MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN

S2-FGJV-ENV-PLN-0019

SEPTEMBER 2022

This Spoil Management Plan (SMP or plan) forms part of Future Generation's environmental management framework as described in the EMS. It has been prepared for the construction of the Snowy 2.0 Main Works project and sets out measures to minimise the impacts of spoil emplacement.

Revision Record

Rev.	Date	Reason for Issue	Responsible	Accountable	Endorsed
P	06.09.2022	Updated as per DPE comments	J. Adams	E.Porter	M. Franceschi

Document Verification

RACIE Record

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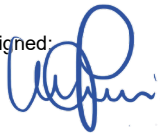
E ndorsed:	Name: Massimo Franceschi Job Title: Project Director Signed:  Date: 06/09/2022

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Revision Tracking

Rev.	Date	Description of Revision
A	29.11.2019	Initial draft for Snowy Hydro review
B	29.05.2020	Updated to address SHL comments and include RTS and COA details
C	12.06.2020	For agency consultation
D	16.07.2020	Updated to address comments from agencies.
E	24.07.2020	Updated to address comments from NPWS meeting. For DPIE
F	05.08.2020	Update following comments from NRAR, received 05.08.2020. For DPIE
G	11.08.2020	Update following DPIE comments. For approval.
H	01.01.2021	Updated Appendix A, D and E, and inclusion of Appendix G and I
I	14.04.2022	Updated to address DPE comments
J	25.05.2022	Updated to address DPE comments
K	09.06.2022	Updated to address DPE comments
L	27.06.2022	Updated to remove Appendix I and enable approval of Appendix G
M	21.07.2022	Updated to include references to comprehensive monitoring plan at GF01 as required by DPE
N	22.07.2022	Updated to include Tantangara Spoil Management Plan
O	24.08.2022	Updated to address DPE comments to GF01 Management Plan
P	06.09.2022	Updated to address DPE comments to Tantangara Management Plan

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ABBREVIATIONS AND DEFINITIONS

Acronym	Definition
ABA	abscisic acid
AC	Acid consuming
Acid Sulfate Soils Manual	*The Acid Sulfate Soils Manual,* NSW Acid Sulfate Soil Management Advisory Committee, 1998
AEP	Annual Exceedance Probability
AFL	Agreement for Lease
AHD	Australian Height Datum
AMD	Acid and metalliferous drainage
ANC	Acid neutralising capacity
AUL	Auxiliary left (turn)
APP	Acid producing potential
ASS	Acid Sulfate Soils
BAR	Basic Right (turn)
Blue Book	*Managing Urban Stormwater: Soils and Construction.* Landcom, (4th Edition) March 2004
CAP	Construction Area Plan
CLM Act	*Contaminated Land Management Act 1997*
CLMP	Contaminated Land Management Plan
COA	Conditions of Approval
CRS	Chromium Reducible Sulfur
CSSI	Critical State significant infrastructure
DAWE	Department of Agriculture Water and Environment
DoEE	Department of Environment and Energy (restructured on 1 February 2020, with environmental functions merged into DAWE)
DPIE	NSW Department of Planning, Industry and Environment
D&B	Drill and blast
EC	Electrical conductivity
ECS	Emission Control System
ECVT	Emergency egress, cabling and ventilation tunnel
EIL	Ecological investigation levels
EIS	Environmental Impact Statement
EMMP	Exploratory Works Excavated Material Management Plan
EMS	Environmental Management Strategy
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPL	Environment Protection Licence
ESCP	Erosion and Sediment Control Plan
FSL	Full Service Level

Acronym	Definition
Future Generation	Future Generation Joint Venture
Future Generation-PMS	Future Generation Project Management System
GBR	Geotechnical Baseline Report
HIL	Health Investigation Level
HRT	Head Race Tunnel
HSL	Health Screening Level
KNP	Kosciuszko National Park
MAT	Main access tunnel
Main Works EIS	*Snowy 2.0 Main Works - Environmental Impact Statement*
MOL	Minimum operating level
NAF	Non-acid Forming
NAG	Net Acid-Generation
NAPP	Non-acid Producing Potential
NEPM	National Environmental Protection Measures 1999 (and 2013 amendment)
NOA	Naturally occurring asbestos
NPWS	National Parks and Wildlife Service
NPW Act 1974	*National Parks and Wildlife Act 1974*
NRAR	Natural Resources Access Regulator
OEH	NSW Office of Environment and Heritage
PAF	Potential acid forming material
PAF-LC	Potential acid forming material – low capacity
PEP	Project Execution Plan
POEO	*Protection of the Environment Operations Act 1997*
POEO General Regulation	*Protection of the Environment Operations (General) Regulation 2009*
POEO Waste Regulation	*Protection of the Environment Operations (Waste) Regulation 2014*
PPE	Personal Protective Equipment
Project, the	Snowy 2.0 Main Works
QMP	Quality Management Plan
REMMs	Revised environmental management measures
RORO	Roll on-Roll off (containers)
SAP	Sensitive Area Plans
SCADA	Supervisory control and data acquisition
SMP	Spoil Management Plan (this Plan)
Snowy Hydro	Snowy Hydro Limited
Spoil volume (m^3)	Unless stated otherwise this represents the volume of spoil in cubic metres when placed including compaction factors
Submissions Report or RTS	*Response to Submissions Snowy 2.0 Main Works*
TBM	Tunnel boring machine
TSS	Total suspended solids

Acronym	Definition
VENM	Virgin Excavated Natural Material
WAL	Works Access Licence
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
Waste Classification Guidelines	*Waste Classification Guidelines,* NSW Environmental Protection Authority, 2014
XRD	X-ray diffraction
XRF	X-ray fluorescence

1. INTRODUCTION

1.1. Context

1.1.1. Overview

Snowy Hydro Limited (Snowy Hydro) is constructing a pumped hydro-electric expansion of the Snowy Mountains Hydro-electric Scheme (Snowy Scheme), called Snowy 2.0. Snowy 2.0 will be built by the delivery of two projects: Exploratory Works (which is complete) and Snowy 2.0 Main Works.

Snowy 2.0 is a pumped hydro-electric project that will link the existing Tantangara and Talbingo reservoirs through a series of new underground tunnels and a hydro-electric power station. Most of the project's facilities will be built underground, with approximately 27 kilometres of concrete-lined tunnels constructed to link the two reservoirs and a further 20 kilometres of tunnels required to support the facility. Intake and outlet structures will be built at both Tantangara and Talbingo Reservoirs.

Snowy 2.0 will increase the generation capacity of the Snowy Scheme by an additional 2,000 MW, and at full capacity will provide approximately 350,000 MWh of large-scale energy storage to the National Electricity Market (NEM). This will be enough to ensure the stability and reliability of the NEM, even during prolonged periods of adverse weather conditions.

WeBuild (formerly Salini Impregilo), Clough and Lane have formed the Future Generation Joint Venture (Future Generation), and have been engaged to deliver both Stage 2 of Exploratory Works and Snowy 2.0 Main Works. This plan has been prepared for the Snowy 2.0 Main Works project.

1.1.2. Construction activities and program

Construction of the Snowy 2.0 Main Works project includes, but is not limited to:

- pre-construction preparatory activities including dilapidation studies, survey, investigations, access etc;
- an underground pumped hydro-electric power station complex;
- water intake structures at Tantangara and Talbingo reservoirs;
- power waterway tunnels, chambers and shafts;
- access tunnels;
- new and upgraded roads to allow ongoing access and maintenance;
- power, water and communication infrastructure, including:
    - a cable yard to facilitate connection between the NEM electricity transmission network and Snowy 2.0;
    - permanent auxiliary power connection;
    - permanent communication cables;
    - permanent water supply to the underground power station; and
- post-construction revegetation and rehabilitation.

The Snowy 2.0 Main Works construction program is summarised in Figure 1-1.

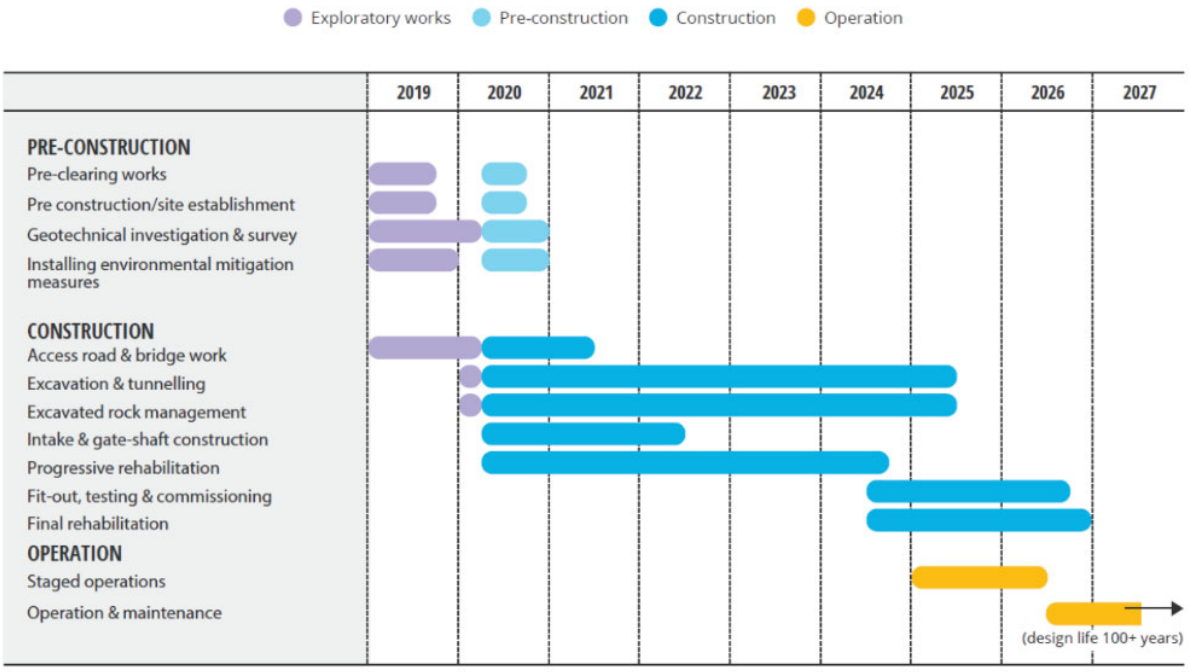


Figure 1-1: Timing of Snowy 2.0 Main Works

Snowy 2.0 Main Works includes numerous work fronts as shown in Figure 1-2. These work fronts include:

- Lobs Hole Ravine Road;
- Lobs Hole;
- Marica;
- Plateau;
- Rock Forest;
- Talbingo; and
- Tantangara.

This management plan excludes the operation of the hydro-electric scheme. Operation will be addressed through a separate Snowy Hydro 2.0 framework or document.

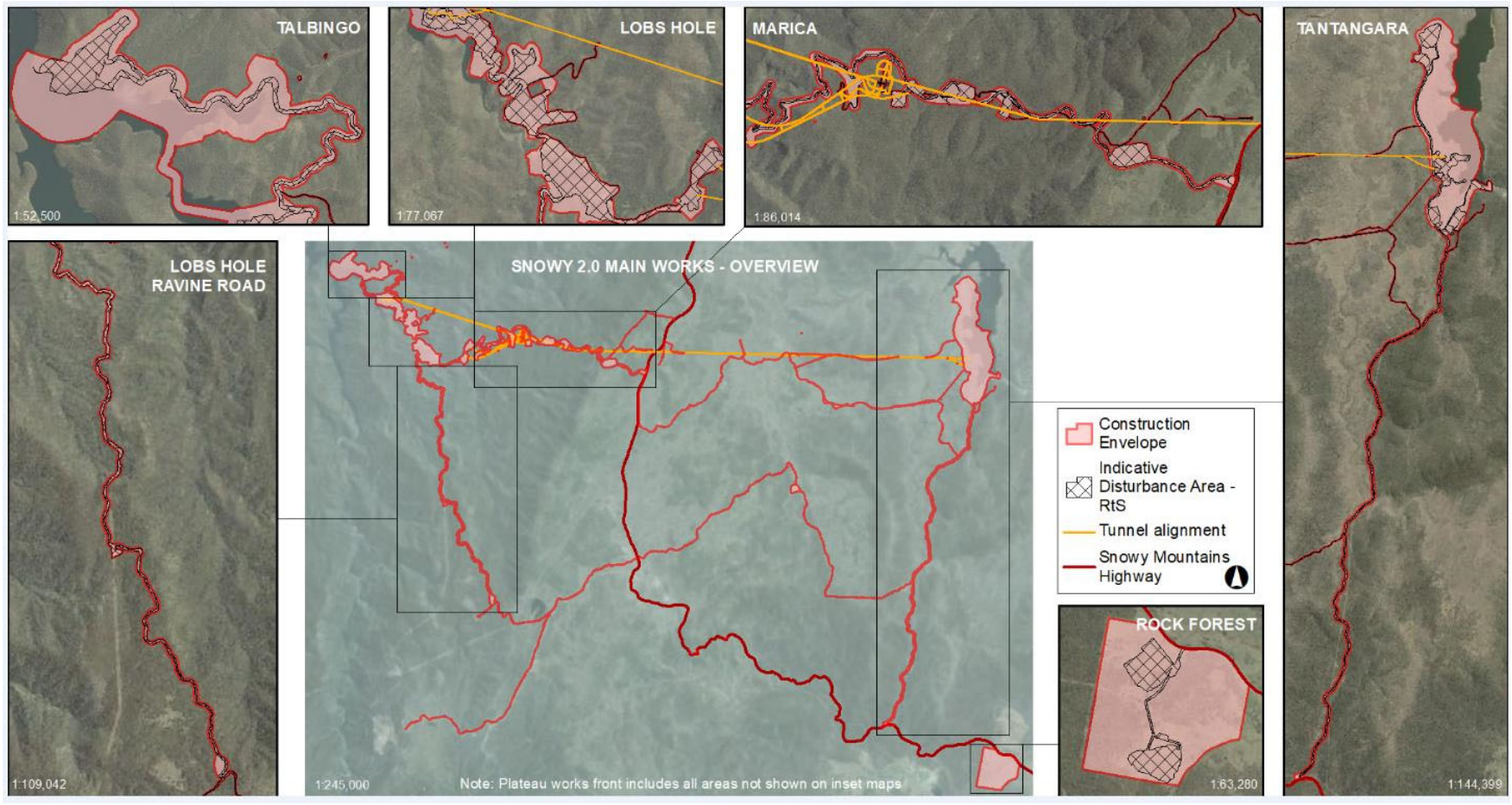


Figure 1-2: Snowy 2.0 Main Works work areas

1.2. Project Approval

On 7 March 2018 the NSW Minister for Planning declared Snowy 2.0 to be State significant infrastructure (SSI) and critical State significant infrastructure (CSSI) under the *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.

An environmental impact statement for the first stage of Snowy 2.0, the Exploratory Works for Snowy 2.0 (Exploratory Work EIS) was submitted to the then Department of Planning and Environment in July 2018 and publicly exhibited between 23 July 2018 and 20 August 2018. Approval for the first stage of Snowy 2.0 was granted for Exploratory Works by the Minister for Planning on 7 February 2019. The purpose of Exploratory Works is primarily to gain a greater understanding of the underground geological conditions at the new power station. In accordance with section 5.25 of the EP&A Act, the infrastructure approval for the Exploratory Works was modified on 2 December 2019 and on 27 March 2020.

An environmental impact statement for the second stage of Snowy 2.0, the Main Works for Snowy 2.0 (Main Work EIS) was submitted to Department of Planning and Environment (DPE) in September 2019 and was publicly exhibited between 26 September 2019 and 7 November 2019. A total of 222 submissions were received during the public exhibition period, including 10 from government agencies, 30 from special interest groups and 182 from the general public. In February 2020, the response to submissions (RTS or Submissions Report) was issued to DPE to address the public and agency submissions (*Snowy 2.0 Main Works - Preferred Infrastructure Report and Response to Submissions*, February 2020).

Following consideration of the Main Works EIS and RTS, approval was granted by the Minister for Planning and Public Spaces on 20 May 2020, through issue of Infrastructure Approval SSI 9687.

Further to the Infrastructure Approval, the Main Works RTS includes revised environmental management measures (REMMs) within Appendix C which will also be implemented for the project.

In addition to the State approval, a referral (EPBC 2018/8322) was prepared and lodged with the Commonwealth Department of Agriculture, Water and the Environment (DAWE) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Commonwealth Minister's delegate determined on 5 December 2018 that Snowy 2.0 Main Works is a "controlled action" under the EPBC Act. The EPBC Act referral decision determined that the project will be assessed by accredited assessment under Part 5, Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979.*

1.3. Disturbance area

A key refinement following public exhibition of the Main Works EIS was a change to and clarification of disturbance area terminology. The revised disturbance area terminology as per the Infrastructure Approval, RTS and this plan is outlined in Table 1-1. An example of the terminology is shown in Figure 1-3 at Ravine Road.

Table 1-1: Disturbance area terminology

Term	Definition	Reasoning
Project area	The project area is the broader region within which Snowy 2.0 will be built and operated, and the extent within which direct impacts from Snowy 2.0 Main Works are anticipated.	The project area does not represent a footprint for the construction works, but rather indicates an area that was investigated during environmental assessments.
Construction envelope	The envelope within which the disturbance area of the development may be located.	As detailed design continues, final siting of the infrastructure (i.e. the disturbance

Term	Definition	Reasoning
Disturbance area	The area within the construction envelope where the development may be carried out; the precise location of the disturbance area will be fixed within the construction envelope following final design.	area) can move within the assessed construction envelope subject to recommended environmental management measures and provided it does not exceed the limits defined by the construction envelope.

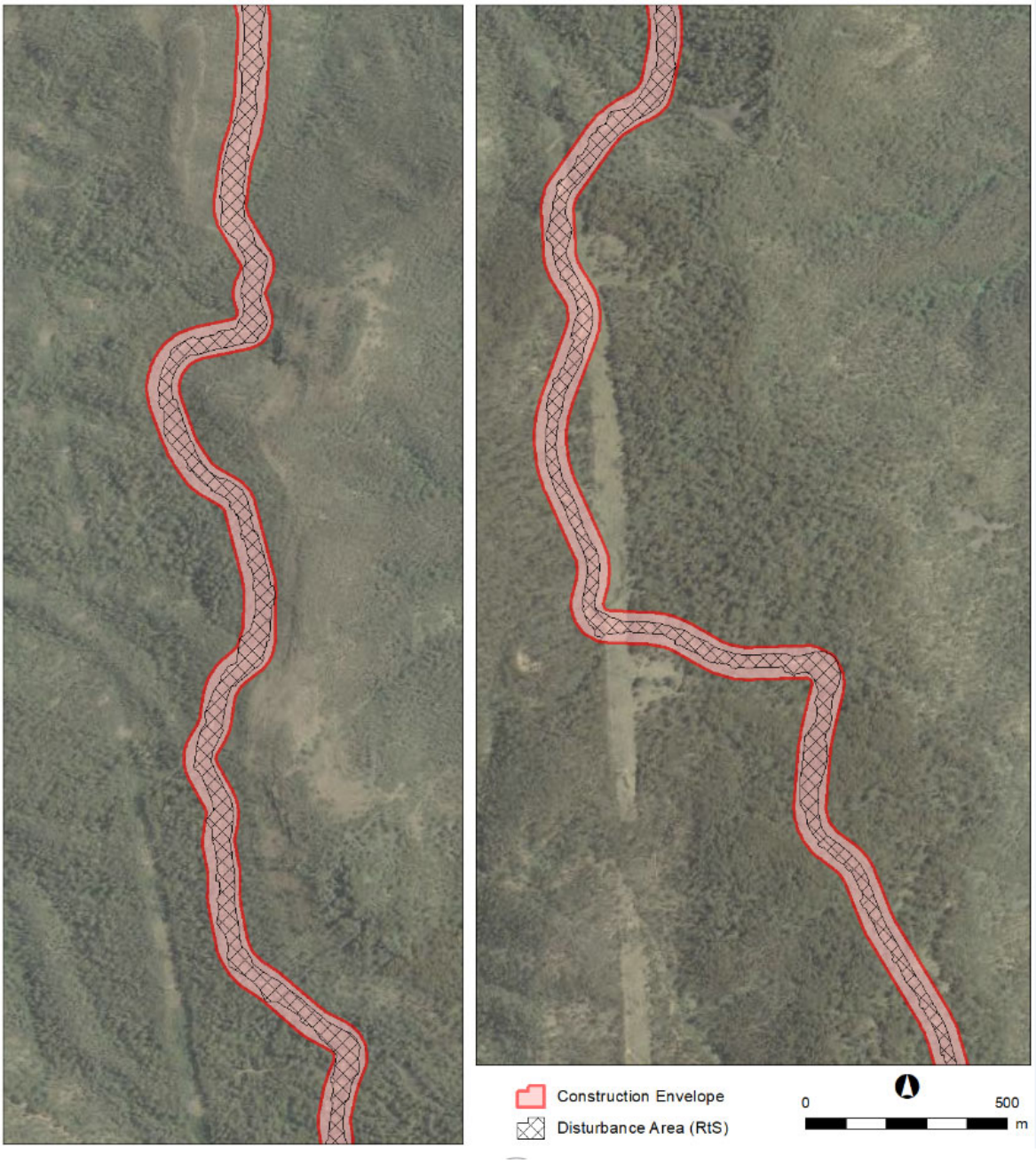


Figure 1-3 Disturbance area and construction envelope

1.4. Environmental Management System

The overall environmental management system for the project is described in the Environmental Management Strategy (EMS). The EMS forms part of the Project Management System (Future Generation-PMS) and will include any requirements specified in the contract documents, where appropriate. All Future Generation-PMS procedures will support, interface or directly relate to the development and execution of the plan.

This Spoil Management Plan (SMP or plan) forms part of Future Generation's environmental management framework as described in the EMS. It has been prepared for the construction of the Snowy 2.0 Main Works project. It does not relate to the operational phase of the project. This plan supersedes the existing Stage 1 and Stage 2 Exploratory Works Excavated Materials Management Plans (EMMP). It will also form the EMMP for the Exploratory Works project until the Exploratory Works Infrastructure Approval is surrendered. Figure 1-4 presents the approach for transitioning management plans from Stage 1 and Stage 2 Exploratory Works to Main Works. Detail on further staged updates to the SMP is presented in Section 1.6.

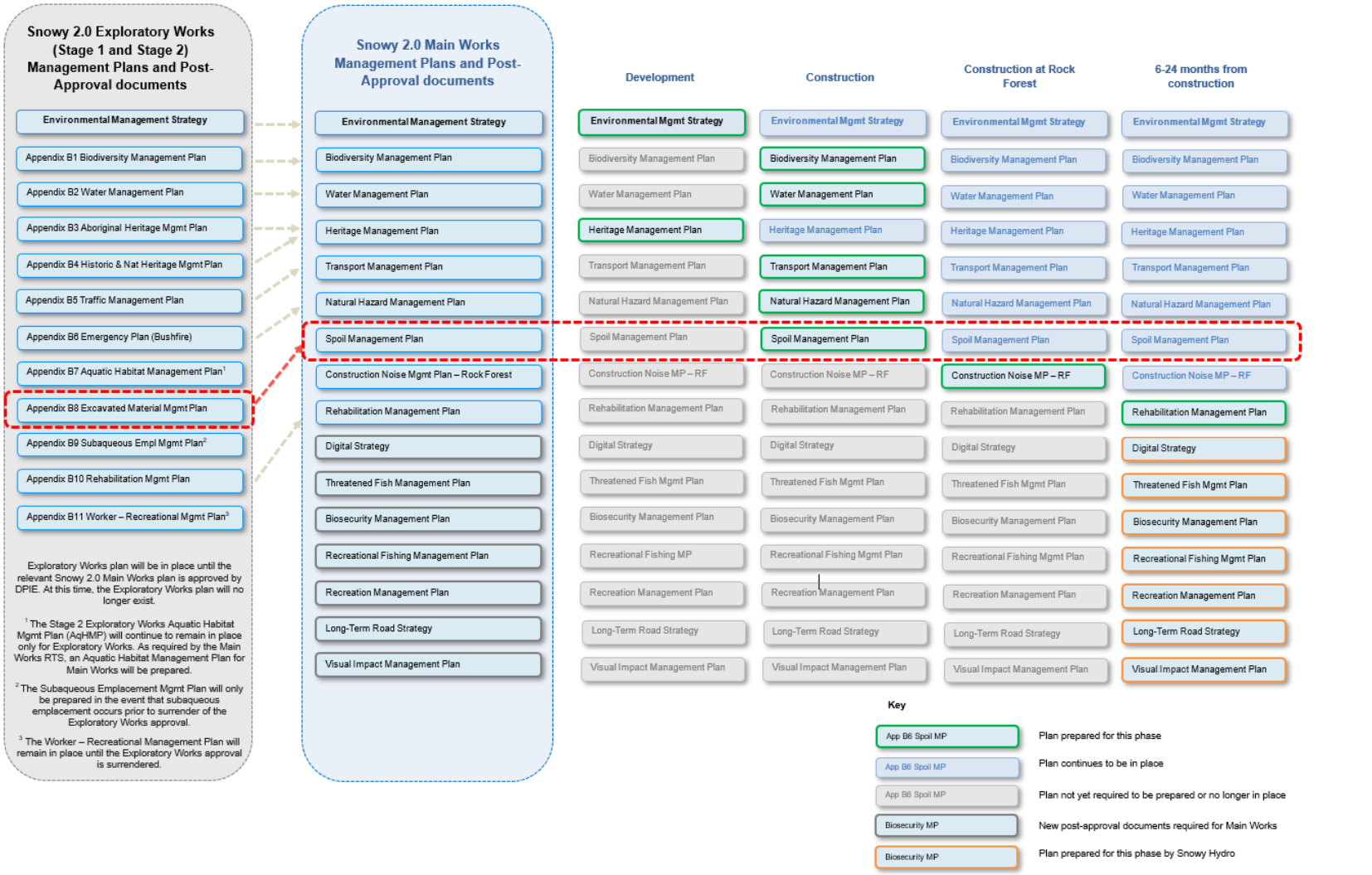


Figure 1-4 Management plans and post-approval documents with SMP indicated

1.5. Purpose and objectives

The purpose of this SMP has been prepared to address the construction environmental management requirements of:

- the Infrastructure Approval (SSI 9208) issued for the Snowy 2.0 Exploratory Works on 7 February 2019;
- the Infrastructure Approval (SSI 9687) (Infrastructure Approval) issued for Snowy 2.0 Main Works on 20 May 2020;
- the *Main Works Snowy 2.0 - Environmental Impact Statement*; and
- the revised environmental management measures (REMMs) within the *Preferred Infrastructure Report and Response to Submissions Main Works for Snowy 2.0* (Main Works Submissions Report or RTS);
- the additional information provided to the Department by EMM on 24 March 2020 and 7 April 2020.

The purpose of this plan is to describe how the project proposes to minimise and manage construction impacts during the handling, transport and emplacement of spoil.

The key objectives of the SMP is to:

- ensure appropriate measures are implemented to address the relevant conditions of approval and the revised environmental management measures listed within Submission Report as detailed within Table 3-2 of this plan; and
- ensure appropriate measures are implemented to avoid or minimise impacts associated with spoil management to surround environment and community as described in Section 6 of this Plan.

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

1.6. Staging

The Infrastructure Approval requires the preparation, submission and approval of several management plans prior to the commencement of the relevant work activity. In accordance with the note to Schedule 3, Condition 7 of the Infrastructure Approval, this SMP has been prepared for approval in stages. This is described in Table 1-2 and graphically presented in Figures 1-5 through 1-10. Note that:

- stages are not necessarily sequential and may be timed concurrently;
- the body of this plan and Appendices A – E will generally remain unchanged from Stage 1, once approved by the Planning Secretary. Appendices F – J will be developed (or updated) for each subsequent stage;
- consultation on each stage will occur with the relevant stakeholders specified in Schedule 3, Condition 7a prior to seeking approval from the Planning Secretary of that stage (refer Section 1.7); and
- The relevant stage will not commence until the update to this plan has been approved by the Planning Secretary.

Table 1-2: Proposed staging of this plan

Stage of this plan	Scope of this plan relevant to the Stage	Where addressed	Timing
Stage 1	• Spoil generation and reuse in construction and permanent infrastructure including: – Compound, logistics laydowns and camp locations to level the site as part of construction (construction pads); – Main access tunnel (MAT), Emergency egress, cabling and ventilation tunnel (ECVT), Talbingo Adit and Tantangara Adit portal (permanent operational pads and structures); and – road works across the project. • Spoil disposed of off-site (if required) Note that this Stage involves placement of spoil in the Lobs Hole emplacement area for the purposes of constructing the Main Yard site. Filling will be limited to that required to progressively construct the Main Yard pads on which facilities (plant, workshop, material handling and so forth) would operate for the duration of the construction program. Permanent placement of spoil at Lobs Hole will commence progressively following removal of the facilities and is not expected to occur until late in the construction program. This SMP will be updated to address design requirements for the Lobs Hole emplacement area prior to commencing final placement at that location.	Sections 1 – 9, and Appendix A – F of this plan	Prior to commencement of construction.
Stage 2	• Construction at GF01 emplacement area.	Appendix G	Consult on and obtain approval of Appendix G prior to commencement of this activity
Stage 3	• Construction at Ravine Bay emplacement area.	Appendix H	Consult on and obtain approval of Appendix H prior to commencement of this activity
Stage 4	• Construction at Tantangara emplacement area.	Appendix I	Consult on and obtain approval of Appendix I prior to commencement of this activity
Stage 5	• Construction at Rock Forest emplacement area.	Appendix J	Consult on and obtain approval of Appendix J prior to commencement of this activity
Stage 6	• Final placement of spoil at Lobs Hole emplacement area.	Appendix F (updated)	Consult on and obtain approval of updates to Appendix F prior to commencement of this activity

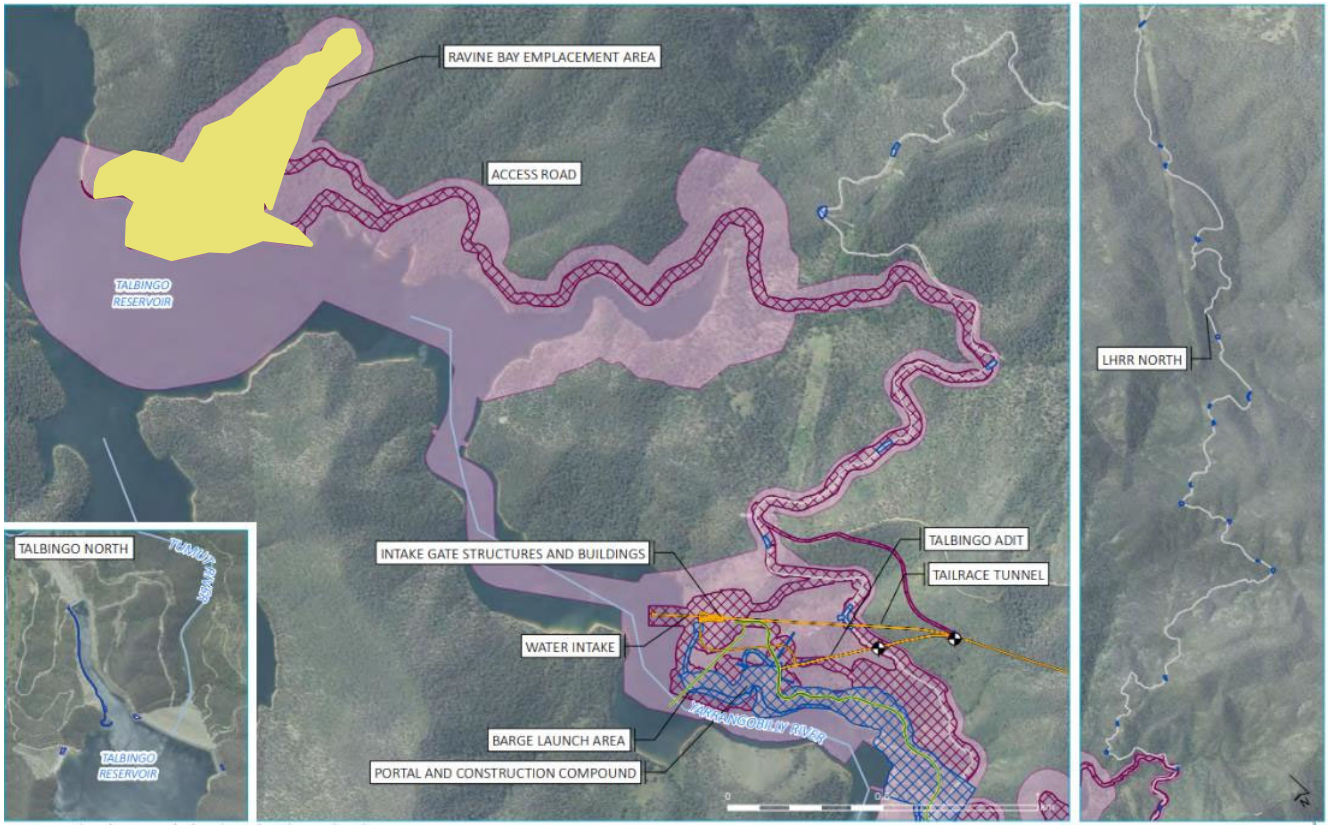


Figure 1-5 Scope and staging of this plan – Talbingo area

Code	Stage
	Construction and spoil handling to occur within this **construction envelope**[1] as approved under the Main Work Infrastructure Approval and Stage 1 of this plan.
	Exploratory Works disturbance area[1].
	Main Works indicative disturbance area[1]
	Construction not to commence until the detailed plan for the emplacement area is consulted on with the relevant agencies and approved by the Planning Secretary

Note 1: The disturbance area is an estimation of the area required for construction works based on the current level of project design. The precise location of the disturbance area may move within the broader construction envelope and consequently there will be some further refinements to the disturbance area. Note that the Approved Exploratory Works disturbance area (SSI 9208) will also be a disturbance area for Main Works, even following surrender of the Exploratory Works Approval. The cumulative disturbance area for the Main Works and approved Exploratory Works is therefore presented in this figure.

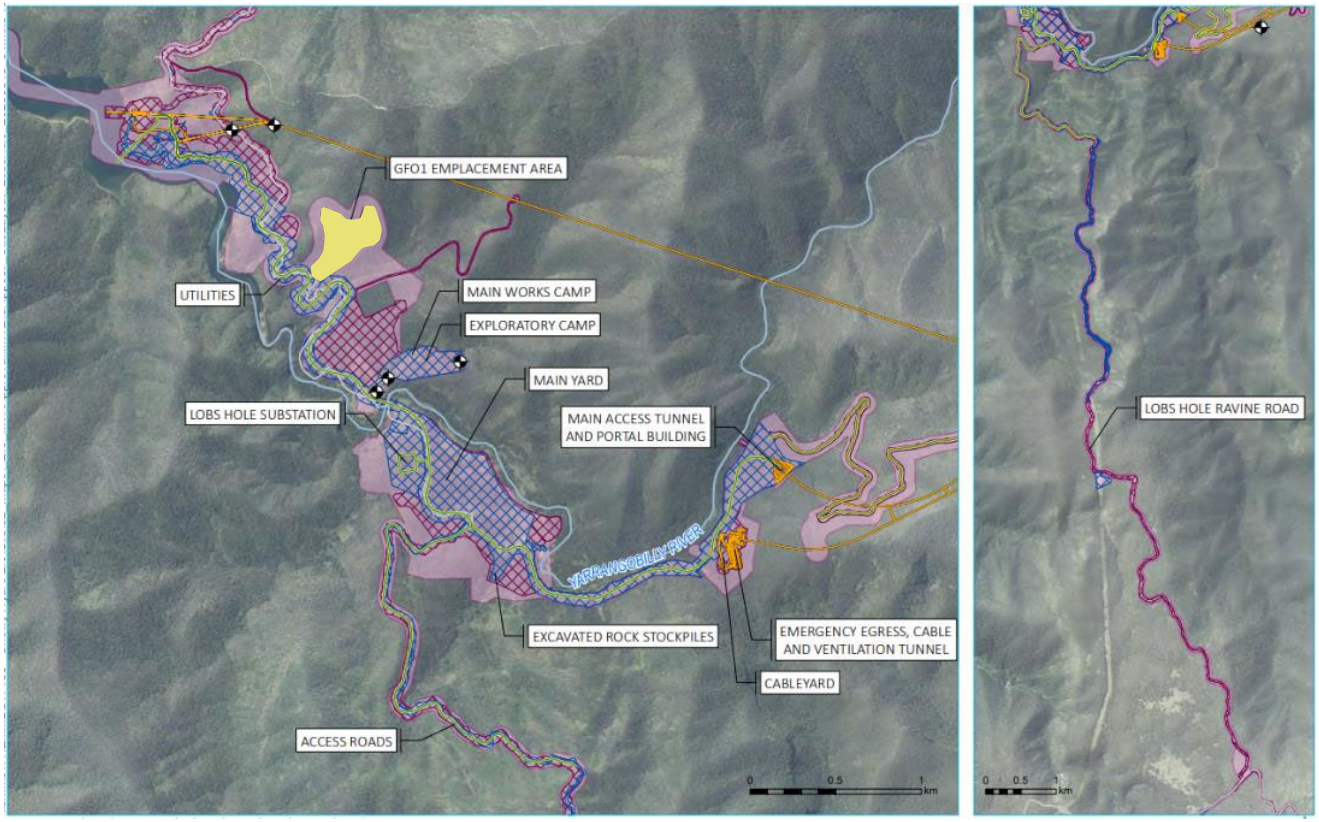


Figure 1-6 Scope and staging of this plan – Lobs Hole and GF01

Code	Stage
	Construction and spoil handling to occur within this **construction envelope**[1] as approved under the Main Work Infrastructure Approval and Stage 1 of this plan.
	Exploratory Works disturbance area[1].
	Main Works indicative disturbance area[1]
	Construction not to commence until the detailed plan for the emplacement area is consulted on with the relevant agencies and approved by the Planning Secretary

Note 1: The disturbance area is an estimation of the area required for construction works based on the current level of project design. The precise location of the disturbance area may move within the broader construction envelope and consequently there will be some further refinements to the disturbance area. Note that the Approved Exploratory Works disturbance area (SSI 9208) will also be a disturbance area for Main Works, even following surrender of the Exploratory Works Approval. The cumulative disturbance area for the Main Works and approved Exploratory Works is therefore presented in this figure.

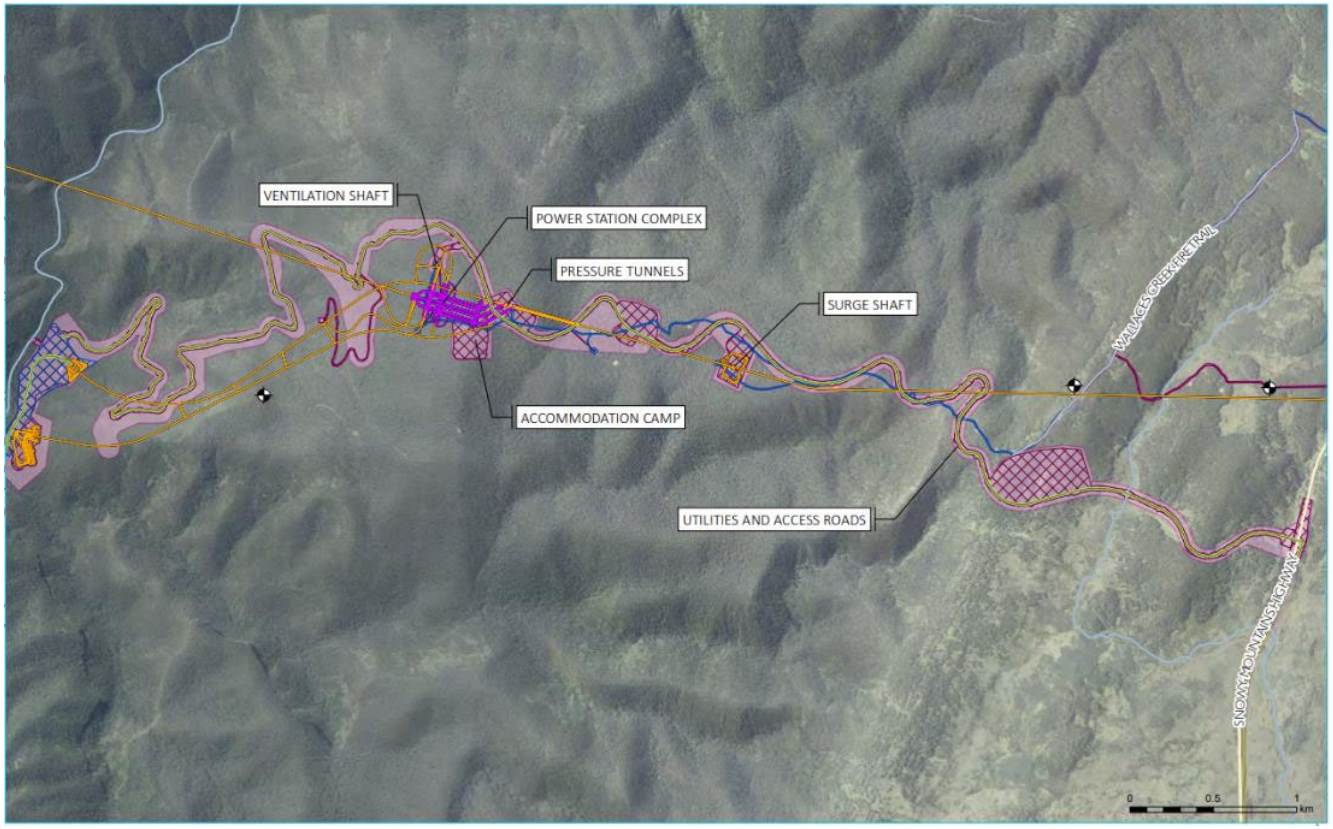


Figure 1-7 Scope and staging of this plan – Marica

Code	Stage
	Construction and spoil handling to occur within this **construction envelope**[1] as approved under the Main Work Infrastructure Approval and Stage 1 of this plan.
	Exploratory Works disturbance area[1].
	Main Works indicative disturbance area[1]

Note 1: The disturbance area is an estimation of the area required for construction works based on the current level of project design. The precise location of the disturbance area may move within the broader construction envelope and consequently there will be some further refinements to the disturbance area. Note that the Approved Exploratory Works disturbance area (SSI 9208) will also be a disturbance area for Main Works, even following surrender of the Exploratory Works Approval. The cumulative disturbance area for the Main Works and approved Exploratory Works is therefore presented in this figure.

Figure 1-8 Scope and staging of this plan – Plateau

Code	Stage
	Construction and spoil handling to occur within this **construction envelope**[1] as approved under the Main Work Infrastructure Approval and Stage 1 of this plan.
	Exploratory Works disturbance area[1].
	Main Works indicative disturbance area[1]

Note 1: The disturbance area is an estimation of the area required for construction works based on the current level of project design. The precise location of the disturbance area may move within the broader construction envelope and consequently there will be some further refinements to the disturbance area. Note that the Approved Exploratory Works disturbance area (SSI 9208) will also be a disturbance area for Main Works, even following surrender of the Exploratory Works Approval. The cumulative disturbance area for the Main Works and approved Exploratory Works is therefore presented in this figure.

