operations that can be undertaken without endangering the safety of persons engaged in fire-fighting activities. The maintenance of equipment related to this will be specifically addressed in the Exploratory Works Bush Fire Management Plan.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			The Bush Fire Management Plan shall incorporate the provision of a full time, onsite emergency response team (ERT). The ERT should be fully trained and equipped to deal with all potential bush fire events. Snowy Hydro should liaise with the RFS District offices of Riverina Highlands and Monaro to determine the appropriate level of training and equipment required to fulfil this task.
			A copy of the Bush Fire Management Plan and Bushfire Evacuation and Response Procedures will be submitted to the NSW RFS District offices of Riverina Highlands and Monaro for comment. Any comments provided by the District offices shall be incorporated into any amended plans.
			Snowy Hydro shall liaise with the relevant Bush Fire Management Committees (BFMC) and Local Emergency Management Committees to ensure the committees are aware of the proposal and all assets associated with the proposal are incorporated into future risk management plans.
	PUS03		To minimise the consequences of fire incidents involving vehicles engaged in tunnel construction and excavation, all vehicles that are required to enter the tunnel will be fitted with onboard automatic engine fire suppression systems that comply with AS 5062 - 2016. In addition, all vehicles will be provided with portable fire extinguishers that comply with AS 2444 – 2001.
APZs	PUS02 PUS04	• APZs will be designed implemented and maintained as prescribed in the BFHRA.	• APZs will be designed implemented and maintained as prescribed in the BFHRA.
		• At the detailed design stage, consideration will be given to the administration building, for the allowance of an APZ.	• At the detailed design stage, consideration will be given to the administration building, for the allowance of an APZ.
		• At the detailed design stage, consideration will be given to the accessibility of fire trucks within the defendable space of the portal construction pad structures, as well as the accessibility to the fire water tanks at this location.	• At the detailed design stage, consideration will be given to the accessibility of fire trucks within the defendable space of the portal construction pad structures, as well as the accessibility to the fire water tanks at this location.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Access	PUS03 PUS05	• Consideration should be given to the implementation of passing bays or reversing bays at regular intervals in the upgrade of Upper and Lower Lobs Hole Ravine Road.	Consideration should be given to the implementation of passing bays or reversing bays at regular intervals in the upgrade of Upper and Lower Lobs Hole Ravine Road.
		• Consideration of marine traffic management to minimise conflict between reservoir users and barge activities during Exploratory Works.	Consideration of maritime traffic management to minimise conflict between reservoir users and barge activities during Exploratory Works through the development and implementation of a maritime traffic management plan. Mitigation measures to be implemented include: • establishing exclusion zones around barge access infrastructure and at other locations where navigation channel widths are constrained; • undertaking community notification prior to maritime operations and barging. Posting information material at the boat ramps including the location of exclusion zones and informing on legally enforceable speed restrictions around construction plant and equipment in accordance with the Marine Safety Act 2013; and • ensuring construction plant and equipment are fitted with Automatic Identification Systems.
		• At the detailed design stage, consideration should be given to a fire trail, around the perimeter of the accommodation camp and within the APZ of the camp.	At the detailed design stage, consideration should be given to a fire trail, around the perimeter of the accommodation camp and within the APZ of the camp.
			A community bush fire refuge will be provided at Lobs Hole providing a refuge for anyone caught out by fire preventing an evacuation. This will include those staying at the accommodation camp.
			Appropriate access standards for staff, fire fighters, emergency service workers and those involved in evacuation will be provided.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
Water supply	PUS04 PUS06	If spray systems are to be incorporated into the design of the buildings, dedicated fire water supplies will be increased to accommodate the systems.	Adequate water supply and pressure is to be designed, implemented and maintained during construction for fire fighting purposes. If spray systems are to be incorporated into the design of the buildings, dedicated fire water supplies will be increased to accommodate the systems. To facilitate safe first attack fire-fighting operations by staff, all buildings of the accommodation camp will be served by a fire hose reel system. Regardless of any floor area thresholds or other exclusions permitted in Clause E1.4 of the National Construction Code, the fire hose reel system will serve all buildings (irrespective of occupancy classification) and comply with all other requirements of Clause E 1.4 of the National Construction Code and AS 2441.
Services (gas and electricity)	PUS05 PUS07	Location and maintenance of services will be carried out so as not to contribute to the risk of bush fire or impede the fire fighting effort.	Location and maintenance of services will be carried out so as not to contribute to the risk of bush fire or impede the fire fighting effort.
Buildings, facilities and storage areas	PUS08		Buildings are to be constructed in accordance with relevant National Construction Code, Building Code of Australia and Australian Standards. To maximise the safety of the camp's occupants, the accommodation camp's buildings or parts of buildings that are classified as Class 1 a, 1 b, 2, 3, 4 or 9b under the provisions of Volume One of the National Construction Code will be provided with a smoke alarm system or detection system (as applicable). All buildings are to be provided with portable fire extinguishers that are suitable for the fire hazard protected and in accordance with the requirements of AS 2444 - 2001.
			Diesel generators and associated fuel storage at the portal construction pad, construction compound at Lobs Hole and the barge access (north and south) infrastructure will be designed, housed and maintained so that they will not serve as a risk to surrounding bushland and will be located away from the hazard, wherever possible.

Table 8.1 Revised environmental management measures

Impact	Reference #	Environmental management measures	Revised environmental management measures
			A suitable storage facility will be designed and constructed for the storage of the ammunition for blasting activities and fuel storage, to minimise potential for ignition of surrounding vegetation and to reduce the storage area susceptibility to bush fire impacts.

CHAPTER 9

EVALUATION AND CONCLUSION

9 Evaluation and conclusion

This chapter presents the overall impacts and benefits of Exploratory Works, with regard to strategic need, environmental, social and economic impacts and considers the response to project changes and additional assessments undertaken in the response to submissions.

9.1 Strategic need

The EIS stated the following with regard to the strategic need for Exploratory Works:

> The Snowy Scheme is the largest engineering project ever undertaken in Australia and is one of the largest and most complex hydro-electric schemes in the world. Its construction is seen by many as a defining point in Australia's history. Snowy 2.0 involves linking Talbingo and Tantangara reservoirs within the existing Snowy Scheme, and will increase the generation capacity of the Snowy Scheme by almost 50%. Snowy 2.0 will provide an additional 2,000 MW generating capacity, and make approximately 350,000 MWh (about 175 hours at full power) of storage available to the NEM at any one time.
>
> The development of Snowy 2.0 is consistent with Commonwealth and NSW strategic planning and policy objectives, including the NSW Renewable Action Plan. With the planned retirement of generation powered by fossil fuels, there is a need for reliable electricity supply to counteract a decline in the reserve generation capacity available in the NEM. The development of Snowy 2.0 will play a key role in helping NSW and the broader NEM achieve energy system reliability and security, with relatively low costs and emissions. Compared with other alternatives, Snowy 2.0 provides:
>
> - increased storage capacity, longer lifespan for storage, and cheaper full life cycle cost when compared to current lithium-ion storage batteries;
> - more efficient dispatch of electricity to major load centres and less emission generation when compared to traditional electricity generating plants; and
> - improved security and reliability of supply when compared to the intermittency of primary renewable energy sources (such as wind and solar).
>
> Snowy 2.0 would also increase generation competition in the NEM at peak times, and thus exert downward pressure on peak energy prices and providing economic benefits to the consumer. The Feasibility Study delivered in December 2017 confirmed that Snowy 2.0 is economic, technically feasible and financeable (Snowy Hydro 2017).
>
> Before the detailed design of the power station cavern for Snowy 2.0 can be finalised, Exploratory Works are needed to gain a better understanding of the underground conditions and confirm the precise location of the power station and its construction method. This requires excavating an exploratory tunnel. It is important to note:
>
> - excavating exploratory tunnels are common practice internationally to inform design, and was completed for both Tumut 1 and Tumut 2 power stations; and
> - the underground power station for Snowy 2.0 will be in the Ravine Beds geological unit, and there is limited existing information available given it is at much greater depth and in different rock conditions than Tumut 1 and Tumut 2 power stations.