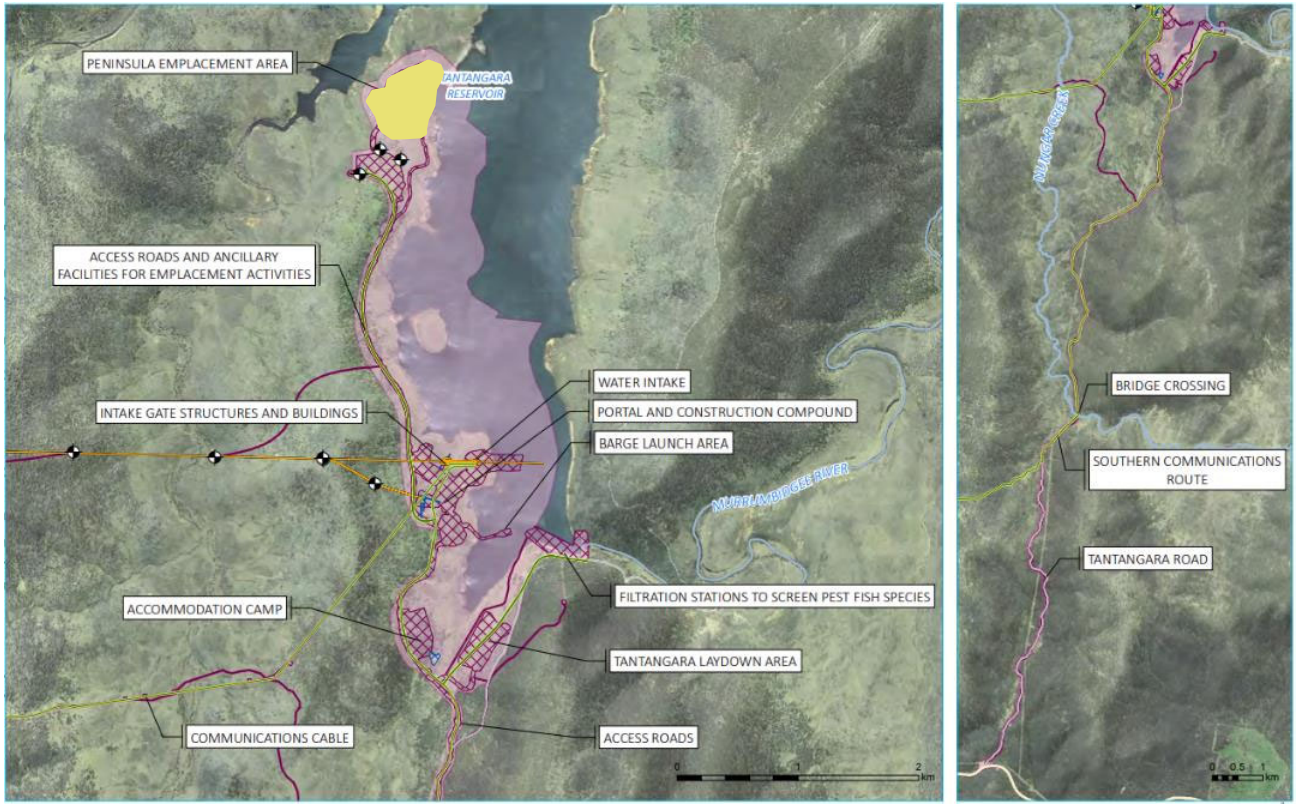


Figure 1-9 Scope and staging of this plan – Tantangara

Code	Stage
	Construction and spoil handling to occur within this **construction envelope**[1] as approved under the Main Work Infrastructure Approval and Stage 1 of this plan.
	Exploratory Works disturbance area[1].
	Main Works indicative disturbance area[1]
	Construction not to commence until the detailed plan for the emplacement area is consulted on with the relevant agencies and approved by the Planning Secretary

Note 1: The disturbance area is an estimation of the area required for construction works based on the current level of project design. The precise location of the disturbance area may move within the broader construction envelope and consequently there will be some further refinements to the disturbance area. Note that the Approved Exploratory Works disturbance area (SSI 9208) will also be a disturbance area for Main Works, even following surrender of the Exploratory Works Approval. The cumulative disturbance area for the Main Works and approved Exploratory Works is therefore presented in this figure.

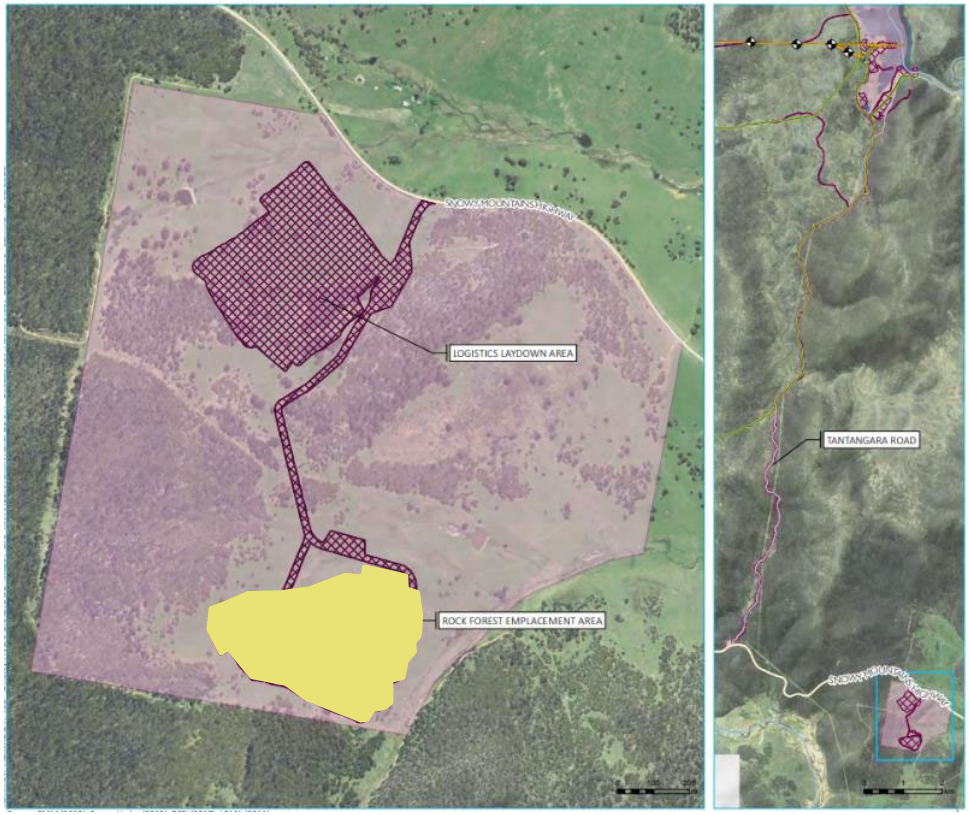


Figure 1-10 Scope and staging of this plan – Rock Forest

Code	Stage
	Construction and spoil handling to occur within this **construction envelope**[1] as approved under the Main Work Infrastructure Approval and Stage 1 of this plan.
	Exploratory Works disturbance area[1].
	Main Works indicative disturbance area[1]
	Construction not to commence until the detailed plan for the emplacement area is consulted on with the relevant agencies and approved by the Planning Secretary

Note 1: The disturbance area is an estimation of the area required for construction works based on the current level of project design. The precise location of the disturbance area may move within the broader construction envelope and consequently there will be some further refinements to the disturbance area. Note that the Approved Exploratory Works disturbance area (SSI 9208) will also be a disturbance area for Main Works, even following surrender of the Exploratory Works Approval. The cumulative disturbance area for the Main Works and approved Exploratory Works is therefore presented in this figure.

1.7. Consultation

In accordance with schedule 3, condition 7a of the Infrastructure Approval, the SMP is to be prepared by a suitably qualified and experienced person in consultation with;

- National Parks and Wildlife Service (NPWS);
- Environment Protection Authority (EPA);
- the Water Group;
- Natural Resources Access Regulator (NRAR);
- NSW Department of Primary Industries (DPI); and
- Transport for NSW (TfNSW).

This plan was prepared by Derek Low. Derek has over 13 years' experience in infrastructure and remediation. He was responsible for delivery of the environmental monitoring program for the Rhodes Remediation Projects (Lednez and Allied Feeds remediations) and was EMS Leader at Orica Botany, managing compliance for the Botany Groundwater Clean-up and HCB Repackaging Project (among others). Derek is currently the DPIE approved Independent Environmental Representative on the Inland Rail – Parkes to Narromine Project and the DPIE approved Independent Compliance Auditor on the Sydney Football Stadium Redevelopment, Moorebank Intermodal Precinct and Sydney Modern Art Gallery Expansion (among others).

Revisions of this plan and development of the appendices have been undertaken by Vincent Gillies and Veronique Levy.

1.7.1. Consultation on Stage 1 of this plan

On 12 June 2020 the plan was issued to stakeholder agencies for review and comment on Stage 1 (as set out in Table 1-2). Comments from consultation have been incorporated into this plan where appropriate. Comments are summarised in Table 1-3.

Table 1-3: Consultation undertaken for this plan

Date	Consultation	Outcomes
12 June 2020	The plan (Rev C) was issued (electronically) to all stakeholders for review and comment	-
24 June 2020	EPA agency briefing (Online presentation) of the plan.	-

Date	Consultation	Outcomes
3 July 2020	NPWS – response provided on the plan.	NPWS raised comments on better defining spoil minimisation, beneficial reuse and maximisation of placement in the emplacement areas. Section 6 of the plan has been updated to clarify this. Refer to the consultation on 16 July 2020 (below) and Section 6.2 of this plan regarding reuse of non-reactive spoil elsewhere in the KNP. NPWS raised comments about identification of risks and contingencies relevant to Lobs Hole Main Yard. Appendix F has been updated to address this. NPWS raised comments about topsoil. The Topsoil Strategy in Appendix B has been updated to address these. NPWS raised comments about monitoring and reporting. Spoil specific monitoring and reporting has been updated in Section 9 of this plan. Section 1.4 has also been updated to better clarify that the plan relates to construction only. NPWS also raised comments about obtaining as built documentation. Refer to the consultation on 16 July 2020 (below) regarding this matter.
8 July 2020	TfNSW – response provided on the plan.	TfNSW raised issues around Vehicle Management Plans, off site movements along State Roads and works in the road corridor. Sections 4.2.5 and 5.6.1 of the Transport Management Plan were updated to include details on truck types and volumes transporting spoil from Marica to Rock Forest (the only regular off site spoil transport route) and details on Vehicle Management Plans respectively. Section 6 of this plan has been updated to better clarify that spoil deemed to be unsuitable and needing to be disposed of off the project is expected to be negligible and would be managed as per the POEO Act and POEO Waste Regulation.
10 July 2020	EPA – response provided on the plan	The EPA noted the staging of the plan and reiterated that a comprehensive Emplacement Management Plan is required, which includes but is not limited to: i) dredging; ii) channel excavation; and iii) underwater blasting. The EPA requested the opportunity to provide comment on these documents as they become available. Future Generation will ensure that the EPA is consulted on the: • detailed plans for each emplacement area, within the Spoil Management Plan, as required by Sch 3 Cond 7e) • specific plans covering dredging, channel extraction and underwater blasting in the Talbingo Reservoir and Tantangara Reservoir, within the Water Management Plan, as required by Sch 3 Cond 31 c). The EPA raised comments regarding monitoring, contingency measures and Trigger Action response Plans for temporary stockpiles. Section 9 of the plan has been updated to address this.
16 July 2020	Updated plan (Rev D) submitted to NPWS for review in response to their initial comments	-

Date	Consultation	Outcomes
20 July 2020	NPWS online meeting to discuss Future Generation's responses to comments raised by NPWS	Agreed on response to issues raised with the exception of the following: Opportunities for reuse of non-reactive spoil elsewhere within the KNP was not confirmed by NPWS. NPWS requested that the plan include details about provision of as built plans to NPWS. Future Generation will be providing detailed as built documentation to Snowy Hydro. Provision of as built documentation from Snowy Hydro to NPWS is to be managed separate to this Plan.
21 July 2020	NPWS online meeting to address residual comments raised by NPWS from 3 July 2020.	NPWS sought further clarification on beneficial reuse Terms around beneficial reuse elsewhere in the KNP has been refined to reflect schedule 3 condition 4. NPWS sought further clarification on design of the exploratory works eastern emplacement area. To note, the Exploratory Works eastern emplacement area will be filled during Main Works for the purposes of constructing the Main Yard and the final Lobs Hole emplacement area. Final design of the Lobs Hole emplacement area will be addressed in accordance with the staging specified in Section 1.6 and the Rehabilitation Management Plan
5 August 2020	NRAR – response provided on the plan	NRAR recommended that the Project review the detailed design of the emplacement areas and associated sediment/contamination dams to ensure consistency with relevant exclusions under Schedule 1 of the Water Management (General) Regulation 2018 or to identify where alternate designs or the need to hold water entitlement may be required. Impacts on third order (or above) watercourses and, therefore, licensing requirements under the Water Management (General) Regulation 2018 will be determined through detailed design of the emplacement areas. Dam designs, function and licensing requirements under the Water Management (General) Regulation 2018 will be determined through detailed design of the emplacement areas. Dams, if required for the non-excluded purposes under the Schedule of the Regulation, will be designed and constructed in accordance with Dams Safety NSW (formerly Dam Safety Committee) guidelines as relevant. The detailed designs are being developed as per the staging of this plan described in Section 1.6. These designs will be subject to separate consultation with agencies and approval from the Department. Future Generation will ensure that NRAR is consulted on the detailed plans for each emplacement area. Furthermore, Future Generation will ensure that the licenses (if required) are obtained prior to the triggering works commencing.

Date	Consultation	Outcomes
		NRAR stated that design objectives in Table 7-1 for surface water management are supported. These will assist in achieving the requirements of the "Guidelines for Controlled Activities on Waterfront Land (NRAR 2018)". It recommended that the Project ensure the detailed design of works within waterfront land are consistent with the "Guidelines for Controlled Activities on Waterfront Land (NRAR 2018)". Table 7-1 of this plan reflects the design objectives as required by Schedule 3 Condition 6 of the Infrastructure Approval and must be complied with. These objectives are being incorporated into the detailed design of each emplacement area, which will consider constructability, landform and environmental protection. The detailed designs are being developed as per the staging described in Section 1.6 of this plan and these designs will be subject to separate consultation with agencies and approval from the Department. As stated in Section 1.5, specific on-site management measures identified in this plan will be incorporated into site documents where relevant. These site-specific documents will be prepared for construction activities and will detail the management measures which are to be implemented on the ground. Construction personnel will be required to undertake works in accordance with the mitigation measures identified in the site-specific documents.

1.7.2. Consultation on future stages of this plan

Appendices H and J (and updates to approved appendices) will be issued for consultation prior to submitting these sections to the Planning Secretary to obtain approval for the works to which they relate.

On 20 July 2022 subsequent stages of the plan were issued to stakeholder agencies for review and comment (as set out in Table 1-2). Comments from consultation have been incorporated into this plan where appropriate. Comments are summarised in Table 1-3.

Table 1-4: Consultation undertaken for Stages 2 and 4 of this plan

Date	Consultation	Outcomes
20 July 2021	Submitted Appendix G – GF01 to EPA, NPWS, NRAR, Water Group, DPI Fisheries for consultation.	-
28 July 2021	Verbal online consultation held with EPA and NPWS regarding Appendix G – GF01	-
20 July 2021	Submitted Appendix G – GF01 to EPA, NPWS, NRAR, Water Group, DPI Fisheries for consultation.	-
28 July 2021	Verbal online consultation held with EPA and NPWS regarding Appendix G – GF01	-

Date	Consultation	Outcomes
04 August 2021	Responses to Appendix G received from TfNSW.	TfNSW noted that with no placement in water and no movement of spoil on roads external to the project site, they had no objection to the document. Minor comments regarding an additional map identifying the location of works to the larger project site and insertion of a statement noting no spoil movements on roads external to the project were suggested. FGJV added the map to Section 1.1 and the statement to Section 4.1.
28 September 2021	Responses to Appendix G received from NPWS.	NPWS requested clarification on how the Conditions of Approval were to be met, landform design updates during construction would be communicated, landform stability would be achieved, and how rehabilitation and recreation had been considered as the respective management plans have not yet been developed. FGJV provided additional information regarding landform construction throughout the plan and agreed to ongoing consultation with relevant agencies to communicate design updates.
24 November 2021	Further online consultation held with NPWS regarding Appendix G – GF01.	NPWS requested a number of minor clarifications and confirmation regarding water management and ecological aspects of GF01 during construction and rehabilitation. FGJV updated Table 1-2, and Section 2.1 with clarifications.
26 November 2021	Further online consultation held with EPA regarding Appendix G – GF01.	An independent reviewer from Earth Systems assisted EPA and DPE in the review of Appendix G – GF01. Further detail on water management, AMD testing classification, testing methodologies, spoil treatment, and spoil placement were requested. For continuity across all site, FGJV updated Appendix A, D, and E with spoil testing, NOA, and AMD details respectively. Further water management was not relevant to the management plan appendix but was committed to following a more detailed procedure with appropriate monitoring.
07 December 2022	Submitted Appendix I – Tantangara to EPA, NPWS, NRAR, Water Group, DPI Fisheries for consultation.	All comments received from agencies relating to Appendix G – GF01 were transcribed to Appendix I – Tantangara where relevant.
16 December 2021	Verbal online consultation held with EPA and NPWS regarding Appendix I – Tantangara.	-
22 December 2021	Responses to Appendix I received from TfNSW.	TfNSW, including maritime, requested additional information regarding where the spoil was sourced and where it was placed, whether placement would occur in reservoir, a communication strategy for members of the public and a marine control plan. FGJV updated Section 5.1 to include the additional information and clarify that no in reservoir placement at Tantangara was anticipated, no roads external to project would be utilised in spoil placement at Tantangara, and that no spoil placement works at Tantangara should affect reservoir users.

Date	Consultation	Outcomes
22 December 2021	Responses to Appendix I received from NPWS.	NPWS requested clarification on how the water quality would be managed and guidelines met, key environmental issues such as weeds and reservoir water level fluctuations would be managed, landform compaction would be met, and how rehabilitation and recreation had been considered as the respective management plans have not yet been developed. FGJV provided additional information regarding landform construction throughout the plan and agreed to ongoing consultation with relevant agencies to communicate design updates.
21 January 2022	Verbal online consultation held with EPA and independent reviewer regarding Appendices A, D, E, and G.	Additional detail was requested to be inserted into
14 February 2022	Verbal online consultation held with EPA and independent reviewer regarding Appendix I.	EPA requested clarification on NOA impacted spoil management and excess water and confirmation that the proposed water management was adequate for the TBM methodology. FGJV amended the TBM NOA excavation methodology in Appendix A, D, as the TBM will no longer be operated in slurry mode but will be operated in an enclosed conveyor mode with wetted spoil. Additionally, FGJV agreed to ongoing consultation with relevant agencies regarding site specific controls including compaction rates and potential pollution controls for the protection of water quality.
11 April 2022	Online consultation with DPE and EPA to discuss comments	
14 April 2022	Online consultation with EPA to discuss close out of comments outlined in the meeting held 11 April	
16 May 2022	Online consultation with DPE and subject matter expert (SME) to discuss further comments	DPE and SME requested clarification of NAG suite testing, PAF material encapsulation during placement, including covering any PAF material that could be present on the outer edges of the emplacement areas, and the storage of material while awaiting laboratory results.
15 July 2022	Online consultation with EPA to discuss leachate detection procedure	
3 August 2022	EPA response to proposed leachate detection procedure	EPA confirmed the proposed leachate detection for GF01 is satisfactory
2 September 2022	Online consultation with EPA to discuss leachate detection procedure	
7 September 2022	EPA response to proposed leachate detection procedure	EPA confirmed the proposed leachate detection for Tantangara is satisfactory

2. ENVIRONMENTAL REQUIREMENTS

2.1. Legislation

Legislation relevant to the management of spoil includes:

- *Environmental Planning and Assessment Act 1979* (EP&A Act);
- *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation);
- *Contaminated Land Management Act 1997* (the CLM Act);
- *Protection of the Environment Operations Act 1997* (POEO Act);
- *Protection of the Environment Operations (General) Regulation 2009* (POEO General Regulation);
- *Protection of the Environment Operations (Waste) Regulation 2014* (POEO Waste Regulation); and
- *Waste Avoidance and Resource Recovery Act 2001* (WARR Act).

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Appendix A1 of the EMS.

2.2. Conditions of Approval

Table 2-1 details the conditions from the Infrastructure Approval which are relevant to spoil management.

Table 2-1: Conditions of approval relevant to spoil management

Condition	Requirement	Where addressed
Spoil Management		
Schedule 3, condition 7	Prior to the commencement of construction, the Proponent must prepare a Spoil Management Plan for the development to the satisfaction of the Planning Secretary. This plan must: (a) be prepared by a suitably qualified and experienced person in consultation with the NPWS, EPA, Water Group, NRAR, NSW DPI and TfNSW;	Section 1.6 and Section 1.7 of this plan
	(b) provide an overarching framework for the management of all spoil generated on site - including the testing, classification, handling, temporary storage and disposal of spoil – that complies with the spoil management requirements in condition 4 above;	Sections 5 – 9 and Appendix A – F of this plan
	(c) include a detailed plan for managing the temporary spoil stockpiles of the development, which includes suitable triggers for remedial measures (if necessary) and describes the contingency measures that would be implemented to address any water quality risks;	Section 6.5 and Section 9 and Appendix C of this plan
	(d) include a detailed plan for managing all the reactive or contaminated spoil generated on site, including the contingency measures that would be implemented if the volumes of this spoil are greater than expected and unsuitable for land disposal;	Section 6 and Appendix D and E of this plan Contaminated Land Management Plan Waste Management Plan

Condition	Requirement	Where addressed
	(e) detailed plans for each of the permanent spoil emplacement areas that have been prepared using both analogue and erosional-based methods: these plans must: • describe how the development of each emplacement area would be co-ordinated with the rehabilitation of the site in accordance with the approved Rehabilitation Management Plan; • describe the measures that would be implemented to comply with the spoil management requirements in condition 4 above and the design objectives in Table 2; • include a topsoil strategy outlining the measures that would be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target PCTs in the long term, having regard to the approved strategy in the Rehabilitation Management Plan; • identify the key risks for the successful completion of each emplacement area and the contingency measures that would be implemented to address these risks; and • include detailed completion criteria and performance indicators for each emplacement area, including criteria for triggering remedial action (if necessary);	Appendix F and Appendix G of this plan.
	(f) include a program to monitor and publicly report on: • the management of spoil on site; • the implementation of each of the detailed plans, including the effectiveness of the proposed mitigation and contingency measures; and • progress against the detailed completion criteria and performance indicators of each permanent spoil emplacement area.	Section 9 of this plan
	Note: The Proponent may stage the preparation of the Spoil Management Plan, including the preparation of detailed plans for each permanent spoil emplacement area. However, the detailed plans must be approved prior to any construction occurring in the relevant emplacement area.	Section 1.6 of this plan
Schedule 3 condition 4	The Proponent must: (a) minimise the spoil generated by the development;	Section 6 of this plan
	(b) test and classify the relevant physical and chemical characteristics of the spoil;	Section 5 and Appendix A of this plan
	(c) manage, use or dispose of the spoil in accordance with its classification	Section 6 and Appendix D and E of this plan
	(d) develop and implement suitable procedures for handling, storing and disposing of any: • potentially acid forming material; • asbestiform mineral fibres; • contaminated material	Section 6 and Appendix D and E of this plan
	(e) only place non-reactive spoil, which has a low geochemical risk and is suitable for reuse, in the western emplacement area	Section 6 and Appendix E of this plan
	(f) maximise the reuse of non-reactive spoil on site and in other parts of the Kosciuszko National Park	Section 6 of this plan
	(g) maximise the use of the permanent spoil emplacement areas	Section 6 of this plan

Condition	Requirement	Where addressed
	(h) minimise the spoil left at Lobs Hole and Marica for incorporation into the final landform	Section 6 of this plan
	(i) minimise the water quality impacts of the temporary and permanent emplacement areas	Section 6, 8, 9 and Appendix C, E and F – J of this plan Surface Water Management Plan
	(j) not place any spoil from the tunnel boring machines in the active storages or below the full supply level of either the Talbingo Reservoir or Tantangara Reservoir without the approval of the Planning Secretary	Section 6 of this plan
	(k) not place any spoil from dredging, channel excavation or underwater blasting in the eastern and western emplacement areas, or in the active storages or below the full supply level of either the Talbingo Reservoir or Tantangara Reservoir without the approval of the Planning Secretary.	Section 6 of this plan
Schedule 3, condition 5	Apart from the spoil that is provided to the NPWS for use in other parts of the Kosciuszko National Park, sent off-site, used to construct temporary or permanent infrastructure for the development or used to rehabilitate the site, the Proponent must ensure that all the spoil generated by the development is disposed of in the following emplacement areas: a) Ravine Bay; b) GFO 1; c) Lobs Hole; d) Tantangara; or e) Rock Forest. *Note: The location of these emplacement areas is shown in the figures in Appendix 2* (of the COA).	Section 6 of this plan
Schedule 3, condition 6	The Proponent must ensure the permanent spoil emplacement areas comply with the design objectives in Table 2 (of the COA entitled *Design Objectives for Permanent Spoil Emplacement Areas*).	Appendix F – J of this plan
Schedule 3, condition 8	The Proponent must implement the approved Spoil Management Plan for the development.	Section 8 and 9 of this plan

2.3. Environmental Management Measures

Environmental safeguards and management measures are included in the EIS in Appendix G. During preparation of the Submissions Report, revised environmental management measures (REMMs) were developed and are included in Appendix C of the Submissions Report.

The revised environmental management measures relevant to this Plan are listed in Table 2-2 below.

Table 2-2: Management measures from the RTS relevant to spoil management

Impact	Ref #	Revised environmental management measure	Where addressed
Rehabilitation	REHAB 01	A Rehabilitation Management Plan will be prepared for the new landforms at Tantangara Reservoir, Lobs Hole and Talbingo Reservoir. The plan will: • include a detailed plan for rehabilitation of the site;	Section 7 and Appendix F – J of this Plan.

Impact	Ref #	Revised environmental management measure	Where addressed
		• include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the sites, and triggering any remedial action (if necessary); • describe the measures that would be implemented to: – comply with the rehabilitation objectives and associated performance and completion criteria; – progressively rehabilitate the site; – include a program to monitor and report the effectiveness of these measures	Rehabilitation Management Plan
Creation of new landforms	REHAB 02	New landforms will: • be safe, stable and non-polluting; • maximise surface drainage to the natural environment	Section 7 and Appendix F – J of this Plan. Rehabilitation Management Plan
Assessment of surface disturbance and excavation areas	CONTAM01	Targeted investigations will be undertaken prior to construction along the surface disturbance areas using a risk-based approach. The results of these targeted investigations will determine the level of management to be implemented.	Section 5.3 of this Plan. Contaminate d Land Management Plan
Assessment of imported Virgin Excavated Natural Material (VENM)	CONTAM02	Prior to the importation of any VENM during construction, the VENM source(s) will be identified and assessed against the definition of VENM in the Waste Classification Guidelines (NSW EPA, 2014) and the POEO Act. The VENM source(s) will be assessed by an appropriately qualified contaminated land consultant.	Contaminate d Land Management Plan Waste Management Plan
Contaminated soil management during construction	CONTAM03	Protocols for the management of contaminated soil during construction will be included in the CEMP or EMS.	Contaminated Land Management Plan
Excavated rock waste management and transport	CONTAM04	Material which has been assessed as not suitable for reuse on land or for subaqueous disposal or cannot be reused will be classified in accordance with the Waste Classification Guidelines (NSW EPA 2014). Depending on the classification of the material, a licensed waste transport company will be used to transport material which is required to leave the project, to an appropriately licensed facility. Excavated material may be subject to treatment and application on site	Section 5.6 and 6.7 of this Plan. Contaminated Land Management Plan. Waste Management Plan
Asbestos management	CONTAM05	An Asbestos Management Plan (AMP) will be developed if areas and items are identified during pre-construction investigations as containing Asbestos Containing Materials ACM (ACM), or areas are suspected of containing ACM (such as historical buildings). The AMP will address unexpected finds of ACM. Specifically, protocols will be stipulated for separation, monitoring, validation and clearance of asbestos	Asbestos Management Plan

Impact	Ref #	Revised environmental management measure	Where addressed
Asbestos management	CONTAM06	An Occupational Hygienist (Hygienist) will be on-site for the duration of the excavation works where ACM has been identified from pre-construction or where unexpected finds of ACM are encountered.	Asbestos Management Plan
PAF rock	CONTAM07	An Excavated Rock Management Plan would be developed which would include measures identified in the Preliminary Site Investigation – Contamination (Table 9.1, Item 4 of Appendix N.1)	This Plan
PAF / NOA rock management	Table 9.1, Item 4 of Appendix N.1	An Excavated Spoil Management Plan would be developed which would include: • Procedures for handling, geochemical sampling and testing, classification, storage and disposal/placement of excavated rock to ensure that excavated material is appropriately managed;	Sections 5 – 9 and Appendix A – J of this Plan
		• Monitoring required to mitigate potential impacts from placement of excavated rock material;	Section 9 and Appendix F – J of this Plan
		• A clear, effective and trackable mechanism for implementing mitigation measures;	Section 6, 8 and 9 of this Plan
		• Allowances for the treatment and separate placement of some PAF/NOA material in dedicated permanent emplacements in accordance with excavated rock management strategies for the Project;	Sections 6.8 and 6.9 and Appendix D and E of this Plan
		• Allowances for the treatment of tunnel drainage containing AMD components for excavations in Possible, Likely and Confirmed AMD hazard areas;	Section 6.10 of this Plan Groundwater Management Plan
		• A process for the identification/characterisation/quantification of PAF/NOA material and activity specific risk assessments;	Section 5 and Appendix A of this Plan
		• A continued excavated material characterisation program would be developed which will allow for adequate assessment of NOA, acid metalliferous drainage (AMD)/neutral metalliferous drainage (NMD)/saline drainage (SD) material, and reduce the risk of material being misclassified as 'benign' and being managed inappropriately, and may include:	Section 5 and Appendix A of this Plan
		– Geochemical kinetic testing of each key lithology or alteration type identified to have an actual PAF, Potentially acid-forming—low capacity (PAF-LC)), or potential (uncertain) AMD risk	
		– Sequential Net Acid-Generation (NAG) testing, where TS >1% is reported in any single addition NAG tests (even where classification of the sample indicates NAF)	
		– Chromium Reducing Sulfur (CRS) testing, where is reported equal to or greater than 0.3% in single addition NAG tests	
		– Creation of a graphical or statistical analysis of AMD sample distribution to identify any critical information gaps, and develop a block model for potentially AMD forming material in the Possible to Confirmed Criticality Assessment areas	
		– Any laboratory analysis be compared to/correlated with x-ray fluorescence (XRF) core scans conducted by CSIRO	

Impact	Ref #	Revised environmental management measure	Where addressed
		and previous laboratory x-ray diffraction (XRD), abscisic acid (ABA), and NAG tests and management responses to mitigate identified risks associated with potentially AMD forming material	
Unexpected Finds	CONTAM08	An unexpected finds procedure will be included in the CEMP. Workers will be trained to identify potential contamination that may be encountered during construction	Contaminated Land Management Plan.
Alpine humus soils and peat bogs and fens	SOIL01	Mitigations will be included in the Rehabilitation Management Plan to minimise impacts to Alpine humus soils and peat bogs/fens.	Rehabilitation Management Plan
Loss of soil resource	SOIL02	Development and implementation of soil management measures to assist in the preservation of the quantity and quality of the soil resource including: • an inventory of soils to be stripped, including depths and volumes; and • topsoil management measures including stripping and stockpiling procedure.	Section 6.4 and Appendix B of this Plan Rehabilitation Management Plan
Soil erosion and sedimentation	SOIL03	Site-based Erosion and Sediment Control Plans (ESCPs) will be prepared by a suitably qualified erosion and sediment control specialist.	Section 6.11 and 9 and Appendix C of this Plan Surface Water Management Plan
Soil capability	SOIL04	The Rehabilitation Management Plan (refer to REHAB01) will be implemented and will include measures to minimise: • loss of soil; • loss of organic matter and nutrient decline; • soil structural decline; and • compaction. Regular rehabilitation monitoring will be undertaken to identify any defects, such as slumping, erosion or poor vegetation establishment. Identified defects will be rectified	Section 9 and Appendix F – J of this Plan Rehabilitation Management Plan

The COA requires the project to be conducted in accordance with the Exploratory Works EIS and RTS as relevant. Environmental safeguards and management measures are included in the Exploratory Works EIS in Section 6.3. During preparation of the Exploratory Works Submissions Report, REMMs were developed and are included in Section 8 of that Submissions Report.

The REMMs relevant to this Plan are listed in Table 2-3 below. If additional measures are cross-referenced from another section of the EIS or Submissions Report, these measures are also included.

In accordance with Schedule 2, Condition 3 of the Infrastructure Approval, if there is any inconsistency between the Exploratory Works and Main Works documents, the most recent document will prevail to the extent of the inconsistency (i.e. Main Works).

Table 2-3: Exploratory Works management measures from the EIS relevant to spoil management

Impact	Ref #	Environmental management measure	Where addressed
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: • preserve as much of the topsoil and subsoil as possible; • minimise the risk of contamination; • minimise the risk of any topsoil degradation or compaction during construction and following reinstatement; • ameliorate subsoil where required for use in rehabilitation works; • minimise topsoil mixing with unsuitable soil and spoil materials during stripping and stockpiling; and • ensure reinstatement of soil horizons in the correct order and required depths to allow for rehabilitation.	Section 6.4 and 6.5 and Appendix B and C of this Plan Rehabilitation Management Plan
		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.	Section 6.4 and 6.5 and Appendix B and C of this Plan Rehabilitation Management Plan
Contaminated land	CON02	An Excavated Rock Management Plan will be prepared prior to the commencement of tunneling. The Plan will include:	This Plan
		• 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	Sections 5 – 9 and Appendix A – J of this Plan
		• 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.	Section 9.1.3 and 9.1.4 of this Plan Surface Water Management Plan and Groundwater Management Plan
		• 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;	Section 6.5 and 6.9 and Appendix E and F of this Plan

Impact	Ref #	Environmental management measure	Where addressed
		– progressive verification of the adequacy of design options; – minimisation of placement footprint where possible; and – minimising the construction footprint and extent to which soil and vegetation within the riparian zone are disturbed.	
	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).	Section 5 and 6.7 and Appendix A of this Plan Waste Management Plan
Water quality impacts from rock emplacement areas	WM8.1	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.	Note that this is no longer relevant as the Main Works COA permits the placement of spoil across Lobs Hole, which includes the Exploratory Works eastern and western emplacement areas. Refer to Section 6 and Appendix F of this Plan
	WM8.2	During establishment, the water management controls for construction areas (WM_2.1 to 2.8) will be applied.	Surface Water Management Plan
	WM8.3	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.	Section 8 and Appendix E and F of this Plan
	WM8.4	Any remnant mine workings located within the eastern and western rock and soil emplacement areas will be rehabilitated (if necessary).	Section 8 and Appendix E and F of this Plan
	WM8.5	The eastern emplacement area will be used to store any material that has higher geochemical risk. 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. Once design levels are reached, the landform will be top-soiled and vegetated.	Note that this is no longer relevant as the Main Works COA permits the placement of spoil across Lobs Hole, which includes the Exploratory Works eastern and western emplacement areas. The Exploratory Works eastern emplacement area will not be set aside for treatment of reactive material as it will be filled to construct the Main Yard. Reactive material will be managed in designated treatment areas in locations so as
	WM8.6	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.	

Impact	Ref #	Environmental management measure	Where addressed
		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.	to prevent environmental harm. Refer to Sections 6, 8 and Appendix E and F of this Plan
	WM8.7	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.	Refer Water Management Plan
	WM8.8	The eastern and western emplacement areas will be rehabilitated following removal of all material. Lick Hole Gully will be reinstated 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.	Note that this is no longer relevant as the Main Works COA permits the placement of spoil across Lobs Hole, which includes the Exploratory Works eastern and western emplacement areas. Refer to Section 6 and Appendix F of this Plan
Excavated material management	MOD2 - 005	The Excavated Material Management Plan will be updated and the Subaqueous Emplacement Management Plan will be prepared to provide consideration to the management of excavated material generated by TBM tunnelling.	This is no longer relevant as the Main Works COA permits the placement of spoil above and below full supply level (FSL) at Ravine Bay and Tantangara peninsula. This Plan will be updated for approval prior to the commencement of construction in these locations. Refer Section 6 and Appendix H and I of this Plan (once prepared).
Impacts to aquatic habitat and biota during dredging and subaqueous placement	ECO15 -1	The subaqueous placement monitoring program for Talbingo Reservoir will be developed and implemented.	
	ECO15 -3	Measures relevant to aquatic ecology will be implemented as described below including: the extent of the placement area will be minimised as far as practicable;	
	ECO15 -4	Measures relevant to aquatic ecology will be implemented as described below including: the extent of the dredge footprint will be minimised as far as practicable;	
	ECO15 -5	Measures relevant to aquatic ecology will be implemented as described below including: 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);	
	EECO1 5-6	Measures relevant to aquatic ecology will be implemented as described below including: 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;	
Flood Risk	FM1.2-1	The western emplacement will be designed to prevent the risk of emplacement material being entrained in flood waters during a 1 in 5000-year flood event.	Note that this is no longer relevant as the Main Works COA permits the placement of spoil across Lobs Hole, which includes the Exploratory Works

Impact	Ref #	Environmental management measure	Where addressed
			eastern and western emplacement areas. Section 9 and Appendix F of this Plan

2.4. Licences and Permits

Environment Protection Licence (EPL) 21266 has been issued for the project for the scheduled activity of extractive activities for the Exploratory Works phase. The premises boundary for the Exploratory Works EPL has been expanded to encompass both Exploratory Works and Main Works activities and the governing scheduled activity for Main Works is Electricity Generation. A Construction Lease and Works Access Licence has also been established with NPWS in order to carry out the relevant Snowy 2.0 Main Works.

2.5. Guidelines

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

- *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Land* (NSW Gov 2013);
- *Soil and Landscape Issues in Environmental Impact Assessment* (DLWC 2000);
- *Acid Sulfate Soils Assessment Guidelines* (Ahern et al. 1998);
- *The land and soil capability assessment scheme: second approximation* (OEH 2012);
- *The Australian soil classification* (Isbell 2016);
- *Acid sulfate soils manual* (Stone et al 1998);
- *NSW EPA Guidelines for consultants Reporting on Contaminated Sites* (OEH 2011);
- *Waste Classification Guidelines Part 1: Classifying waste* (NSW EPA 2014);
- *Managing Urban Stormwater: Soils and Construction.* Landcom, (4th Edition) March 2004 (reprinted 2006) (the Blue Book);
- *Acid Sulfate Soils Manual,* NSW Acid Sulfate Soil Management Advisory Committee, 199;
- *National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM), NEPC 2013;*
- *Preventing Acid and Metalliferous Drainage Leading Practice Sustainable Development Program for the Mining Industry,* Department of Industry 2016 (AMD Guideline);
- *Australian Standard 1141 Methods for sampling and testing aggregates;*
- *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia,* Western Australian Department of Health 2009.

3. EXISTING ENVIRONMENT

The following sections summarise the existing soil and geological environment within and adjacent to the Project based on the information contained in Appendix L and N of the Main Works EIS, the Main Works Submissions Report and Chapter 5.3, Appendix H and Appendix K of the Exploratory Works EIS.

On 4 January 2020, the Snowy 2.0 project site and overall northern section of KNP was impacted by a significant bushfire. The project site at Lobs Hole was severely impacted with much of the groundcover and trees burned, leaving the catchment area with bare soil and no ground protection. Other parts of the Main Works project area including the Plateau, Marica and Tantangara were also impacted by the bushfire to varying degrees.

3.1. Landscape and topography

Elevation across the soil assessment area ranges from about 550-1450 m AHD. Slope and slope length are major factors affecting the risk of soil erosion and although the majority of works sites are gently sloping the steep slopes (>15%) in some areas of the project result in an extreme soil erosion hazard rating. Through the design process, infrastructure has been positioned on flatter areas within the topographic constraints of the Main Works sites.

The soil assessment area is located within two markedly different terrains; the Kiandra Tablelands (the plateau) and the Ravine area (Lobs Hole, Marica and Talbingo Reservoir project areas). The Kiandra Tablelands are represented by mature undulating tablelands in the central and eastern portion of the Project Area. The Ravine area consists of steep valleys and ravines of the Yarrangobilly River and tributaries primarily in the western portion of the Project.

These two main terrains are separated by an escarpment that trends north-northeast, perpendicular to the tunnel alignment. This escarpment is coincident with the mapped trace of the Long Plain Fault and is accepted as marking the surface trace.

The Lobs Hole and Marica project areas are within a steeply incised ravine and along the western fringe of the Long Plains fault escarpment. Most of this area is characterised by deep gorges and steep sloping ridges, the product of incision from watercourse flow and glaciations, with localised areas of lower grade, such as ridgelines, saddles, benches, and alluvium beside watercourses.

The central and eastern part of the soil's assessment area (generally east of the Snowy Mountains Highway) are drained by creeks flowing into the Murrumbidgee River (Gooandra Creek, Tantangara Creek and Nungar Creek). The Eucumbene River drains a narrow region of the Project Alignment between Wallaces Creek Fire Trail and the Snowy Mountains Highway (SMEC 2018a). The subalpine plateau that includes the Tantangara project area has had a complex geomorphic history resulting in a landscape of disrupted drainage patterns, swampy basins and erosion surfaces. The Rock Forest site, situated outside the boundary of KNP, is located on relatively gentle slopes.

The majority of the project is located between the Tantangara and Talbingo Reservoirs, within the catchments of the Yarrangobilly, Eucumbene and Murrumbidgee rivers. Receiving waters include the Yarrangobilly, Eucumbene, Tumut and Murrumbidgee Rivers and some of their tributaries, and the Talbingo and Tantangara Reservoirs.

Landscape and topography changes across the project, with the steeper terrain of the Lobs Hole area evident compared to the high plains of the Plateau and Tantangara.

3.2. Geology

The project area is within the south-eastern portion of the Lachlan Fold Belt of NSW. The geology of the soils (Main Works EIS) consists of a wide range of rock types from sediments, metamorphosed sediments and intrusive and extrusive volcanics.

The geology of the plateau area comprises granites that have formed faulted, stepped ranges at the point where the South Eastern Highlands in NSW turn west into Victoria (NPWS 2003). The South Eastern Highlands are part of the Lachlan Fold Belt that runs through the eastern states as a complex series of metamorphosed Ordovician to Devonian sandstones, shales and volcanic rocks intruded by numerous granite bodies.

The area between Talbingo and Tantangara reservoirs is structurally deformed, with numerous folds and several major faults associated with the north-south trending Long Plain Fault. Long Plain Fault - forms the western boundary of the Tantangara Block and the plateau. The fault trends in a north-northeast direction over a distance of more than 200 km, from the Upper Murray River to west of the Brindabella Ranges near Canberra.

The geology of the ravine area consists mostly of marine deposits of shale, slate, greywacke, siltstone, limestone and conglomerate of the Ravine Beds, Byron Range Groups and Yarrangobilly Limestone. These are overlain by the Devonian Boraig (rhyolite), Gooandra Volcanics (Ordivician basalts) and Tertiary basalts at the top of Ravine Road.

The Yarrangobilly Limestone is present as massive karstic limestone beds along the eastern limit of the Ravine Group.

3.3. Salinity

The Main Works EIS identified that the salt levels in all soils was very low, with chloride below the limit of reporting. No salt affected land was mapped within Snowy River Shire.

Groundwater across the soils assessment area consists of shallow systems in peats/bogs and other localised unconsolidated materials and deeper groundwater associated with deeper fractured rock (i.e. Ravine Beds). Salinity levels are expected to be low in shallow groundwater areas where the groundwater is readily recharged via rainfall and snow melt.

There is no evidence to suggest that salinity is an issue within the soils assessment area for the Project.

3.4. Soils

The soils of the project area reflect the extreme climatic gradient across the ravine and Plateau, and complex geology on which the soils have formed. Climatic conditions have a more dominant role in soil formation across the alpine and subalpine areas of the Plateau compared to the low-lying areas of the ravine.

The range of geologies present has led to a wide variety of soils forming across the project area including Kandosols, Tenosols, Rudosols, Dermosols, Chromosols, Vertosols, Ferrosols and Organosols.

Based on the Main Works EIS, the main soils types of the major project work areas are brown podzolic soils for Talbingo Reservoir and Lobs Hole, red loams for Marica, red loams, transitional alpine humus soils and alpine humus soils across the plateau and alpine humus soils at the Tantangara Reservoir.

The topsoils generally have moderate to low erodibility with moderate to high organic matter contents. The soils analysed from the exploratory works soil survey (Main Works EIS) did not contain any samples that were sodic or magnesic.

3.5. Contamination

Based on contamination investigations (main Works EIS), there is a risk of encountering pre-existing contaminated soil from previous land use activities at Lobs Hole or from Naturally Occurring Asbestos (NOA).

The Lobs Hole is area of contamination concerns as it was the site of a copper mine in the late nineteenth century through to 1916. As part of the Exploratory Works EIS soil sample results were compared to the NEPM Health Investigation Level (HIL) / Health Screening Level (HSL) B (applicable to residential sites with minimal soil access such as will be the case at the accommodation camp) and HIL/HSL C (applicable to public open spaces) and Ecological Investigation Levels (EILs). Concentrations and analytes analysed were below the applicable human health investigation and screening criteria at all locations however, some exceedances of EILs for copper, nickel, arsenic and zinc were identified. It is inferred that these exceedances are related to former mine workings, and others are likely to be due to natural background levels.