Design and construction of excavations of the size and complexity proposed are highly dependent on the rock properties and structural geology at the identified locations. No existing Snowy Scheme tunnel or excavation currently intersects the Ravine Beds geological unit, and therefore it is extremely important to understand excavation conditions, water seepage, rock bedding and faulting conditions, particularly in the area of the power station cavern.

Should Exploratory Works not proceed prior to the main Snowy 2.0 project (the subject of a separate application and assessment process) there is a risk that a lack of information on rock conditions could lead to unsuitable areas being excavated which would in turn have several negative impacts including the potential for additional works and greater surface disturbance. This would result in increased environmental and social impacts, as well as risks to schedule, costs and safety. Exploratory Works has been proposed and is needed to ensure this critical information is available to finalise the design of the power station cavern for Snowy 2.0, should it proceed.

The strategic need for Exploratory Works was discussed further in sections 5.2 and 6.5 of this RTS. The strategic need for Exploratory Works is considered to have been clearly demonstrated in the EIS and remains valid with consideration of the submissions received, project improvements and additional assessments undertaken.

9.2 Design development and assessment principles

The EIS stated the following with regards to the design development and assessment principles for Exploratory Works:

Consistent with the principles of ecologically sustainable development, Exploratory Works has been designed to avoid and minimise impacts where possible. In the first instance this has included consideration of site suitability based on design and construction needs, existing assets and infrastructure (such as road access), and environmental conditions. Lobs Hole is relatively remote, is accessed by a network of existing tracks, and has been cleared and disturbed by previous land uses. This has contributed to the ability to avoid and minimise impacts, in particular, impacts that would otherwise be associated with new access roads and clearing through undisturbed sites. As far as possible, works have been limited to previously disturbed land.

Snowy Hydro has been working with NPWS since the announcement of Snowy 2.0. Consultation on the Exploratory Works has been to ensure its development and design avoids and minimises impacts to biodiversity, heritage, recreation, and considers their long term objectives for land management in KNP.

The avoidance and minimisation of impacts has been carried through Exploratory Works as an iterative process between design and environment assessment, and supported by consultation activities. This process has been described throughout this EIS (see Chapter 4, 5, and 6). Exploratory Works has been informed and refined by the results of field surveys and consultation with key stakeholders, in particular NPWS and OEH. On this basis, a number of significant impacts on biodiversity, heritage, recreation and land use have been avoided and minimised.

An avoidance footprint has been defined by the EIS to limit the extent of direct impacts and disturbance. This is a commitment made by Snowy Hydro and will be implemented by the construction contractor(s) It is anticipated the construction method would be further refined during detailed design to ensure avoidance and minimisation objectives are met.

The iterative design approach to avoiding and minimising impacts has continued to be implemented through in the response to submissions through the development of project improvements and revised mitigation measures. Project improvements and mitigation measures were designed to further minimise impacts, improve the constructability of Exploratory Works and meet stakeholder expectations and are detailed in Chapter 3 and Chapter 8.

9.3 Biophysical, social and economic impacts

The EIS stated the following with regards to biophysical, social and economic impacts:

> The Exploratory Works project area supports a variety of natural settings and landscape features including escarpments, ravines, rivers, creeks and reservoirs associated with KNP. It is also used for recreational pursuits such as remote camping at Lobs Hole and fishing in Talbingo Reservoir. There has been a long history of Aboriginal presence in the Snowy Mountains and the Walgalu people continue to have a cultural association with the region. The high country also has a rich history from early exploration, pastoralism and settlement, as well as the construction of the Snowy Scheme. A number of nearby townships were originally established as a result of the Snowy Scheme, some of which continue to support the Snowy Scheme's workforce today.

The existing environment identified in the EIS remains valid with consideration of the submissions received, project improvements and additional assessments undertaken.

9.3.1 Biophysical environment

The EIS stated the following with regards to impacts to the biophysical environment:

> Impacts to the biophysical environment are likely to arise in two ways; via direct impacts from clearing of vegetation and ground disturbance, and via indirect impacts (eg water runoff, noise and light) to adjacent areas during construction activities. Following the avoidance and minimisation measures adopted through design, the main impacts concluded for Exploratory Works are described and assessed as follows.