Soil contamination associated with proposed construction activities may occur as a result of spills or unplanned releases of potentially contaminating materials. This can include potential spills of fuels or hazardous chemicals, such as petrol, oil and lubricant and other chemicals (e.g. herbicides) at storage locations, use locations, or during transport.

Any contaminated materials encountered during will be managed in accordance with the Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0049). Off-site disposal of contaminated materials will occur in accordance with Section 5.9 of this Plan and the Waste Management Plan (S2-FGJV-ENV-PLN-0048).

3.6. Naturally Occurring Asbestos (NOA)

NOA is the natural geological occurrence of asbestos (asbestiform) minerals found in association with geological deposits including rock, sediment or soil. The EIS reported that there is potential for NOA within the Main Works project area. Predominantly of tremolite-actinolite and actinolite fibres, within geological units proposed to be intersected by tunnelling activities and ground disturbance works. Specifically, NOA has been reported in the Gooandra Volcanics, Boggy Plain Site and Shaw Hill Gabbro units.

The following activities are proposed to encounter NOA:

- Two section of the Head Race Tunnel (HRT) (approximate 7.5 km section in total)
- Surface excavation works, including road upgrades and construction areas at Plateau and Marica.

The location of NOA is presented graphically in Figure 3-1 below and in Table 3-1.

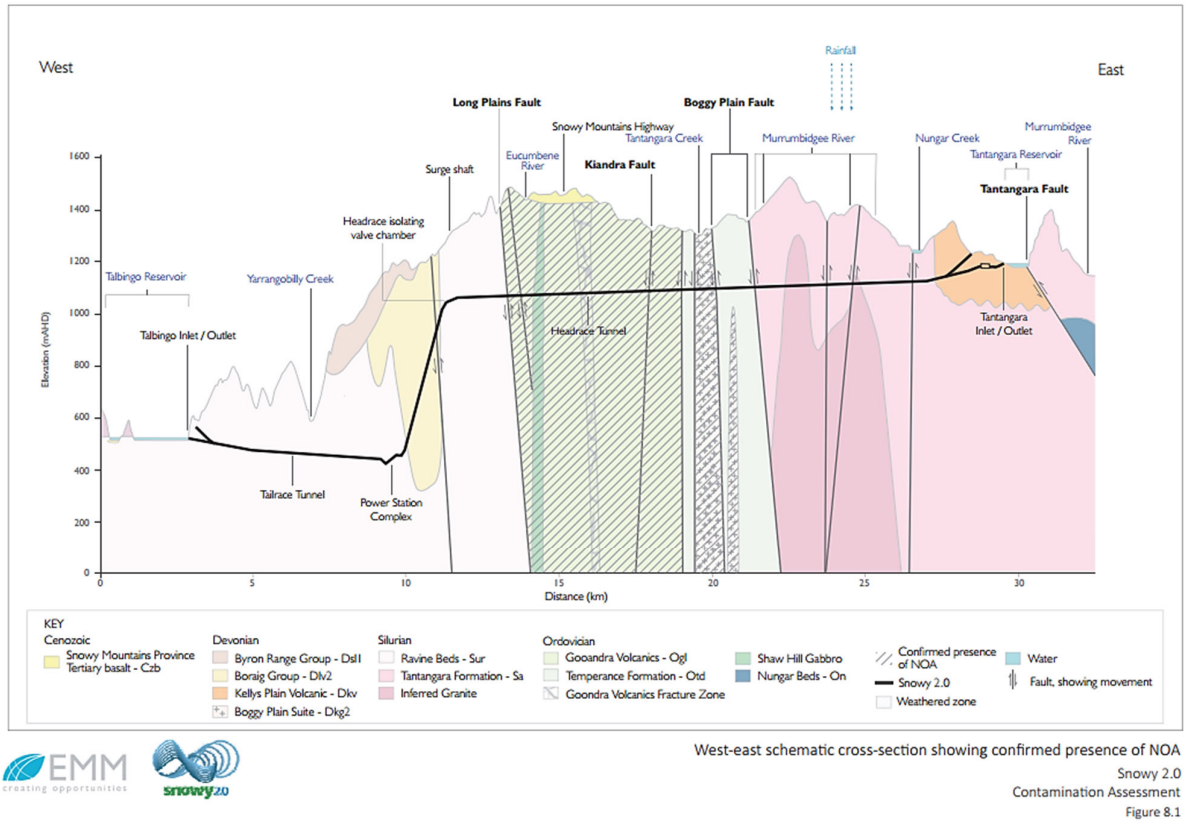


Figure 3-1: SMEC west-east cross section showing confirmed presence of NOA

Based on the Geotechnical Baseline Report, NOA is likely or confirmed to be found in a length of 7.5 km in the HRT and will be encountered by tunnel boring machine (TBM) from the Tantangara zone.

The total volume of material to dispose coming from this length would be approximately 845,000m^3 in situ. Further information provided by Snowy Hydro indicates that 7.5% of the predicted total to be NOA, which is equivalent to 62,300 m^3 of in situ rock. Including an additional 10% contingency, the total capacity to manage is 150,000 m^3 bulked.

3.7. Acid and Metalliferous Drainage (AMD)

3.7.1. Presence

Acid and Metalliferous Drainage (AMD) has traditionally been referred to as ‘acid mine drainage’ or ‘acid rock drainage’ (ARD) and refers to potential for rock to be potentially acid forming (PAF) through exposure of sulfide minerals, most commonly iron sulfide (pyrite FeS_2) with oxygen and water. This reaction generates acidic water which reacts with the minerals in the surrounding rock material creating a metal rich discharge. Whether rock is PAF or non-acid forming (NAF) and/or acid consuming (AC) is determined from the acid-base account. The potential for acid metalliferous drainage is dependent on the total sulfur content and the neutralising capacity of the rock.

The EIS included a review of existing data and reports which assessed the potential for acid mine drainage on the project. This included a review:

- URS (2015) Lobs Hole Site Investigation and Remediation Assessment;

- EMM (EIS 2019) Contamination Assessment, Main Works for Snowy 2.0;
- EMM (EIS 2019) Soils and Land Assessment, Main Works for Snowy 2.0;
- EMM (EIS 2019) Excavated Rock Placement, Main Works for Snowy 2.0;
- SMEC (2019a) Acid Metalliferous Drainage, Issue E.

URS identified areas that have been impacted by AMD in waste material, located between the redundant Lobs Hole mine shaft and processing area, and the Yarrangobilly River. Results from sediment samples collected between the former Lobs Hole copper mine and Yarrangobilly River identified off-site migration of these impacts with potential impacts to nearby sensitive environmental receptors less than 700 metres downstream.

SMEC determined the likelihood of intersecting AMD in the targeted geological units. This was presented in the Contamination Assessment contained within the EIS and in Figure 3-2.

The Contamination Assessment within the EIS identified a potential to intersect PAF rock during blasting or tunnel boring. Along the tunnel alignment it was determined that AMD materials were highly variable due to the tendency of pyrite to occur in veins and seams. PAF rock was confirmed in within the Tantangara (one sample was PAF-LC), Temperance (one sample was PAF-LC), Gooandra Volcanics and Ravine Beds formations.

Ranking	AMD hazard classification	Geological units
Unlikely: certain exclusion of formations potentially containing PAF	0	Tertiary Basalt, Byron Range Group, Kelley's Plain Volcanics, Peppercorn Formation, Boggy Plain Suite intrusions, Adaminaby Beds, Bolton Beds
Possible: possible presence of rock formation potentially containing PAF	1	Boraig Group, Shaw Hill Gabbro
Likely: rock formations potentially containing PAF – PAF not already detected	2	
Confirmed: PAF confirmed in the formations tested	3	Gooandra Volcanics, Ravine Beds, Tantangara Formation[1], Temperance Formation[1]

Note: 1 One sample was reported as PAF-LC

Source SMEC 2019a

Figure 3-2: SMEC AMD hazard classification

The confirmed presence of PAF material is shown in Figure 3-3 below.

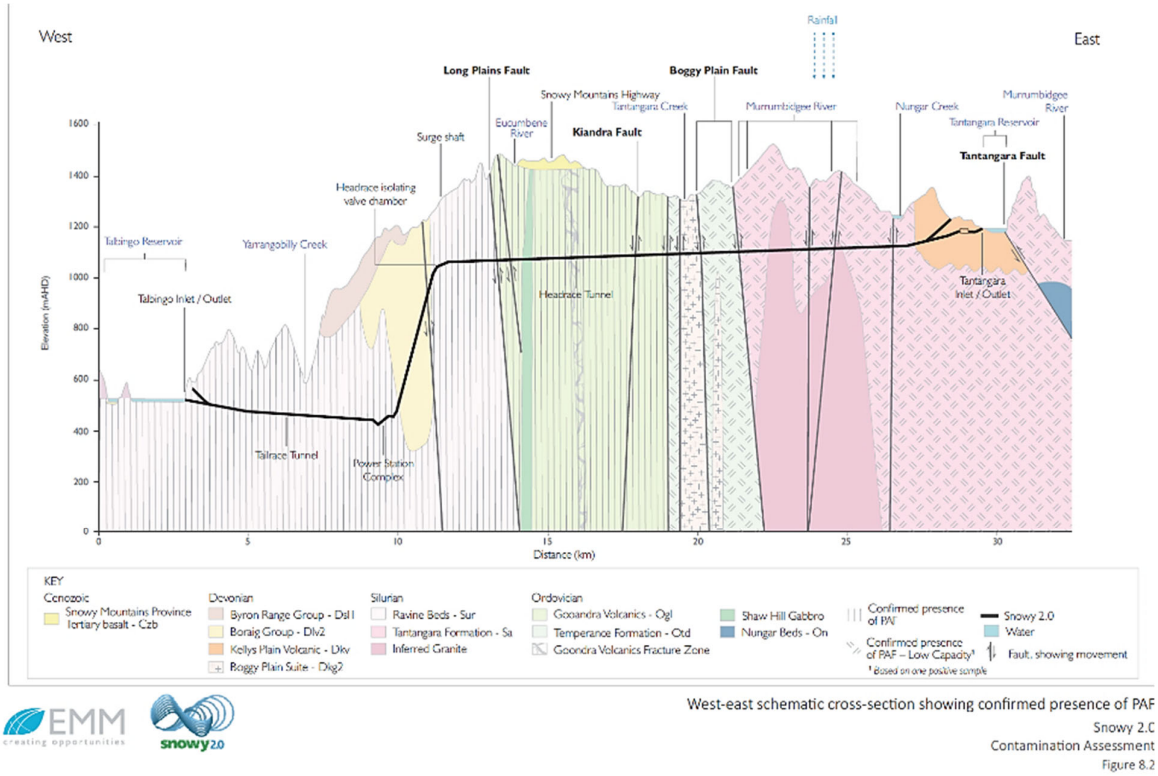


Figure 3-3: West-East cross section showing confirmed presence of PAF material

3.7.2. Characteristics

3.7.2.1. Acid-base accounting

The CSIRO undertook a risk characterisation of rock material (EIS Appendix L, Annexure B). As part of the risk characterisation, 115 samples were investigated for acid-base accounting. Key results are summarised below:

- Total sulphur and associated maximum potential acidity (MPA) varied by a factor of 15 between baseline and enriched groups, respectively.
- 23% of samples were classified as having net acid generation (NAG) capacity.
- Mean acid neutralisation capacity (ANC) was similar in both baseline and enriched groups.
- The ANC was in excess of MPA for all samples with 93% nominally classified as very low risk.

Figure 3-4 (reproduced from EIS Appendix L, Annexure B) compares the ANC and MPA from all 115 samples and demonstrates the above key results. All samples except one were analysed to have greater capacity to neutralize than to generate acid. Samples that did not contain twice the amount of ANC compared to MPA are classified as PAF material. A few samples are shown to occur below the ANC to MPA 2:1 ratio line in Figure 3-4.

A relative risk ranking based on mean ANC to MPA ratios identified spoil from the Gooandra Volcanics, Byron/Boraig Groups and Peppercorn/Tantangara/Temperance Formation geological groups as having the greatest, but importantly low risk, potential for acid generation.

In summary, available geochemistry data indicates that some spoil is likely to be PAF. However, overall spoil is likely to have Acid Neutralising Capacity that is in excess of the maximum potential acidity. Therefore, there is considerable opportunity to utilise the available Acid Neutralising Capacity to mitigate acid risks.

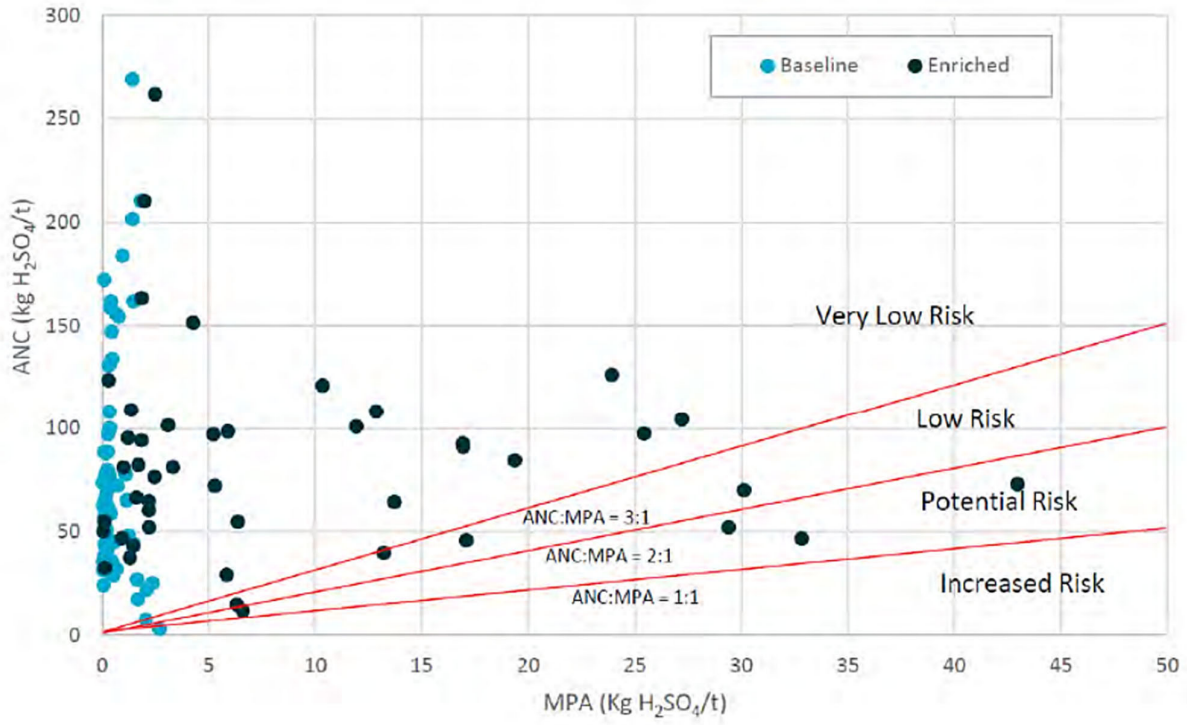


Figure 3-4: Categorisation of ANC versus MPA risk (source: EIS Appendix L, Annexure B)

3.7.2.2. Leachate testing

As part of the CSIRO risk characterisation, 115 samples were also investigated for leachate analysis using the Australian Standard Leaching Procedure (ASLP). The ASLP was applied to assess the leachability of pollutants (major ions, carbon, metals and nutrients etc) under anoxic, oxic and weak acid conditions designed to simulate the sub-aqueous and on-land placement exposures.

Figure 3-5 presents a summary of the potential water quality of leachate (as indicated by ASLP results) under anoxic, oxic and weak acid conditions.

	Leachate characteristics	
Conditions	**Talbingo/Marica Zones**	**Tantangara Zone**
Anoxic conditions (potential to occur in both in reservoir and land-based emplacements)	• Neutral pH ranging from 6.6 to 7.7. • Low leachable salts (EC ranges from 100 to 289 µS/cm). • Total nitrogen is likely to be similar to or below WQO values for reservoirs and watercourses. • Arsenic is likely to be similar to the WQO value for watercourses but below the value for reservoirs. • Concentrations of other metals are likely to be below WQO values for reservoirs and watercourses.	• Neutral pH ranging from 6.2 to 7.6. • Low leachable salts (EC ranges from 93 to 324 µS/cm). • Total nitrogen is likely to be similar to or below WQO values for reservoirs and watercourses. • Concentrations of metals are likely to be below WQO values for reservoirs and watercourses.
Oxic conditions (likely to occur in both in-reservoir and land-based emplacements)	• Moderately alkaline (pH ranges from 8.1 to 10). • Low leachable salts (EC ranges from 42 to 239 µS/cm). • Total nitrogen is likely to be similar to or below WQO values for reservoirs and watercourses. • Aluminium is likely to exceed the WQO for watercourses by a factor of 13 and reservoirs by a factor of 7. • Arsenic is likely to exceed the WQO for watercourses by a factor of 3 but be below the value for reservoirs. • Concentrations of other metals are likely to be below WQO values for reservoirs and watercourses.	• Moderately alkaline (pH ranges from 8.2 to 9.9). • Low leachable salts (EC ranges from 43 to 116 µS/cm). • Total nitrogen is likely to be similar to or below WQO values for reservoirs and watercourses. • Aluminium is likely to exceed the WQO for watercourses by a factor of 16 and reservoirs by a factor of 8. • Arsenic is likely to exceed the WQO for watercourses by a factor of >2 but be below the value for reservoirs. • Concentrations of other metals are likely to be below WQO values for reservoirs and watercourses.
Weak acid conditions (potential to occur in land-based emplacements)	• Moderately alkaline (pH ranges from 7.6 to 9.6). • Low leachable salts (EC ranges from 40 to 274 µS/cm). • Total nitrogen is likely to be similar to or below WQO values for reservoirs and watercourses. • Aluminium is likely to exceed the WQO for watercourses by a factor of 7 and reservoirs by a factor of 3. • Arsenic is likely to exceed the WQO for watercourses by a factor of 3 but be below the value for reservoirs. • Concentrations of other metals are likely to be below WQO values for reservoirs and watercourses.	• Moderately alkaline (pH ranges from 8.0 to 9.8). • Low leachable salts (EC ranges from 37 to 124 µS/cm). • Total nitrogen is likely to be similar to or below WQO values for reservoirs and watercourses. • Aluminium is likely to exceed the WQO for watercourses by a factor of 11 and reservoirs by a factor of 5. • Arsenic is likely to be similar to the WQO value for watercourses but below the value for reservoirs. • Concentrations of other metals are likely to be below WQO values for reservoirs and watercourses.

Figure 3-5: Potential leachate quality (source: EIS Appendix L, Annexure B)

3.7.2.3. Elutriate tests

The CSIRO undertook an environmental categorisation of spoil to provide information to assist in assessing the potential impacts of the placement of spoil on water and sediment quality within Talbingo Reservoir. The release of substances from the rock material was assessed using a series of elutriate tests that involved mixing and leaching rock with reservoir water. Of the analytes tested, pH, EC and aluminium frequently exceeded WQOs, with dissolved aluminium being the only substance consistently identified as a contaminant of potential concern. Consequently, a Dissolved

Aluminium Assessment for Talbingo Reservoir was undertaken to investigate the relationships between the concentrations Total Suspended Solids (TSS) and concentrations of dissolved aluminium. When applying a conservative TSS concentration of 100 mg/L the aluminium release (9–16 µg/L) is predicted to be similar to the background aluminium concentration in the reservoir and well below the WQO value of 55 µg/L.

3.8. Acid Sulfate Soils

The combination of the acid sulfate soils mapping and the geomorphic features in the project disturbance areas (Main Works EIS) suggest that there is a low potential for the occurrence of acid sulfate soils in the Main Works area.

There is no local scale acid sulfate soils (ASS) mapping for the Main Works soils assessment area. Although usually associated with coastal environments, acid sulfate soils can also occur at higher elevations inland, associated with anaerobic conditions along river and lake beds and in saline seepage areas where there are organic-rich deposits. A review of the national Atlas of Australian Acid Sulfate Soils (Fitzpatrick *et al.* 2011) shows that the proposed project footprint intersects three areas mapped as having a high probability of ASS:

- Talbingo Reservoir (Aq(p4)[1]) - works below the mapped dam full supply level;
- Tantangara Reservoir (Aq(p4)) - on the western side, works below the mapped dam full supply level; and
- east of Eucumbene Reservoir (Ak(p4)[2]) - southern portion of Rock Forest.

Investigations in the exploration area concluded that the likelihood of ASS being present in the Middle Bay barge ramp was low (EMM 2018). A site assessment of Talbingo Reservoir concluded that there was a low potential for the occurrence of ASS. The EIS also found that the geomorphic conditions at the Tantangara Reservoir are also not conducive to the formation of acid sulfate soils.

The combination of the acid sulfate soils mapping and the geomorphic features in the project disturbance areas suggest that there is a low potential for the occurrence of acid sulfate soils in the Main Works area. This is supported by observations from the geomorphology, geology and hydrogeology field survey teams of who did not identify or map any ASS within the project area.

4. ENVIRONMENTAL ASPECTS AND IMPACTS

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

Key aspects of the project that could result in spoil related impacts are identified in Table 4-1. The extent of these impacts will depend on the nature, extent and magnitude of construction activities and their interaction with the natural environment (Column 2). This is further exacerbated by environmental factors (Column 3).

Table 4-1: Project aspects and impacts relevant to spoil

Environmental Aspects (Activities that may impact spoil management)	**Potential Environmental Impacts**	**Environmental Factors (Conditions)**
Topsoil stripping Earthworks Drainage works Tunnelling works Establishing areas for the accommodation camp and portal pad Remediation of contaminated sites Stockpiling of materials Transport of materials Storage of hazardous chemicals	Generating and/or spreading contaminated waste materials to soil and water. Sediment runoff. Excess consumption of resource and energy use. Excess waste being directed to landfill. Unlawful disposal of materials. Permanent and temporary loss of soils, landform and land capability. Soil degradation – nutrient and structural decline. Soil erosion – due to exposure of cleared areas and poor stockpile management. Loss of structure – due to compaction and double handling of soils. Loss of nutrients – occurs during stockpiling and impacts ability of area to regenerate after rehabilitation. Loss of soil – during stripping and as a result of poor handling and management prior to rehabilitation. Loss of topsoil – through initial clearing and poor management and stockpiling.	**Existing site contamination** – suitable materials can be re-used however contaminated materials may require remediation or disposal offsite. **Soil type** – more erodible soil types have an increased soil erosion potential. **Soil moisture** – increased soil moisture decreases soil mobilisation. **Wind speed** – strong winds will increase the potential of soil loss and erosion. **Rainfall** – heavy rainfall increases soil entrainment. **Extent of vegetation cover** – vegetation assists in stabilising soils and reduces the ability for erosion. **Geology** – Some geological formations are known to contain NOA and AMD.

4.1. Construction areas

Construction areas required to deliver the project are presented in Figures 4-1 – 4-6 and are described as follows. Refer to Section 1.6 regarding the staging of the emplacement areas.

- Talbingo:
  - Talbingo Reservoir: the lower reservoir for Snowy 2.0 and will include the Tail Race Tunnel (TRT) and water intake structure. The site will also be used for temporary construction compounds and other temporary ancillary activities.
  - Ravine Bay emplacement area: an in-reservoir pad constructed using surplus drill and blast (D&B) spoil from the Talbingo Reservoir bed up to Full Supply Level (FSL). Combined D&B and TBM spoil will be placed on top of the D&B pad and on existing land to the north of the reservoir.

  - GF01 emplacement area: a land-based emplacement in a gully between Ravine Bay and Lobs Hole. GF01 will be constructed using surplus D&B and TBM spoil.
  - Lobs Hole: the area will be used primarily for construction but will also become the main entrance to the power station during operation (via the MAT). Lobs Hole will provide access to the Snowy 2.0 Exploratory Works tunnel, which will be refitted to become the MAT, as well as the location of the ECVT, portal, associated services and accommodation camp. Permanent placement of surplus D&B and TBM spoil will occur in the Main Yard, but be minimised.
- Marica: the area will be used primarily for construction purposes including construction of vertical shafts to the underground power station (ventilation shaft) and HRT (surge shaft), and a small accommodation camp;
- Plateau: the area (predominantly within an existing track) will be used for construction and operation of buried communications and power supply cables to operational infrastructure between Talbingo and Tantangara reservoirs. At depth, the HRT will be excavated across the plateau.
- Tantangara:
  - Tantangara Reservoir: the upper reservoir for Snowy 2.0 and include the HRT and intake structure. The site will also be used for a temporary construction compound, accommodation camp and other temporary ancillary activities.
  - Tantangara peninsula emplacement area: an in-reservoir pad constructed using D&B spoil from the Tantangara Reservoir bed up to FSL. It is noted that this pad will be constructed above the typical reservoir operating levels and will only be inundated during construction if a major flood event were to occur. The pad is expected to be inundated once Snowy 2.0 operation commences. Combined D&B and TBM spoil will be placed on top of the D&B pad and on adjoining land above the FSL.
- Rock Forest: the area comprises private property under lease to Snowy Hydro for use as a logistics site during construction as well as a permanent emplacement area for spoil.

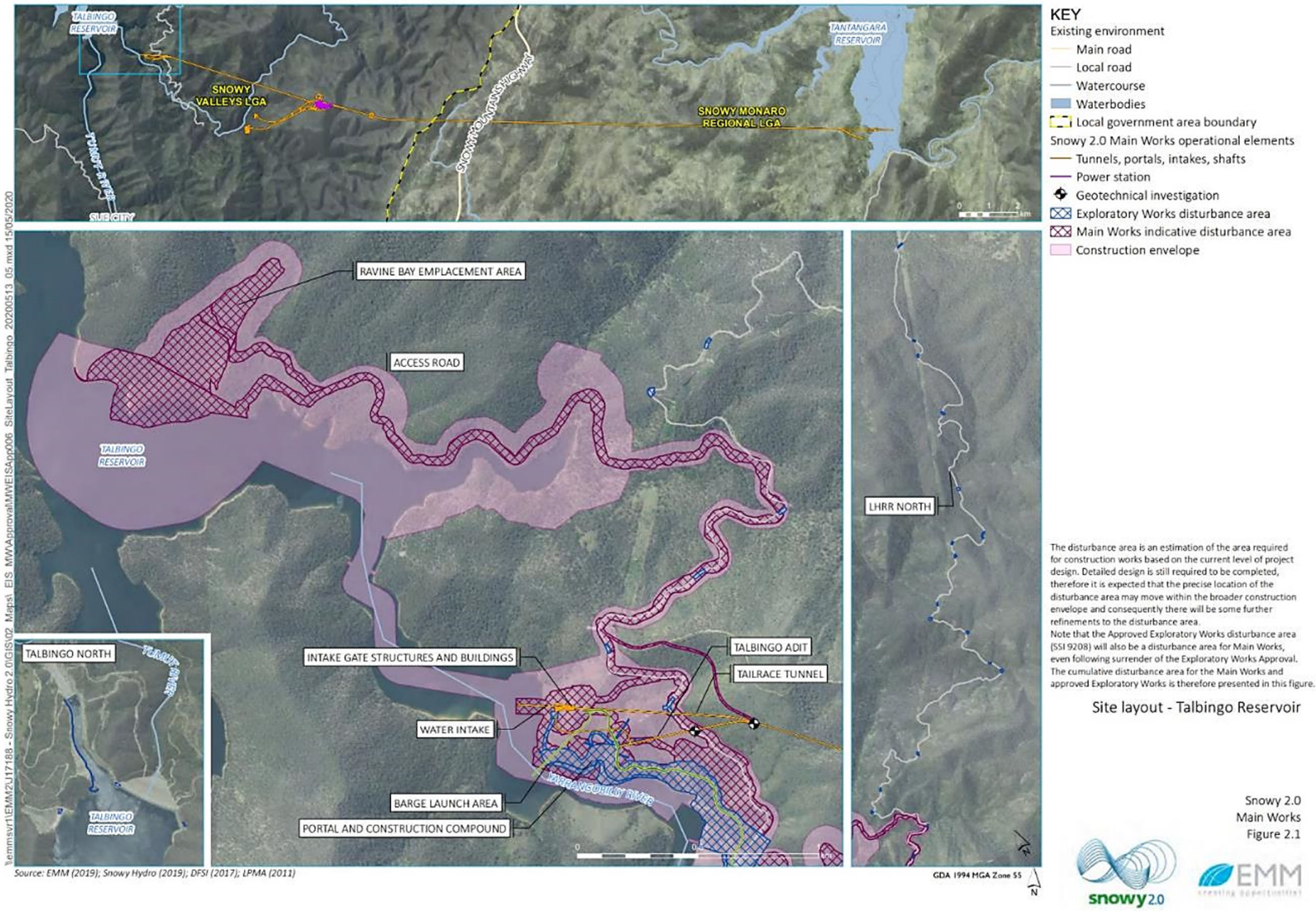


Figure 4-1: Construction areas – Talbingo (Infrastructure Approval Appendix 2)

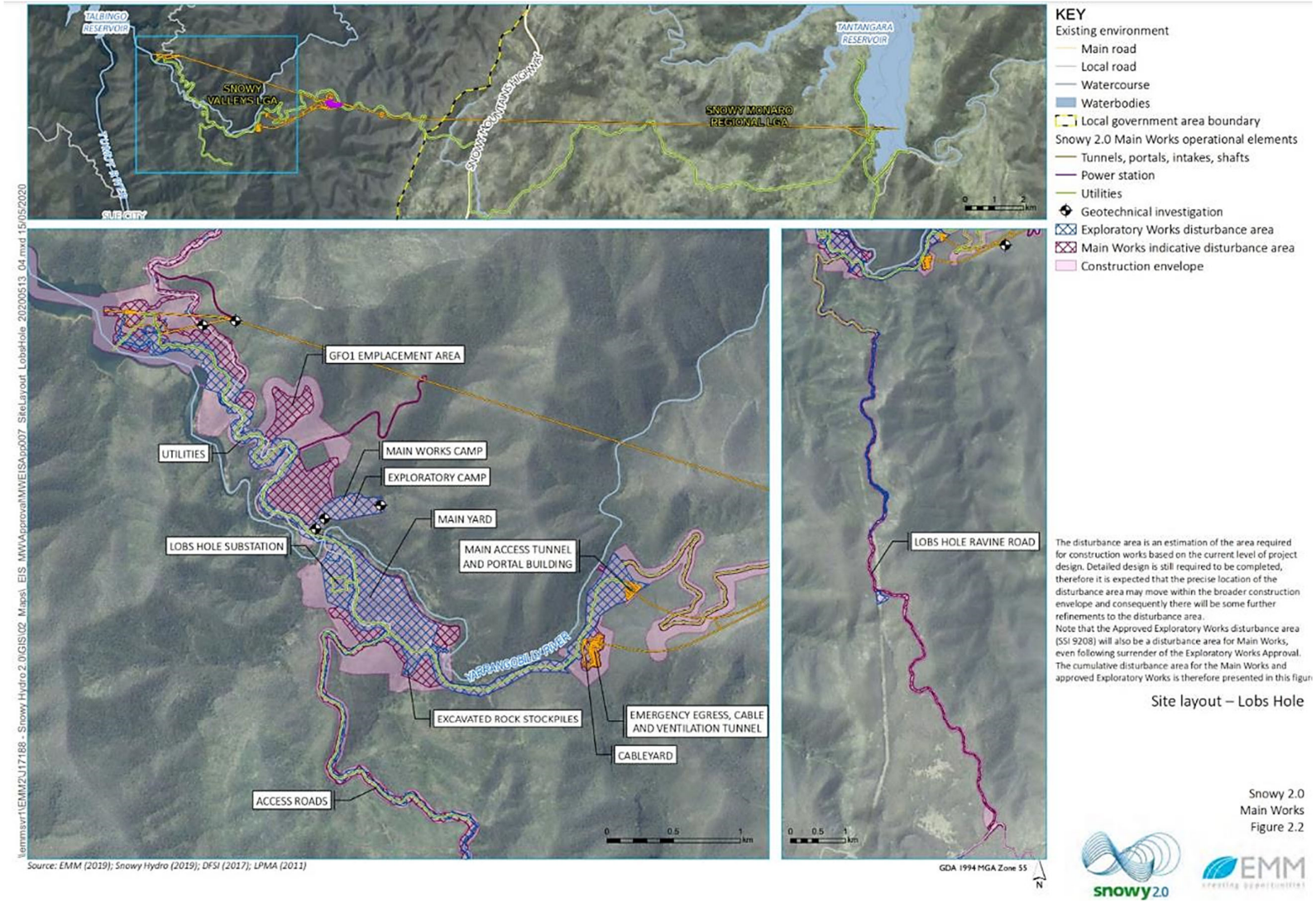


Figure 4-2: Construction areas – Lobs Hole (Infrastructure Approval Appendix 2)

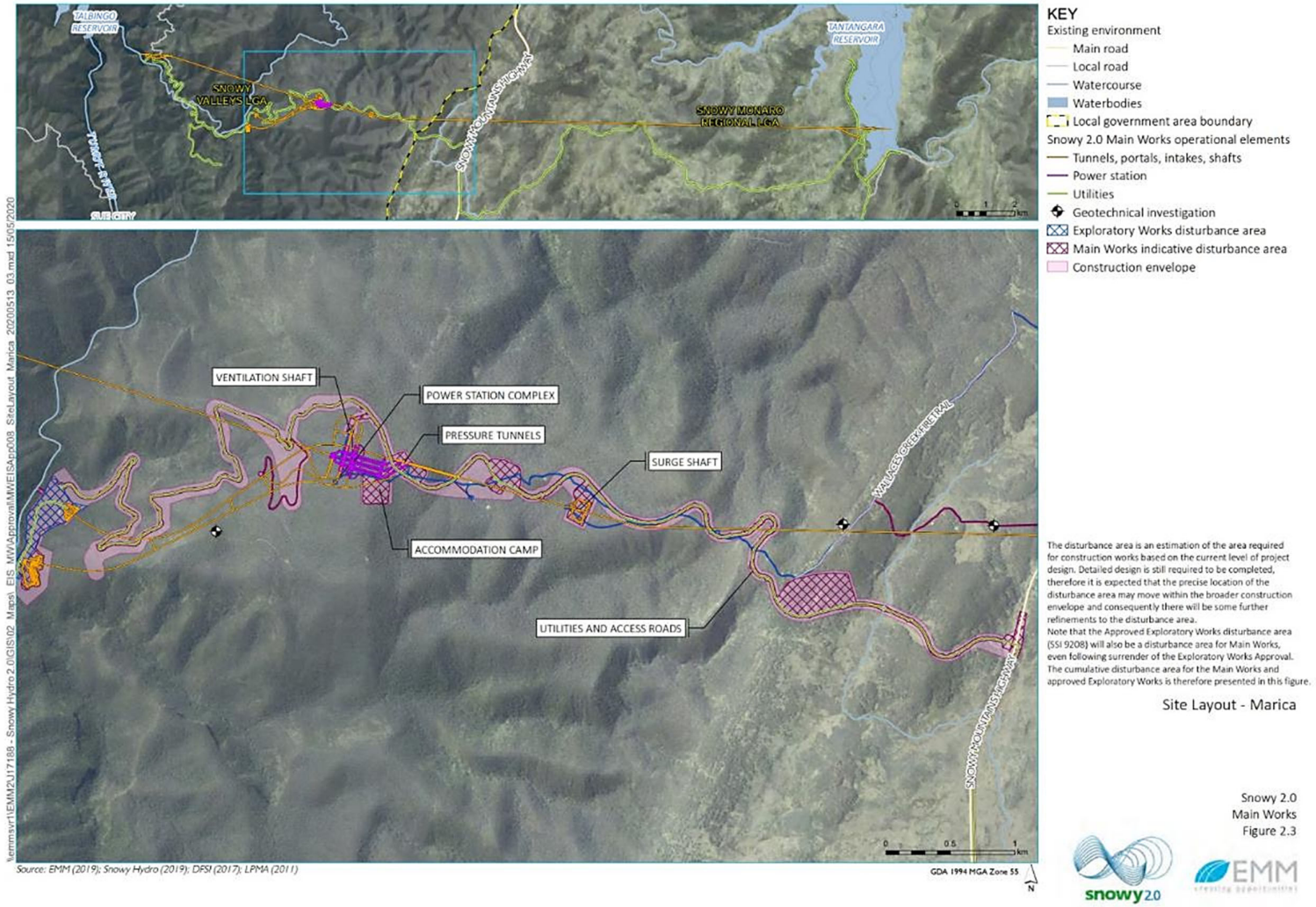


Figure 4-3: Construction areas – Marica (Infrastructure Approval Appendix 2)

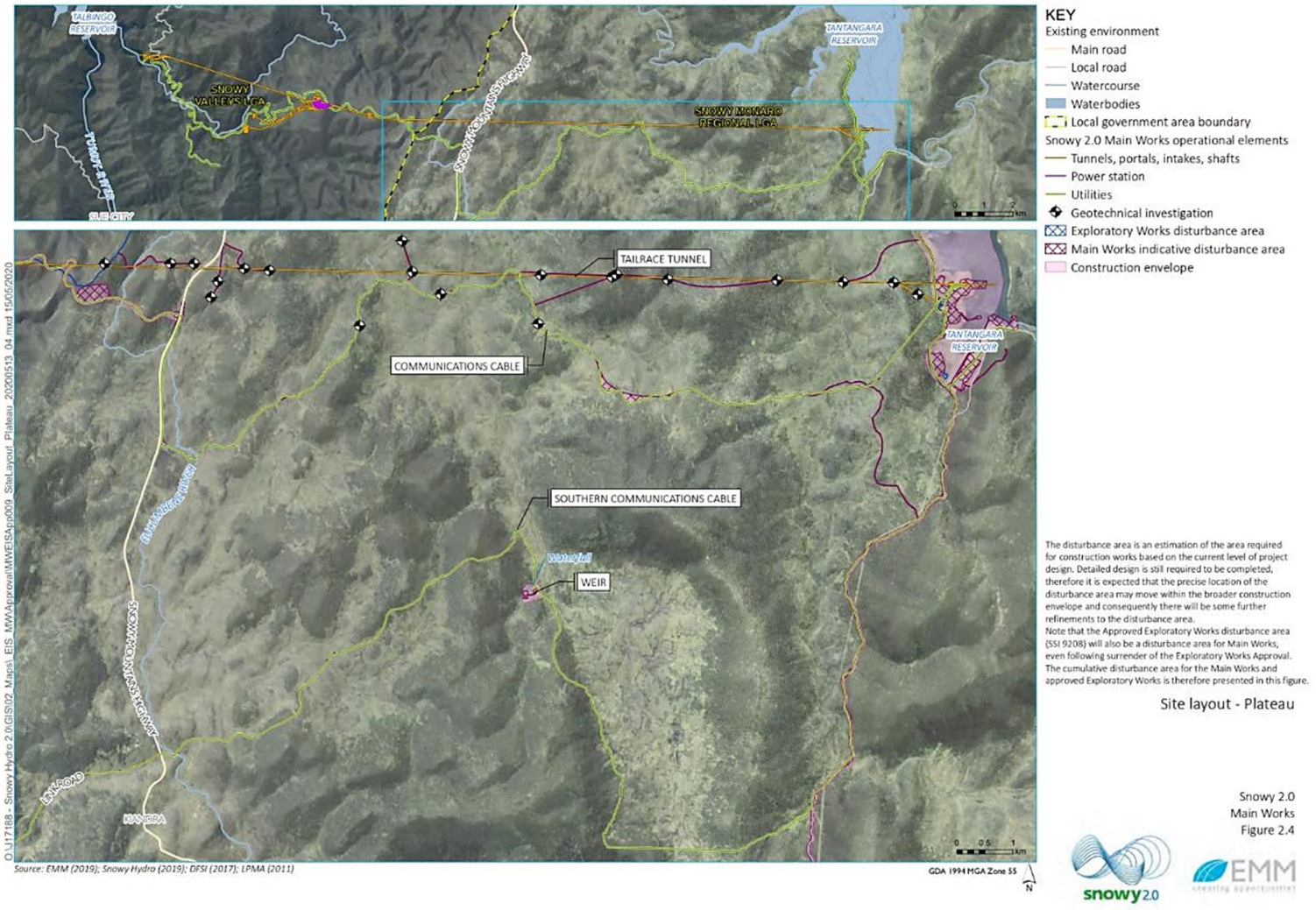


Figure 4-4: Construction areas – Plateau (Infrastructure Approval Appendix 2)

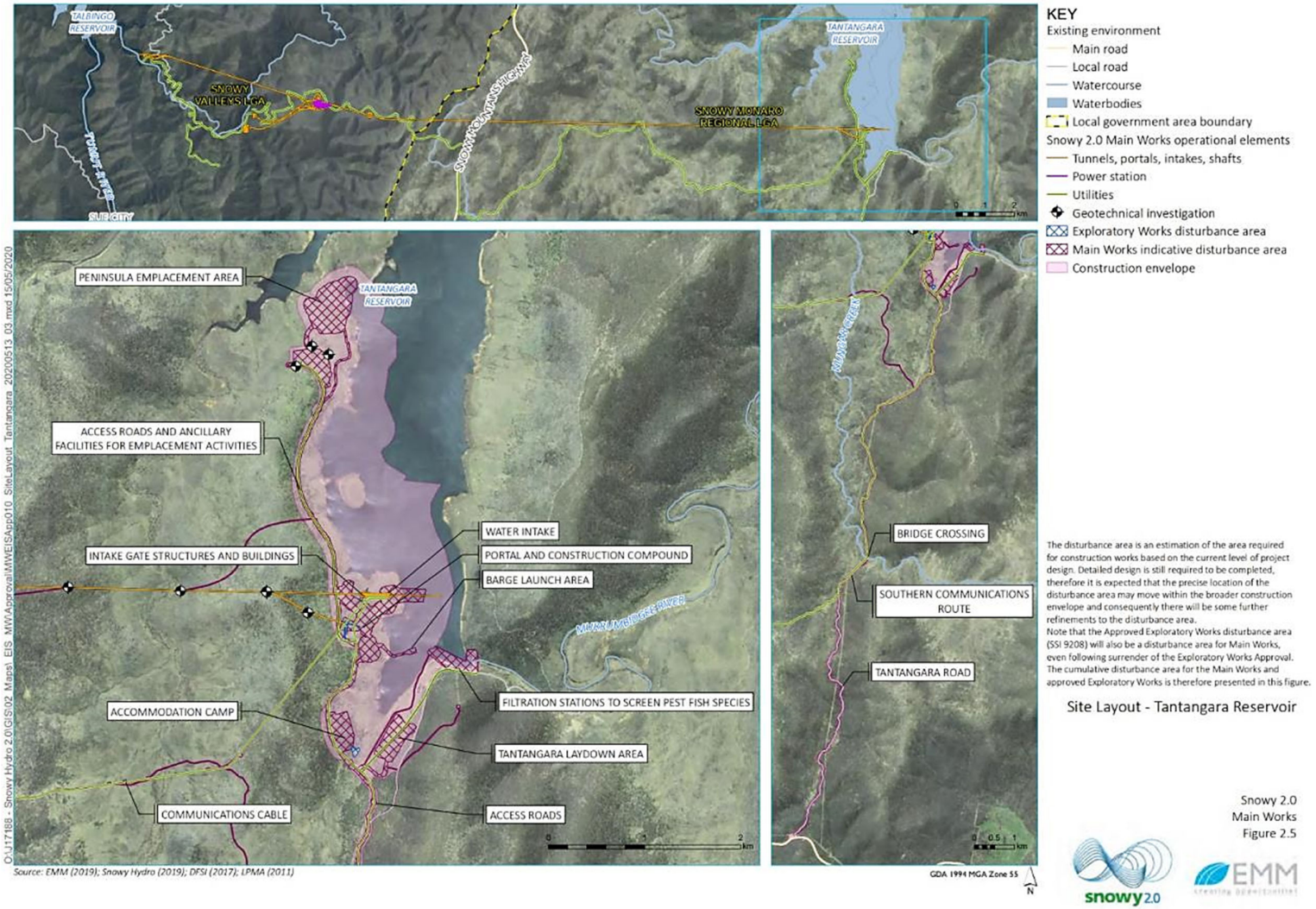


Figure 4-5: Construction areas – Tantangara (Infrastructure Approval Appendix 2)

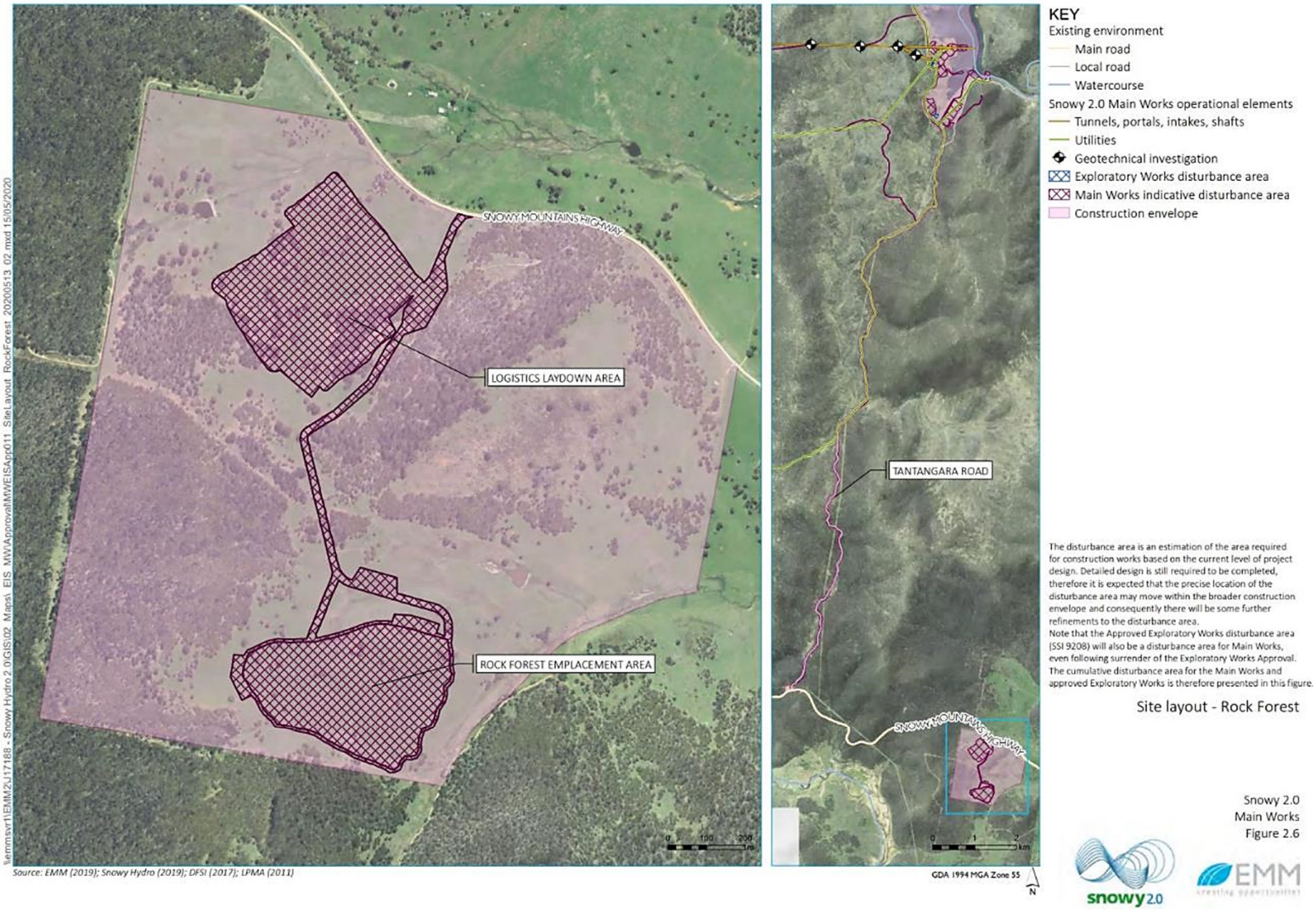


Figure 4-6: Construction areas – Rock Forest (Infrastructure Approval Appendix 2)

4.1. Construction activities

Table 4-2 presents an overview of construction activities, all of which will generate or consume (or both) spoil to some extent.

Table 4-2: Overview of construction activities

Component/stage	Typical activities
Construction - access road and bridge work	• Site preparation of all roads (new or upgraded), including: – Clearing boundary is surveyed and pegged out – Removal/trimming of any hazardous trees following pre-construction survey if required as per assessment recommendations – Any pre-clearing activities are completed, such as facilitating the egress of fauna – Erosion and sediment control measures will be installed prior to works commencing, or as early as practicable • Construct retaining walls where needed • Excavate road level • Lay road base, pavement and drainage • Construct bridges and culverts • Install road furniture such as signs and safety barriers • Talbingo edit access road inlet infill works
Construction - excavation and tunnelling	• Construct portals and adits • Mobilisation and site setup of TBMs (where required) • Excavate power waterways, power station cavern, and associated tunnel infrastructure • Install ground support where required • Receipt and use of precast segments for tunnels where required • Spoil management and haulage
Construction - Spoil management	• Transport of spoil from tunnels, adits, portals and surge shaft to stockpile areas • Testing of spoil for suitability of placement (where required) • Transport to and filling of placement areas within the reservoirs and on-land placement for construction pads and/or permanent landforming
Construction - intake and gate shaft construction	• Clearing and grubbing • Cut excavation and benching to required depth, retaining a temporary rock plug to allow dry works zone • Install permanent rock anchors where required • Concrete works • Removal of rock plug • Dredging and excavation with underwater blasting to establish approach channels
Construction – progressive rehabilitation	• Collection and storage of indigenous/native seed and alpine sods • Progressive rehabilitation comprising: – Stabilisation of slopes and preparation of sites for revegetation – Mitigation of sediment runoff – Hydroseeding/hydro mulching/planting of slopes • Decommissioning of infrastructure by removal of all temporary facilities • Reinstatement of topsoil and seeding and planting of vegetation • Protection of revegetation and weed management

Separate to the project, TransGrid, the operator and manager of the high voltage electricity transmission network in NSW and the ACT, proposes to connect Snowy 2.0 to the existing high voltage transmission network. This work would (subject to separate approval) involve the

construction and operation of new electricity transmission lines and an electricity substation to the west of the Talbingo Reservoir to connect Snowy 2.0 to the existing electricity transmission network at Nurenmerenmong, east of Tumbarumba. There is expected to be a small amount of spoil generated from TransGrid's surface works in the vicinity of the Talbingo zone that may be required to be managed by Future Generation.

4.2. Excavation and tunnelling methods

4.2.1. Tunnelling

The excavation of the underground tunnels and caverns (which will form the power station complex) represent most of the civil construction activities required. Two primary methods of excavation will be used for the underground works: TBMs and D&B. Figure 4-7 shows the likely locations of where these two primary methods will be used.

Broadly, drill and blast will be initially used to excavate access adits to allow for excavation of the HRT and TRT through use of TBM. D&B will also be used for the initial section of the MAT (approved under Snowy 2.0 Exploratory Works) and ECVT until there is competent rock to launch the TBMs to undertake the remainder of the excavation. D&B will be used to excavate the underground caverns and attached small waterway tunnels as well as permanent access and construction adits around the power station complex, as well as to excavate some areas at the surface such as intakes and access roads. D&B will also be used to enable the TBMs to be positioned for removal.

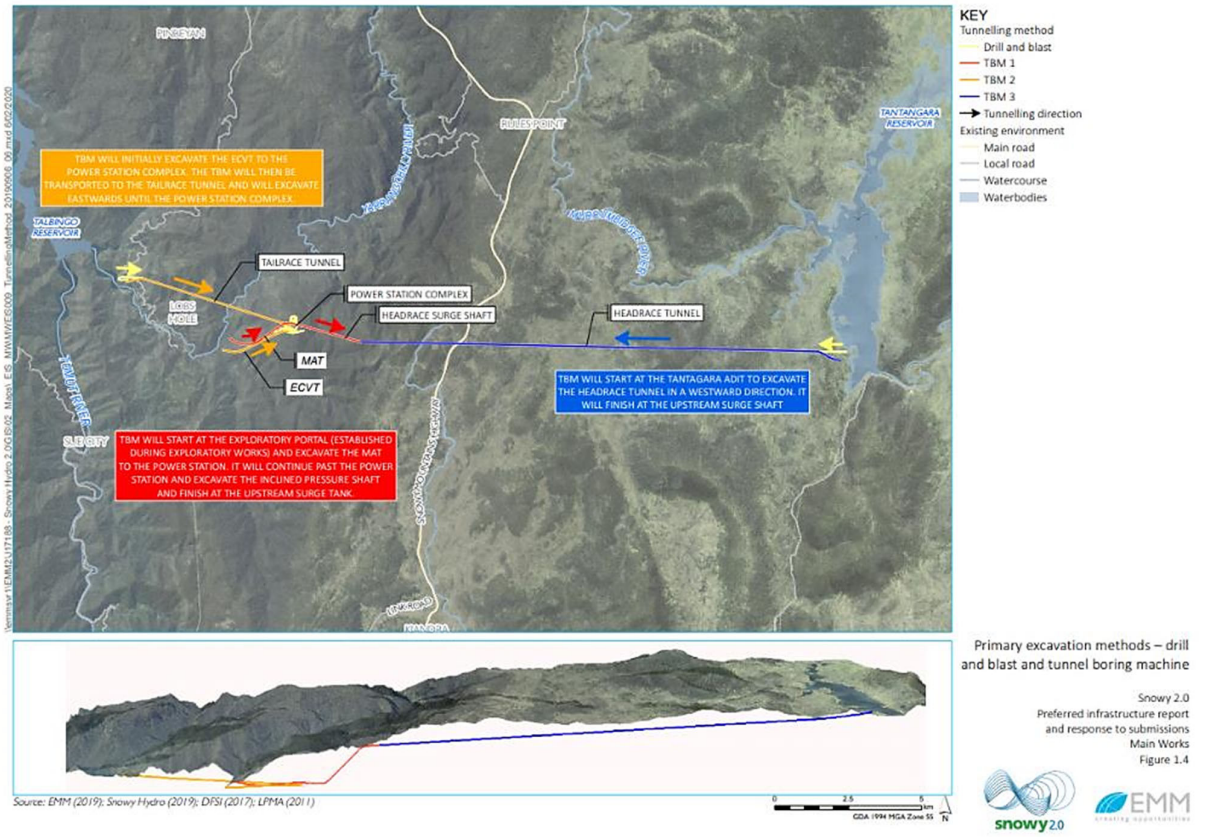


Figure 4-7: Primary excavation methods (RTS, EMM)

4.2.1.1. Drill and Blast

D&B method will be used where material cannot be excavated by normal excavator and ripper tool-mounted excavator both in an open area and tunnels, and / or where particle size selection is a key mitigation in managing the potential risks associated with placement.

D&B excavation will be performed as a cyclical operation and will involve the following main activities:

- 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 leading work face 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.

D&B patterns will be studied to suit the rock categories and adjusted according to the actual geological conditions. The current plan will involve the use of emulsion explosives for the production holes and emulsion cartridges for the contour holes. This is described in further detail in the Blast Management Plan (S2-FGJV-ENV-PLN-0045).

Figure 4-8: presents the particle size distribution of spoil derived from the drill and blast technique. As shown, the average particles derived from drill and blast will be greater than 100 mm in diameter. Figure 4-9 shows the indicative D&B sequence.

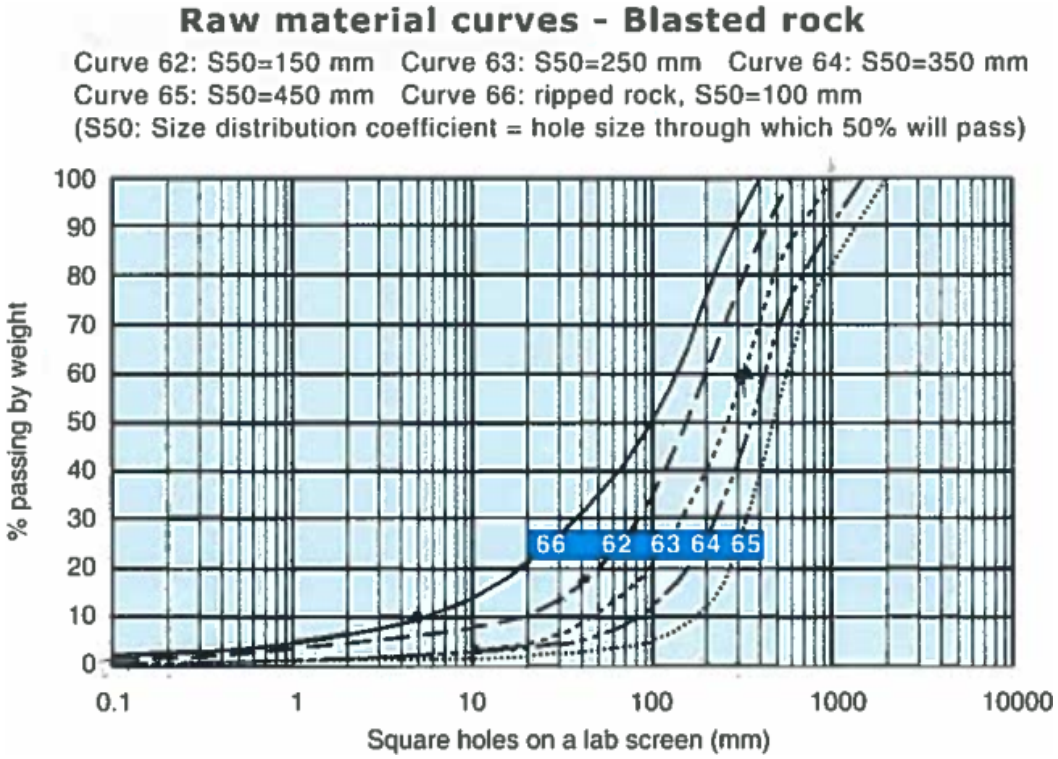


Figure 4-8: Raw material curves for drill and blast (Bellopede R et al 2011)

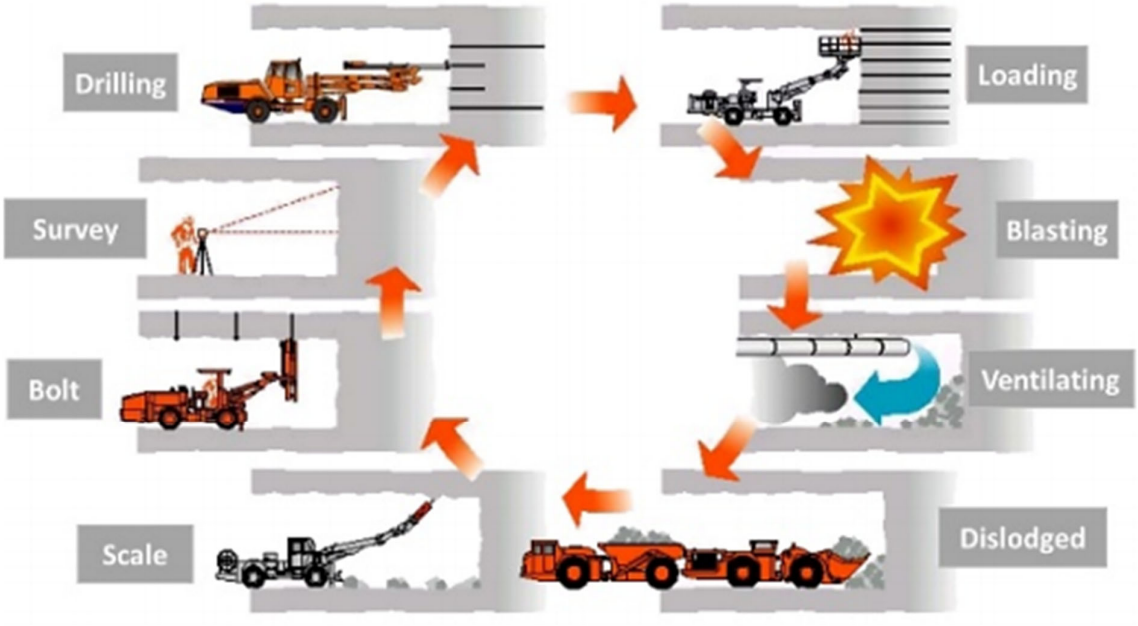


Figure 4-9: Indicative D&B sequence

4.2.1.2. Tunnel Boring Machines

TBMs are used to excavate tunnels with a circular cross section. The selection of the TBM is one of the most important technical aspects of the project as the method provides better advance rates than conventional D&B method as the excavation progresses underground and into the tunnel.

Two types of TBMs are proposed for Snowy 2.0:

- Single shield TBM;
- Multi-mode TBM – Combination of single shield and enclosed conveyor TBM.

The TBMs will have an excavation diameter of approximately 11.60 m, however this may increase an additional 100-200 mm. Each machine will be fully equipped to perform the excavation, ventilation, lining, removal of spoil and management of NOA.

Non-systematic surveys will also be conducted ahead of the TBMs to identify potentially critical areas with poor rock conditions, high fracturing or the presence of an aquifer. The TBMs will be equipped with devices to perform the following surveys:

- Seismic reflection surveys;
- Geoelectrical surveys; and
- Systematic probing (ahead of cutter face).

The survey results will be used to assess the draining and pre-excavation grouting requirements before advancing excavation. The TBMs will be equipped with drilling machines to drill drainage holes with PVC pipes to relieve groundwater pressures. If required, pre-excavation grouting will also be used to seal-off groundwater inflow and to improve the stability of the excavation face. Post-excavation grouting from the segmental lining may also be used to further consolidate the surrounding rock and/or prevent water ingress if required.

An example diagram showing the TBM is provided in Figure 4-10 below.

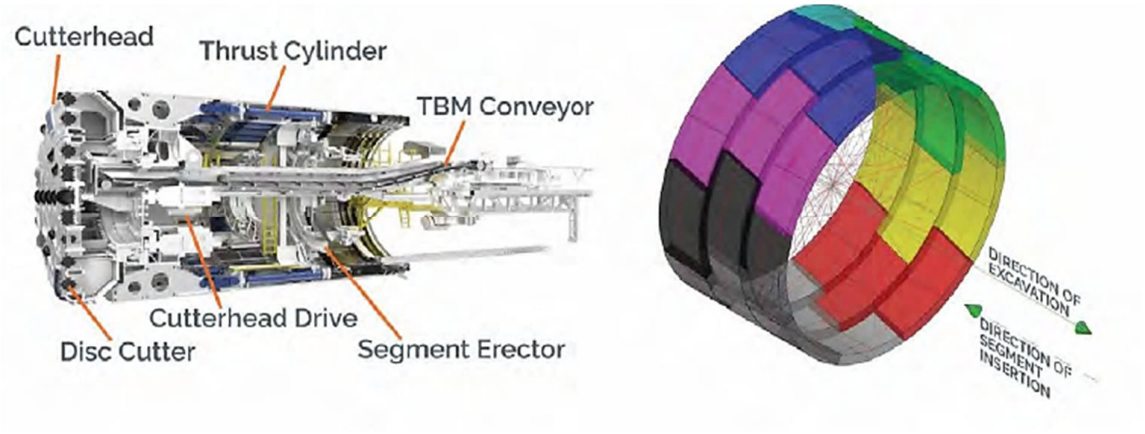
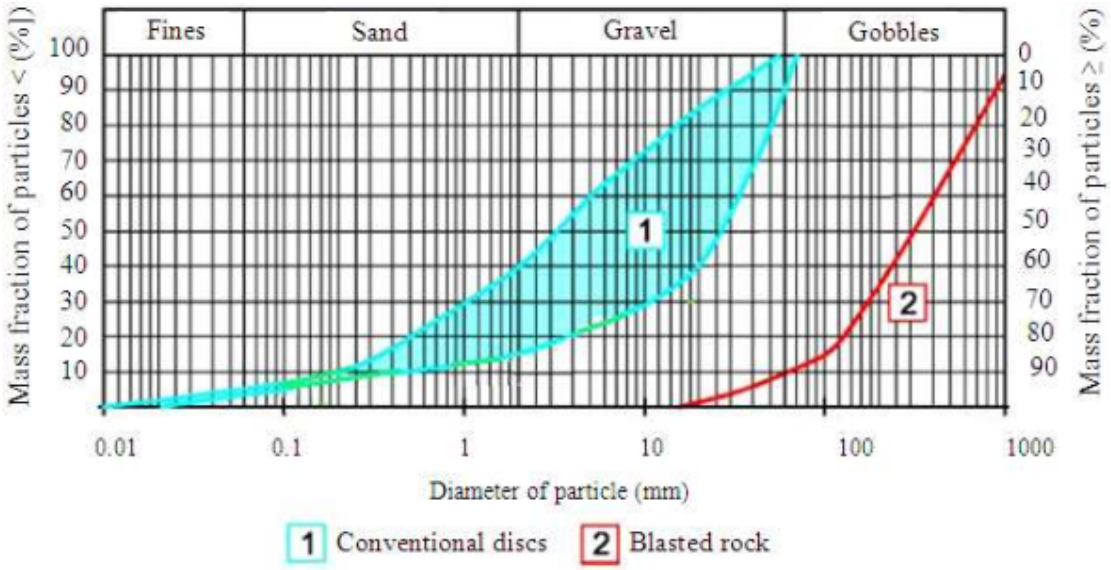


Figure 4-10: Example Tunnel Boring Machine

The particle size distribution of TBM spoil, compared to that generated by D&B is presented in Figure 4-11. While the spoil generated by the TBM tunnelling method will be finer in particle size distribution compared to the D&B material, the existing management measures proposed to minimise and mitigate potential impacts are considered suitable, as identified in Sections 6 – 8 of this plan.



Source: Bellopede R et al. "Main Aspects of Tunnel Muck Recycling". American Journal of Environmental Sciences 7 (4): 338-347, 2011

Figure 4-11: Particle size distributions for different excavation techniques: TBM excavation (1) and D&B excavation (2)

4.2.1.3. Tunnelling plant

Indicative plant and equipment required for tunnelling works includes: the TBMs, excavators, dump trucks, bulldozers, rollers, graders, truck and dogs, drilling rigs, grout pumps, agitator trucks, shotcrete pumps, semi-trailers, water carts, light vehicles, compressors, generators, drills, jumbos, boomers, hydraulic breakers, air tracks, explosives transport vehicle, water bowsers, 4WD telescos, stihl saws, forklifts, light towers, compressors, gas monitors, rescue equipment, batteries, ventilation fans, fuel trucks, cement tankers, shotcrete robots, shotcrete pumps, boom lifts sucker trucks and water pumps.

4.2.2. Open cut excavation

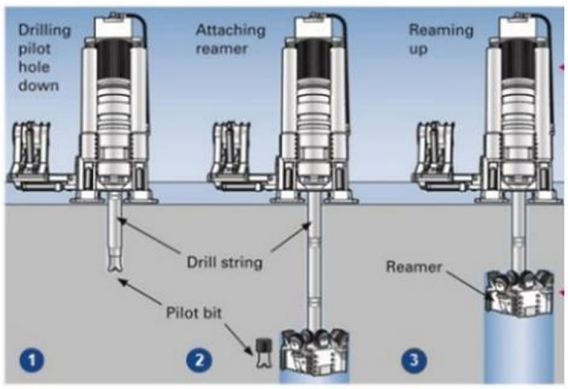
Conventional open cut excavation is the method used at open excavation of soil and rippable hard material (not rock). Open cut excavation involves the removal of soil or rock from a site to form an open face, hole or cavity using tools, machinery or explosives. It involves excavating down to below ground level to the desired depth. For the purposes of spoil volumes, requirements and management measures (as described elsewhere in this Plan), this material is considered surface D&B spoil and will be managed as such.

4.2.3. Vertical boring

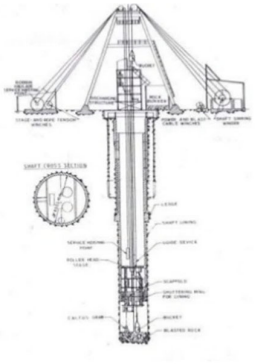
Vertical boring is the most efficient method of vertical shaft excavation. Two methods will be adopted: raise boring and blind sinking. Both are described below and graphically shown in Figure 4-12.

Raise boring is a process used to create a circular hole between an underground cavern or tunnel and the surface, without the need for explosives. A raise boring machine is at the surface and a pilot hole is drilled down to the underground cavern. Once it has broken through, a reaming head is used to create the required tunnel size by raising the head back up to the surface.

Blind sinking refers to the fact that there is no access to the bottom of the shaft by some other means. Initial excavation occurs from the surface and bores down. The shaft 'sinks' as it is lowered into the ground as excavation continues to progress down to the desired depth. The 'blind sink' methodology uses drill and blast practices and blasted rock is hoisted or cycled back to the surface. A temporary portal crane will be constructed on the surface that will facilitate the transport of personnel and materials into and out of the shaft.



Raise boring



Blind sinking

Figure 4-12: Vertical boring (EMM, EIS)

4.2.4. Underwater excavation, blasting and dredging

The intake structures in the Talbingo and Tantangara Reservoirs will be constructed with a rock plug in place to prevent reservoir water flowing into the tunnel and flooding the underground works. The rock plug will be removed in the second stage once all underground and tunnelling works are completed. Underwater excavation will be undertaken for the tunnel intakes' rock plug removal. These works would be carried out using underwater control blasting or rotating cutter. Dredging work used for the intakes' rock plug removal works, where the top layer (underwater) is weak enough to be dredged and sucked to spoil.

The requirement for dredging and under water blasting will be minimised as far as practicable. Where necessary these works will generally be carried out through:

- Lowering of reservoir levels (if of benefit to selected equipment positioning);
- Installation of silt curtains; and
- Use of a single handling of dredge and or blasted material.

4.3. Spoil transport

Spoil will be transported from its source to its destination via truck using both the internal construction road network and the external road network.

A Vehicle Management Plan will detail internal haulage routes, vehicle types and traffic controls to ensure the safe and efficient movement of vehicles (including those related to transport of spoil) across the project.

Spoil will be transported form Marica to Rock Forest via the public road network. Details on external truck movements are presented in the Traffic Management Plan (S2-FGJV-ENV-PLN-0008) and will be complied with throughout construction.

5. SPOIL CHARACTERISATION

5.1. Spoil characterisation overview

Future Generation have developed a spoil characterisation program based on:

- *National Environment Protection (Assessment of Site Contamination) Measure* (ASC NEPM), NEPC 2013
- *Preventing Acid and Metalliferous Drainage Leading Practice Sustainable Development Program for the Mining Industry*, Department of Industry 2016 (AMD Guideline)
- *Australian Standard 1141 Methods for sampling and testing aggregates*
- *Guidance Note On The Membrane Filter Method For Estimating Airborne Asbestos Dust,* National Occupational Health and Safety Commission: 3003 (1988)
- *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia,* Western Australian Department of Health 2009
- *Waste Classification Guidelines*, NSW EPA 2014.
- *AMIRA ARD test handbook (AMIRA, 2002)*
- *Global Acid and Metalliferous Drainage (GARD) Guide, developed by the International Network for Acid Prevention (INAP, 2008)*
- *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (MEND, 2009)*
- *Guidelines for metal leaching and acid rock drainage at mine sites in British Columbia (Price, 1998).*

The program enables the assessment of contamination, NOA and potentially reactive spoil to reduce the risk of material being misclassified as 'benign' and being managed inappropriately, and for proper offsite disposal (if required).

The program is presented in Appendix A. It is summarised in Table 5-1.

Table 5-1: Overview of spoil characterisation program

Aspect	Approach
Contamination	Investigations at Lobs Hole have been completed and do not require any further assessment. Targeted investigations will be undertaken prior to construction using a risk-based approach, along the surface disturbance areas that have not been assessed. Specific Sampling, Analysis and Quality Plan (SAQP) will be prepared to inform the scope, method and sample frequency of investigations in accordance with the ASC NEPM.
Spoil (D&B and TBM)	Characterisation of D&B and TBM probe spoil to ensure potential AMD, NMD and SD is not incorrectly classified as non-reactive. Sampling and analysis to align with relevant parts of the AMD guidelines. Sampling comprises both rapid field sampling and periodic laboratory analysis of D&B and TBM spoil. AMD samples to focus on Possible, Likely and Confirmed AMD hazard areas (Boraig Group, Shaw Hill Gabbro, Tantangara, Temperance, Gooandra Volcanics and Ravine Bed) units.

Aspect	Approach
	Characterisation of D&B and TBM generated spoil to verify presence of NOA Sampling and analysis to align relevant parts of ASC NEPM and AS4964–2004. Sample to occur at: • excavation front of each geological boundary; and • approximately every 100-150m within the same geological formation, where there is potential or likely NOA.
Stockpiles	Characterisation of stockpiles for correlation of D&B and TBM spoil sampling (AMD, NMD, SD and NOA), or to verify treatment needs and outcomes. Post-excavation sampling must be undertaken in accordance with relevant parts of AS 1141, AMD Guidelines, ASC NEPM and AS4964–2004. Sample frequency based on risk assessment. NOA samples to focus on Gooandra Volcanics, Boggy Plain Site and Shaw Hill Gabbro units. AMD samples to focus on Possible, Likely and Confirmed AMD hazard areas (Boraig Group, Shaw Hill Gabbro, Tantangara, Temperance, Gooandra Volcanics and Ravine Bed) units.
Asbestos in air	Monitoring of tunnel air quality in HRT Daily airborne asbestos monitoring in the HRT in areas identified as likely or confirmed NOA. Monitoring to occur in accordance with Guidance Note on The Membrane Filter Method For Estimating Airborne Asbestos Dust, NOHSC: 3003 (1988)
Waste	Classification of waste material to be disposed of off-site to ensure lawful transport and disposal. The waste material will be tested and classified in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014).

In summary the spoil will be assessed and classified as follows:

- **Non-reactive** spoil suitable for use or placement within the project, or elsewhere within Kosciuszko National Park.
- **Reactive** spoil suitable for use or placement within the project with appropriate treatment (if required) and engineering and environmental controls.
- **NOA** (both reactive or non-reactive) spoil to be placed within designated encapsulation cells at the Tantangara Peninsula emplacement area with appropriate engineering and environmental controls.
- **Unsuitable** spoil to be disposed of off-site to facilities lawfully permitted to receive it (waste).

Further detail on the proposed spoil uses and destinations is detailed in Section 6.

5.2. Onsite laboratory

An onsite material testing laboratory accredited by NATA will be established. Offsite facilities will also be used to supplement the onsite laboratory. Testing will include traditional concrete, soils and aggregate testing, PAF material parameters (e.g. acid-base accounting) and asbestos detection. The laboratory will test both coarse and fine materials.

The onsite laboratory will ensure effective turnaround of test results and allow timely advanced planning around spoil handling and disposal.

Full laboratory equipment, testing and procedures will be documented by the service provider, separate to this Plan.

Testing procedures and analytes will be quality controlled through Future Generation's Quality system and checked by SHL's quality system.

5.3. Contamination investigations

Details on further contamination investigations are presented in Section 5.1 of the Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0049). Investigations at Lobs Hole have been completed and do not require any further assessment. Targeted investigations will be undertaken prior to construction using a risk-based approach, along the surface disturbance areas that have not been assessed.

Once investigations are completed at each nominated area, a report providing conclusions on site suitability, material characterisation and recommendations for health and environmental controls during construction will be prepared. Where contamination is considered to be significant enough to warrant specific controls to manage risks from exposure, site−specific management plans will be prepared that set out the appropriate measures to be implemented to manage contamination while the construction area is in use.

5.4. AMD assessment

The AMD testing program includes:

- Field XRD / XRF scanning, and pH and EC screening;
- Geochemical kinetic testing of each key lithology or alteration type identified to have an actual PAF, Potentially acid-forming—low capacity (PAF-LC)), or potential (uncertain) AMD risk. Kinetic testing is being undertaken and will be used to inform the placement program as necessary;
- Sequential Net Acid-Generation (NAG) suite testing, where Total Sulfide >1% is reported in any single addition NAG tests (even where classification of the sample indicates Non-Acid Forming conditions). NAG suite testing to be carried out by the on site laboratory.

A graphical or statistical model will be created to enable analysis of AMD sample distribution to identify any critical information gaps, and develop a block model for potentially AMD forming material in the Possible to Confirmed areas.

Laboratory analysis will be compared to/correlated with field scanning and probing to mitigate identified risks associated with potentially PAF material.

The criteria outlined in Table 5-2 below classifies the materials varying acid-generating capacities, acid-neutralising capacities and NMD or SD potential based on test result so that the risk profiles of those materials can be identified and managed appropriately.

Table 5-2: AMD classification criteria (AMD Guideline, Department of Industry 2016)

GENERAL AMD RISK CLASSIFICATION	DETAILED AMD RISK CLASSIFICATION		
	DESCRIPTION	AMD & NMD[1] RISK CLASSIFICATION	AMD & NMD & SALINITY RISK CLASSIFICATION
Potentially acid-forming (PAF)	High potential for acid generation (AG1)	AG1	AG1 Saline
	Moderate / high potential for acid generation (AG2)	*AG2*	AG2 Saline
	Moderate potential for acid generation (AG3)	AG3	AG3 Saline
			AG3 Non-Saline
	Low potential for acid generation (AG4)	AG4	AG4 Saline
			AG4 Non-Saline
Non-acid-forming (NAF)	Unlikely to be acid generating (UAG)	UAG	UAG Saline
			UAG Non-saline
		UAG NMD	UAG NMD Saline
			UAG NMD Non-saline
	Likely to be acid consuming (LAC)	LAC	LAC Saline
			LAC Non-Saline
		LAC NMD	LAC NMD Saline
			LAC NMD Non-Saline

NMD = pH neutral mine drainage (pH 6–8).

5.5. NOA assessment

Based on the Geotechnical Baseline Report, NOA is likely to be found in a length of approximately 7.5 km in the HRT and will be encountered by TBM from the Tantangara zone within Gooandra Volcanics, Boggy Plain Site and Shaw Hill Gabbro units.

The total volume of material to be managed is approximately 150,000 m^3 bulked.

NOA assessment will comprise testing of the TBM spoil and tunnel air quality monitoring. During tunnelling, sampling and monitoring for NOA will be depend on the geological conditions.

Asbestos analysis of spoil will be conducted in accordance with Australian Standard Method for the Qualitative Identification of Asbestos in Bulk Samples (AS4964–2004).

Airborne asbestos monitoring will be conducted daily during excavation in ‘likely’ and ‘confirmed’ geological units; being Gooandra Volcanics, Boggy Plain Site and Shaw Hill Gabbro units. Monitoring to occur in accordance with Guidance Note On The Membrane Filter Method For Estimating Airborne Asbestos Dust, NOHSC: 3003 (1988).

Any asbestos detected should be reported as such and the corresponding material classified and managed as NOA.

5.6. Unsuitable material

Material will be classified as Unsuitable where investigations and testing demonstrate that contamination or other unsuitable characteristics, are present at concentrations that are

unacceptable for reuse on the project, elsewhere in KNP (as requested by NPWS) or for permanent placement.

Where material is nominated for off-site disposal, the material will be tested and classified in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014) as set out in the Waste Management Plan (S2-FGJV-ENV-PLN-0048).

6. SPOIL MANAGEMENT STRATEGY

6.1. Overview

For clarity, all volumes of spoil are referred to as the volume placed and factor in compaction factors. Approximately 10 million m^3 of spoil will be generated by the Project. This material is generated through:

- construction of the tunnel intakes at both reservoirs;
- tunnelling for power waterways, access tunnels and adits;
- excavation of underground caverns, chambers and shafts;
- road establishment and upgrades; and
- site establishment for construction areas and accommodation camps.

Future Generation's approach to spoil extraction, reuse and placement minimises the environmental and social impacts associated with the work as far as is reasonably practicable. The strategy for the management of spoil will aim to prioritise the reuse and placement of materials, based on its generating source and classification, consistent with the requirements of the Infrastructure Approval and the objectives and commitments from the EIS and RTS:

- Beneficial re-use of non-reactive spoil within permanent infrastructure will be maximised.
- Beneficial re-use of non-reactive spoil within temporary infrastructure will be tracked and removed once no longer required. Spoil will be relocated to an approved emplacement area, reused for permanent infrastructure, or disposed of offsite to facilities lawfully permitted to receive it.
- Spoil that cannot be re-used in permanent infrastructure will be directed to the approved emplacement areas at Talbingo (Ravine Bay, GF01 and Lobs Hole), Tantangara Reservoir and outside KNP at Rock Forest as a priority:
    - Reactive material would be placed in the aforementioned emplacement areas with prior treatment and / or appropriate engineering controls to manage leaching and reaction both in the short term and long term.
    - NOA material would be placed within designated encapsulation cells above the FSL of the Tantangara Reservoir emplacement area.
    - TBM spoil must not be placed in the active storages or below the FSL of either the Talbingo Reservoir or Tantangara Reservoir without the approval of the Planning Secretary.
    - Spoil from dredging, channel excavation or underwater blasting must not be placed in the Exploratory Works eastern and western emplacement areas, or in the active storages or below the FSL of either the Talbingo Reservoir or Tantangara Reservoir without the approval of the Planning Secretary.
    - It is anticipated that, following completion of construction activities for Snowy 2.0 Main Works, Lobs Hole, Tantangara and Marica will be re-opened to recreational users. As such surplus materials at these locations will be minimised, through reuse or permanent placement in one of the designated emplacement areas (refer Sections 6.2 and 6.3). Spoil retained at these locations will be limited to the volume required to achieve rehabilitation.
    - Placement of spoil will be carried out 24 hours a day, seven days a week and 365 days a year.

- Non-reactive spoil will be reused for the purposes of rehabilitation of temporary work areas in accordance with the Rehabilitation Management Plan, once approved. The re-use of non-reactive spoil in other parts of the KNP would also be maximised in accordance with schedule 3 condition 4 f) of the Infrastructure Approval. 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.
- Unsuitable material will be disposed of offsite to facilities lawfully permitted to receive it.

Figures 6-1 to 6-3 present the overall approach to reuse, placement and disposal spoil on the project based on the material type and classification. Table 6-1 presents the spoil volume breakdown for each area from which its sourced, to be reused or placed.