The key impacts to the biophysical environment identified in the EIS remain valid with consideration of the submissions received, project improvements and additional assessments undertaken.

i Conservation

The EIS stated the following with regards to conservation impacts:

> Conservation values include biodiversity and heritage, which contribute to the overall values of KNP. Field surveys identified the Yarrangobilly River and associated riparian corridor as an area containing important ecological habitat for a number of native and threatened species, and high Aboriginal archaeological heritage values. The 50 m exclusion surrounding the Yarrangobilly River, accompanied by a suite of other relevant mitigation measures, will protect these values.
>
> In locations that will be disturbed by Exploratory Works, most of the land has been previously disturbed and considered to be of low significance for Aboriginal archaeology. However, the land contains habitat for native and threatened fauna including the Gang-gang Cockatoo, Eastern Pygmy-possum, Booroolong Frog, Smoky Mouse and Masked Owl. Residual impacts to biodiversity are considered to be one of the most important issues to be managed during Exploratory Works.

The impacts on Smoky Mouse habitat is potentially the most serious and therefore specific limitations to design and construction along identified habitat on Lobs Hole Ravine Road have been recommended. The minor loss of native vegetation and impacts to threatened species will require offsets in accordance with legislation, and implementation of a biodiversity offset strategy will be determined in consultation with NPWS and OEH.

Over a hundred potential historic heritage items were identified including 16 considered to be of local significance. The majority of these sites have been avoided by Exploratory Works. For example, the Washington Hotel has purposely been excluded from the works by applying a 20 m buffer from the item to avoid impacts. However, five items considered to be of local significance are within the disturbance footprint. Four of these sites are associated with the former Lobs Hole Mine and will be subject to archival recording before any impacts to the items can occur. One site (Ravine cemetery) is within the disturbance footprint but has been recommended to be avoided during construction. While the majority of potential heritage items are not assessed to warrant protection or management, the material heritage at Lobs Hole is considered to be of value to the local community and individuals with historic ties to the area.

As part of the CEMP, residual impacts on conservation values will be managed through the implementation of a Cultural Heritage Management Plan and a Threatened Species Management Plan. Protocols will be put in place to manage any unexpected finds for threatened species, historic heritage and Aboriginal cultural heritage.

The potential for impacts to the threatened Murray crayfish in Talbingo Reservoir through subaqueous placement of excavated material was identified as an additional conservation impact through the response to submissions. This is addressed in Section 4.3.1 of this RTS. Targeted surveys will be undertaken to identify Murray crayfish habitat, occurrence and frequency in Talbingo Reservoir and develop likelihood of occurrence mapping within Talbingo Reservoir. Once likelihood of occurrence mapping is completed the subaqueous placement program and placement areas will be reviewed and measures to avoid and minimise impacts to Murray crayfish will be taken to inform revised assessments of significance which will be provided to DPI Fisheries and DPE. Any residual impacts to Murray crayfish will be offset in consultation with DPI Fisheries.

Further information has also been provided regarding the assessment and management of historic heritage. Appendix C of this RTS provides revised management measures and mitigation for the Lobs Hole historic landscape, including the various elements of which it is comprised. A research design and excavation method will be prepared to support and guide archaeological test excavation.

All other conservation impacts identified in the EIS remain valid with consideration of the submissions received, project improvements and additional assessments undertaken.

ii Land

The EIS stated the following with regards to conservation impacts:

The nature and location of Exploratory Works means that impacts on landform and soil characteristics, including ground movement and cave (karst) systems, is an important consideration. The disturbance footprint has been reduced as far as practical to avoid and minimise disturbance to landforms, soils and cave (karst) systems, and methods of excavation have been designed to create minimal seismic or subsidence risk. Identified geodiversity, a value of KNP, along Lobs Hole Ravine Road has largely been avoided with minor disturbance confined to one boulder scree/ block stream. Yarrangobilly Caves is approximately 8 km north east of the Exploratory Works project area and will not be impacted.

There are some isolated areas of existing contamination, mostly near Lobs Hole, but these do not present health risks and are generally avoided by Exploratory Works. The former Lobs Hole Mine is largely contained within the avoidance footprint to limit the potential for contamination impacts offsite.