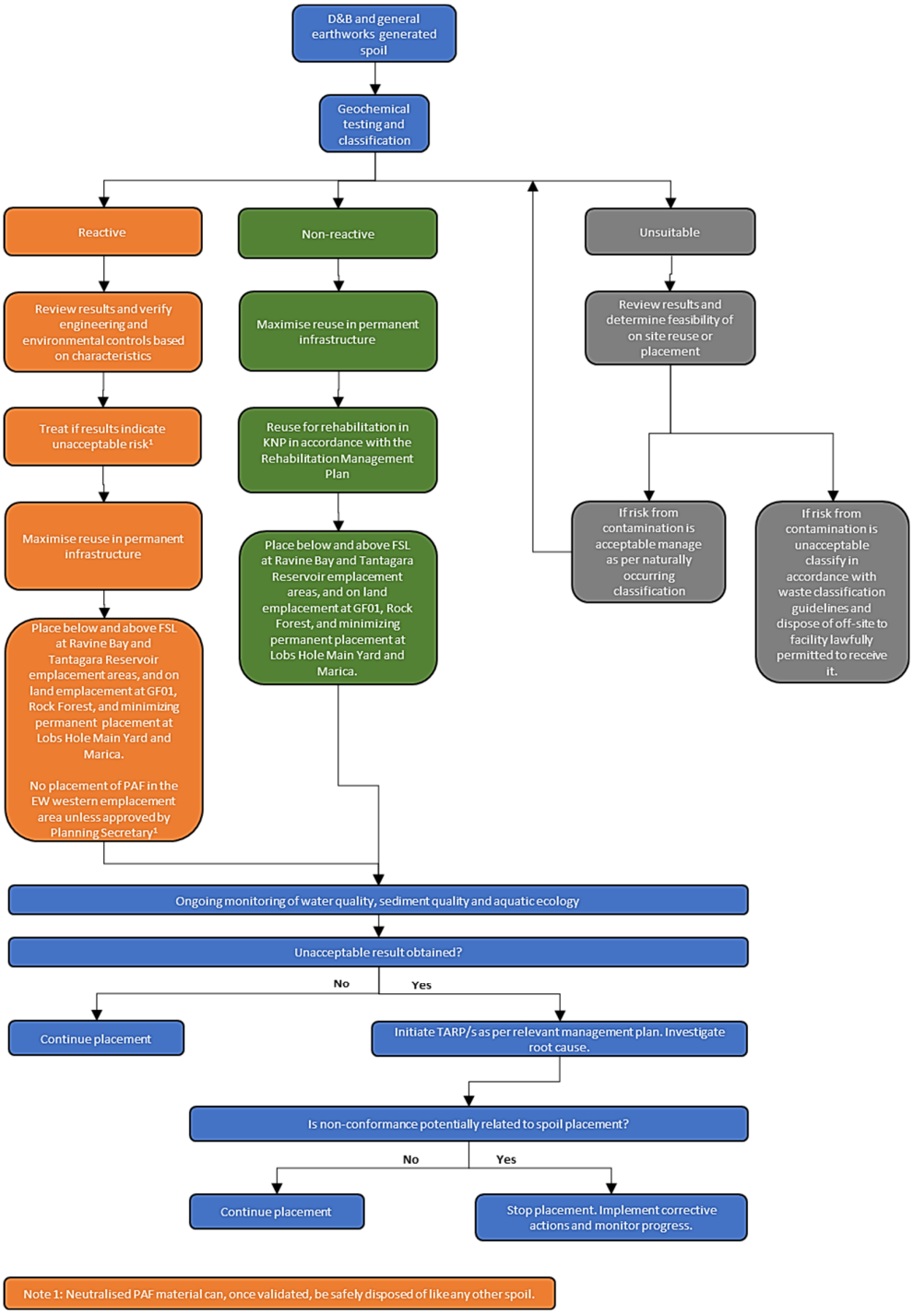


Figure 6-1: D&B and earthworks generated material flow chart

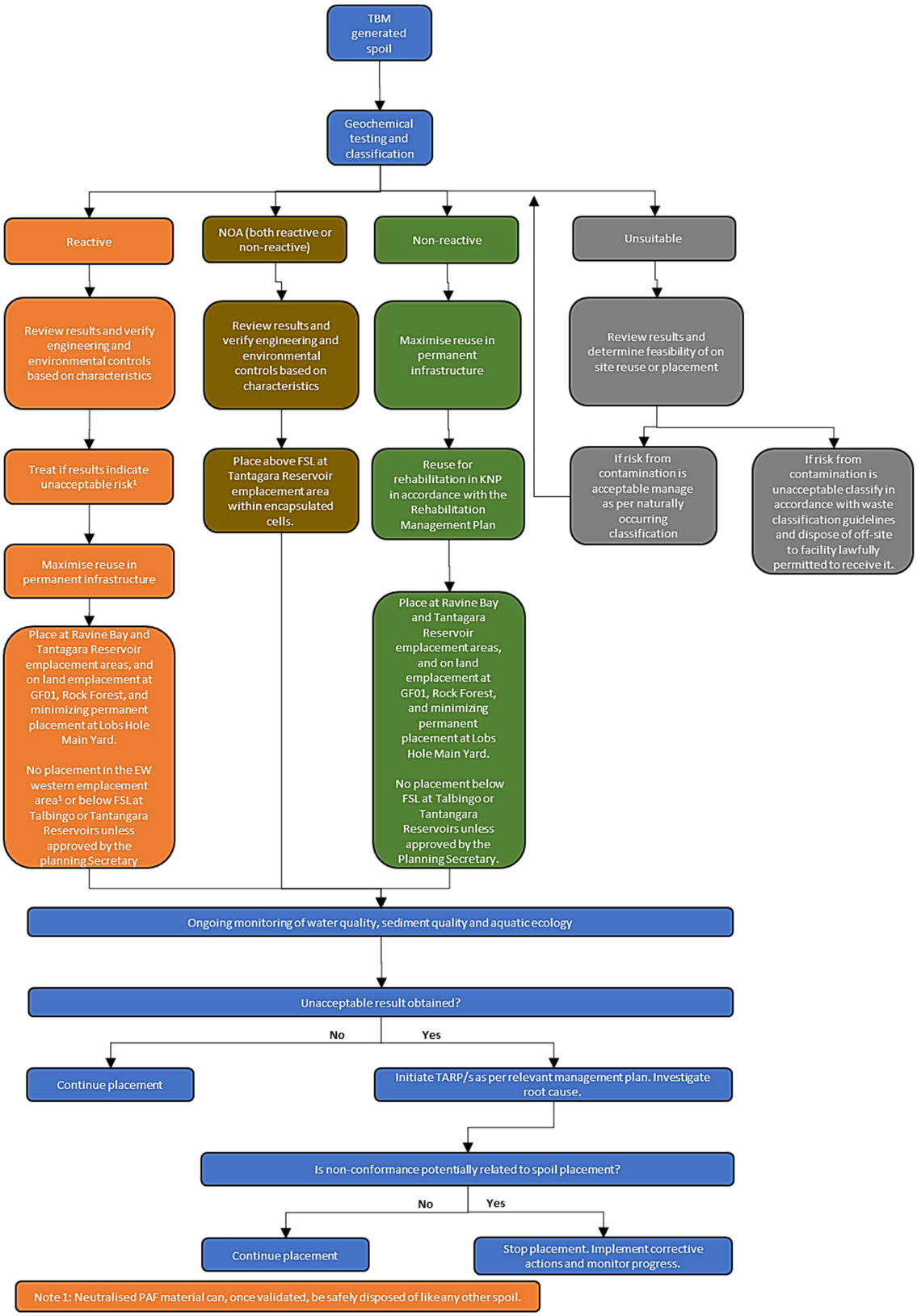


Figure 6-2: TBM generated material flow chart

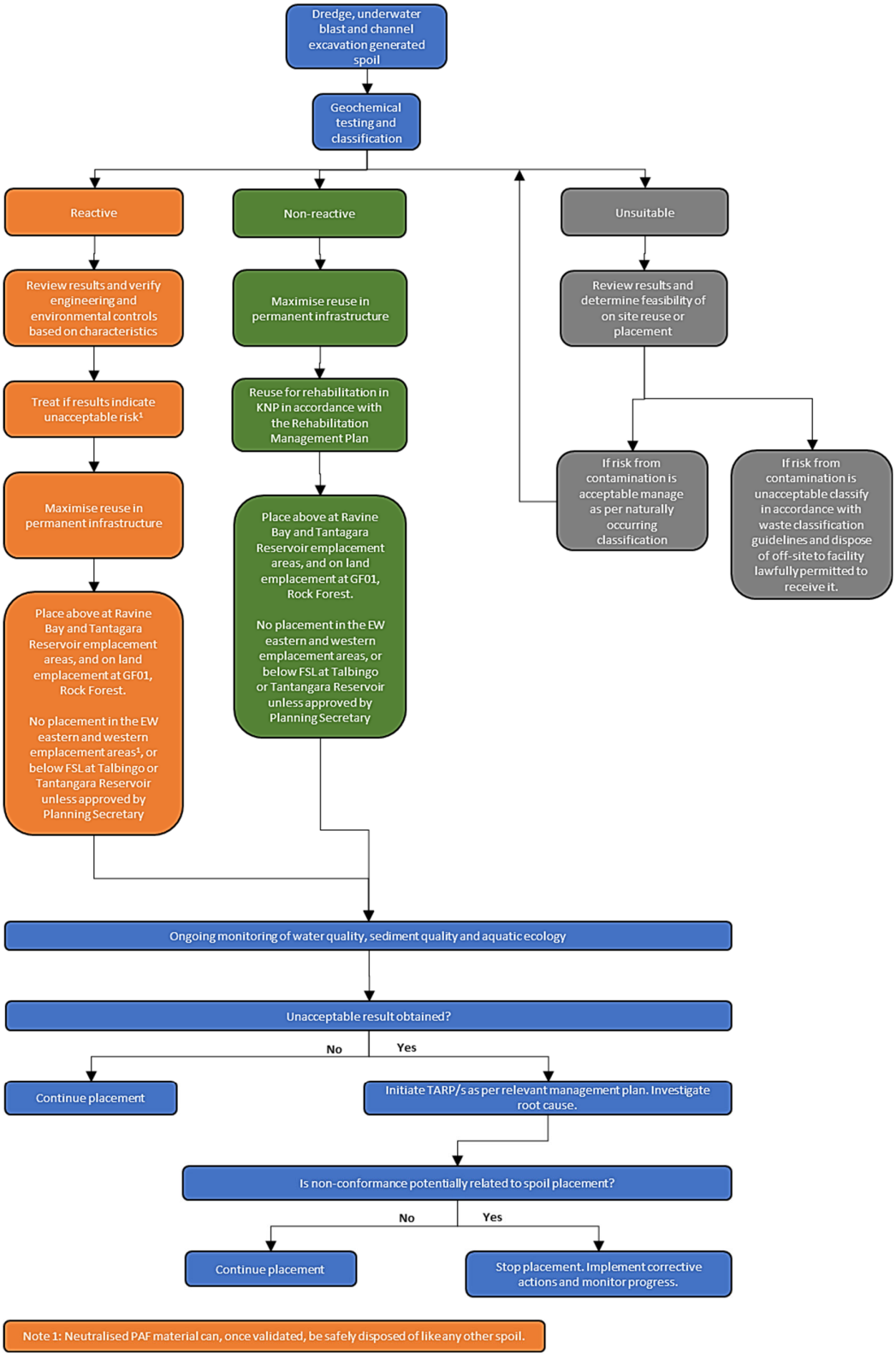


Figure 6-3: Dredge, underwater blasting and channel excavation generated material flow chart

Table 6-1: Spoil generation, reuse and placement

Spoil generation			Spoil reuse		Spoil Placement in emplacement areas[2]					
Source area	Activity	Volume[1]	Purpose	Volume[1]	Placement approach	Ravine Bay[1,3]	Lobs Hole[1,3]	GF01[1,3]	Tantangara[1,3]	Rock Forest[1,3]
Talbingo (including reservoir and Lobs Hole)	The bulk of the spoil comes from the construction of the underground power station and associated construction tunnels, the TRT, the Talbingo intake structure and the establishment of barge ramps, new access roads or the upgrades of existing access roads.	6.0	Fill at the MAT, ECVT and Talbingo and portal (permanent operational pads and structures). Selected fill and tunnel backfill and rock armour. As the TBM bores a round tunnel, substantial volumes are required to back fill the tunnel base to achieve a safe and trafficable base level. Permanent road in the project area.	1.1	Combination of land application in KNP and in-reservoir placement with only D&B material placed within the active storage of Talbingo Reservoir unless otherwise approved by the Planning Secretary; and geomorphic design on final landform. Material from dredging, channel excavation or underwater blasting will not be placed in the Exploratory Works eastern and western emplacement areas or below FSL of Talbingo reservoir without the approval of the Planning Secretary."	2.5	1.6	0.8	-	-
Marica	Spoil generated from mobilisation and establishment activities and construction of permanent assets including Marica Road, Marica West Road and HRT surge shaft.	0.5	Fill at the shaft portal (permanent structures). Permanent roads in the project area.	0.2	Land application outside KNP, with geomorphic design on final landform.	-	-	-	-	0.3
Plateau	Construction in this area relates to minor road upgrades. Tunnelling works in this area do not involve any surfacing. Spoil generated or consumed in the Plateau is negligible.									

Spoil generation			Spoil reuse		Spoil Placement in emplacement areas[2]					
Source area	Activity	Volume[1]	Purpose	Volume[1]	Placement approach	Ravine Bay[1,3]	Lobs Hole[1,3]	GF01[1,3]	Tantangara[1,3]	Rock Forest[1,3]
Tantangara	Spoil is primarily from the Tantangara intake structure and HRT and the establishment of barge ramps, new access roads or the upgrades of existing access roads.	3.4	Fill at the Tantangara portal (permanent operational pads and structures). Selected fill and tunnel backfill and rock armour. As the TBM bores a round tunnel, substantial volumes are required to back fill the tunnel base to achieve a safe and trafficable base level. Permanent roads in the project area.	0.7	In-reservoir placement with only D&B material placed within the active storage of Tantangara Reservoir unless otherwise approved by the Planning Secretary; and geomorphic design on final landform. Material from dredging, channel excavation or underwater blasting will not be placed below FSL of Tantangara reservoir without the approval of the Planning Secretary.	-	-	-	2.7	-
Total		**9.9**		**2.0**		**2.5**	**1.6**	**0.8**	**2.7**	**0.3**

Notes:

1. All volumes are in million m^3 compacted volume when placed. All volumes rounded to 0.1million m^3.
2. Construction of each emplacement area, and placement of spoil in those areas, is being staged as per Section 1.6. This SMP will be updated for consultation and approval of the detailed plan for each emplacement area prior to the relevant construction occurring. The Stages are as follows:
    - Lobs Hole – Stage 1 for Main Yard construction
    - GF01 – Stage 2.
    - Ravine Bay – Stage 3.
    - Tantangara – Stage 4
    - Rock Forest – Stage 5.
    - Lobs Hole – Stage 6 (for final formation).
3. Volumes for placement in the permanent emplacement areas may be adjusted to enable rehabilitation requirements to be achieved. The volumes required will be determined by agreed rehabilitation designs. Refer to Section 7 for further detail.
4. During the design process significant volumes of spoil were identified for beneficial reuse in permanent infrastructure at Marica. To minimize heavy vehicle movements between Marica to Rock Forest, spoil will be temporarily stockpiled at Marica. Spoil quantities for temporary stockpiling at Marica and final design for Rock Forest emplacement area will be confirmed at Stage 5.

6.2. Minimisation and beneficial reuse

6.2.1. Minimisation

Future Generation will reduce the amount of spoil generated through design optimisation. Material will only be excavated where required to construct the project. Where possible both temporary and permanent infrastructure has been designed to minimise excavation. This includes:

- reducing infrastructure footprints;
- sighting and positioning infrastructure in areas with lower undulations and milder slopes where possible; and
- micro sighting road works, bends and passing bays to use equal cut to fill balances where possible.

It is anticipated that, following completion of construction activities for Snowy 2.0 Main Works, Lobs Hole, Marica, and Tantangara will be re-opened to recreational users. As such surplus spoil will be minimised at these locations, in accordance with schedule 3, condition 4 (h) of the Infrastructure Approval, through the following:

- spoil at Lobs Hole that is surplus to required volume to achieve the final landform that complies with schedule 3, condition 6 of the Infrastructure Approval will be placed at the Ravine Bay emplacement area and / or GF01 (depending on construction phasing);
- spoil at Marica that is surplus to the required volume for permanent infrastructure or rehabilitation works will be placed at the Rock Forest emplacement area;
- spoil at Tantangara that is surplus to the required volume for permanent infrastructure or rehabilitation works will be placed at the Tantangara emplacement area.

6.2.2. Beneficial reuse

Future Generation will maximise the reuse of non-reactive spoil on site in permanent infrastructure (consistent with schedule 3, condition 4 (f) of the Infrastructure Approval) so as to reduce the overall volume of material requiring placement. The reuse is presented in Table 6-1. Approximately 2 million m^3 of non-reactive spoil is anticipated to be able to be reused in:

- fill at the MAT, ECVT and Talbingo and Tantangara portals (permanent operational pads and structures);
- selected fill and tunnel and shaft backfill and rock armour; and
- permanent road in the project area.

Temporary work areas in the KNP will be rehabilitated to a standard that complies with schedule 3, condition 9 of the Infrastructure Approval. Non-reactive spoil will be made available so that these requirements are satisfied.

The reuse of non-reactive spoil in other parts of the KNP would also be maximised in accordance with schedule 3 condition 4 f) of the Infrastructure Approval. 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.

6.3. Placement

Future Generation's breakdown of spoil source and destination for permanent placement is presented in Table 6-1, with the location of each emplacement area presented in Figure 6-4. The spoil strategy is such that:

- spoil placement in the approved spoil emplacement areas has been maximised as far as practicable, whilst ensuring spoil for reuse in permanent infrastructure has also been maximised, adequate supplies are available for rehabilitation; and
- no spoil will be left in the KNP for any other purposes or locations unless otherwise requested and approved by NPWS.

Detailed plans for the development (extraction, stockpiling, placement) and design (objectives, risks and completion criteria) for each emplacement area will be progressively developed and included in Appendixes F – J. The detailed plans must be approved prior to any construction occurring in the relevant emplacement area.

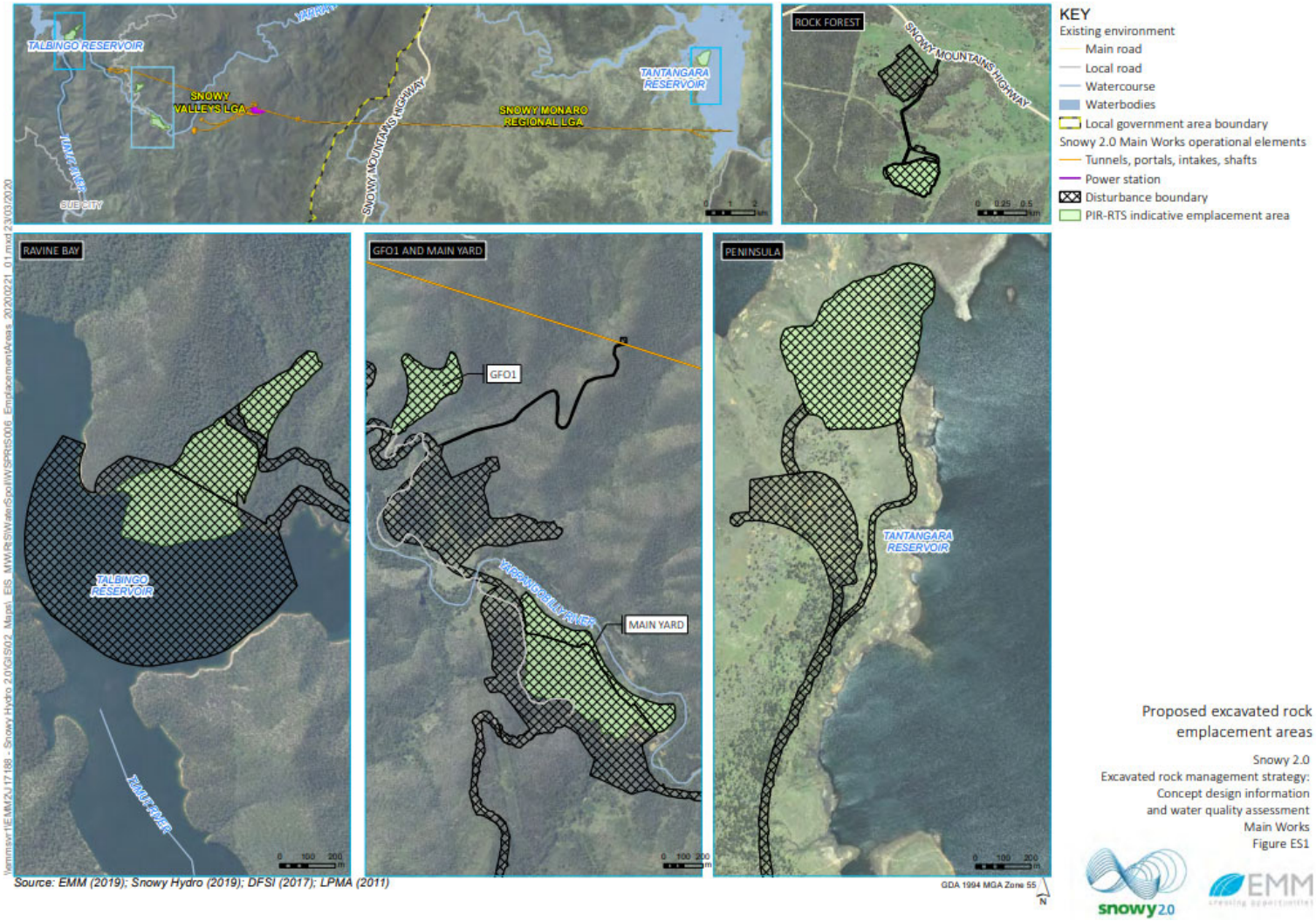


Figure 6-4: Spoil emplacement areas (EMM, 2020)

6.4. Topsoil

A Topsoil Strategy has been prepared in Appendix B and will be implemented. It outlines the measures that would be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target PCTs in the long term, along with relevant measures for topsoil stripping and maintenance.

Details on the topsoil balance for the site, including a strategy for:

- maximising the reuse of topsoil on site (provided it is suitable for reuse);
- using other suitable growth media; and
- importing additional topsoil to the site (if necessary)

are to be presented in the Rehabilitation Management Plan in accordance with schedule 3, condition 10 (e) of the Infrastructure Approval.

6.5. Stockpile management

Temporary stockpiles will be used to enable ex-situ testing and manage material flows across the project. Stockpiles would be utilised within the approved construction envelope at the tunnel portals, accommodation camp pads and roadways. Temporary stockpiles will be dynamic, changing in size and location over time in response to:

- changes to construction footprints and site layouts;
- material supply (i.e.: the timing and rate of excavation at each work area);
- testing methods and turnaround times;
- material demand (i.e.: the timing and rate of material reuse, emplacement or disposal).

All stockpiles will be designed and managed implementing principles of erosion and sediment control. This includes the preparation of a specific erosion and sediment control plans (ESCPs) for each stockpile area, in accordance with Section 5 of the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) and implementation of those controls on site. The ESCPs will consider:

- planning (e.g. preparation of a series of progressive plans and environmental work method statements);
- minimum disturbance to existing vegetation (e.g. 'no go' barriers);
- good topsoil management for revegetation/rehabilitation (e.g. stripping and stockpiling);
- runoff control (e.g. onto, through/around and off the sites; separation of 'clean' and 'dirty' flows);
- erosion control (i.e. retaining soil at its place of origin) including application of geofabric and or polymers, managing stockpile heights and angle of slopes;
- sediment control (i.e. final line of defence such as sediment basins, fences and traps); and
- progressive revegetation/rehabilitation (e.g. temporary on some stockpiles).

Further detail is presented in Section 9 and in the stockpiling procedure in Appendix C.

6.6. Contaminated material

As described in Sections 3 and 5 there is potential to encounter contaminated material on site. Key management measures to be implemented:

- investigations will be carried out be undertaken by a suitably qualified and experienced person in accordance with guidelines made or approved under the CLM Act;

- where contamination is identified and considered to be significant enough to warrant specific controls to manage risks from exposure, appropriate measures will be implemented to manage contamination while the construction area is in use;
- the contamination specialist will make recommendations to Snowy Hydro for the further actions and remediation (if required);
- Snowy Hydro will liaise with the relevant authorities including NPWS to determine the appropriate options and further actions to manage contaminated material;
- spoil which is classified as contaminated, which is not suitable for reuse on site, will be transported to a treatment or disposal facility that is legally able to accept the material for treatment, reuse or disposal;
- contaminated material will be stored in designated stockpile locations. These locations will be determined on site in consultation with engineers and construction supervisors, the locations will be included in Sensitive Area Plans;
- site staff and workers will be made aware of likely indicators for contamination such as discolouration or staining of soils, visible signs of plant stress, presence of drums or other waste material, stockpiles or fill material, and odours;
- the Unexpected Finds Protocol will be implemented in the event previously unidentified contamination is encountered during works.

6.7. Waste management

Future Generation is committed to maximising beneficial reuse of spoil on the project, or elsewhere within the KNP (subject to the needs and approval of NPWS). Investigations to date indicate that volumes of anthropogenic contaminated material are negligible due to the quality of the local environment. Additionally, natural occurring contaminants (NOA and AMD) are able to be managed on site and therefore, will not be required to be disposed of offsite (refer Sections 6.8 and 6.9, Appendix D and Appendix E for details). However, in the unlikely event spoil is not able to be reused or placed on the project it will need to be disposed of off-site as a waste. Key management measures to be implemented are:

- waste disposal is to be in accordance with the POEO Act and the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act);
- spoil to be disposed of off the project (if any) will be tested and dealt with in accordance with the POEO Act and *Waste Classification Guidelines Part 1: Classifying Waste* (EPA, 2014), or any superseding document;
- a waste register will be maintained, detailing the spoil amounts, date and details of disposal;
- waste spoil that is unable to be reused or recycled will be disposed of offsite at a licensed waste management facility, or premises lawfully permitted to accept the materials following classification; and
- a s.143 notice under the POEO Act will be obtained should spoil be transported to a site which is not licensed under the POEO Act to accept such waste. Sites and / or facilities licensed for receipt of waste under the POEO Act will not require a section 143 notice.

All off site movements will be tracked to ensure material is sent to its designated receiving facility, with details entered into the project waste register:

- general waste spoil will be tracked via run sheets, truck logs, tip dockets and s143 certificates as relevant;

- in the very unlikely event waste spoil is classified as trackable waste under the POEO Waste Regulation, it will be tracked via EPA's Online Waste Tracking Tool (using consignment authorisation and transport certificates) or the EPA WasteLocate application.

6.8. Naturally Occurring Asbestos (NOA)

A Naturally Occurring Asbestos Management Plan (NOAMP) has been prepared in Appendix D and will be implemented. It sets out the measures to be undertaken to appropriately handle and place NOA material, along with contingency measures to be implemented if the volumes of spoil are greater than expected and unsuitable for placement on the project. In summary:

- Future Generation will excavate transport and place NOA under controlled conditions to prevent airborne fibres being released to atmosphere and protect workers;
- NOA will be encapsulated in designated cells within the Tantangara emplacement area. The cells will be lined with geosynthetics or clay material, capped and overlaid with a highly visible marker layer; and
- monitoring of airborne asbestos would occur for the duration of NOA excavation and emplacement works.

6.9. Acid and Metalliferous Drainage (AMD)

An Acid and Metalliferous Drainage Management Plan (AMDMP) has been prepared in Appendix E and will be implemented. It sets out the measures to be undertaken to appropriately handle and place PAF material, along with contingency measures to be implemented if the volumes of spoil are greater than expected and unsuitable for placement on the project. In summary:

- Future Generation will use designated treatment areas for PAF material to be treated separately from the non-PAF material;
- Treatment areas will be constructed and operated to minimise interaction with waters;
- PAF material would be blended with ANC material, or lime, until neutralised; and
- Where there is sufficient material, PAF material will be encapsulated within NAF material in emplacement areas to minimise interaction with air and water. If there is insufficient material, treated PAF material will be used.

Neutralised PAF material can, once validated, be safely disposed of like any other spoil.

6.10. Tunnel drainage

All tunnel drainage, including tunnel drainage within excavations in Possible, Likely and Confirmed AMD hazard areas are to be directed to the process water treatment plant whereby it will undergo treatment prior to reuse in process. In the event there is surplus water to that required in process it will be used in general construction (e.g. for dust control) or discharged to the environment at a point licenced under EPL 21266. All discharges would comply with the criteria specified in EPL 21266. Further detail is available in the Water Management Plan (S2-FGJV-ENV-PLN-0010).

6.11. Surface waters

A Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) has been prepared and details measures for managing surface water impacts arising from construction works (including spoil handling and placement). The measures have been developed in accordance with the following guidelines (the Blue Book series):

- *Managing Urban Stormwater, Volume 1 (Landcom 2004);*
- *Managing Urban Stormwater, Volume 2A Installation of Services (DECC 2007); and*

- *Managing Urban Stormwater, Volume 2C Unsealed roads (DECC 2008).*

The key elements of the surface water management system are as follows:

- training and awareness of risks associated with erosion and sediment, controls and management practices and the purpose and implementation of Erosion and Sediment Control Plans (ESCPs) will be provided through the use of site inductions and 'toolbox' meetings;
- an appropriately experienced and qualified Soil Conservationist will be engaged for the duration of the project to advise project personnel on erosion and sediment controls and periodically inspect all erosion and sediment controls being implemented during construction;
- site specific ESCPs will be developed and maintained during construction to give effect to the measures from the Blue Book. The measures include:
    - segregate clean and dirty water including clean water diversions as early as possible and for the duration of construction;
    - capture, contain, treat and discharge construction, process water and wastewater to receiving water environments;
    - reuse of treated and captured water as much as practicable in order to avoid release into the surrounding watercourses;
    - capture and segregate runoff from the following locations:
        - spoil emplacement areas;
        - topsoil and subsoil stockpiles; and
        - other disturbed areas (i.e. roads);
- a surface water monitoring program (S2-FGJV-ENV-PLN-0107-F) has been developed and will be implemented as part of the Surface Water Management Plan. It details the monitoring to be undertaken from treatment plants, sediment basins and receiving waters throughout the construction program and assigns water quality criteria to measure for each. The monitoring program allows Future Generation to evaluate the performance of surface water controls;
- Trigger Action Response Plans (TARPs) (Section 6 of the Surface Water Monitoring Program S2-FGJV-ENV-PLN-0107-F) have been developed and will be implemented where water quality results indicate a non-conformance with the relevant criteria or if visible signs of sedimentation, turbid water or floating hydrocarbons are observed in receiving waters. The TARPs provide an efficient and effective process for the identification, investigation, rectification and reporting of non-conformities, including those that may relate to spoil handling and placement.

6.12. Leachate Detection Procedure

To manage potential leachate seepage from the PSEs, specific Leachate Detection Procedures will be implemented and followed for each of the spoil emplacement areas. Monitoring will be carried out at applicable surface water and ground water point which will continually assess if leachate is occurring from the spoil emplacement.

The data and information gathered during monitoring will to feed into management processes that seeks to minimise the Project's impact on surface and groundwater. Potential seepage and runoff will be collected in a leachate basin downstream of the treatment emplacement area. Collected water will be tested for potential contamination which will be guided by the EPL. Water will be irrigated to the spoil emplacement area (to promote evaporation) or, where the water quality is not suitable for reuse, treated in the process water treatment plant. Should the water treatment plant have insufficient capacity to treat the water, the water will be classified and will be disposed on offsite at a facility licensed to accept the classification of water.

A leachate detection procedure was prepared for GF01 (S2-FGJV-ENV-PRO-0055) and Tantangara (S2-FGJV-ENV-PRO-0057). Specific procedures will be prepared for each of the spoil emplacement areas.

7. PROGRESSIVE REHABILITATION AND EMPLACEMENT DESIGN

The decommissioning, land-forming and landscaping proposed for the project is detailed in the Rehabilitation Management Plan (S2-FGJV-ENV-PLN-0023). Random backfill, as defined and tested in accordance with Roads and Maritime (RMS) Specification R44, obtained on site may be used for rehabilitating the works. Exposed areas will be progressively rehabilitated where not impacted by active construction. Methods will include permanent revegetation, or temporary protection with spray mulching or cover crops.

Detailed plans for the design (objectives, risks and completion criteria) for each emplacement area will be progressively developed and included in Appendixes F – J once prepared. The detailed plans must be approved prior to any construction occurring in the relevant emplacement area.

Geomorphic and ecological characterisation of construction areas will be undertaken prior to disturbance to record the existing conditions and values and the placement and rehabilitation approach will be progressive, incorporating the design objectives as set out in Table 7-1.

Table 7-1: Design objectives for Permanent Spoil Emplacement Areas

Aspect	Objective
Landforms	• As natural as possible, including minimising the use of linear or engineered structures • Sympathetic with the landforms in the surrounding area, particularly from a visual, water management and ecological perspective • Suitable drainage density • Safe, long-term stable and non-polluting • Where feasible, gradients along the water line of the reservoirs that could be exposed under normal conditions (i.e. above the minimum operating level) must be suitable for safe recreational use and consistent with the approved Recreation Management Plan • Provide suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting with slopes typically spaced at around 200 metres measured on the slope to allow for spraying from vehicles, or as approved by the NPWS
Water management	• Integrate the drainage of the emplacement area with the surrounding drainage network, including any upstream flows and residual run-on water • Minimise downstream water flows and velocities with any changes to be quantified and addressed though suitable design • Minimise valley infill • Create natural drainage lines that are long-term sustainable having regard to the selection of suitable underlying materials, including rock sizing and grading • Minimise the use of large rocks in drainage lines • Minimise the concentration of water on landforms unless this is consistent with accepted drainage density and geomorphic design practices • Minimise the generation and dispersion of sediment in the Talbingo Reservoir, Tantangara Reservoir or other waterways
Erosional stability	• Minimise steep slopes, particularly slopes that will be difficult to access and maintain (such as slopes over 18º or 1V:3H) • The final surface of the landform must be long-term sustainable with sufficient topsoil (or some other suitable growth medium) to maintain a soil water profile and sustain vegetation • Maximise the revegetation of the final surface • Ensure areas subject to wave action are suitably protected or the slopes are flattened to limit wave action
Land Use	• Native vegetation and habitat must be consistent with the approved Rehabilitation Management Plan • Recreational facilities and use must be consistent with the approved Recreation Management Plan

Aspect	Objective
Constructability	• The emplacement area must be constructible having regard to the: - availability of suitable material, including topsoil - erosion and sediment control; - access; - initial shaping of natural ground; - progressive rehabilitation; - shapes and benching; and - safety around water

8. ENVIRONMENTAL MANAGEMENT MEASURES

A range of environmental requirements and control measures are identified in the Main Works EIS, Submissions Report and the Infrastructure Approval. Safeguards and management measures will be implemented to avoid, minimise or manage impacts due to spoil emplacement.

Specific safeguards and management measures to address potential impact of spoil are identified in Table 8-1. Regardless of the allocation of responsibilities within this plan, the responsible party is to be assigned in accordance with the Contract.

Individual management plans have been (or will be) prepared as part of the EMS suite of documents to outline how dust, noise, traffic, biodiversity, soil and water and social impacts that are associated with spoil will be managed. The plans have been prepared in accordance with the Infrastructure Approval, REMMs and Employer Requirements. The measures from those documents are not replicated within this SMP.

Table 8-1: Spoil management measures

ID	Measure / Requirement	Responsibility	Source document
General			
SM01	Training will be provided to all project personnel, including relevant sub-contractors on spoil management practices and the requirements from this plan through inductions, toolboxes and targeted training.	Future Generation	Good Practice
SM02	Management measures from this plan will be included in relevant site environmental documents including for example, Work Packs and/or Site Environmental Plans (SEPs).	Future Generation	Good Practice
Characterisation			
SM03	The spoil characterisation program in Appendix A will be implemented. The program will enable adequate assessment of contaminated materials, NOA, acid metalliferous drainage (AMD)/neutral metalliferous drainage (NMD)/saline drainage (SD) material, and reduce the risk of material being misclassified as 'benign' and being managed inappropriately.	Future Generation	COA Sch 3 Cond 4 Table 9.1, Item 4 of EIS Appendix N.1 EW CON02
SM04	Targeted investigations will be undertaken prior to construction along the surface disturbance areas using a risk-based approach. The results of these targeted investigations will determine the level of management to be implemented.	Future Generation Snowy Hydro	MW REMM CONTAM01 EW REMM CON02
SM05	Material which has been assessed as not suitable for reuse on land or for subaqueous disposal or cannot be reused will be classified in accordance with the Waste Classification Guidelines (NSW EPA 2014).	Future Generation	MW REMM CONTAM04 EW REMM CON03
SM06	Prior to the importation of any VENM during construction, the VENM source(s) will be identified and assessed against the definition of VENM in the Waste Classification Guidelines (NSW EPA, 2014) and the POEO Act. The VENM source(s) will be assessed by an appropriately qualified contaminated land consultant.	Future Generation	MW REMM CONTAM02
Spoil handling and management			
SM07	Spoil generation will be minimised through design optimisation and beneficial reuse as set out in Section 6.2 of this Plan.	Future Generation	Schedule 3 condition 4
SM08	Spoil is to be only re-used, placed or disposed of in accordance with its classification as set out in Section 6.1 of this Plan.	Future Generation	Schedule 3 condition 4

ID	Measure / Requirement	Responsibility	Source document
SM09	Apart from the spoil that is provided to the NPWS for use in other parts of the Kosciuszko National Park, sent off-site, used to construct temporary or permanent infrastructure for the development or used to rehabilitate the site, the Proponent must ensure that all the spoil generated by the development is disposed of in the following emplacement areas: • Ravine Bay; • GFO 1; • Lobs Hole; • Tantangara; or • Rock Forest.	Future Generation Snowy Hydro	Schedule 3 condition 5
SM10	TBM spoil must not be placed in the active storages or below the full supply level of either the Talbingo Reservoir or Tantangara Reservoir without the approval of the Planning Secretary.	Future Generation	Schedule 3 condition 4
SM11	Spoil from dredging, channel excavation or underwater blasting must not be placed in the eastern and western emplacement areas, or in the active storages or below the full supply level of either the Talbingo Reservoir or Tantangara Reservoir without the approval of the Planning Secretary.	Future Generation	Schedule 3 condition 4
SM12	The beneficial reuse of non-reactive spoil on the project will be maximised where possible.	Future Generation	Schedule 3 condition 4
SM13	The beneficial reuse of non-reactive spoil elsewhere in the KNP will be maximised where possible (as requested and approved by NPWS).	Future Generation Snowy Hydro	Schedule 3 condition 4
SM14	Off-site disposal of spoil will be minimised where possible. Surplus spoil will be directed to the permanent spoil emplacement areas as a priority over off-site disposal.	Future Generation	Schedule 3 condition 4
SM15	Spoil left at Lobs Hole, Marica and Tantangara for incorporation into the final landform should be minimised.	Future Generation	Schedule 3 condition 4
SM16	The Exploratory Works western emplacement area must only receive non-reactive spoil, which has a low geochemical risk and is suitable for reuse. Reactive spoil must not be directed to the Exploratory Works western emplacement area.	Future Generation	Schedule 3 condition 4
SM17	The Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0049) will be implemented to ensure appropriate management of contaminated material on site.	Future Generation Snowy Hydro	Schedule 3 condition 4 Schedule 3 condition 7 MW REMM CONTAM03
SM18	An unexpected finds procedure is included in the Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0049). Workers will be trained to identify potential contamination that may be encountered during construction	Future Generation Snowy Hydro	MW REMM CONTAM08
SM19	The Naturally Occurring Asbestos Management Plan (Appendix D of this Plan) will be implemented to ensure appropriate management of Naturally Occurring Asbestos encountered during works.	Future Generation	Schedule 3 condition 4 Schedule 3 condition 7 Table 9.1, Item 4 of EIS Appendix N.1

ID	Measure / Requirement	Responsibility	Source document
SM20	The Acid and Metalliferous Drainage Management Plan (Appendix E of this Plan) will be implemented to ensure appropriate management of AMD material encountered during works.	Future Generation	Schedule 3 condition 4 Schedule 3 condition 47 Table 9.1, Item 4 of EIS Appendix N.1 EW REMM CON02
SM21	The Waste Management Plan (S2-FGJV-ENV-PLN-0048) will be implemented to ensure appropriate classification, use and disposal of waste from the project.	Future Generation	MW REMM CONTAM04 EW REMM CON03
SM22	Material which is not suitable for reuse or placement or on onsite remediation, will be transported to a facility that is lawfully permitted to receive that material.	Future Generation	EW REMM CON03
SM23	The Stockpile Procedure (Appendix C of this Plan) will be developed to ensure temporary stockpiling is appropriately managed and that any adverse impacts are controlled and rectified.	Future Generation	Schedule 3 condition 7 EW REMM CON02
SM24	The Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) will be implemented to ensure impacts on surface waters as a result of spoil handling and placement are minimised.	Future Generation Snowy Hydro	Schedule 3 condition 4
SM25	Site-based Erosion and Sediment Control Plans (ESCPs) will be prepared by a suitably qualified erosion and sediment control specialist.	Future Generation	Schedule 3 condition 4 MW REMM SOIL03
SM26	A non-naturally occurring Asbestos Management Plan (S2-FGJV-HAS-PLN-0010) has been developed and will be implemented to manage Asbestos Containing Materials ACM (ACM), or areas are suspected of containing ACM (such as historical buildings). The AMP addresses unexpected finds of ACM. Specifically, protocols will be stipulated for separation, monitoring, validation and clearance of asbestos	Future Generation	MW REMM CONTAM05 MW REMM CONTAM08
SM27	An Occupational Hygienist (Hygienist) will be on-site for the duration of the excavation works where ACM has been identified from pre-construction or where unexpected finds of ACM are encountered.	Future Generation	MW REMM CONTAM06
SM28	The process Water Treatment Plants will receive all tunnel drainage, including tunnel drainage containing AMD components for excavations in Possible, Likely and Confirmed AMD hazard areas. The water will be reused in the tunnelling process following treatment. Any discharge to the environment will only occur where the water is treated so as to comply with the criteria in EPL 21266.	Future Generation	Table 9.1, Item 4 of EIS Appendix N.1
SM29	The Topsoil Strategy (Appendix B of this Plan) will be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target PCTs in the long term.	Future Generation	Schedule 3 condition 7 MW REMM SOIL02 EW REMM SOIL01
SM30	A hold point process will be established and implemented requiring approval by the Future Generation Environment Manager or Construction Manager prior to the placement of material generated from dredging, channel excavation or underwater blasting. This hold point process will note that this material cannot be placed in the Exploratory Works eastern and western emplacement areas without the approval of the Planning Secretary.	Future Generation	Schedule 3 condition 4(k) and DPIE comments

ID	Measure / Requirement	Responsibility	Source document
SM31	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. To note, the Exploratory Works western emplacement area will be filled during Main Works for the purposes of constructing the Main Yard. Nevertheless only non-reactive spoil will be placed at this location.	Future Generation	Schedule 3 condition 4 EW REMM WM8.3
SM32	Any remnant mine workings located within the eastern and western rock and soil emplacement areas will be rehabilitated (if necessary).	Future Generation	EW REMM WM8.4
SM33	The eastern emplacement area will be used to store any material generated during Exploratory Works that has higher geochemical risk. 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. Once design levels are reached, the landform will be top-soiled and vegetated. To note, the Exploratory Works eastern emplacement area will be filled during Main Works for the purposes of constructing the Main Yard. PAF material will be managed as set out in Appendix E of this Plan.	Future Generation	EW REMM WM8.5
SM34	Runoff from Lick Hole Gully during Exploratory Works 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. To note, the Exploratory Works eastern emplacement area will be filled during Main Works for the purposes of constructing the Main Yard and the final Lobs Hole emplacement area. Final design of the Lobs Hole emplacement area will be addressed in accordance with the staging specified in Section 1.6 and the Rehabilitation Management Plan. Operational controls that require ongoing management following completion of construction would be of no impost the NPWS.	Future Generation	EW REMM WM8.6
SM35	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. To note, the Exploratory Works eastern emplacement area will be filled during Main Works for the purposes of constructing the Main Yard and the final Lobs Hole emplacement area. Final design of the Lobs Hole emplacement area will be addressed in accordance with the staging specified in Section 1.6 and the Rehabilitation Management Plan. Operational controls that require ongoing management following completion of construction would be of no impost the NPWS.	Future Generation	EW REMM WM8.6
SM36	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. To note, the Exploratory Works eastern emplacement area will be filled during Main Works for the purposes of constructing the Main Yard and the final Lobs Hole emplacement area. Final design of the Lobs Hole emplacement area will be addressed in accordance with the staging specified in Section 1.6 and the Rehabilitation Management Plan.	Future Generation	EW REMM WM8.7

ID	Measure / Requirement	Responsibility	Source document
SM37	The western emplacement will be designed to prevent the risk of emplacement material being entrained in flood waters during a 1 in 5000-year flood event. To note, the Exploratory Works eastern emplacement area will be filled during Main Works for the purposes of constructing the Main Yard and the final Lobs Hole emplacement area. Final design of the Lobs Hole emplacement area will be addressed in accordance with the staging specified in Section 1.6 and the Rehabilitation Management Plan.	Future Generation	EW REMM FM1.2-1
SM38	The monitoring in Section 9 of this Plan will be implemented to identify and track the performance of: • the management of spoil on site; • the implementation of each of the detailed plans, including the effectiveness of the proposed mitigation and contingency measures; and • progress against the detailed completion criteria and performance indicators of each permanent spoil emplacement area.	Future Generation	Schedule 3 condition 7 Table 9.1, Item 4 of EIS Appendix N.1
SM39	Monitoring measures to be included as part of the Surface and Groundwater Monitoring Program, to monitor potential impacts from the placement of spoil.	Future Generation	EW REMM CON02
Emplacement area design and rehabilitation			
SM40	The permanent spoil emplacement areas will be designed to comply with the design objectives in Table 2 (of the COA entitled *Design Objectives for Permanent Spoil Emplacement Areas*).	Future Generation	Schedule 3 condition 6 Schedule 3 condition 7
SM41	New landforms will: • be safe, stable and non-polluting; • maximise surface drainage to the natural environment.	Future Generation Future Generation	MW REMM REHAB02
SM42	Detailed plans for each of the permanent spoil emplacement areas that have been prepared using both analogue and erosional-based methods will be developed for approval prior to commencement of construction of the applicable placement area. The plans will: • describe how the development of each emplacement area would be co-ordinated with the rehabilitation of the site in accordance with the approved Rehabilitation Management Plan; • describe the measures that would be implemented to comply with the spoil management requirements in condition 4 and the design objectives in Table 2 of the COA; • include a topsoil strategy outlining measures the measures that would be implemented to ensure the surface pf the emplacement areas will be suitable to sustain the target PCTs in the long term, having regard to the approved strategy in the Rehabilitation Management Plan; • identify the key risks for the successful completion of each emplacement area and the contingency measures that would be implemented to address these risks; and • include detailed completion criteria and performance indicators for each emplacement area, including criteria for triggering remedial action (if necessary)	Future Generation	Schedule 3 condition 7
SM43	The Rehabilitation Management Plan (S2-FGJV-ENV-PLN-0023) will be implemented (once approved) for the new landforms at Tantangara Reservoir, Lobs Hole and Talbingo Reservoir.	Future Generation	MW REMM REHAB01

ID	Measure / Requirement	Responsibility	Source document
SM44	Mitigations will be included in the Rehabilitation Management Plan to minimise impacts to Alpine humus soils and peat bogs/fens.	Future Generation	MW REMM SOIL01
SM45	The Rehabilitation Management Plan (refer to REHAB01) will be implemented and will include measures to minimise: • loss of soil; • loss of organic matter and nutrient decline; • soil structural decline; and • compaction.	Future Generation	MW REMM SOIL04
SM46	Regular rehabilitation monitoring will be undertaken to identify any defects, such as slumping, erosion or poor vegetation establishment. Identified defects will be rectified.	Future Generation	MW REMM SOIL04

9. COMPLIANCE MANAGEMENT

9.1. Monitoring and inspection

The spoil inspection and monitoring regime is summarised in Table 9-1. Monitoring records and inspection reports will be internally recorded, the findings and outcomes will be reported to the relevant agencies in accordance with the compliance tracking reporting requirements stated in Section 8 of the EMS.

Table 9-1: Environmental monitoring summary

Activity	Frequency / type	Responsibility	Record	Timing
Road, bridge and drainage construction excavation	Weekly inspection of stockpile areas (refer Section 9.1.2)	Future Generation	Inspection report	For duration of construction of this activity
Tunnel excavated spoil	Daily workplace inspections	Future Generation	None – observation only	For duration of construction of this activity
	TBM probing during tunnelling as described in Appendix A.	Future Generation	Inspection report Laboratory test report	
	Laboratory testing of spoil sampled and tested as described in Appendix A.	Future Generation	Laboratory test report	
Temporary Stockpiles	Weekly inspection of stockpile areas (refer Section 9.1.2)	Future Generation	Inspection report	All
Emplacement area	Weekly inspection of stockpile areas (refer Section 9.1.2)	Future Generation	Inspection report	For duration of construction of this activity
	Daily workplace inspections	Future Generation	None – observation only	
Off-site transport (if required)	Truck movement run sheets for each truck transporting spoil off site (outside the project)	Future Generation	Waste register, truck run sheets (truck counts), log books and tip dockets.	For duration of construction of this activity
Groundwater	*Refer Groundwater Management Plan*			All
Surface Water	*Refer Surface Water Management Plan*			All

9.1.1. Workplace Inspections

Future Generation has developed a program of environmental inspections for the project. Scheduled and regular workplace inspections will be carried out across the site, including in stockpile and spoil management locations, by Supervisors and environmental staff. Details are provided in Section 8 of the EMS.

9.1.2. Temporary stockpiling

Monitoring of temporary stockpiling enables the identification of potential issues associated with material handling and storage prior to impacts occurring on surrounding soils, surface waters and

groundwaters occurring (which are identified by their respective monitoring programs). The temporary stockpile monitoring program is presented in Table 9-2.