Other areas of environmental concern are the site of the former settlement of Ravine and the local campsites where shallow contamination may be present due to past waste disposal, fuel leaks and agricultural activity. However, early soil sampling indicated no health risk and there is considered to be low potential for naturally occurring asbestos to exist

A range of mitigation and risk management measures will be implemented including erosion and sediment controls, surface rehabilitation and monitoring.

Additional assessments of impacts to the fossiliferous beds and rock stream geodiversity features were undertaken as part of the response to submissions and are provided in Appendix B. The geodiversity assessments found that the proposed impacts to geodiversity features are acceptable.

The design of the eastern emplacement area was revised through the response to submissions to be a temporary stockpile only and will further minimise impacts to land.

All other impacts to land identified in the EIS remain valid with consideration of the submissions received, project improvements and additional assessments undertaken.

iii Water

The EIS stated the following with regards to conservation impacts:

Exploratory Works will include management systems to minimise disturbance to water resources by avoiding discharge to or extraction from the Yarrangobilly River, and implementing on-site controls for sediment and erosion, water re-use and for safe storage of chemical compounds. The works will have minimal influence on flood water behaviour and infrastructure will, as far as possible, be above the flood plain.

Key elements of Exploratory Works such as tunnelling, excavation and rock emplacement will, invariably, impact surface and groundwater systems. The potential issues include fine sediment in runoff, accidental spills, seepage at rock emplacement sites and changes to flow regimes from new infrastructure such as bridges. These impacts will, however, be minimised through further design and control measures.

Erosion and sediment controls will be an important management measure to prevent sediment laden and process water from being uncontrollably released to the environment. A water treatment plant will be built at the portal construction pad and a wastewater (sewage) treatment plant built at the accommodation camp, to ensure water quality objectives for discharge water to Talbingo Reservoir are met.

Sites where excavated materials are placed on land will be designed to be physically and chemically stable landforms. Monitoring of surface and groundwater will be designed to detect potential changes in water quality resulting from these areas.

The initial phase of subaqueous placement in Talbingo Reservoir has been designed to minimise impacts by selecting suitable placement locations, methods, and environmental controls. The strategy for managing and monitoring subaqueous placement will be confirmed in consultation with EPA. Additional investigations are currently underway and will be needed to inform the suitability of further placement, including geochemical analysis and hydrodynamic modelling.

There will be some localised drawdown of groundwater due to tunnelling but this will not adversely impact local ecosystems or vegetation potentially dependent on groundwater.

As discussed in Section 3.4 additional water management measures have been developed through the response to submissions include:

- additional treatment of process water to achieve discharge criteria before discharge to Talbingo Reservoir;
- additional treatment of wastewater to achieve discharge criteria before discharge to Talbingo Reservoir;
- a revised stormwater discharge regime;
- additional erosion and sediment controls for construction areas, road works and portal construction pad; and
- revised water management for the eastern emplacement area to include active rather than passive management of runoff.

The proposed additional mitigation measures all further minimise impacts to water and improve the environmental performance of Exploratory Works. The impacts to water identified in the EIS remain valid with consideration of the submissions received and have been minimised further through the proposed project changes.

9.3.2 Social and economic

The EIS stated the following with regards to social and economic impacts:

> Impacts to social values are primarily connected to the amenity and conservation values of KNP as part of recreational uses. Social and economic impacts are also associated with the influx of workforce and contribution to local business and housing. The main impacts concluded for Exploratory Works are described and assessed as follows.

The submissions process identified public access to recreational areas on Talbingo Reservoir including the spillway and Talbingo boat ramp as being key concerns for the community. Further mitigations are therefore proposed to offset the impacts of Exploratory Works on public access to recreational areas on Talbingo Reservoir. This will include providing improved recreational facilities at the Talbingo boat ramp including a pontoon, beach area and picnic and BBQ facilities.

i Amenity and public safety

The EIS stated the following with regards to amenity and public safety:

> The construction associated with Exploratory Works will have potential to cause noise and vibration impacts, impacts to local air quality and visual amenity. However, due to the isolated and remote location many of these impacts are not perceptible to identified sensitive receivers. Predicted noise exceedance is primarily limited to one residence in Talbingo, for about six weeks during the upgrade of Spillway Road. Consultation with affected residents will be undertaken to determine appropriate management measures.
>
> There will be additional vehicle movements to and from Lobs Hole, via Snowy Mountains Highway, Link Road and Miles Franklin Drive. The level of service of these roads will not change as a result of the Exploratory Works. However, roads within the construction area will be closed to the public during the Exploratory Works for public safety.

Other public safety risks are bushfire, the protection of essential services such as water supply, the transport and handling of dangerous goods, and emergency access and evacuation. These risks will be mitigated through design of buildings, construction areas and other assets to include appropriate bushfire protection standards and emergency access and evacuation protocols will be developed as part of an Emergency Response Plan.

The response to submission identified interactions between the public and the barge access infrastructure at Talbingo spillway as presenting a risk to public safety. Subsequently it is proposed to close the spillway to public access for the duration of Exploratory Works.

With the addition of this proposed management measure the impacts to public safety identified in the EIS remain valid with consideration of the submissions received, project changes and additional assessments undertaken.

ii Recreation

The EIS stated the following with regards to recreation:

> There will be temporary impacts (ie for the duration of Exploratory Works) on recreational visitors, predominantly at the remote area camping site at Lobs Hole (Ravine campground) and the water recreation pursuits on Talbingo Reservoir. The closure of the campground will be offset by enabling currently unavailable sites within the KNP to be opened to low impact camping as an alternative.
>
> The works at Talbingo Reservoir also have potential to impact swimmers, water skiers, fishers and boat and other seasonal visitors. Works at the reservoir will be scheduled to avoid interruption during periods of peak visitor demand.
>
> Recreational use of KNP is one of the objectives of the PoM. There will be long term recreational benefits and opportunities to be realised through upgrades to roads and facilities after Exploratory Works. These will enhance the capacity of the area for increased access and use, and provide for facilities to remain resilient to visitation.

As stated in Section 9.3.2 above the submissions process identified impacts to recreational areas on Talbingo Reservoir including the spillway and Talbingo boat ramp as being key concerns for the community. Further mitigations are therefore proposed to offset the impacts of Exploratory Works on recreational areas on Talbingo Reservoir. This will include providing improved recreational facilities at the Talbingo boat ramp including a pontoon, beach area and picnic and BBQ facilities.

The proposed additional mitigations will thereby enhance the long term positive recreational benefits of Exploratory Works identified in the EIS.

iii Economic factors

The EIS stated the following with regards to economic factors:

> Around 200 workers will be employed over the life of the Exploratory Works. Workers will be rostered on a 'swing shift' where they will likely work continuously (for example for two weeks) and then have time off before next shift (for example one week off). All workers will be accommodated on-site when they are rostered-on. Some employees will be sourced from the local labour force but most will FIFO and/or DIDO. It is estimated that up to 40 workers may relocate to live in local towns and there is sufficient local rental housing to cater for this need.

Exploratory Works has potential to impact service level providers, such as community services, facilities and infrastructure particularly in Cooma and Tumut, via the influx of the workforce to the local area. The social impacts on service level providers as a result of these population changes are predicted to be low as there will be no measurable impacts on the capacity of community services and infrastructure. This is based on the negligible population changes and the existing service and infrastructure capacity of service level providers within the local area.

This EIS provides estimates of the monetary value of all material costs and benefits associated with Exploratory Works. The costs and benefits have been compared transparently to provide an estimate of the project's net benefit.

The economic impacts of Exploratory Works identified in the EIS remain valid with consideration of the submissions received, project improvements and additional assessments undertaken.

9.4 Snowy Hydro's commitments

The EIS stated the following with regards to Snowy Hydro's commitments:

Snowy Hydro is committed to maintaining its excellent environmental track record of work within the KNP. The environmental management framework that will govern the avoidance, minimisation and management of impacts during the Exploratory Works has been set out to ensure responsibilities and accountabilities for environmental performance are clear (see Chapter 6 of the EIS).