Table 9-2: Temporary stockpile monitoring

No.	Requirement	Timing
1	Confirm that the designated stockpile site is capable to receive the likely spoil volumes and types, and approved to be established (check that the site is within the designated approved disturbance area, free from no-go areas etc). Refer to the Sensitive Area Plans for confirmation.	Prior to use of temporary stockpile location
2	Update the Sensitive Area Plan if necessary and reissue to project personnel.	Prior to use of temporary stockpile location
3	Confirm that stockpile site is signposted to clearly demarcate the spoil type it is designed to receive (D&B, TBM, PAF, NOA, other potentially contaminated material, benign material)	Prior to use of temporary stockpile location
4	Confirm that soil and water controls have been installed in accordance with the Blue Book (Landcom, 2004) and the site-specific Erosion and Sediment Control Plan.	Prior to use of temporary stockpile location
5	If site is to be used for treatment of PAF material, confirm that: • the design requirements from Section 4 of the AMDMP (in Appendix E) have been complied with; and • site-specific Erosion and Sediment Control Plan have been implemented.	Prior to use of temporary stockpile location for the treatment of PAF material
6	Confirm stockpiles are not showing signs of significant erosion (rills, slumps, sedimentation of surrounds, turbid water runoff)	Daily observation
7	Monitor (visual) dust generated during the handling of stockpiles	Daily observation
8	Confirm controls from site-specific Erosion and Sediment Control Plan have been maintained and are in working order.	Weekly
9		Following large rain event
10	Confirm seepage from PAF stockpiles is being collected and irrigated on to the PAF stockpile or sent to the process water treatment plant.	Weekly

9.1.3. Erosion and sedimentation

Monitoring of general erosion and sediment controls is documented in the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011). The monitoring include:

- regular monitoring and maintenance of surface water diversion structures, drainage structures and erosion control measures implemented through the construction stage; and
- erosion and sediment controls including sediment basins will be designed in accordance with the *Blue Book* (Landcom, 2004) and all relevant mitigation measures in Section 6 of the SWMP. This includes determining appropriate sizing of sediment basins and ground stabilisation measures to reduce catchment sizes from disturbed areas.

9.1.4. Surface water

Appendix A of the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) details the monitoring to be undertaken from treatment plants, sediment basins and receiving waters throughout the construction program and assigns water quality criteria to measure for each. Routine and event-based monitoring is specified.

In addition, specific leachate detection procedures will be implemented for each of the spoil emplacement areas. The procedures will monitor for any potential surface water contamination. Refer to Section 6.12.

9.1.5. Groundwater

Groundwater monitoring will occur across the site in accordance with the Groundwater Monitoring Program, Appendix A of the Groundwater Management Plan (S2-FGJV-ENV-PLN-0012). The program has been developed to monitor potential impacts to groundwater during construction of the project. The program is an extension of the EIS baseline monitoring.

The objectives of the Program are to:

- identify and quantify groundwater quality and groundwater levels;
- assess compliance with relevant consent and license conditions and other monitoring requirements including prescribed targets for the Project; and
- assess and modify where required the effectiveness of water mitigation measures.

The Program provides detailed inspection criteria including:

- groundwater monitoring locations;
- parameters/analytes to be monitored;
- type of monitoring;
- frequency of monitoring, and
- monitoring methodology.

In addition, specific leachate detection procedures will be implemented for each of the spoil emplacement areas. The procedures will monitor for any potential groundwater contamination. Refer to Section 6.12.

9.2. Training

All site personnel will undergo the Future Generation site induction relating to spoil management issues, including:

- existence of this SMP;
- relevant legislation;
- roles and responsibilities for spoil management; and
- other specific responsibilities for spoil management.

Targeted training in the form of toolbox talks or pre-start briefs will also be provided to personnel with a key role in spoil management. Further details regarding the staff induction and training are outlined in Section 5 of the EMS.

9.3. Trigger Action Response Plan

Trigger Action Response Plans (TARPs) provide an efficient and effective process for the identification, investigation, rectification and reporting of non-conformities.

9.3.1. Stockpiling

Table 9-3 presents the triggers for undertaking remedial works on stockpiles to ensure adverse impacts on the surrounding environment are prevented or minimised.

Table 9-3: Triggers for undertaking remedial works

Trigger	Action
Stockpiling of spoil in incorrect location	1. Stop works on problem stockpile.
	2. Inspect stockpile and confirm incorrect material type (D&B, TBM, PAF, NOA, benign) etc.
	3. Investigate impact to verify extent of cross contamination (if any).
	4. Recover incorrectly placed material plus any material impacted by cross contamination and relocate to correct stockpile location. Ensure correct controls are applied at destination stockpile prior to placement at that location.
	5. Confirm signage and other environmental controls are correctly installed
	6. Monitor performance of controls during recommenced works to ensure controls are effective
Forecast high winds or large rain event identified in weather forecast	1. Inform project personnel of increased dust, erosion risk.
	2. Inspect stockpile erosion and sedimentation controls and ensure controls are installed as per the ESCP.
	3. Monitor stockpiles for airborne dust, erosion.
	4. Refer to steps below if airborne dust or erosion observed.
Observed airborne dust leaving site	1. Investigate and identify source.
	2. Apply water to active stockpiles, reduce heights of stockpile loading and unloading where possible. Monitor effectiveness of controls.
	3. Apply stabilisation (water, cover, polymer) to reduce fugitive dust potential on inactive stockpiles. Monitor effectiveness of controls.
	4. If control 2 above is not effective on an active stockpile, stop works on source stockpile. Appy stabilization. Only recommence works on the source stockpile once stabilization is complete.
	5. Monitor performance of controls during recommenced works to ensure controls are effective.
Observed erosion / sedimentation from stockpiles (i.e. controls inappropriately installed or controls failed)	1. Investigate and identify source.
	2. Stop works on active stockpile which is subject to erosion.
	3. Inspect stockpile erosion and sediment controls and ensure controls are installed as per the ESCP. Upgrade controls as necessary.
	4. Investigate impact to verify if any off-site impacts have occurred. Initiate TARP 2 from the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) if required by the Surface Water Management Plan.
	5. Monitor effectiveness of controls. Only recommence works on the source stockpile once erosion and sediment controls are determined to be appropriately installed.
	6. Monitor performance of controls during recommenced works to ensure controls are appropriate.

9.3.2. Surface water

TARPs have been developed for surface water and will be implemented where water quality results indicate a non-conformance with the relevant criteria in accordance with the Surface Water Management Plan. This includes such non-conformities that may have been caused by spoil excavation, handling and placement. Refer to Appendix A in the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) for further details.

9.3.3. Groundwater

TARPs have been developed for groundwater and will be implemented where groundwater trigger value banding is exceeded during a monitoring event for groundwater quantity, quality, pressures and/or levels. This includes such non-conformities that may have been caused by spoil excavation, handling and placement. Refer to Appendix A the Groundwater Management Plan (S2-FGJV-ENV-PLN-0012) for further details.

9.4. Auditing

Audits will be undertaken to assess the effectiveness of spoil management measures, compliance with this SMP, the conditions of the Infrastructure Approval, Main Works EIS, Submissions Reports and other relevant approvals, licences and guidelines.

Audit requirements are detailed in Section 8.3 of the EMS.

9.5. Reporting

Spoil specific reporting is presented in Table 9-4 and will be completed and made publicly available in accordance with schedule 3 condition 7 (f) and EPL 21266.

Table 9-4: Spoil reporting

Detail	Frequency
Volume of spoil excavated from tunnelling.	6 monthly for the duration of construction
Volume placed at each emplacement area: • Ravine Bay • GFO • Lobs Hole • Tantangara • Rock Forest. and a brief summary of progress towards final design objectives listed in Table 7-1 of this Plan.	
Volume disposed of off-site (if any).	
Volume reused elsewhere in KNP (if any).	
Volume of AMD material treated (if any).	
Volume of NOA excavated and placed in encapsulation (if any).	

APPENDIX A – CHARACTERISATION PROGRAM

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX A – SPOIL CHARACTERISATION PROGRAM

S2-FGJV-ENV-PLN-0019

JUNE 2022

This Spoil Characterisation Program has been prepared as part of the Main Works Spoil Management Plan (S2-FGJV-ENV-PLN-0019) to describe methods for assessment of AMD and NOA material.

Revision Record

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I	08.06.2022	Issue to DPE	J. Adams	E. Porter	M. Franceschi

Document Verification

RACIE Record

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Accountable:	Name: E. Porter Job Title: Environmental Manager Signed: EPorter Date: 09.06.2022
Consulted:	See distribution list on Page 3.
Informed:	See distribution list on Page 3.
Endorsed:	Name: Massimo Franceschi Job Title: Project Director Signed: Date: 09.06.2022

RACIE Terms

R	**Responsible** The person who actually produces the document.
A	**Accountable** The person who has the answer for success or failure of the quality and timeliness of the document.
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Revision Tracking

Rev.	Date	Description of Revision
A	29.05.2020	Initial draft for Snowy Hydro review
B	12.06.2020	For agency consultation
C	21.07.2020	For DPIE
D	03.12.2021	Updated with EPA comments
E	27.01.2022	Updated to address EPA comments, reflect changes made to the “Lobs Hole Operational Material Characterisation and Handling Procedure” and reflect the “Tantangara Operational Material Characterisation and Handling Procedure.”
F	11.03.2022	Updated to reflect the amended method of NOA excavation
G	14.04.2022	Updated in accordance with DPE comments
H	25.05.2022	Updated to address DPE comments.
I	09.06.2022	Updated to address DPE comments

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1. BACKGROUND

Preliminary investigations completed during the EIS provided an understanding of the geochemical characteristics of the material to be extracted during the project and their associated risks. These materials include:

- Reactive materials capable of generating Acid and Metalliferous Drainage (AMD), also known as Potentially Acid Forming materials (PAF);
- Materials containing Naturally Occurring Asbestos (NOA); and occasionally; and
- Reactive materials capable of generating Neutral and Metalliferous Drainage (NMD), Saline Drainage (SD) and Alkaline Drainage (AD).

Continuous investigations will be undertaken during construction so that tunnel sections that have not been assessed during the EIS investigations can be characterised and material extracted can be classified. The purpose of the on-going materials characterisation during construction is to continually:

- Assess the presence of existing Reactive and NOA material, and the risks posed to project workers and the environment, so that appropriate controls can be implemented and adjusted during construction;
- Chemically classify the material as Reactive and/or NOA, to confirm suitability for:
    - re−use or emplacement within the project footprint; or
    - off−site disposal to a receiving site or licensed landfill in accordance with the applicable land use criteria, *Waste Classification Guidelines* (NSW EPA, 2014) or applicable Resource Recovery Exemption and Order, where required.

Site−specific management plans and procedures have been, and are being prepared that set out the appropriate measures to be implemented to manage these materials while the construction area is in use. Procedures take the methods of extraction into account: Drill and Blast (D&B) and Tunnel Boring Machine (TBM), consider validation processes for spoil emplacement and treatment should the material be identified as PAF. All documents aim to address the conditions from the Infrastructure Approval relevant to spoil management.

2. OVERVIEW

Future Generation has developed the following material characterisation program based on the documents below:

- *Preventing Acid and Metalliferous Drainage* Leading Practice Sustainable Development Program for the Mining Industry, Department of Industry 2016 (AMD Guideline);
- *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Mate*rials (MEND, 2009);
- *AMIRA ARD test handbook* (AMIRA, 2002);
- *Global Acid and Metalliferous Drainage (GARD) Guide*, developed by the International Network for Acid Prevention (INAP, 2008);
- *Guidelines for metal leaching and acid rock drainage at mine sites in British Columbia* (Price, 1998);
- *Waste Classification Guidelines* (NSW EPA 2014);
- *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* (Western Australian Department of Health 2009);
- *Australian Standard 4964-2004*, Method for the qualitative identification of asbestos in bulk samples;
- *Guidance Note On The Membrane Filter Method For Estimating Airborne Asbestos Dust* (National Occupational Health and Safety Commission: 3003 (1988)); and
- *Australian Standard 1141,* Methods for sampling and testing aggregates. Method 3.1: Sampling – Aggregates.

The program is summarised in Table 1-1 below.

Table 2-1: Overview of the material characterisation program

Aspect	Approach
General Knowledge	Preliminary investigations have been completed and provide understanding of the geochemical characteristics of the material to be extracted along the entire length of the tunnel and the environmental risks associated. Materials of concern are: • PAF material that could generate AMD; • Other reactive materials that could generate neutral metalliferous, saline and alkaline drainage; and • NOA containing material.
Objective	Confirm EIS outcomes throughout construction by undertaking targeted investigations using a risk-based approach, and address gaps in the assessment.
Spoil (D&B and TBM)	Characterise D&B and TBM spoil from stockpile or probe chips to ensure potential AMD, NMD and SD is correctly classified. Align sampling and analysis procedures with relevant parts of the AMD guidelines. Include both rapid field testing and periodic laboratory analysis of D&B and TBM spoil in the program.
	Characterise D&B and TBM generated spoil to verify the presence of NOA. Align sampling and analysis with relevant parts of ASC NEPM and AS4964–2004.

Aspect	Approach
Stockpiles and placed material	Crosscheck that the geochemical characteristics of the emplaced D&B and TBM spoils and the material excavated during operation correlate, so that treatment needs are adjusted if required and outcomes recorded. Undertake post-excavation sampling in accordance with relevant parts of AS 1141, AMD Guidelines, ASC NEPM and AS4964–2004. Sampling frequency to be based on risk assessment.
Asbestos in air	Monitor tunnel air quality in HRT for airborne asbestos (AA). Increase AA monitoring in areas where NOA has been identified as likely or confirmed. Monitoring to occur in accordance with *Guidance Note on The Membrane Filter Method For Estimating Airborne Asbestos Dust*, NOHSC: 3003 (1988).
Waste	Classify waste material to be disposed of off-site to ensure lawful transport and disposal. Classify and test waste material in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014).

3. MATERIAL CHARACTERISATION – SAMPLING AND ANALYSIS

3.1. Location

Sampling and analysis will tighten on units and location where material of concern have been located as follows:

- NOA : Gooandra Volcanics, Boggy Plain Site and Shaw Hill Gabbro units; and
- Reactive Materials: Boraig Group, Shaw Hill Gabbro, Tantangara, Temperance, Gooandra Volcanics and Ravine Bed units.

3.2. Sampling

An example schematic of the operational material characterisation and handling strategy is provided as Attachment A of this plan.

3.2.1. Sampling Locations

On-site geochemical sampling/testing during excavation will be undertaken to provide an initial classification of the material, including Reactive/PAF/AMD and NOA determinations. Samples will be collected from:

- D&B probing holes, and stockpile material;
- TBM probing holes, excavated material from the conveyor, and fresh stockpile material; and
- Spoil Emplacement Areas including fresh and treated spoil.

3.2.2. Sampling frequency

For each composite sample from D&B or TBM material, at the rate specified below, on-site analysis detailed in Section 3.3.2 will be implemented.

Sampling frequencies adopt a risk-based approach and are derived from the standards and guidelines listed in Section 1 as follows:

- For Reactive Materials (MEND, 2009):
  - D&B: at least one composite sample per 320 m^3 of excavated material corresponding to a 3 m advance
  - TBM: at least one composite sample per 800 m^3 of excavated material corresponding to a 10 m advance
  - Emplacements: at least one composite sample daily for each emplacement where fresh material has been deposited.
- For NOA:
  - excavation front of each geological boundary, and
  - every 100 m within the same geological formation, focussing on Gooandra Volcanics, Boggy Plain Site, Temperance formation and Shaw Hill Gabbro units.

3.2.3. Excavation Sampling

3.2.3.1. Sampling of Drill and Blast material

Air-percussive probe drilling (in advance of the excavation face) is to be undertaken to assist with the geological and geotechnical assessment and includes televiewer logging.

A typical probing cycle for D&B excavations involves:

- Drilling ahead of the D&B excavation at various lengths depending on the bend radius of the tunnel;
- D&B excavation advancing up to 10 m short of the probe length to ensure an overlap of test boundaries;
- Collecting all surplus material following geological/geotechnical testing requirements and combine to create a composite.
- Suspending excavation activities (as required), and repeating probing.

Chip samples are collected from the probe hole. If sufficient material is recovered during probing, then geochemical characterisation will be undertaken at the pre-excavation stage. If insufficient material is recovered from the probe, then composite samples will be collected from the fresh stockpile material for every 3 m of D&B advance.

The sampling frequency has been set at one composite sample per 320 m^3 of material representing an approximate advance of 3 m. The sample increment size will vary depending on the size of the D&B spoil, with a minimum mass of 10 kg. For each composite sample table from on-site analysis detailed in Section 3.3.2 will be implemented.

3.2.3.2. Sampling of Tunnel Boring Machine material

- Air-percussive probe drilling is undertaken ahead of the excavation face to assist with the geological and geotechnical assessment. The probe hole is logged with a televiewer. The length of the probe is 60 m with an overlap of 15 m between subsequent probe holes.

A typical probing cycle for TBM excavations involves:

- assembling the drilling rig mounted on an erector adapter plate
- Installing horizontal drill ports for horizontal drilling through the cutter head ahead of the tunnel face. Inclined drill ports will be integrated into the shield structure to facilitate probe drilling and pre-excavation grouting around the shield. These drill ports are accessible from the erector-mounted drill.
- Drilling of inclined holes with an inclination of not more than 10°. The machine will be capable of allowing rotary drilling equipment to obtain cores through the cutter head and to develop forward ground treatment (consolidation grouting).

The quantities of chip samples collected from the probe hole are minimal and must be stored for geotechnical validation. Wherever possible, core or chip samples collected from the probe will be used to characterise the material and decide on subsequent appropriate handling, treatment, transportation, and disposal methods at the pre-excavation stage. If insufficient material can be recovered from the probe, then fresh samples will be collected from the conveyor belt. If the conveyor belt is not accessible, then material will be sampled from the fresh stockpiled material.

The sampling frequency has been set at one composite sample per 800 m^3 of material representing an advance of 10 m. The sample increment size has been set to 10 kg, in accordance with AS1141. For each composite sample table from on-site analysis detailed in Section 3.3.2 will be implemented.

3.2.4. Emplacement Area Sampling

The emplacement areas will be sampled and tested to validate that the material has been placed in the correct location and has been appropriately treated. The approach is as follows:

- Sampling of non-reactive, non-NOA emplacements the day after placement of fresh material to verify that no reactive material has been incorrectly placed in a non-reactive emplacement.

- Sampling of Mixed/Treated reactive material emplacements after treatment has occurred (currently set at 6 days after treatment).

Sampling of the material placed on the emplacements must be undertaken in accordance with Australian Standard 1141-3.1 *Methods for sampling and testing aggregates* (or equivalent). At least one composite sample will be taken daily for each emplacement where fresh material has been deposited. The sample increment size will vary depending on the size of the spoil, with a minimum mass of 10 kg in accordance with AS1141.

Composite samples will be obtained from the permanent emplacement areas at locations and at frequencies that enable confidence in the material classification. Sub-samples (those that make up the composite samples) are to be collected uniformly throughout the emplacement to account for potential variability in fresh and treated spoil characteristics. Samples should also be collected at various depths in the stockpile (not just the surface) to a maximum depth of the most recent lift so that previously compacted material is not disturbed.

Where possible it is recommended that a systematic grid sampling pattern be followed. An example of a sample pattern for stockpiles is presented in Figure 3-1.

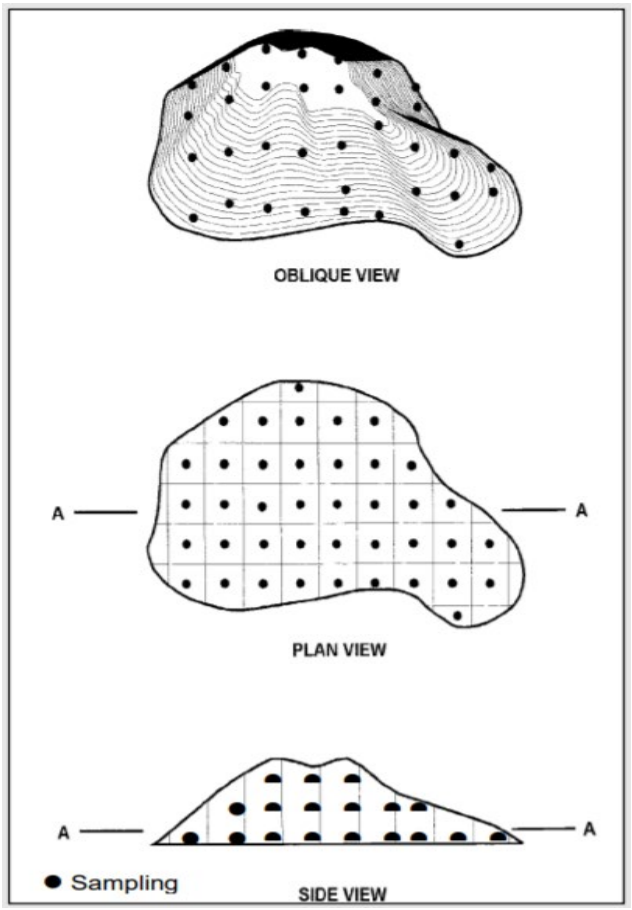


Figure 3-1: Stockpile sample pattern (RMS 2015)

Quantity movements will be informed by the Area Superintendent and the surveyors. Survey methods such as LiDAR, drones and rovers may also be used.

3.2.5. Underwater excavation and dredging

Information relating to the management of material excavated from underwater (or dredged) is provided in the Dredge Management Plan. No dredge material will be placed on the Spoil Emplacements.

3.3. Analysis Plan for Reactive Material

3.3.1. Approach

The analysis plan is divided in 2 stages:

- Stage 1: On site analyses – fast analyses that can be undertaken with the simple facilities available on site and provide appropriate information for spoil placement (see Section 3.3.2).
- Stage 2: More elaborate analyses undertaken in the NATA accredited laboratories that are used to validate the site data (see Section 3.3.3).

3.3.2. Onsite analysis

3.3.2.1. XRF - Field-based elemental composition assessments

A field X-ray fluorescence (XRF) machine has been deployed to enable a rapid first-pass estimate of the spoils' AMD potential by measuring sulfur and calcium content. The AMD-generating and AMD-neutralising capacity of common sulfide and carbonate minerals from mineralogical data collected via XRF analysis can then be calculated using the Acid Base Accounting Tool (see Section 3.3.3.1).

For every one D&B or TBM composite sample taken, the average elemental concentration will be derived from a total of 30 measurements (five cross pattern XRF measurements on 6 pieces of spoil).

3.3.2.2. NAG Suite

For each D&B or TBM composite sample taken NAG suite analysis will be conducted at the on-site laboratory (or at an offsite laboratory during on-site laboratory commissioning) and will be used as the primary method for identifying NAP and PAD materials (i.e AMD classification assessments).

For each D&B or TBM composite sample taken ANC measurements will be conducted at the on-site laboratory (or at an offsite laboratory if PAF materials as temporarily stockpiled) as the primary method for quantifying limestone addition, or NAF blending requirements to convert PAF materials to NAF materials with a minimum ANC/MPA ratio of 3.

NAG suite is measured after reaction of the sample with hydrogen peroxide to rapidly oxidise sulfide minerals present. Both acid generation and acid neutralisation occur simultaneously during the oxidation, hence the NAG suite represents a measurement of the net amount of acid that could be generated by the sample after oxidation. A sample with a NAG pH of 4.5 or less is considered to be acid forming.

Equipment to carry out NAG suite analysis will be on site no later than the second quarter of 2022. XRF testing will continue to be used as a proactive measure, to manage spoil movement.

3.3.2.3. pH and EC

Analysis of pH and EC of spoil slurry will provide an indication of NMD, saline and alkaline drainage. The pH value indicates whether the oxidation of sulfides has exhausted the neutralising capacity of the material (acid pH), and the EC value provides a measure of the amount of soluble salts (salinity) available to be leached from the material.

A 1:1, 2:1 or 5:1 liquid-to-solid slurry of the sample (typically the <2 mm size fraction sieved from a crushed sample) is made with deionised water and the pH and EC values are measured after a defined period of time. The same liquid: solid extraction ratio should be used for all samples to provide a common basis for comparisons between samples.

3.3.3. Validation by a NATA accredited laboratory

For quality control and assurance purposes, validation of material classification using a NATA accredited laboratory will be conducted on D&B and TBM spoil as well as on the emplaced material. Unless within approximately 100 m of predicted changes of lithology or in areas of high AMD potential, the frequency of external laboratory validation of classification will be reduced as the correlation of between the onsite and laboratory results strengthens.

Laboratory Acid Base Accounting (ABA) and NAG suite tests will be undertaken to confirm first pass analyses results, and additional testing will be undertaken to support these if required.

3.3.3.1. Acid Base Accounting

Acid Base Accounting (ABA) analyses suite consists of:

- pH;
- Sulfur species including sulfide (Chromium Reducible Sulfur-CRS); and
- Acid Neutralisation Capacity.

Acid Base Accounting (ABA) data interpretation provides an estimate of the balance between the potential for a material to generate acid and to neutralise acid. The outputs are the Net Acid Producing Potential (NAPP) and the Neutralisation Potential Ratio (NPR), expressed in units of kilograms of sulfuric acid per tonne (kg H_2SO_4/t). ABA calculations are summarised below:

- Maximum Potential Acidity (MPA): MPA = weight% S x 30.6;
- Acid Neutralising Capacity (ANC);
- NAPP = MPA – ANC; and
- Neutralisation Potential Ratio (NPR) : NPR = ANC/MPA.

If the MPA is less than the ANC, then the NAPP is negative, indicating that the sample may have sufficient ANC to prevent acid generation. Conversely, if the MPA exceeds the ANC, then the NAPP is positive, indicating that the material may be acid-generating. The ANC/MPA ratio provides an indication of the relative margin or factor of safety (or lack thereof) for a given material.

The relationship between ANC and sulfur/ sulfide content for the range of samples obtained by an AMD characterisation program is displayed on an acid base account plot (see Figure 3-1). The plot shows the distribution of samples between the higher and lower risk (of generating a net acidic pH) domains.

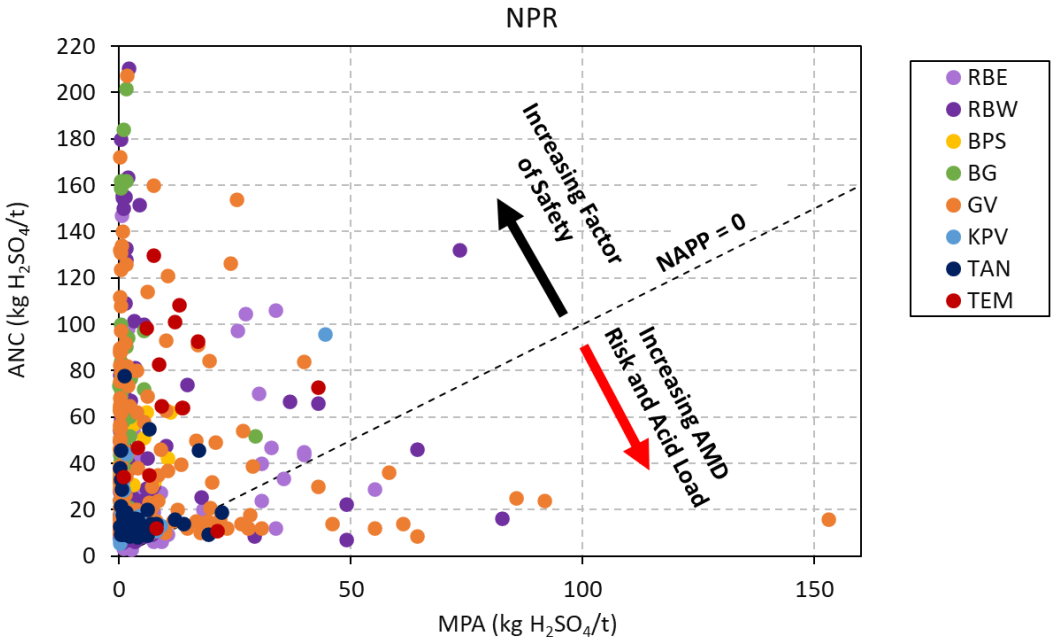


Figure 3-2: ABA plot for the samples collected to mid-January 2022

3.3.3.2. Net Acid Generation test

NAG tests include:

- NAG pH;
- NAG pH4.5; and
- NAG pH7.

The NAG suite includes NAG pH (see Section 3.3.2.2) and two additional tests which consist in back-titrating the amount of acid released to pH values of 4.5 and 7.0 and expressed in units of kg H_2SO_4/tonne. The data provides an indication of the amount of alkaline reagent required to neutralise acid material. These back-titrations will only be undertaken if the NAG pH is less than 4.5 and the material needs to be treated.

NAG pH is combined to the NAPP to confirm the Non/Potential Acid Forming characteristics of the material, with samples being classed as Non Acid Forming (NAF), PAF or Uncertain (UC) following the AMIRA (2002) classification. The outcome of the NAG tests for samples collected to date is provided in the figure below.

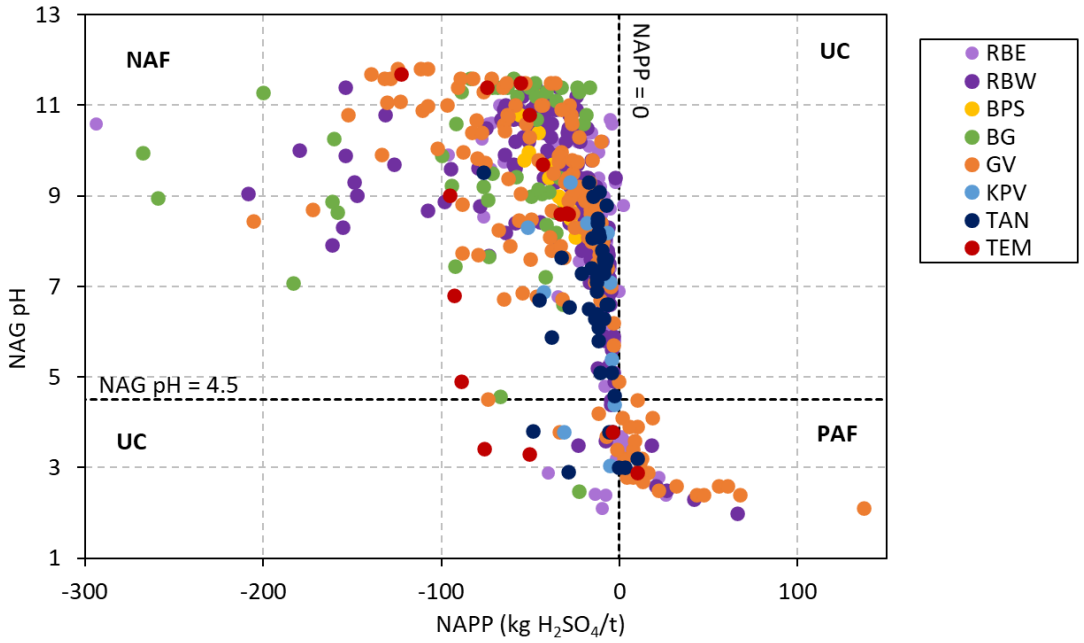


Figure 3-3: Classification (distribution) for each geological unit using the AMIRA methodology **(AMIRA 2002)**

3.3.3.3. Additional Geochemical testing

Additional testing may be required to account for environmental compliance or when material classification is uncertain (e.g., when sulfur ABA and NAG suite results are conflicting). In particular, sulfur and carbon speciation testing may be undertaken if other testing indicates the overestimation of acid-generation potential or if elevated carbon is present.

Additional testing can include:

- Sulfur speciation (if other testing indicates the overestimation of acid-generation potential);
- Carbon speciation (if elevated carbon is present);
- Water leach soluble elements; and
- Mineralogical assessment by X-ray diffraction (XRD).

3.4. Analysis Plan for NOA

Based on the Geotechnical Baseline Report and information provided by Snowy Hydro, NOA is likely to be found in the 7.5 km section of the headrace tunnel after the Tantangara zone and 7.5% of the predicted total material extracted from that area may contain NOA. This is equivalent to 62,300 m^3 of in situ rock. Including an additional 10% contingency, the total bulk volume to manage is 150,000 m^3 (considering the density difference between the rock and the spoil).

NOA assessment will be undertaken in the excavated material and in the tunnel. Air quality monitoring will be considered in parallel to the mineralogical investigations of Asbestos. Table 3-1 summarises information contained in the *Chemical, Hazardous and Fibrous Materials Management Plan* (S2-FGJV-HAS-PLN-0004) and shows how spoil assessment and air quality will be associated.

Table 3-1: Sampling and monitoring - tunnelling

NOA hazard classification	TBM spoil sampling	Air Quality*	General controls
Unlikely: '0'	Testing of spoil from TBM	Periodic air quality monitoring for tunnel to include assessment of airborne asbestos fibre concentration	Standard TMB operations
Possible and Likely: '1 & 2'	Continue with sampling as above. Frequency of testing to respond to geological conditions and observations	Daily air monitoring	Tunnel segregation, decontamination equipment and dual control TBMs on standby
Confirmed: '3'	Continue with sampling as above. Testing to confirm level of contamination	Conduct air monitoring within each zone or chamber and use personal monitors at all work fronts	Dual mode TBMs operated in enclosed mode (or open mode subject to risk assessment), segregated zones with ventilation and decontamination units

*limits for airborne contaminants for worker health and safety are provided in the Chemical, Hazardous and Fibrous Materials Management Plan (S2-FGJV-HAS-PLN-0004) and Appendix D of the Spoil Management Plan (S2-FGJV-ENV-PLAN-0019).

Asbestos analysis of spoil will be conducted in accordance with *Australian Standard Method for the Qualitative Identification of Asbestos in Bulk Samples* (AS4964–2004). Analysis will be undertaken by either:

- On site Laboratory;
- NATA accredited laboratory;
- SafeWork Australia approved laboratory; and/or
- Regulator-operated laboratory.

Asbestos identification will be undertaken by phase-contrast microscopy (PCM) or polarised-light microscopy (PLM).

Soil asbestos analysis will comply with *Australian Standard Method for the Qualitative Identification of Asbestos In Bulk Samples* (AS4964–2004) or be demonstrated to be able to achieve the equivalent level of results to this Australian Standard. AS4964–2004 provides for a tiered approach to detecting the presence of asbestos in soil samples.

Airborne asbestos monitoring will be conducted daily during excavation in 'likely' and 'confirmed' geological units; in accordance with *Guidance Note On The Membrane Filter Method For Estimating Airborne Asbestos Dust*, NOHSC: 3003 (1988). Any asbestos detected in spoil or in air should be reported as such and the corresponding material classified and managed as NOA.

3.5. Quality Assurance/Quality Control (QA/QC)

In addition to validation sampling, duplicate subsamples will be sent to an external NATA Accredited laboratory. The validation frequency may vary depending on the advancement of the excavation and the units excavated. If the excavation is not progressing then the frequency will decrease, while it may increase if the excavation is progressing at maximum efficiency and units encountered are known areas of concern.

Duplicate samples will be collected at a frequency defined by a risk approach in agreement with the documentation. The frequency of duplicate samples collected will increase for emplacement areas when known PAF or NOA zones are being excavated.

All test results/data/surveys acquired are to be uploaded on management software system as received.

4. MATERIAL CLASSIFICATION

4.1. Correlation and modelling

The information collected will be collated in a database and used for the following purposes:

- Any laboratory analysis be compared to/correlated with XRF core scans conducted by CSIRO and previous laboratory XRD, ABA, and NAG tests and management responses to mitigate identified risks associated with potentially AMD forming material.
- A graphical or statistical model will be created to enable analysis of AMD sample distribution to identify any critical information gaps and develop a block model for potentially AMD forming material in the Possible to Confirmed areas.

4.2. AMD classification

The criteria outlined in Table 4-1 below classifies the material's varying potential acid-generating and acid-neutralising capacities based on test result so that the risk profiles of those materials can be identified and managed appropriately. The criteria were developed based on the data collected during the EIS and by CSIRO and presented in Figure 4-1. The data is continuously being updated.

Table 4-1: AMD classification criteria

General AMD risk classification	Laboratory validation tests
Potentially acid forming (PAF)	NAG pH < 4.5
Non-acid forming (NAF)	NAG pH > 4.5

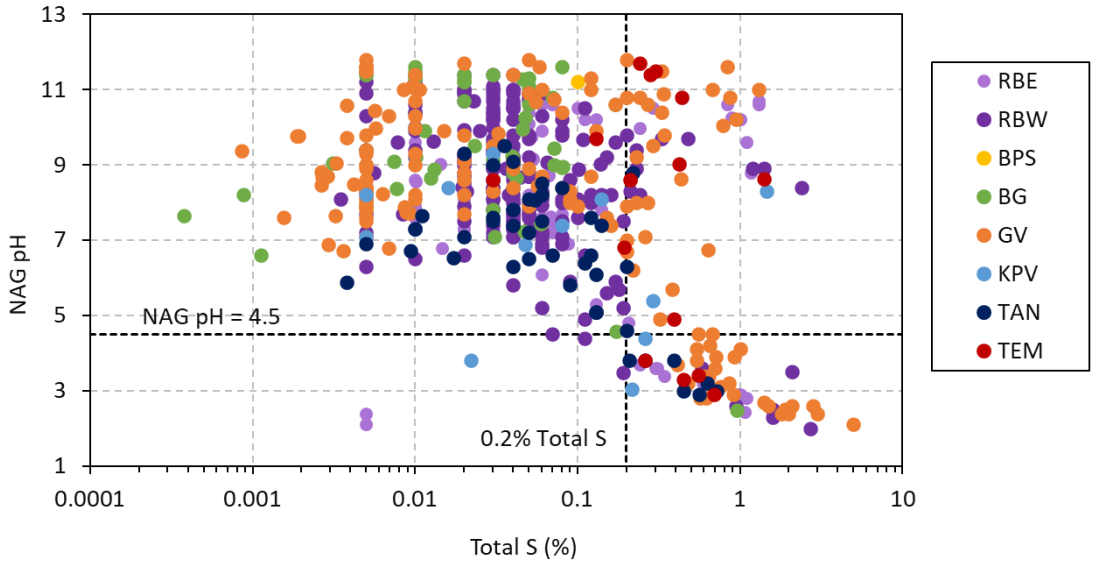


Figure 4-1: Site sulfur cut-off based on NAG pH 4.5

Other laboratory test parameters will be used to validate the selected cut-off values, and to advise appropriate blending ratios (if required).

4.3. NOA classification

Assessment of NOA presence in the spoil can only be undertaken using polarised light microscopy (PLM) at the site laboratory. It cannot be automatised. If any level of NOA is identified in the spoil, then it will be managed as NOA material.

4.4. Off-Site Disposal

Where investigations and testing demonstrate that the excavated material is not appropriate for reuse on the project, elsewhere in KNP (as requested by NPWS) or for permanent placement it will be disposed of off-site to a facility lawfully permitted to receive it.

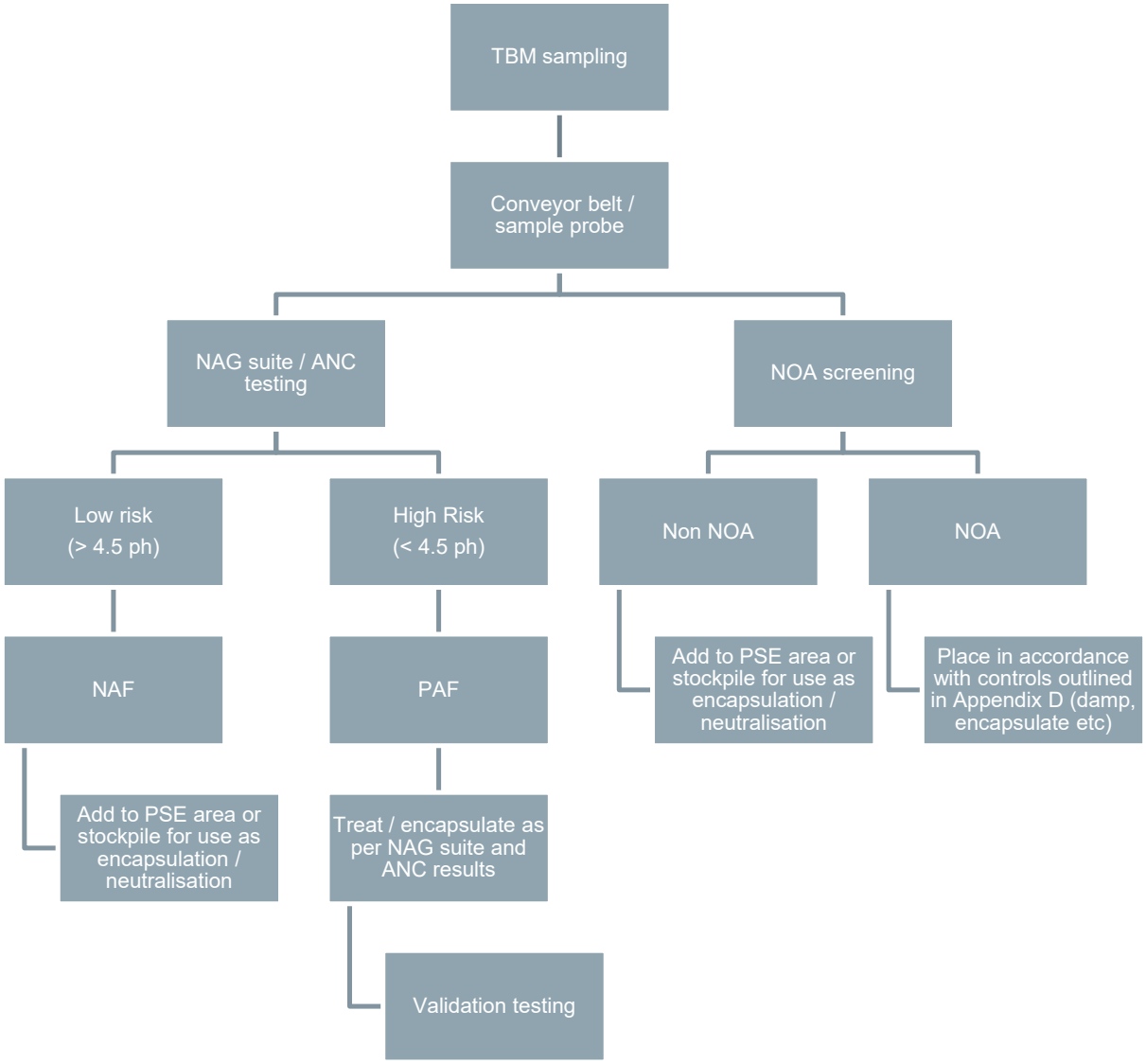
Where material is nominated for off-site disposal, the material will be tested and classified in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014). Under the guidelines waste is classified into six waste classes:

- Special waste (including NOA);
- Liquid waste;
- Hazardous waste;
- Restricted solid waste;
- General solid waste (putrescible); and
- General solid waste (non-putrescible).

Further detail is presented in the Waste Management Plan (S2FGJV-ENV-PLN-0048).

ATTACHMENT A – EXAMPLE TANTANGARA MATERIAL CHARACTERISATION AND HANDLING STRATEGY (TBM)

Material Characterisation and handling strategy – TBM / Manual



Note: NAG suite testing will be carried out on site from no later than 30 June 2022. ANC testing will be carried out on site from no later than 31 December 2022.

APPENDIX B – TOPSOIL STRATEGY

Purpose

This strategy for topsoil includes measures to be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target PCTs in the long term, along with relevant measures for topsoil stripping and maintenance.

Details on the topsoil balance for the site, including a strategy for:

- maximising the reuse of topsoil on site (provided it is suitable for reuse);
- using other suitable growth media; and
- importing additional topsoil to the site (if necessary)

are to be presented in the Rehabilitation Management Plan in accordance with Schedule 3, Condition 10 e) of the Infrastructure Approval.

Rehabilitation Principles

Key principles have been established to rehabilitate disturbed areas from impacts of the project and its potential changes to the park's character and habitats.

These include:

- preserve the KNP's natural assets and values;
- agree on future land use and consider long-term site management;
- minimise construction impacts wherever possible through planning of access areas and no-go zones;
- establish processes prior to construction works to enable organic matter to be used in revegetation and ongoing rehabilitation during the construction works Stage;
- establish appropriate treatments for minimisation of runoff into waterways;
- protect existing native fauna and their habitats including the Smoky Mouse and Booroolong Frog, critically endangered and endangered under Commonwealth legislation, respectively;
- rehabilitate disturbed areas to their pre-existing state at completion of construction activity in consultation with NPWS; and
- minimise visual impact of construction works from significant public viewpoints.

Topsoil Stripping

Topsoil will be stripped progressively and in a staged manner.

Suitable topsoil should be identified through the following steps:

- identify soil resources and stripping guidelines;
- screen or sort the topsoil to remove stumps, roots, clay lumps or stones. These components should be retained for future reuse in rehabilitation as much as possible.