Snowy Hydro's consultation with key stakeholders and the community is ongoing. Working together with NPWS is fundamental to achieving long term management objectives, and has been important in the development of Exploratory Works. Snowy Hydro has set out in its commitments, the ability for the Exploratory Works to be reversible (ie decommissioned and suitably rehabilitated) should unacceptable impacts occur or if Snowy 2.0 does not proceed. Snowy Hydro has also been working with NPWS to develop appropriate offsets for biodiversity and recreational uses, for predicted impacts.

The biodiversity offset strategy has now been finalised in consultation with NPWS and OEH and is provided in Appendix B. Snowy Hydro's commitments identified in the EIS remain valid with consideration of the submissions received, project improvements and additional assessments undertaken.

9.5 Conclusion

The EIS stated the following with regards to the conclusion:

Exploratory Works is essential to the final design of Snowy 2.0.

Snowy 2.0 is in the public interest as it will ultimately provide the ability to counteract the predicted shortfall in reliable electricity supply and generation capacity available in the NEM, as it transitions from a predominantly fossil-fuel based market to a renewable one. It will provide a reliable, secure and relatively low cost and emission solution compared to other alternatives.

Exploratory Works has been designed to avoid and minimise impacts where possible. The residual impacts have been identified and assessed. The key impacts of Exploratory Works are associated with direct and indirect impacts from vegetation clearance and ground disturbance, such as loss of native habitat for threatened species and potential changes to water quality from construction activities. During construction, a number of roads and walking tracks will need to be closed off to the public. On completion of Exploratory Works, most sites will be reopened, subject to the requirements of the Snowy 2.0 main project, currently in a design phase.

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

Exploratory Works is considered to be justified and in the public interest because:

- it seeks to promote the management and conservation of resources, while also permitting appropriate development to occur which is in line with the objects of the EP&A Act;
- the benefits of Snowy 2.0 are in the public interest and will provide long term reliable energy, environmental and economic benefits;
- it is a necessary precursor to finalising the detailed design for Snowy 2.0. The exploratory tunnel is needed to understand the geotechnical conditions of the site for the underground power station;
- the design of Exploratory Works has been an iterative design and environmental assessment process to ensure impacts have been avoided and minimised as much as possible. This has included refining the design in consultation with NPWS and OEH;
- the environmental impact assessment has identified that residual impacts can be appropriately managed and offset in consultation with NPWS and OEH;
- consultation with NPWS, OEH and other key stakeholders has been undertaken to ensure appropriate management objectives are identified and incorporated into the construction and long term management framework for Exploratory Works; and
- Snowy Hydro has committed to the long term environmental management and rehabilitation of impacted sites, including removal, decommissioning and rehabilitation if needed. Therefore, should Snowy 2.0 not proceed, long term negative environmental issues can be reasonably avoided.

The project improvements and additional mitigations proposed through the response to submissions will further minimise and avoid impacts as well as enhance the benefits from Exploratory Works. The conclusions of the EIS and justification for Exploratory Works identified in the EIS remains valid with consideration of the submissions received, project improvements and additional assessments undertaken.

Abbreviations

ABS	Australian Bureau of Statistics
AC	Acid consuming
ACHAR	Aboriginal Cultural Heritage Assessment Report
ACKMA	Australian Cave and Karst Management Association
ACT	Australian Capital Territory
ADCPs	Acoustic doppler current profilers
AEP	Annual exceedance probability
AHD	Australian height datum
AHMIS	Aboriginal heritage management information system
AMP	Asbestos management plan
ANZEC	Australian and New Zealand Environment Council
APZ	Asset protection zone
API	Aerial photo interpretation
AQMP	Air Quality Management Plan
ARI	Average return interval
BAM	Biodiversity Assessment Method
BC Act	NSW *Biodiversity Conservation Act 2016*
BC Regulation	NSW *Biodiversity Conservation Regulation 2017*
BCF	Biodiversity Conservation Fund
BDAR	Biodiversity Development Assessment Report
BFMC	Bushfire Management Committees
BFRHA	Bush fire risk and hazard assessment
BFMP	*Snowy 2.0 Exploratory Works Bush fire Management Plan*
BFRMP	Bush Fire Risk Management Plans
BOS	Biodiversity Offset Scheme
BTEX	Benzene, toluene, ethylbenzene and xylene
CBP	Concrete batching plant
CEMP	Construction environment management plan
CHMP	Cultural heritage management plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSSI	Critical state significant infrastructure
CTMP	Construction traffic management plan
DAE	Dilute acid extraction