The following steps are recommended during topsoil stripping:

- Environmental avoidance areas will be marked and fenced;
- Undertake preparation of the site and installation of control measures as required by the EMS and other sub-plans. In particular, erosion and sediment control measures will be installed and further planned for where progressive installation is required;

- The area to be stripped will be clearly identified to avoid over stripping and / or entering areas beyond the disturbance footprint. The target depths of topsoil and subsoil to be stripped for each location will be clearly communicated to machinery operators and supervisors;
- Subsoil stockpile locations will be identified during planning and will be stripped of topsoil before they are used for stockpiling of subsoils. Topsoil stockpile locations will not require stripping of topsoil;
- Collect vegetative matter for future use a seed source from which indigenous plants can be propagated.
- To minimise soil exposure duration, stripping will commence as soon as practicable prior to bulk earthworks;
- All plant and machinery involved in topsoil stripping will be inspected and certified to be free of weed seed and pest plant material prior to mobilisation to site as per section 5.1 of the Weed and Feral Animal Management Plan. Machinery and vehicles working in areas of known weed infestation will be washed down before moving to “clean areas”. All vehicle washdown will be recorded on a Hygiene Declaration Form (within the Biodiversity Management Plan (S2-FGJV-ENV-PLN-0008)). Records of weed hygiene inspections and washdown will be kept in the vehicle and in the project office for auditing and inspection purposes;
- Any trees present will be cleared and grubbed before topsoil salvage;
- Machinery haulage circuits will be located to minimise the compaction of the stockpiled soil;
- Topsoil and subsoil will be stripped to the required depths and then stockpiled where not immediately required in the works. Subsoil will be stripped and stockpiled separately to topsoil where identified as suitable for re-use. Depending on compaction and recovery rates, deep ripping may be required to maximise topsoil recovery. Where soils are shallower, topsoil and subsoils will be stripped and stockpiled together;
- Handling and rehandling of stripped topsoil will be minimised as far as practicable by progressively stripping vegetation and soil only as needed for development activities;
- An inventory of soils to be stripped, including depths and volumes will be developed; and
- Topsoil from contaminated areas, or areas of weeds will not be recovered for rehabilitation works. These materials will be appropriately managed on-site or if there is a potential to spread contamination then the material will be sent off-site to a disposal facility that is lawfully permitted to receive it;
- To avoid dust hazards, soil will not be stripped during particularly dry conditions. Alternatively, water trucks can be used as a control mechanism during dry conditions. Refer to the Air Quality Management Plan for further information.

Topsoil and subsoil maintenance

Topsoils will be maintained following stripping as follows:

- Topsoil will be stockpiled, signposted and separated from other materials, and tracked;
- Stripped topsoil will be stockpiled separately from woody material and subsoil stockpiles;
- Topsoil stockpile heights will not exceed 2.5 m, to minimise the risk of compaction and to maintain the viability of the soil seed bank;
- Topsoils will be stockpiled using methods and machinery that limit the amount of compaction so as to minimise soil structural decline;

- Topsoil stockpiles will be placed away from water discharge zones and flow paths; topsoil should not be stockpiled against fences or vegetation and should be retained separately from mulch (apart from a surface layer);
- Topsoil stockpiles will have control measures installed to prevent erosion, sedimentation and dust emissions. Stockpiles in place for extended period shall be suitably stabilised;
- Topsoils to be maintained for an extended period of time should have the surface left in a rough state and monitored for weed management; and
- The stockpiles should be accessible to enable weed control to be carried out. Weed management shall be implemented on a routine basis;
- Topsoil stockpiles may be subject to application of weed-free mulch, from clearing activities on the project in the locality from which the topsoil was sourced (where possible), to manage nutrient decline;
- Topsoil stockpiles to be covered with weed-free mulch, jute mesh, geofabric or similar to assist with reducing temperature extremes and reducing weeds and helps to maintain its integrity for future use.

Subsoils will be maintained following stripping as follows:

- Subsoil should be removed and stockpiled separately from topsoil;
- Areas will be compacted to an appropriate density following backfilling with subsoil;
- Excess displaced subsoil (e.g. on trenches) will be prevented from mixing with topsoil;
- Excess subsoil will be stockpiled separately for disposal/re-use by appropriate methods. This may include burial in voids, or, if tested and found suitable, as fill; and
- Inspections for dispersion and erosion of subsoil stockpiles will be undertaken, particularly on moderately dispersive soils. Suitable measures will be applied to reduce erosion potential as required.

Topsoil spreading

The following measures are designed to minimise the loss of soil during respreading on rehabilitated areas and promote successful vegetation establishment:

- A soil balance will be prepared as part of the Rehabilitation Management Plan (S2-FGJV-ENV-PLN-0023) before the topsoil is spread, which shows the depths and volume of soils to be reapplied in particular areas. The plan will take account of the relative erodibility of the soils, with more erodible material being placed on flatter areas to minimise the potential for erosion (where practicable and this does not conflict with the final land use);
- Stockpiled topsoil will be tested prior to its reuse by a NATA accredited testing laboratory to ascertain its suitability for use in revegetation works. The soil test certificate will contain the date of testing and details of the types of test undertaken and their results, including cation analysis, pH values, salt content, particle analysis and any recommendations on the use of the topsoil. If the soil test certificate indicates any stockpiled topsoil to be unsuitable for use in revegetation works, the measures recommended in the soil test certificate to improve the stockpiled topsoil will be implemented as agreed to by Snowy Hydro and NPWS.
- To assist in preventing possible dispersion of soilborne pathogens, topsoils will be used in the general area from which they were sourced where possible (e.g.: Talbingo, Marica, Tantangara and Rock Forest);

- Topsoil will be respread in even layers at a thickness appropriate for the land capability of the area to be rehabilitated and the soil resources available;
- Topsoil are not to be overly compacted and left slightly rough (light cultivation after reinstatement may be required) to provide a suitable seed bed for revegetation, which will be undertaken as soon as practicable after topsoil re-spreading. Plant and equipment for topsoil spreading will be selected and used to prevent excessive compaction;
- Where works have removed subsoil or deeper regolith, the area to be rehabilitated may need to be re-profiled and/or deep ripped, before the subsoil is respread onto the site (or all at once if not stripped and stored separately), followed by the topsoil;
- Soils will be lightly scarified on the contour to encourage rainfall infiltration and minimise run-off. Continuous slopes would be avoided where possible;
- As soon as practicable after respreading, a sterile cover crop (or other form of cover if a cover crop is unsuitable) should be established to limit erosion and soil loss. A cover crop will also provide good mulch for native plant establishment. Where vegetative cover has not been established the use of further cover may include mulching (organics or rocks), geofabrics (e.g. jute matting) or soil binding agent until suitable cover is achieved. This will be particularly important for sites with high erosion risk and where season / plant growth conditions are not optimal;
- Long term erosion and sediment controls will be implemented where deemed necessary prior to vegetation;
- In areas likely to experience frost leave, additional measures such as jute mesh, sod revegetation or similar to be used to minimise the risk of erosion;
- Where required, collection of indigenous/native seed and sods for propagation will be undertaken. Where sods were collected prior to construction they are to be used immediately following reinstatement; and
- Rehabilitation Management Plan (S2-FGJV-ENV-PLN-0023) will guide the long-term rehabilitation of the site including establishment of native plant species.

APPENDIX C – STOCKPILING PROCEDURE

A Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) has been prepared and details measures for managing surface water impacts arising from construction works. The measures have been developed in accordance with the following guidelines (the Blue Book series):

- Managing Urban Stormwater, Volume 1 (Landcom 2004);
- Managing Urban Stormwater, Volume 2A Installation of Services (DECC 2007); and
- Managing Urban Stormwater, Volume 2C Unsealed roads (DECC 2008).

Site specific Erosion and Sediment Control Plans (ESCPs) will be developed and maintained during construction to give effect to the measures from the Blue Book. The following techniques will be applied to stockpiles to minimise degradation to topsoils and subsoils and potential impacts on the surrounding environment:

Stockpiling

- The location of stockpiles will be planned in advance of topsoil stripping and bulk earthwork. Stockpile locations will be selected such that they are:
    - away from areas of retained vegetation and outside of the tree protection zone;
    - not exposed to concentrated flows;
    - at least 50m from rivers and creeks;
    - located above the 20% AEP flood event where possible to avoid flood flows;
    - where practicable located on slopes less than 10%. If required to be placed on slopes greater than 10% additional erosion and sediment controls shall be implemented;
    - located outside weed infested areas; and
    - positioned such that erosion of the stockpile and surrounding area is minimised;
- Clean water diversions will be installed upslope of stockpiles and sediment controls installed downslope;
- Stripped topsoil will be stockpiled separately from woody material, subsoil stockpiles and weed infested areas/stockpiles;
- Where possible, topsoil stockpile heights will not exceed 2.5 m, to minimise the risk of compaction and to maintain the viability of the soil seed bank;
- Topsoil and subsoil will be stockpiled using methods and machinery that limit the amount of compaction so as to avoid structural decline.
- If stockpiles are to be maintained for an extended period of time they will be stabilised to minimise the risk of erosion and to help reduce the risk or weed growth;
- Stockpiles will be monitored for weed growth and treated as required in accordance with the weed and feral animal management plan;
- Topsoil stockpiles will be clearly signposted to distinguish them from other materials and tracked to avoid mixing or contamination;
- Where required, lime will be deep ripped into stockpiles to ameliorate soil acidity and elevated exchangeable aluminium. This will also help stabilise any dispersive soils by providing calcium to soil exchange sites; and

- monitoring for erosion of topsoil stockpiles will be undertaken in accordance with Section 9.1.2 of the SMP. Appropriate ameliorants and/or erosion and sediment controls implemented to minimise the risk of soil degradation or offsite impacts; these include:
  - stabilisation (sealing, geofabric or polymer)
  - managing stockpile heights and angle of slopes
  - clean water diversion and dirty water capture.
- Specific leachate detection procedures will be implemented for each of the spoil emplacement areas. The procedures will monitor for any potential surface water contamination. Refer to Section 6.12 of the SMP.

APPENDIX D – NATURALLY OCCURRING ASBESTOS MANAGEMENT PLAN

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX D – NATURALLY OCCURRING ASBESTOS MANAGEMENT PLAN

S2-FGJV-ENV-PLN-0019

MARCH 2022

This Naturally Occurring Asbestos Management Plan (NOAMP) has been prepared as part of the Main Works Spoil Management Plan (S2-FGJV-ENV-PLN-0019) and sets out measures to appropriately handle and place NOA material.

Revision Record

E	09.03.2022	Updated to reflect amended method of NOA extraction	V. Levy	E. Porter	M. Franceschi
Rev.	**Date**	**Reason for Issue**	**Responsible**	**Accountable**	**Endorsed**

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C onsulted:	See distribution list on Page 3.
I nformed:	See distribution list on Page 3.
E ndorsed:	Name: Massimo Franceschi Job Title: Project Director Signed:  Date: 22/03/2022

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NOTE:

***(1) OHC** – Original Hard Copy / **EC**–Electronic Copy / **HC** – Hard Copy / **Aconex** –Electronic Document Management System*

Revision Tracking

Rev.	Date	Description of Revision
A	29.05.2020	Initial draft for Snowy Hydro review
B	12.06.2020	For agency consultation
C	21.07.2020	For DPIE
D	27.01.2022	Updated to reflect EPA consultation and changes to other appendices
E	09.03.2022	Updated to reflect amended method of NOA extraction

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1. INTRODUCTION

Naturally Occurring Asbestos (NOA) is the natural geological occurrence of asbestos (asbestiform) minerals found in association with geological deposits including rock, sediment or soil. The Environmental Impact Statement (EIS) reported that there is potential for NOA within the Main Works project area. Predominantly of tremolite-actinolite and actinolite fibres, within geological units proposed to be intersected by tunnelling activities and ground disturbance works. Specifically, NOA has been reported in the Gooandra Volcanics, Boggy Plain Site and Shaw Hill Gabbro units.

The following activities are proposed to encounter NOA:

- Two section of the headrace tunnel (approximate 7.5 km section in total); and
- Surface excavation works, including road upgrades and construction areas at Plateau and Marica.

The location of NOA is presented graphically in Figure 1-1 below.

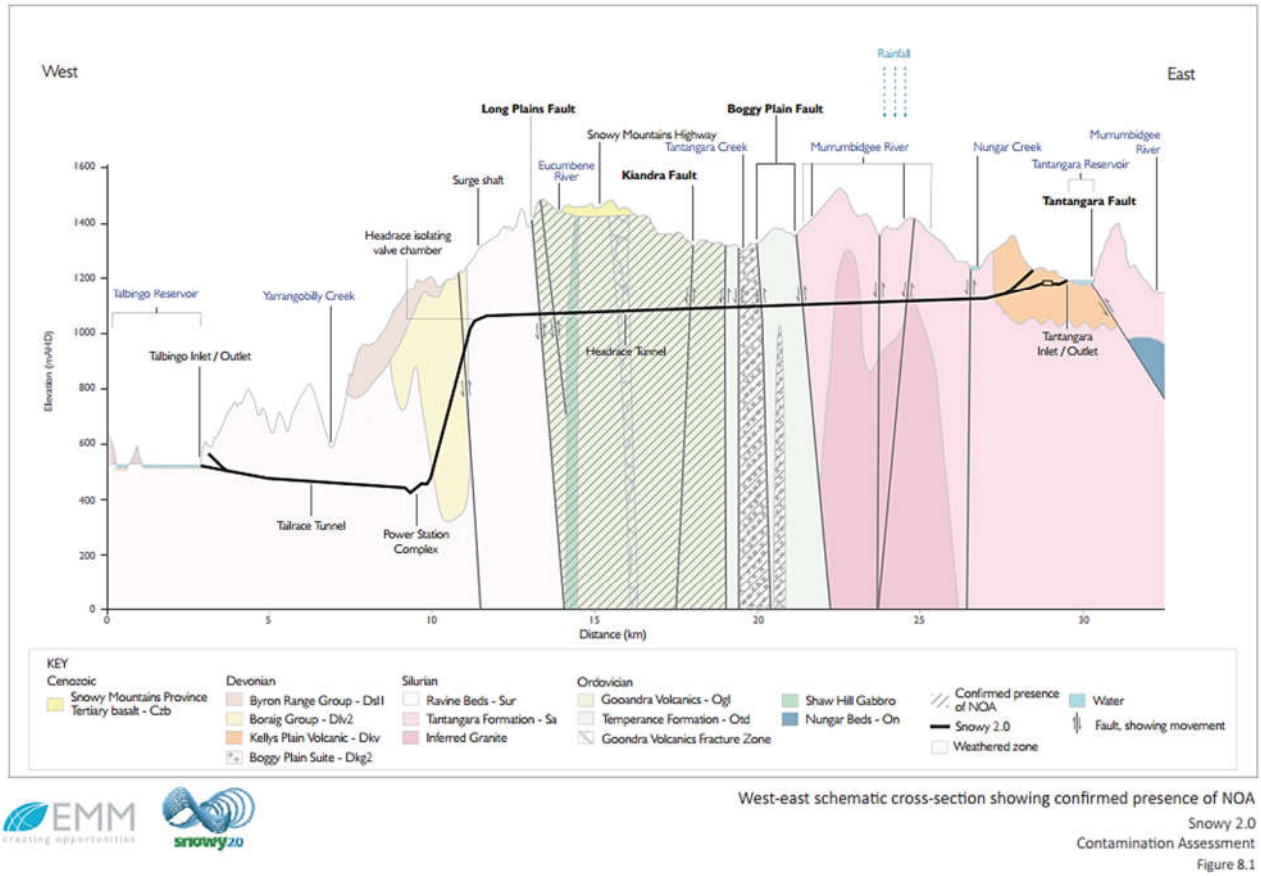


Figure 1-1: SMEC west-east cross section showing confirmed presence of NOA

Based on the Geotechnical Baseline Report, NOA is likely to be found in a length of 7.5 km in the headrace tunnel and will be encountered by the Tunnel Boring Machine (TBM) operating from the Tantangara zone.

The total volume of material to dispose coming from this length would be approximately 845,000 m^3 in situ. Further information provided by Snowy Hydro indicates that 7.5% of the predicted total to be NOA, which is equivalent to 62,300 m^3 of in situ rock. Including an additional 10% contingency, the total capacity to manage is 150,000 m^3 bulked.

After careful consideration on the options to manage NOA (off-site disposal, subaqueous placement, on-land placement), on-land placement at Tantangara peninsula emplacement area

was determined to be the option that provides the least risk and impact on people and the environment.

This Naturally Occurring Asbestos Management Plan (NOAMP) has been prepared as part of the Main Works Spoil Management Plan (S2-FGJV-ENV-PLN-0019) and should be read in conjunction with that document and its other appendices. The NOAMP sets out the measures to be undertaken to appropriately handle and place NOA material, along with contingency measures to be implemented if the volumes of spoil are greater than expected and unsuitable for placement on the project.

2. REGULATORY ENVIRONMENT

2.1. Legislation

Legislation relevant to NOA management includes:

- *Environmental Planning and Assessment Act 1979* (EP&A Act);
- *Environmental Planning and Assessment Regulation 2000 (EP&A Regulation);*
- *Work Health and Safety Act 2011 (WHS Act);*
- *Work Health and Safety Regulations 2017 (WHS Regulation);*
- *Contaminated Land Management Act 1997 (CLM Act);*
- *Protection of the Environment Operations Act 1997 (POEO Act);*
- *Protection of the Environment Operations (Waste) Regulation 2018.*

2.2. Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- *Code of Practice: How to manage and control of asbestos in workplaces* (SafeWork NSW, 2019)
- *Code of Practice: How to safely remove asbestos* (SafeWork NSW, 2019)
- *Australian Standard 1319 Safety Signs for the Occupational Environment;*
- *Australian Standard AS 4260 High Efficiency Particulate Air (HEPA) Filters –Classification, Construction and Performance;*
- *Australian Standard AS 1716 Respiratory Protective Devices;*
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011a);
- *Contaminated Sites: Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (EPA, 2015a);
- *National Environment Protection (Assessment of Site Contamination) Measure 1999, 2013 amendment* (the site contamination NEPM);
- *Managing Land Contamination Planning Guidelines SEPP 55 – Remediation of Land* (Department of Urban Affairs and Planning and EPA, 1998);
- *Management of fibrous minerals in Western Australian mining operations* (Government of Western Australia Department of Mines and Petroleum Resources Safety, 2015);
- *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (NSW EPA, 2015);
- *Sampling Design Guidelines* (NSW EPA, 1995);

- *Guideline on Investigation Levels for Soil and Groundwater - Schedule B(1)* (NEPC, 2013);
- *Guideline on Site Characterisation Schedule B(2)* NEPC (2013); and
- *Guidelines for the NSW Site Auditor Scheme 3rd Edition* (NSW EPA, 2017).

Other reference documents:

- *Snowy 2.0 Environmental Impact Statement Appendix N, Contamination Assessment, (*EMM September, 2019).

3. ASBESTOS ASPECTS AND IMPACTS

Asbestos is a carcinogen and the inhalation of asbestos fibres is known to cause mesothelioma, lung cancer and asbestosis.

Malignant mesothelioma is a cancer of the outer covering of the lung (the pleura) or the abdominal cavity (the peritoneum). It is usually fatal.

Mesothelioma is caused by the inhalation of needle-like asbestos fibres deep into the lungs where they can damage mesothelial cells, potentially resulting in cancer. The latency period is generally between 35 and 40 years, but it may be longer, and the disease is very difficult to detect prior to the onset of illness.

Lung cancer has been shown to be caused by all types of asbestos. The average latency period of the disease, from the first exposure to asbestos, ranges from 20 to 30 years. Lung cancer symptoms are rarely felt until the disease has developed to an advanced stage.

Asbestosis is a form of lung disease (pneumoconiosis) directly caused by inhaling asbestos fibres, causing a scarring (fibrosis) of the lung tissue, which decreases the ability of the lungs to transfer oxygen to the blood. The latency period of asbestosis is generally between 15 and 25 years.

Asbestos poses a risk to health by inhalation whenever asbestos fibres become airborne and people are exposed to these fibres.

Accordingly, exposure should be prevented. The National Exposure Standard (NES) of 0.1 fibres/mL should never be exceeded, and control measures are to be reassessed whenever air monitoring indicates the ‘control level’ of 0.01 fibres/mL has been reached. Code of Practice: How to safely remove asbestos (2016) provides additional information on control levels.

4. NOA CHARACTERISATION

NOA will be characterised in accordance with the Material Characterisation Program in Appendix A of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019).

5. NOA MANAGEMENT

The excavation of the Head Race Tunnel (HRT) is being undertaken via TBM from the Tantangara portal. All encountered NOA will be extracted at this point, then transported to the Tantangara emplacement area where it will be encapsulated.

5.1. Excavation

Upon receiving results that indicate that the TBM is operating within a zone where NOA has been identified, the system will switch to a mode that limits the escape of asbestos fibres from the damp material. The extraction line of the air exchange system will be directed to an emission control system (ECS) at the Tantangara portal containment shed (discussed further below), whereby it will be treated through a High Efficiency Particle Arrester (HEPA) filtration system prior to discharge to air.

The Tantangara portal will be enclosed within a containment shed to enable material handling to occur without harm to the environment, and to manage the work environment so that worker safety is maintained. Material excavated via TBM will be transported to within the containment shed via enclosed conveyors. The containment shed will comprise a number of work zones:

- Zone 1: TBM collector belt;
- Zone 2: Material treatment tanks and transfer belt area;
- Zone 3: Excavated material storage area; and
- Zone 4: Filter press.

An indicative layout is presented in Figure 5-1.

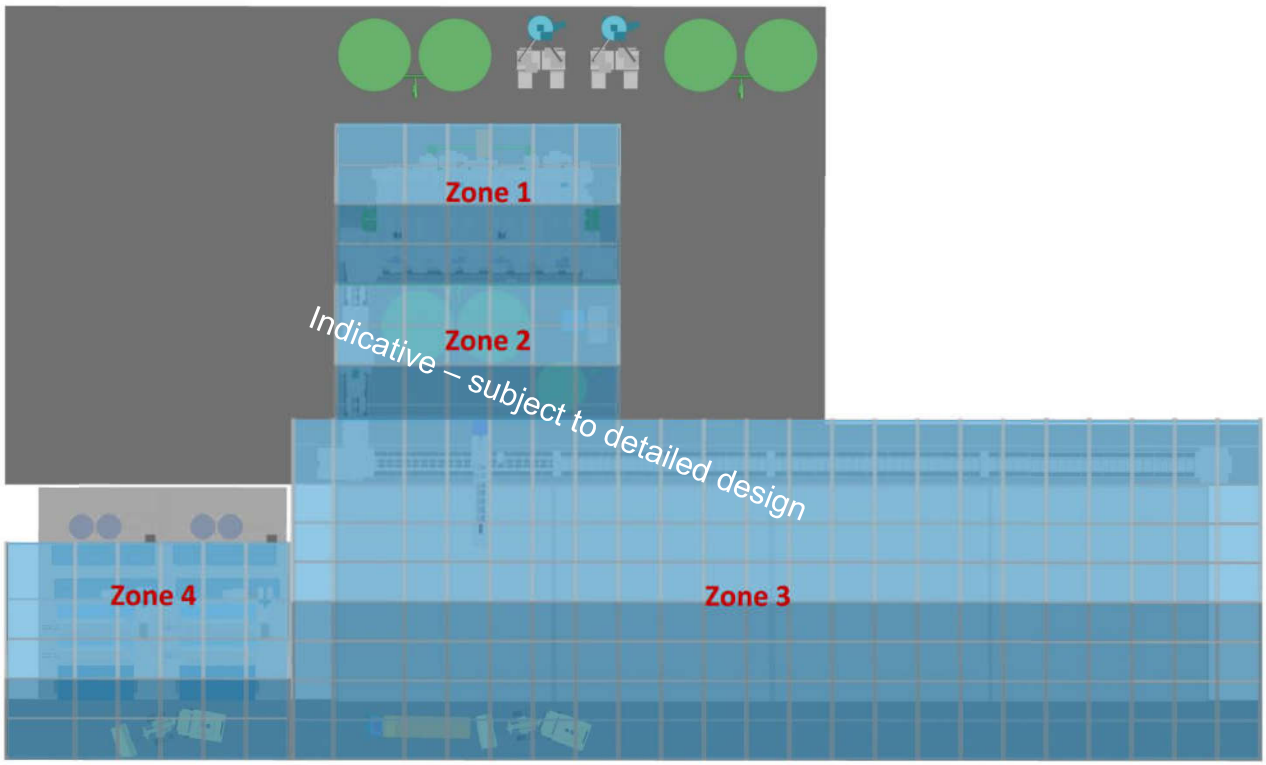


Figure 5-1: Tantangara containment shed layout (indicative)

The material circuit and material treatment plants are designed as closed-circuit systems to allow NOA material to be contained, and not release fibres to the entire shed.

The containment shed will be fitted with an ECS that maintains the atmospheric pressure within the shed (other than in the access and egress air locks) below that outside (i.e.: maintained under negative pressure). The negative pressure state will be continuously monitored and controlled via a Supervisory Control and Data Acquisition (SCADA) system (or similar) within a control room. Where required the ECS extraction rate can be adjusted to ensure negative pressure is maintained. The containment shed air supply intakes will shut-off automatically in the event negative pressure is lost.

Air will be extracted via HEPA filter beds before being discharged to atmosphere. Again, the treatment train will be monitored and able to be controlled via the SCADA system within the control room. The principle of air supply, extraction and treatment is presented graphically in Figure 5-2.

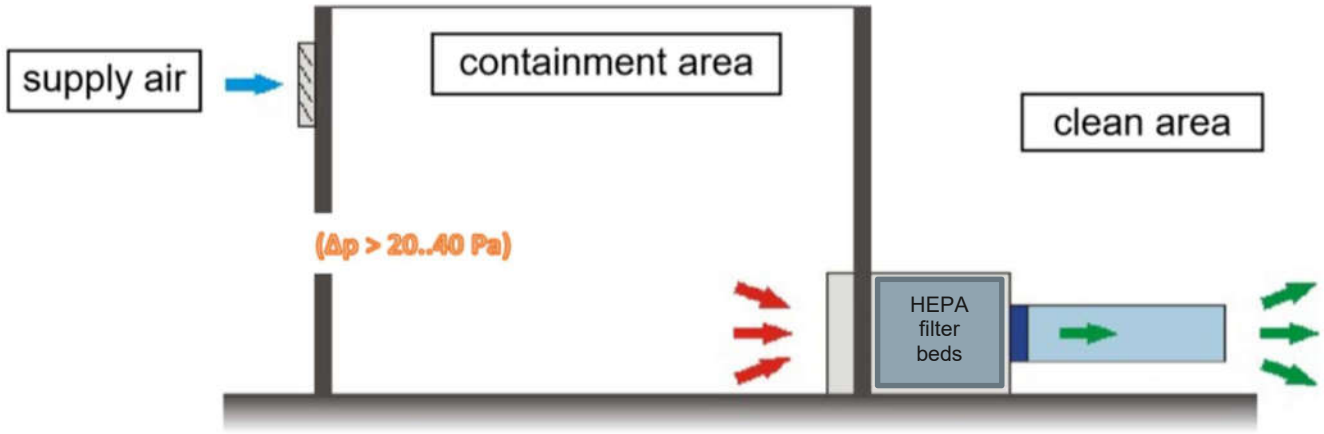


Figure 5-2: Tantangara containment shed principle of air supply, extraction and treatment.

Access and egress for both plant and personnel will be under controlled air locks to prevent the loss of atmosphere within the building to the external environment.

5.2. Loading and transport

To minimise the generation of airborne asbestos fibres and loss of containment of materials, trucks will be loaded inside the containment shed. The large fraction material (sufficiently wetted) will be placed directly into the truck bucket by excavator or front-end loader. The truck bucket will be covered with a mechanical sheet to prevent loss of containment during transport.

The fine fraction excavated material will be placed directly inside the open top roll-on, roll-off (RORO) containers that, once filled, will be covered and transported to the washing tunnel. The RORO containers, once washed, will then be loaded onto the back of a truck and to prevent loss of containment during transport. The rear tailgate will be sealed to prevent leaks of residual liquids.

All plant and equipment (including trucks) exiting the containment shed will be decontaminated (washed down) within the Zone 5 and 6 air locks prior to exiting the containment shed to ensure that no residual material remains on the plant and equipment. All personnel exiting the containment shed will also go through a decontamination process prior to exiting.

Trucks, once loaded with NOA and decontaminated within the containment shed, will drive directly to the Tantangara peninsula emplacement area via the approved transport routes defined in the project Vehicle Management Plan.

5.3. Emplacement

NOA will be placed at the Tantangara emplacement area. Visual schematics of the NOA cell construction are presented in Figure 5-3. The location on site for the containment cell was selected in consultation with the EPA accredited Contaminated Site Auditor based on a number of factors including:

- minimal transportation of the NOA is required, avoiding further contamination;
- the location avoids future disturbance as it will be contained beneath a 3-metre layer of VEMN within the national park;
- the location is positioned at a suitable depth below the new landform level to ensure the material will remain covered; and
- the location presents a negligible risk to human health or the environment.

The Tantangara peninsula emplacement area has sufficient capacity to receive all material generated from the Tantangara portal including NOA material (refer Section 6 of the SMP). In the

unlikely event more NOA is encountered than that currently predicted the encapsulation cells will be able to be sized accordingly. If required the NOA material could be disposed of off-site in accordance with the Waste Management Plan (S2-FGJV-ENV-PLN-0048), however this is not the preferred option. If material is required to be disposed of off-site, benign material would be prioritised over NOA.

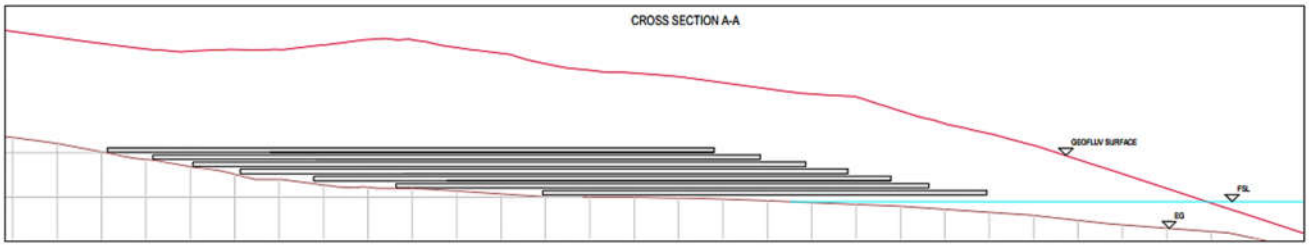


Figure 5-3: NOA encapsulation at Tantangara peninsula emplacement area

The process of encapsulation would be consistent with standard practice of asbestos containing materials throughout NSW, which prevents unplanned disturbance and eliminates future risk. A summary of the process is as follows:

- The base layers of the Tantangara peninsula emplacement area would be installed. The base layers comprise D&B and TBM material, with D&B material placed below FSL and TBM material placed above FSL.
- In cell formations, NOA would be placed on top of an inert foundation layer comprising TBM spoil material. The NOA would be treated and / or covered to prevent fugitive emissions of dust and asbestos fibres during the works and between shifts. This may include application of water, polymer, 0.1 m VENM cap or covers.
- During NOA placement works, the following methods are being used to minimise the generation of airborne particulates:
    - dampening the surface of the site with a water cart;
    - protecting the exposed surface of the NOA disposal area by covering with VENM and/or wetting down the surface with water sprays or soil binder spray;
    - reviewing and communicating weather forecasts including predicted wind direction and speed;
    - stopping work in strong winds; and
    - employing controls to prevent the spread of loose material around the site.
- A highly visible marker layer would be overlayed on the NOA cells so that it can be positively identified in the future.
- A 3 m thick capping layer comprising a mixture of D&B and TBM material would be overlayed on top of the marker layer. The capping layer would be geomorphically shaped so that the final landform minimises its potential for erosion, and integrates into the existing topography around the landform thus minimising impacts to park users in the long term
- Soft soil and topsoil would sit in top of the geomorphic surface and would be rehabilitated in accordance with the Rehabilitation Management Plan (S2-FGJV-ENV-PLN-0023).

Where material characterisation indicates that spoil is both NOA and Potentially Acid Forming (PAF) and as a result requires treatment (see SMP Appendix A and Appendix E), the emplacement area will be kept damp using water carts and sprinkler systems and works will adhere to other safe work practices.

Where material validation indicates that spoil is both NOA and PAF and has been incorrectly placed and is required to be moved, the emplacement area will be kept damp using water carts and sprinkler systems and works will adhere to other safe work practices.

6. HEALTH SAFETY AND ENVIRONMENTAL CONTROL

A range of environmental requirements and control measures are identified in the Main Works EIS, Submissions Report and the Infrastructure Approval. Safeguards and management measures will be implemented to avoid, minimise or manage impacts from asbestos.

Management measures are also specified within the *Code of Practice: How to manage and control of asbestos in workplaces* (SafeWork NSW, 2019) and *Code of Practice: How to safely remove asbestos* (SafeWork NSW, 2019).

The management measures specified in this Plan set out how to manage NOA on the Project in accordance with Future Generation's obligations. Asbestos management is also addressed within:

- S2-FGJV-HSA-PLN-0004 – Chemical, Hazardous and Fibrous Materials Management Plan – provides the overall framework to manage requirements and risk associated with hazardous materials (including ACM) worker health and safety, handling and disposal
- S2-FGJV-ENV-PLN-0049 – Main Works Contaminated Land Management Plan – includes details on further soil investigations and an Unexpected Finds Procedure
- S2-FGJV-HSA-PLN-0010 – Main Works Asbestos Management Plan – includes details on the testing, handling, placement and control of non-naturally occurring Asbestos Containing Materials (ACM).

6.1. Hazardous materials register

Future Generation will establish and maintain a Hazardous Materials Register that includes NOA, recording the specific location, condition and exposure risk of each asbestos area. The accuracy and currency of the Register will be confirmed and updated regularly by conducting site inspections of each asbestos area, or areas where asbestos removal or damage has occurred.

The Register is to be located on site.

The register is to provide the following information on asbestos identified or presumed in the workplace, as well as items confirmed as asbestos-free:

- Description of the building/structure/zone;
- Date of assessment and name of assessor;
- Register data input date;
- Location of NOA;
- Data source;
- Potential risk to occupants (low, medium or high);
- Modifications to items;
- Responsible officer for modifications;
- Date of modification;
- Asbestos free items needed to be identified separately and the actual fibre type, determined through analysis, needs to be stipulated.

The Register will be made available to all employees upon request and made clear by the competent person/team leader/supervisor to any personnel or contractor, prior to their commencing NOA work. The competent person/supervisor must advise workers of the Register and the presence of NOA.

A simple, qualitative risk assessment is completed for each identified item. Each asbestos item identified is given a health risk rating (low, medium, or high), based on the location, asbestos form

and type, and its present condition at the time of the site assessment. The annual asbestos inspection report will be completed by performing a visual assessment. The assessment and report is to be performed by a competent person experienced in identifying asbestos. Those areas not able to be accessed during the course of the site assessment are also to be documented.

6.2. Risk assessment and Job Hazard Analysis

Hazard identification and risk management of tasks involving the work around, handling or removal of NOA will be carried out in accordance with Future Generation's JHA process and procedures. Work environment constraints should be considered in the JHA process as working with chemicals at height or within confined spaces poses additional risks.

The risk assessment process involves identifying, analysing, evaluating, controlling and monitoring sources of asbestos within the perimeter of the works. The presence of asbestos within a work zone is considered a hazard, but the level of risk associated with the hazard is related to the presence of airborne fibres.

6.3. Safe Work Method Statements

SWMS will be prepared for all high-risk construction tasks associated with the Project (including working with NOA) and risk assessed in accordance with the HSMP and WHS laws using the HAZID methodology and details in the HSE Risk Management Procedure.

Upon request, Future Generation will provide the Employer with a copy of any SWMS that are prepared in connection with the performance of the Works, along with evidence that the SWMS have either been prepared or approved by the Contractor.

6.4. Safe work practices

6.4.1. Control of airborne particulates and fibres

The measures to control airborne particulates and fibres described in Section 5 shall be implemented during the excavation, handling and placement of NOA.

6.4.2. Personal protective equipment

The PPE requirements for work involving NOA are to be based on the relevant risk assessment conducted by a suitably qualified person. Section 9.7 and Appendix B of the Code of Practice: How to safely remove asbestos (2019) must be consulted to determine the PPE needs, as well as AS/NZS 1715 and AS/NZS 1716 for specific respiratory protection requirements.

Protective clothing and equipment is to be worn at all times during work in the asbestos work area, prior to the final clearance inspection. Any PPE worn during asbestos disposal is to be treated as asbestos waste and disposed of in the approved waste bags. The laundering of contaminated protective clothing in workers' homes is strictly prohibited. See below a list of site PPE requirements specifically for the removal of asbestos. Other PPE may be required depending on the site-specific PPE requirements e.g. Hard hat.

Coveralls

Disposable coveralls that will be used on site will be disposable coveralls rated to type 5 and:

- One size too big to allow to body movements
- Fitted with a hood and cuffs:
    - If cuffs are loose, they are sealed with tape
    - Coverall legs are worn over footwear and not tucked in
    - The fitted hood is worn over the respirator straps.

Gloves

Gloves are to be disposable; they are not to be reused. Personnel should clean their hands and fingernails thoroughly whenever leaving the asbestos removal work area.

Safety glasses

Safety eye ware is to comply with the Australian Standard AS 1337. These items can be cleaned under running water for reuse.

Footwear

All safety footwear is to comply with the Australian Standard. Safety footwear is to be decontaminated at the end of shift.

Respiratory protective equipment

Disposal RPE are to be worn at all times are to comply with Australian Standard AS 1716 (P2 minimum rated).

6.4.3. Tools and equipment

Tools and equipment to be used for asbestos removal work are required to generate a minimum amount of airborne fibres during use.

At the end of the removal work all tools are to be either:

- Decontaminated (i.e. fully dismantled and cleaned under controlled conditions);
- Placed in a sealed container and used only for asbestos removal work; or
- Disposed of as asbestos waste.

6.4.4. Vehicle cabin air-conditioning systems

Conventional vehicle air-conditioning systems draw air from outside the vehicle through a coarse filter (unsuitable for removing respirable asbestos fibres). To minimise the risk of asbestos fibres being entrained into the vehicle cabins, all equipment (bulldozers, loaders, excavators, dump trucks, light vehicles etc.) used in NOA designated areas would have sealed cabins fitted with a positive pressure filtered ventilation system. Cabin ventilation systems should incorporate the following features:

- monitoring and adjustment of pressure to maintain positive cabin pressure with respect to the ambient environment;
- sufficient system capacity to ensure positive cabin pressure under various conditions;
- fully sealed leakproof system;
- fresh air supplied to the cabin through a multistage filtration system with:
    - two-stage prefilter to preserve the HEPA filter;
    - high efficiency particulate air (HEPA) filter (efficiency 99.997%) to remove sub-micron particulate matter; and
    - in-built air-conditioning system to ensure comfortable cabin temperature.
- The operators require suitable training and instruction to ensure that vehicle windows are not opened under any circumstances (except emergencies) while in designated areas. This includes the route between the dewatering plant and the landfill area for dump trucks transporting NOA contaminated spoil.

6.4.5. Vehicle cabin periodical cleaning

The cabins should be thoroughly cleaned on a regular basis to ensure they remain free from contamination. Cleaning should be conducted using HEPA vacuum cleaner and damp wiping techniques. Cabin floors should be fitted with sheet vinyl (not carpet) coverings to facilitate cleaning.

Operators should only enter / exit the equipment / machinery cabins in clean areas to minimise the ingress of contamination (from shoes) into the cabin environment.

Maintenance works conducted on vehicles and equipment must take into consideration the potential for asbestos contamination.

6.4.6. Asbestos material labelling and signage

A labelling system must be maintained on site to enable the visual and legible identification of all asbestos materials recorded on the site Asbestos Materials Register.

The labels used must comply with AS 1319 Safety Signs for the Occupational Environment, and a competent person is to determine their required location. The labels are to be affixed in a secure manner and checked annually to ensure they are not damaged, missing, obscured or faded.

Warning signs should be placed at the main entrance to the work areas where asbestos is present. This will ensure that asbestos is not unknowingly disturbed without the correct precautions being taken.

Signs are to be displayed at the entry to the site and at site reception areas stating there is an asbestos building and plant materials and product register and when and where a person may inspect the register and the contact details for the HSSE Manager.

All waste products will be packaged and labelled as asbestos at the point of removal. Materials or products that are not labelled, but could potentially contain asbestos, are to be treated as asbestos until tested and confirmed otherwise.

Figure 6-1: Asbestos labels and signage examples

6.4.7. Air monitoring

Air monitoring will be undertaken within and outside NOA work areas for the duration of NOA works.

The air monitoring is to be performed in accordance with the NOHSC Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres [(NOHSC: 3003 (2005)].

'Control levels' are airborne asbestos fibre concentrations, which, if exceeded, indicate there is a need to review current control measures or take other action. These control levels are occupational hygiene 'best practice' and are not health- based standards (they are below the concentration set in the NES for asbestos). The control levels shown in the table below are to be used for the purposes of determining the effectiveness of control measures adopted.

Table 6-1: NOA air monitoring control actions

Control Level (airborne asbestos fibres/mL)	Control / Action for areas inside NOA work zones	Control / Action for areas outside NOA work zones
<0.01	• Continue with control measures	• Continue with control measures
≥ 0.01	• Implement asbestos control measures and continue operations. • Increase monitoring frequency subject to risk assessment	• Review control measures
≥ 0.02	• Implement asbestos control measures and continue operations. • Increase monitoring frequency subject to risk assessment	• Stop removal work and find cause

Monitoring must be undertaken, and work outside the NOA work zones need to stop and controls re-assessed for if the asbestos fibre concentration exceeds 0.01 fibres/mL. Work outside the NOA work zone must stop if the asbestos fibre concentration in atmosphere exceeds 0.02 fibres/mL.

The results of all air monitoring are to be provided to all relevant parties as soon as possible.

6.4.8. Clearance Certificate

Clearance to re-occupy a NOA work area without controls in place is determined by a thorough clearance inspection conducted by an Asbestos Assessor. All of the exclusion zones and warning signs are to remain in place until the clearance certificate to re-occupy has been granted.

6.5. Unexpected finds of NOA

It is possible that previously unidentified NOA will be encountered during the project.

If unexpected/potential asbestos is discovered the Unexpected Asbestos Finds Protocol (Appendix A) will be implemented.

7. CONTINGENCY MEASURES FOR EXCESS MATERIAL

In the unlikely event more NOA is encountered than that currently predicted:

- the encapsulation cells will be able to be sized accordingly;
- if material is required to be disposed of off-site to cater for increased encapsulation cell sizing, benign material would be prioritised over NOA;
- if required the NOA material could be disposed of off-site in accordance with the Waste Management Plan (S2-FGJV-ENV-PLN-0048), however this is not the preferred option.

7.1. Offsite waste disposal

NOA is considered friable asbestos. Asbestos waste is pre classified as ‘special waste’ in the NSW EPA’s Waste Classification Guidelines 2014. If Asbestos is mixed with other waste it must be assessed and disposed of in accordance with the Guidelines for both the asbestos and the other materials with which it is mixed.

Tracking of waste to ensure legal tipping at a licenced facility is one way that Future Generation ensures compliance with its obligations under the POEO (Waste) Regulation 2014. Waste tracking documentation must be completed with appropriate copies being retained. The EPA’s WasteLocate tool is required to be utilised for the transport of asbestos waste from the site to its disposal destination.

Transport and final disposal of asbestos waste material will be carried out by a competent person who carries certification as a transporter of hazardous materials in asbestos waste and in a manner that will prevent the liberation of asbestos dust to the atmosphere.

All asbestos waste material will be buried at an approved landfill site and in a manner approved by the local and state authorities. Prior to payment of invoices, Future Generation must receive copies of waste disposal receipts, as provided by the approved landfills.

All waste disposals will be recorded (date, quantity, disposal contract etc.) in an appropriate register (e.g. within the sites waste management plans for disposal of regulated wastes).

7.2. Notification to SafeWork NSW

Future Generation, as part of it its responsibilities to the workforce, will ensure that a Notice of Intent to remove non-friable asbestos has been lodged with to SafeWork NSW - Asbestos Notifications Branch and acceptance of the notification is received.

7.3. Licensing

NOA is considered friable asbestos. Only Class A licenced asbestos removal contractors will remove friable asbestos.

Where a licenced asbestos removalist is engaged with Future Generation, the following information must be provided to Future Generation by the removalist and copies maintained on-site:

- Asbestos removal licences for workers performing the removal works as per the WHS Regulations (Reg 459);
- Future Generation site specific SWMS;
- Evidence of notification to the relevant authority (SafeWork);
- A site-specific asbestos removal control plan for friable asbestos developed by the asbestos removalist provided to the Asbestos Assessor before work commences.