DECC	NSW Department of Environment and Climate Change
DEE	Commonwealth Department of Environment and Energy
DEMP	Dredge environmental management plan
DIDO	Drive-in drive-out
DNA	Deoxyribonucleic acid
DoI Water	NSW Department of Industry – Lands & Water
DPE	NSW Department of Planning and Environment
DPI	Department of Primary Industries
DPI Fisheries	NSW Department of Primary Industries – Fisheries
DTVs	Default trigger values
EIS	Environmental impact statement
EMM	EMM Consulting Pty Limited
EMS	Environmental Management Strategy
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment protection licence
ERMP	Emergency Response Management Plan
ERT	Emergency response team
ERP	Emergency response plan
ESCP	Erosion and sediment control plan
FIFO	Fly-in fly-out
g	Gram
GDEs	Groundwater dependent ecoystems
GWh	Gigawatt hour
ha	Hectares
HCHAR	Historical Cultural Heritage Assessment Report
HDPE	High density polythene
ICNG	Interim construction noise guideline
ISQG	Interim sediment quality guideline
KGAP	*KNP Geodiversity Action Plan 2012-2017*
kL	Kilolitre
km	Kilometre
KNP	Kosciuszko National Park
KNP FMS	*Kosciuszko National Park Fire Management Strategy 2008-2013*

KNP PoM	*Kosciuszko National Park Plan of Management*
L	Litres
L/s	Litres per second
LEMC	Local Emergency Management Committee
LGAs	Local government areas
LSC	Land and soil capability
m	Metre
m^2	Square metre
m^3	Cubic metre
m/ s	Metres per second
MAT	Main access tunnel
MIC	maximum instantaneous charge
ML	Megalitre
MNES	Matters of national environmental significance
MOL	Minimum Operating Level
MW	Megawatt
MWh	Megawatt hour
NAF	Non-acid forming
NAGD	*National Assessment Guidelines for Dredging*
NCC	Nature Conservation Council
NEM	National electricity market
NML	Noise management level
NOA	Naturally occurring asbestos
NPA	National Parks Association of NSW
NPW Act	NSW *National Parks and Wildlife Act 1995*
NPWS	NSW National Parks and Wildlife Service
NSW	New South Wales
NSW Archaeology	New South Wales Archaeology Pty Ltd
NTU	Turbidity
NVA	Noise and vibration assessment
OEH	NSW Office of Environment and Heritage
OOH	Out of hours
PAD	Potential archaeological deposit
PAF	Potentially acid forming
PAH	Polycyclic aromatic hydrocarbons

PAR	Photosynthetically active radiation
PBP	*Planning for Bush Fire Protection Guideline*
PCTs	Plant community types
PMF	Probably maximum flood
PoM	Plan of management
RAPs	Registered Aboriginal Parties
RFS	NSW Rural Fire Service
RHDHV	Royal HaksoningDHV
RMS	NSW Roads and Maritime Services
RNP	Road noise policy
RTS	Response to submissions
SEARs	Secretary's environmental assessment requirements
SERP	Subaqueous excavated rock placement
SES	NSW State Emergency Services
SHC Act	NSW *Snowy Hydro Corporatisation Act 1997*
SISD	Safe Intersection Sight Distance
SMP EMP	The Snowing Management Plan Environmental Management Plan
Snowy Scheme	Snowy Mountains Hydro-electric Scheme
Snowy Hydro	Snowy Hydro Limited
SOPCs	Stressors of potential concern
SSI	State significant infrastructure
STP	Sewage treatment plant
TRH	Thyrotropin releasing hormone
TSS	Total suspended solid
TTAMP	Traffic, Transport and Access Management Plan
VIC	Victoria
VPA	Voluntary planning agreement
WMP	Water management plan
XRD	X-ray diffraction
XRF	X-ray fluoresce

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