In addition to the above, the following requirements apply:

- Air monitoring must be performed by an Asbestos Assessor who is independent of the removalist;
- At the completion of the removal works a field clearance certificate must be provided by the Asbestos Assessor, independent of the removalist, prior to the start-up of work on site and follow it up with a formal written clearance report, to relevant Future Generation personnel;
- Evidence of use of the EPA WasteLocate tool must be provided by the removalist following the completion of the works to prove that any asbestos removed from the site/s has gone to a facility which is licenced to accept asbestos waste.

8. COMPLIANCE MANAGEMENT

8.1. Training

All site personnel will undergo site induction relating to asbestos management issues including:

- existence and requirements of this NOAMP;
- relevant legislation;
- roles and responsibilities for asbestos management; and
- other specific responsibilities for asbestos mitigation and management measures.

Targeted training in the form of toolbox talks or specific training will also be provided to personnel with a key role in asbestos management. Further details regarding the staff induction and training are outlined in Section 5 of the EMS.

8.2. Inspections

Weekly environmental inspections of the project will occur in accordance with Section 8 of the EMS.

8.3. Review and Auditing

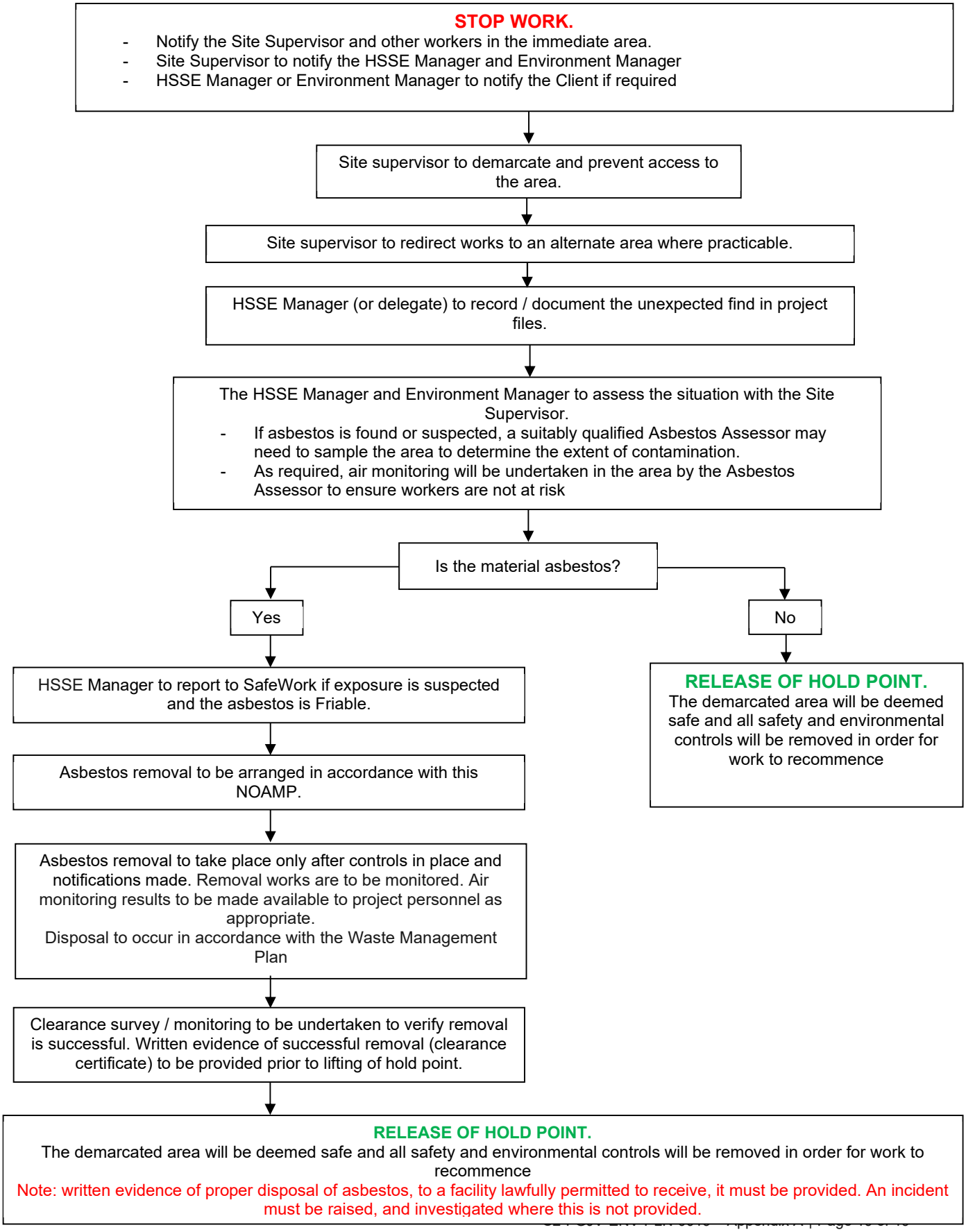
Audits will be undertaken to assess the effectiveness of asbestos management measures, compliance with this NOAMP, the conditions of the Infrastructure Approval, Main Works EIS, Submissions Reports and other relevant approvals, licences and guidelines.

Audit requirements are detailed in Section 8 of the EMS.

8.4. Reporting

Reporting requirements and responsibilities are documented in Section 8 of the EMS.

APPENDIX A – UNEXPECTED FINDS PROTOCOL



APPENDIX E – ACID AND METALLIFEROUS DRAINAGE MANAGEMENT PLAN

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX E – ACID AND METALLIFEROUS DRAINAGE MANAGEMENT PLAN

S2-FGJV-ENV-PLN-0019

JUNE 2022

Revision Record

G	09.06.2022	Issue to DPE	J. Adams	E. Porter	M. Franceschi
Rev.	**Date**	**Reason for Issue**	**Responsible**	**Accountable**	**Endorsed**

Document Verification

RACIE Record

R esponsible:	Name: Jessica Adams Job Title: Environmental Approvals Coordinator Signed:  Date: 09.06.2022
A ccountable:	Name: E. Porter Job Title: Environmental Manager Signed: EPorter Date: 09.06.2022
C onsulted:	See distribution list on Page 3.
I nformed:	See distribution list on Page 3.
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Revision Tracking

Rev.	Date	Description of Revision
A	29.05.2020	Initial draft for Snowy Hydro review
B	12.06.2020	For agency consultation
C	15.07.2020	Revised to address agency comments.
D	21.07.2020	For DPIE.
E	27.01.2022	Incorporating updates made on App A
F	25.05.2022	Addressing DPE comments
G	09.06.2022	Addressing DPE comments

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1. INTRODUCTION

Acid and Metalliferous Drainage (AMD) has traditionally been referred to as 'acid mine drainage' or 'acid rock drainage' (ARD) and refers to potential for rock to be potentially acid forming (PAF) through exposure of sulfide minerals, most commonly iron sulfide (pyrite FeS_2) with oxygen and water. This reaction generates acidic water which reacts with the minerals in the surrounding rock material creating a metal rich discharge. Whether rock is PAF or non-acid forming (NAF) and/or acid consuming (AC) is determined from the acid-base account. The potential for acid metalliferous drainage is dependent on the total sulfur content and the neutralising capacity of the material.

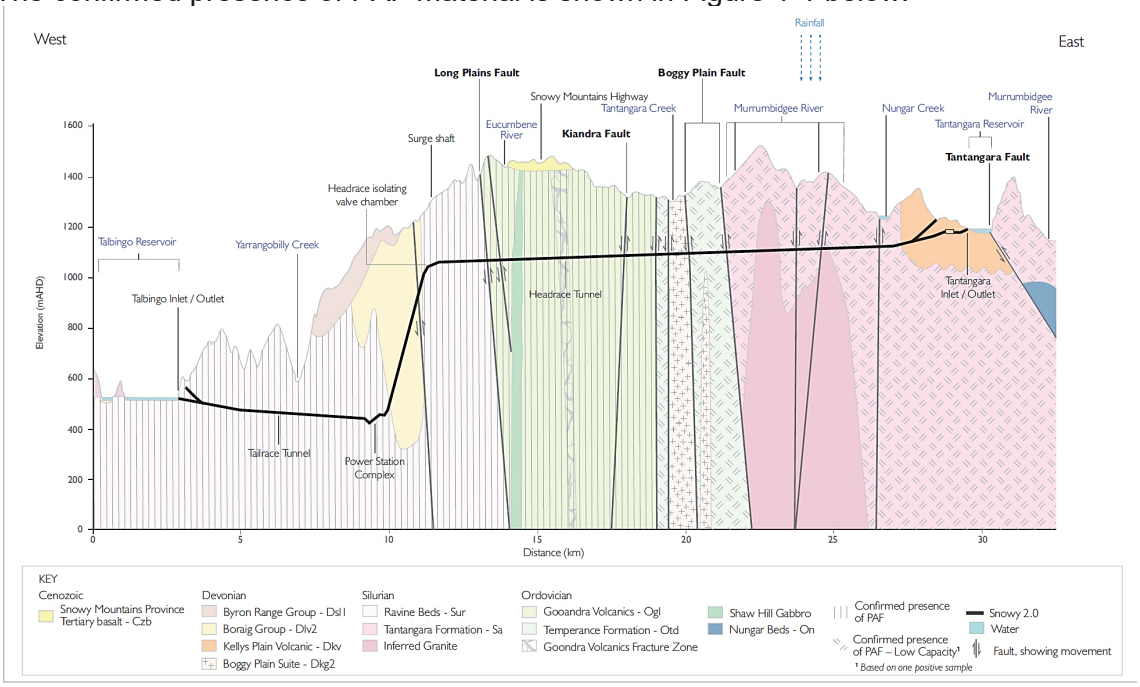
The Contamination Assessment within the EIS identified a potential to intersect PAF material during blasting or tunnel boring. Along the tunnel alignment it was determined that AMD materials were highly variable due to the tendency of pyrite to occur in veins and seams. For the EIS, materials were classed into five categories:

- Potential Acid Forming: PAF;
- Potential Acid Forming – Low Capacity: PAF-LC;
- Non Acid Forming;
- Uncertain: UC; and
- Acid Consuming: AC.

This classification cannot be used in operation due to the analyses' turnaround time, and these categories have been reduced to two: PAF and NAF, which can be achieved in real time for spoil management.

PAF material was confirmed within the Tantangara (one sample was PAF-LC), Temperance (one sample was PAF-LC), Gooandra Volcanics and Ravine Beds formations.

The confirmed presence of PAF material is shown in Figure 1-1 below.



West-east schematic cross-section showing confirmed presence of PAF

Snowy 2.0
Contamination Assessment
Figure 8.2

Figure 1-1: West-East cross section showing confirmed presence of PAF material

This Acid and Metalliferous Drainage Management Plan (AMDMP) has been prepared as part of the Main Works Spoil Management Plan (S2-FGJV-ENV-PLN-0019) and should be read in conjunction with that document and its appendices. The AMDMP sets out the measures to be undertaken to appropriately handle and place AMD material, along with contingency measures to be implemented if the volumes of spoil are greater than expected and unsuitable for placement on the project.

2. REGULATORY ENVIRONMENT

2.1. Legislation

Legislation relevant to acid metalliferous drainage management includes:

- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Environmental Planning and Assessment Regulation 2000 (EP&A Regulation);
- Protection of the Environment Operations (General) Regulation 2009 (POEO General Regulation);
- Protection of the Environment Operations (Waste) Regulation 2014 (POEO Waste Regulation);
- Waste Avoidance and Resource Recovery Act 2001 (WARR Act); and
- Contaminated Land Management Act 1997 (CLM Act).

2.2. Guidelines

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

- Preventing Acid and Metalliferous Drainage Leading Practice Sustainable Development Program for the Mining Industry, Department of Industry 2016 (AMD Guideline).
- Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (MEND, 2009)
- AMIRA ARD test handbook (AMIRA, 2002)
- Global Acid and Metalliferous Drainage (GARD) Guide, developed by the International Network for Acid Prevention (INAP, 2008)
- Guidelines for metal leaching and acid rock drainage at mine sites in British Columbia (Price, 1998).
- Acid Sulfate Soils Assessment Guidelines (Ahern et al. 1998);
- Acid Sulfate Soils Manual (Stone et al 1998);
- Waste Classification Guidelines Part 1: Classifying waste (NSW EPA 2014).

3. AMD MATERIAL CHARACTERISATION

AMD material will be characterised in accordance with the Material Characterisation Program in Appendix A of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019).

The criteria outlined in Table 3-1 below classifies the materials varying acid-generating capacities, acid-neutralising capacities potential based on test result so that the risk profiles of those materials can be identified and managed appropriately. The criteria were developed based on the data collected during the EIS and by CSIRO and are presented in Appendix A of the Spoil Management Plan. The data is continuously being updated and used to inform on site procedures.

Table 3-1: AMD classification criteria

General AMD risk classification	Laboratory validation tests
Potentially acid forming (PAF)	NAG pH < 4.5
Non-acid forming (NAF)	NAG pH > 4.5

Table 3-2 presents the likely AMD classification along the alignment of key infrastructure on the Project. Consistent with earlier investigations, this will be further confirmed during the implementation of the ongoing characterisation program.

Table 3-2: Overview of AMD likelihood as derived from Snowy Hydro Geotechnical Baseline Report

Structure	EIS AMD likelihood	Spoil classification	From Chainage	To Chainage	Total length
HRT01-01	Unknown		100	1855	1755
HRT02	Unknown		911	0	907
HRT01-02	Unknown		100	1400	1300
	NAF	NAF	1400	4450	3050
	PAF-LC	PAF	4450	7550	3100
	NAF	NAF	7550	9495	1945
	NAF to PAF-LC	NAF to PAF	9495	10550	1055
	UC to PAF-LC	PAF	10550	11950	1400
	NAF to PAF	NAF to PAF	11950	14050	2100
	NAF	NAF	14050	16550	2500
	NAF to PAF	NAF to PAF	16550	17528	978
	Unknown		17528	18581	1158
	NAF to PAF	NAF to PAF	18581	18800	219
ECVT01	NAF	NAF	18800	21752	2952
ECVT02	NAF	NAF	19200	19300	105
MAT01	NAF	NAF	19100	21800	2546
TRT01	NAF	NAF	19400	25000	6227
TRT02	NAF	NAF	24600	25200	624
TRT03	NAF	NAF	25160	25500	400

4. PAF MATERIAL MANAGEMENT

4.1. Overview

The strategies for managing PAF material are in order of preference:

- Implement air and water entry control measures such as compaction, associated with strategic waste placement to minimise oxidation;
- Implement treatment (either naturally or via application of an agent) to facilitate neutralisation and to allow water re-use or discharge; and
- Implement surface water controls to reduce contaminant loads escaping to the environment.

4.2. Placement

Further to characterisation and validation (Appendix A), PAF and/or NOA material will be encapsulated by being placed in the central parts of the landforms, away from the final surface edges. The key objectives being:

- Achieving and maintaining an overall risk reduction approach by assigning PAF into the lower risk areas of the final landform;
- Reducing the potential need to rehandle material; and
- Providing a dedicated area in which to apply neutralising reagents (if required).

An example for the initial indication of the 3D location and size of the centre of the landform is presented in Figure 4-1. Compacted NAF (and non-NOA) material will be placed at the bottom and surface of the landform.

To ensure adequate compaction of PAF material, minimising air and water entry, PAF material will be placed from the base up in thin lifts within each PSE, and covered with NAF material. Site specific rates of compaction and other PSE specific controls will be developed in consultation with relevant government agencies.

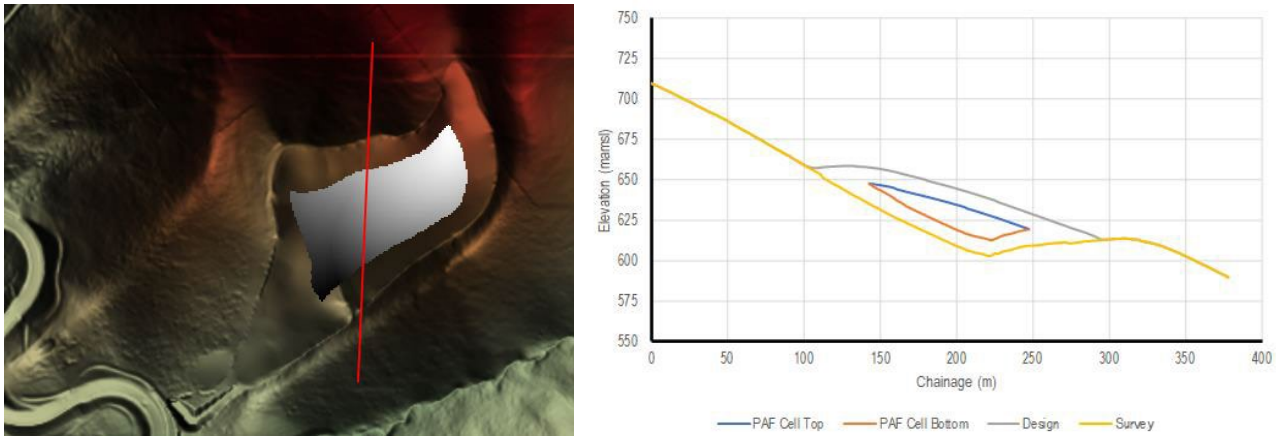


Figure 4-1: Example of PAF material placement at GF01

Reactive spoil will not be placed in the Exploratory Works western emplacement area (at Lobs Hole). Only non-reactive spoil, which has a low geochemical risk and is suitable for reuse, is permitted to be placed in the western emplacement area.

4.3. Emplacement Area Validation Testing and Subsequent Management

The freshly emplaced material will be sampled and tested to validate the material has been placed in the correct location and/or if further action is required. Results from emplacement testing will contribute to the decision-making process regarding the need to mix or neutralise the deposited material, generally within the emplacement area.

- If validation testing confirms NOA (and NAF) material is within the defined central area, then the subsequent excavated material can be placed on top of the previously placed material in accordance with the Naturally Occurring Asbestos Management Plan (SMP Appendix D);
- If validation testing confirms that PAF material is within the defined central area, then the need for the material to be mixed with subsequent layers, neutralised or taken off-site will be informed by the Acid Base Accounting results and the Neutralisation Potential Ratio (NPR). Material with low NPR (≤3) will be managed as follows (to be applied in hierarchical order):
    - Reduce risk by subsequent placement of a NAF layer of known ANC;

- Neutralise the PAF layer with external high ANC material (e.g., Aglime); or
- Relocate material, potentially off-site.

Where pre-emplacement material characterisation indicates that spoil is both NOA and PAF and treatment is required, the emplacement area will be kept damp using water carts and sprinkler systems and works will adhere to all asbestos safe work practices.

- If emplacement testing advises that PAF material has been placed incorrectly (i.e., in a high-risk area) then the following strategies should be applied in a hierarchical order:
  - Reduce risk by mixing (e.g., deep ripping) with the layers below the PAF material;
  - Neutralise with external high ANC material (e.g., limestone); or
  - Relocate material, potentially off-site.

Where pre-emplacement material validation indicates that spoil is both NOA and PAF and has been incorrectly placed and is required to be mixed, neutralised or moved, the emplacement area will be kept damp using water carts and sprinkler systems and works will adhere to all asbestos safe work practices.

All PAF material must undergo post-treatment testing to validate that the material has been effectively neutralised and no longer poses risk of leaching low pH seepage or metals. Neutralisation will be undertaken, sampled and monitored in accordance with industry standards including but not limited to *Acid Sulphate Soils Manual* (ASSMAC, 1998). AMD risk from PAF material located in the central area of the landform will be further reduced by compacting the emplaced material.

4.4. In-situ Emplacement Treatment Area Controls

The controls that will be applied to each PSE treatment area are listed below. Site specific controls including the compaction rates, water quality and erosion and sediment control will be developed with the NSW EPA to ensure effective management.

- A 50 m clearance with named watercourses will be in place at all times. The overall footprint will be minimised where possible;
- Runoff from upstream areas will be diverted around or through the emplacement treatment areas to limit or reduce ingress and leaching. The diversion works will have a 1% AEP capacity. The upstream dams will be designed as a detention basin and will not permanently hold water;
- A larger high-flow diversion drain will be established to convey runoff from upstream areas around the treatment areas in a controlled manner, avoiding uncontrolled overflows. This larger diversion drain will only be engaged if a flood greater than a 1% AEP event occurs;
- High ANC material will be sourced from other excavations on site or will be imported. The imported ANC material (potentially hydrated lime, or finely divided Aglime (calcium carbonate) will be brought to site on an as needs basis, to limit the total quantity stored on-site at any one time. High ANC material will be stored in a secure manner to prevent contamination of the surrounding environment (e.g. within sealed bulker bags or containers). The specific locations will be progressively updated and displayed on the Sensitive Area Maps (SAPs). Stockpile controls will be applied to ensure that no environmental harm occurs as a result of storage (refer Appendix C of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019));
- A barrier system will be installed under the stockpiles to prevent seepage from entering underlying soils and groundwater;
- To ensure adequate compaction of PAF material, minimising air and water entry, PAF material will be placed from the base up in thin lifts within each PSE, where feasible. Sites specific rates

of compaction and other PSE specific controls will be developed in consultation with relevant government agencies.

- Water seepage from the PSE treatment area e.g. during rainfall will be minimised by compaction of materials. Potential seepage and runoff will be collected in a sediment basin downstream of the treatment emplacement area. Collected water will either be irrigated to the treatment (to promote evaporation) or, where possible, treated in the process water treatment plant. The sizing of the basins is subject to final design and are dependent on disturbed ground extent and the utilisation of other erosion and sediment controls but will be compliant with the Managing Urban Stormwater series (the Blue Book). The measures and controls from the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011), monitoring in accordance with the project EPL, and if required, in accordance with Appendix A, Annexure A of the Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107-F), Trigger Action Response Plans will also be implemented throughout construction.
- Material from dredging, channel excavation or underwater blasting will not be placed in the Exploratory Works eastern and western emplacement areas, or in any areas designated for PAF treatment; and
- All personnel involved with the handling, transportation and disposal of high ANC material will wear appropriate personal protective equipment (PPE) to prevent skin contact. This includes, as a minimum, chemical safety goggles, face shields, chemical resistant gloves and overalls.

The efficacy of the measures outlined above will be subject to ongoing verification through inspections and monitoring, as set out in Section 9 of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019.

4.5. Interim Ex-situ Treatment Areas

Before emplacement areas are prepared and approved to receive material for placement, PAF material may require treatment in designated areas.

If testing demonstrates that material is PAF, Future Generation will use designated interim treatment areas for PAF material to be treated separate from the non-PAF material. PAF material will be thoroughly blended with ANC material to create a neutral spoil mass. The volume of ANC material in each layer will be determined stoichiometrically so that the maximum potential acidity from the overlying layer of spoil and sediment is treated. This approach will neutralise AMD within the material.

Interim treatment areas will implement controls including, but not limited to:

- underlying barrier systems; and
- diversion drains and other sediment and erosion controls.

4.6. Contingency measures for excess material

As set out in Section 6 of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019, each emplacement area has surplus capacity for spoil (including PAF material) to be held on site. In the unlikely event that more PAF is encountered than predicted this would require additional treatment and would only impact on production rather than reuse or emplacement. Additionally, PAF material could be disposed of off-site in accordance with the Waste Management Plan (S2-FGJV-ENV-PLN-0048), however this is not the preferred option.

5. COMPLIANCE MANAGEMENT

5.1. Training

All site personnel will undergo site induction relating to AMD management issues including:

- existence and requirements of this AMDMP;
- relevant legislation;
- roles and responsibilities for AMD management; and
- other specific responsibilities for mitigation and management measures.

Targeted training in the form of toolbox talks or specific training will also be provided to personnel with a key role in AMD management. Further details regarding the staff induction and training are outlined in Section 5 of the EMS.

5.2. Inspections and monitoring

Inspections of the project will occur in accordance with Section 9 of the SMP and Section 8 of the EMS and a comprehensive surface water inspection and monitoring program will be implemented, in accordance with the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011), Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107-F), and the Environment Protection Licence.

5.3. Consultation and Revision

In accordance with the Main Works Approval, this Plan, and the governing Spoil Management Plan (SMP) must be prepared in consultation with the NPWS, EPA, Water Group, NRAR, NSW DPI, and TfNSW, prior to approval by the Department of Planning Industry and Environment (DPIE).

At 6-month internals and as required, this Plan will be reviewed, and relevant agencies consulted on progress and upcoming milestones for design and implementation including but not limited to design changes, internal procedures, placement methodologies and spoil characterisation procedures.

In addition, site specific controls including water quality and erosion and sediment control will be developed with the NSW EPA to ensure effective site management.

5.4. Review and Auditing

Audits will be undertaken to assess the effectiveness of AMD management measures, compliance with this AMDMP, the conditions of the Infrastructure Approval, Main Works EIS, Submissions Reports and other relevant approvals, licences and guidelines.

Audit requirements are detailed in Section 8 of the EMS.

5.5. Reporting

Reporting will include monthly internal project reports. Reporting requirements and responsibilities are documented in Section 9.5 of the SMP and Section 8.4 of the EMS.

APPENDIX F – LOBS HOLE MAIN YARD EMPLACEMENT AREA

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX F – LOBS HOLE MAIN YARD

Approval Record			
Document preparation, review and approval		Name in print	Signature
Prepared by	Environmental consultant	D. Low	
Reviewed by	Environmental consultant	R. Walker-Edwards	
Verified by	Environmental Manager	L. Coetzee	
Approved by	Project Director	A. Betti	

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Rev.	Date	Description of modifications / revisions
A	29.05.2020	Initial draft for Snowy Hydro review
B	12.06.2020	For agency consultation
C	15.07.2020	Revised to address agency comments.
D	21.07.2020	Revised to address NPWS comments from meeting. For DPIE

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1. INTRODUCTION

Schedule 3, condition 7 of the Infrastructure Approval requires detailed plans for each of the permanent spoil emplacement areas to be prepared using both analogue and erosional-based methods. The plans must

- describe how the development of each emplacement area would be co-ordinated with the rehabilitation of the site in accordance with the approved Rehabilitation Management Plan;
- describe the measures that would be implemented to comply with the spoil management requirements in condition 4 and the design objectives in condition 6 (Table 2) of the Infrastructure Approval;
- include a topsoil strategy outlining measures the measures that would be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target PCTs in the long term, having regard to the approved strategy in the Rehabilitation Management Plan;
- identify the key risks for the successful completion of each emplacement area and the contingency measures that would be implemented to address these risks; and

Whilst the Lobs Hole Main Yard is within a designated permanent spoil emplacement area, it is the primary base for construction for the western portion of the project. For this reason, this plan has been prepared to address the requirements of condition 7 where relevant to establishing the Main Yard as a construction area (refer to Table 3-1). Design of the Lobs Hole permanent emplacement area (final design) will be developed during construction so as to comply with Design Objectives in schedule 3 condition 6 of the Infrastructure Approval. This plan will be updated for approval prior to commencing final placement works over the Main Yard construction footprint.

2. DEVELOPMENT

The Lobs Hole Main Yard will broadly be developed as follows (dates are indicative only and are provided to describe sequencing):

- April 2020 to October 2020:
  - Commence Main Works in accordance with the baseline program.
  - Any spoil derived from the Exploratory Works (prior to Main Works construction) is directed to the Exploratory Works Western and Eastern emplacement areas only, refer to the Exploratory Works EMMP for detail.
  - From April to October 2020 the spoil is predominantly generated by road works and portal excavation (i.e.: surface works). Surplus material will be directed to the Lobs Hole Main Yard to build the main construction pads.
  - During this period the volume of TBM generated material is negligible.
  - Excavation from Talbingo adit commences and this material is reused as base and sub-base at the Main Yard.
- October 2020 to 2021:
  - The material generated from TBM increases rapidly during this period. This material, together with the rest of spoil generated from roadworks, is directed to the Main Yard as a priority to keep building the construction pads until required capacity is achieved.

- December 2021 to 2023:
  - Extra volumes of spoil generated will be held in the Main Yard temporarily as required before being directed to permanent placement areas (Ravine Bay and GF01) and in permanent infrastructure as required.
- 2023 to 2026:
  - Demobilisation of assets and temporary infrastructure no longer required for the works commences in 2023 and continues to end of construction program in 2026.
  - Permanent placement of spoil at Lobs Hole will be minimised. This will be achieved by directing surplus spoil to Ravine Bay or GF01 emplacement areas, or to elsewhere in the KNP for beneficial reuse (subject to request and approval by NPWS).
  - Construction of permanent placement formation and progressive rehabilitation commences in 2023 (subject to approval of the update to this plan) and continues to end of construction program.

The scheduling of placement is presented graphically in Figure 2-1 .

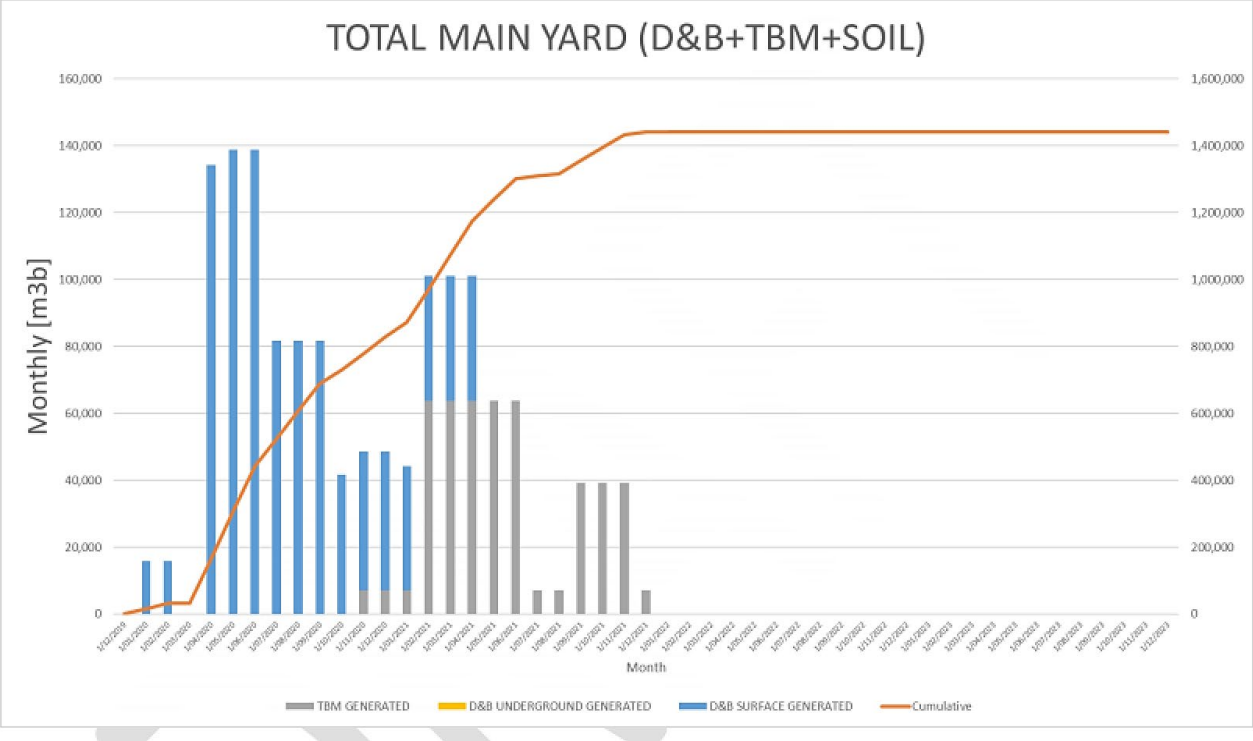

Figure 2-1 Planned monthly and cumulative placement of spoil at the Lobs Hole Main Yard

3. DESIGN

Figure 3-1: represents the current preliminary layout design of the Main Yard at Lobs Hole during construction. This Main Yard would be built-in stages as soon as the spoil becomes available from the various working fronts.

In general terms the construction of the embankments is a bottom-up approach undertaken with conventional earthmoving techniques. The proposed on-land placement construction staging would generally occur as follows:

- Installation of erosion, sediment and drainage control;
- Trimming 150mm of the existing slope should be carried out for the clearing and grubbing of vegetation and topsoil purposes. This would be stockpiled in accordance to the applicable procedures in suitable areas within the construction footprint.
- Place all spoil in horizontal layers and not exceed a thickness of 300 mm with conventional methods.
- Proof rolls each layer using at least 8 to 10 passes using a 12-tonne static roller.
- Progressive stabilisation throughout to minimise extent of exposed / unconsolidated materials.

The application of the design objectives from schedule 3 condition 6 of the Infrastructure Approval for Lobs Hole Main Yard during construction are set out in Table 3-1.

Table 3-1: Design Objectives for Lobs Hole Main Yard during construction

Aspect	Objective	Applicability during construction	How addressed
Landforms	As natural as possible, including minimising the use of linear or engineered structures	Not applicable	Not applicable
	Sympathetic with the landforms in the surrounding area, particularly from a visual, water management and ecological perspective	Not applicable	Not applicable
	Suitable drainage density	Not applicable	Not applicable
	Safe, long-term stable and non-polluting	Applicable	Geotechnical review has been undertaken and incorporated into Main Yard design and construction methodology. Refer below.
	Where feasible, gradients along the water line of the reservoirs that could be exposed under normal conditions (i.e. above the minimum operating level) must be suitable for safe recreational use and consistent with the approved Recreation Management Plan	Not applicable	Not applicable
	Provide suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting with slopes typically spaced at around 200 metres measured on the slope to allow for spraying from vehicles, or as approved by the NPWS	Applicable (in part)	The Main Yard has been designed to support construction, which includes access for vehicles.
Water management	Integrate the drainage of the emplacement area with the surrounding drainage network, including any upstream flows and residual run-on water	Applicable	The design has included development of the surface water controls. Clean waters are to be diverted and dirty

Aspect	Objective	Applicability during construction	How addressed
	Minimise downstream water flows and velocities with any changes to be quantified and addressed though suitable design	Applicable	water is designed to flow to sediment basins. All the sediment basins for construction pads have been designed for the 85th percentile due to limited space, remaining sediment basins for the stockpiles have been designed and modelled for the 95th percentile as the topography is favourable and space is available.
	Minimise valley infill	Not applicable	Not applicable
	Create natural drainage lines that are long-term sustainable having regard to the selection of suitable underlying materials, including rock sizing and grading	Not applicable	The surface water design is such that it provides high performance in managing surface waters on and around the Main Yard. Natural drainage lines are not incorporated until final placement.
	Minimise the use of large rocks in drainage lines	Not applicable	
	Minimise the concentration of water on landforms unless this is consistent with accepted drainage density and geomorphic design practices	Applicable	The surface water design is such that reduces concentrated flows by
	Minimise the generation and dispersion of sediment in the Talbingo Reservoir, Tantangara Reservoir or other waterways	Applicable	The design has included development of the surface water controls. Clean waters are to be diverted and dirty water is designed to flow to sediment basins. All the sediment basins for construction pads have been designed for the 85th percentile due to limited space, remaining sediment basins for the stockpiles have been designed and modelled for the 95th percentile as the topography is favourable and space is available.
Erosional stability	Minimise steep slopes, particularly slopes that will be difficult to access and maintain (such as slopes over 18o or 1V:3H)	Not applicable	Main Yard pad fill slopes are battered at 1.7H:1V or less, or reinforced. Main Yard pad cut slopes are at 1.7H:1V or less slope. Controls for the Surface Water Management Plan would also be implemented.
	The final surface of the landform must be long-term sustainable with sufficient topsoil (or some other suitable growth medium) to maintain a soil water profile and sustain vegetation	Not applicable	Not applicable

Aspect	Objective	Applicability during construction	How addressed
	Maximise the revegetation of the final surface	Not applicable	Not applicable
	Ensure areas subject to wave action are suitably protected or the slopes are flattened to limit wave action	Not applicable	Not applicable
Land Use	Native vegetation and habitat must be consistent with the approved Rehabilitation Management Plan	Not applicable	Not applicable
	Recreational facilities and use must be consistent with the approved Recreation Management Plan	Not applicable	Not applicable
Constructability	The emplacement area must be constructible having regard to the: - availability of suitable material, including topsoil - erosion and sediment control; - access; - initial shaping of natural ground; - progressive rehabilitation; - shapes and benching; and - safety around water	Applicable (in part)	As described above, the Main Yard will receive all spoil from the Talbingo zone as a priority, with surplus directed to GF01 and Ravine Bay (once those detailed plans are approved) and, therefore, sufficient material is available. Erosion and sediment controls for construction are described in Section 3.2 below. As shown in Figure 3-1 the Main Yard is free from the Yarrongabilly River. As the site will be an active construction zone (housing plant, equipment, facilities, laydown etc) the area is being constructed so that access and benching a suitable for works. Topsoil availability, shaping, benching and rehabilitation are relevant to the development of the final emplacement formation. This plan will be updated for approval prior to commencing final placement works over the Main Yard construction footprint and will address those matters at that time.

3.1. Stability

Assessment of the global stability of the proposed cut slopes and fill embankments was carried out using commercially available computer software SLOPE/W incorporating the Morgenstern-Price method for the factor of safety calculation.

Fill slopes are battered at 1.7H:1V or less, or reinforced. Cut batters are at 1.7H:1V or less slope. SLOPE/W was used to analyse the cut sections for global stability. SLOPE/W assesses global stability using the limit equilibrium method. Selected critical sections of the cut slopes were

assessed for stability. Analysis indicates that the proposed batters meet minimum Factor of Safety requirements and no additional reinforcement.

Due to the varying cut and fill activities expected to be carried out to establish the Main Yard, pad footings will be founded on a range of ground conditions. Subject to verification on site by a geotechnical engineer, pad footings would be designed for the serviceability (allowable) bearing pressures in Table 3-2.

Table 3-2: Design Objectives for Lobs Hole Main Yard during construction

GEOTECHNICAL UNIT	ULTIMATE END BEARING PRESSURE (MPa)	SERVICEABILITY END BEARING PRESSURE (MPa)
Natural Soils	N/A	
Compacted Engineered Fill	0.375	0.125

3.2. Surface water control

The final subgrade will be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

A surface drainage network will be installed that directs any surface water run-off away from the slope area and into a controlled drainage system. All paved surfaces will be sloped to provide satisfactory drainage towards catch basins/collection points.

Clean water flows from upstream catchments is design to be diverted / passed via culverts under the roadways. Sediment bearing flows from earthworked areas have been directed to sediment basins.

All the sediment basins for construction pads have been designed to be compliant with the Managing Urban Stormwater series (the Blue Book). Basins are designed for the 85th percentile due to limited space, sediment basins for the stockpiles have been designed and modelled for the 95th percentile as the topography is favourable and space is available.

Sediment basins are designed to be planted to the shallow marsh zone and where maintenance access is not required to surrounding slopes. Sediment basin planting would be prioritised to be established prior to the commencement of construction activities where sediment loads will be high and expected to inhibit plant growth.

The measures and controls from the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) would also be implemented throughout construction.

3.3. Exploratory Works Eastern and Western emplacement areas

Two temporary spoil emplacement areas at Lobs Hole are approved to receive spoil as part of Exploratory Works. These will be filled in as part of the establishment of the various pads at the Main Yard.

Reactive spoil is not allowed to be placed in the Exploratory Works western emplacement area (at Lobs Hole) unless approved by the Planning Secretary.

Spoil from dredging, channel excavation or underwater blasting must not be placed in the Exploratory Works eastern and western emplacement areas unless approved by the Planning Secretary.

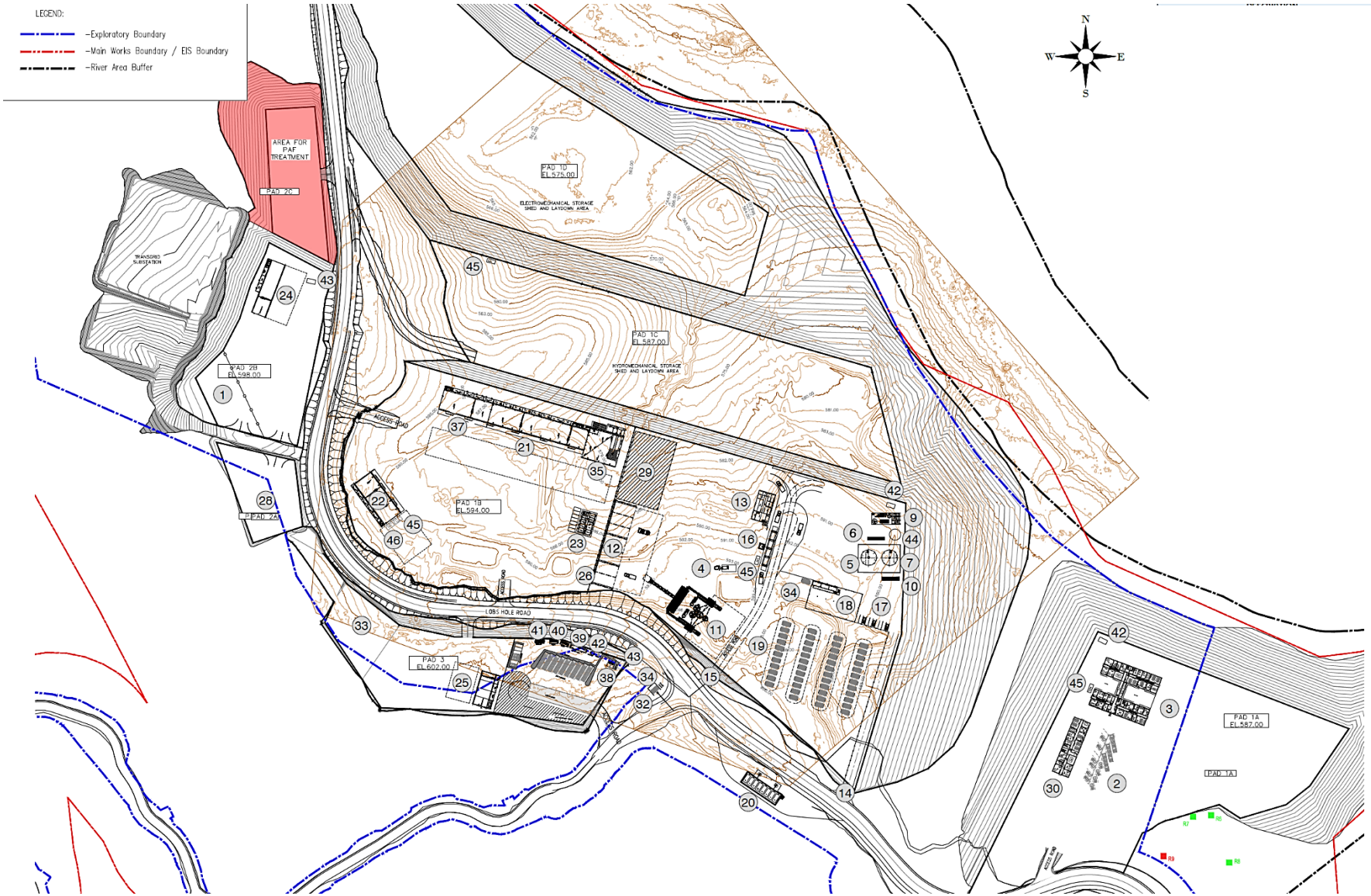

Figure 3-1: Main Yard general layout (indicative – not for construction)

4. FINAL PLACEMENT AND REHABILITATION

Following the completion of most construction activities, the Main Yard construction pads will be decommissioned and the landform will be reshaped and rehabilitated. This will occur progressively as certain areas within the Main Yard facility are no longer required to support construction of the project. This Appendix to the Spoil Management Plan (S2-FGJV-ENV-PLN-0019) will be updated in accordance with the staging set out in Section 1.6 of that plan to gain approval of the final design prior to the final placement works commencing. Future Generation will ensure that the design is developed to:

- comply with the design objectives and requirements schedule 3, condition 6 of the Infrastructure Approval; and
- be consistent with the design principles as set out in the Preferred excavated rock management strategy Concept design information and water quality assessment (EMM March 2020), submitted to the Department on 24 March 2020.

The initial designs, prepared to support the granting of the Infrastructure Approval, on which the Lobs Hole emplacement area will be based are presented in Figure 4-1 and Figure 4-2. The emplacement area will adopt geormorphic design principles, enhancing the visual amenity of the area and providing a “natural looking” landform. The form also reduces potential for erosion and sediment impacts.

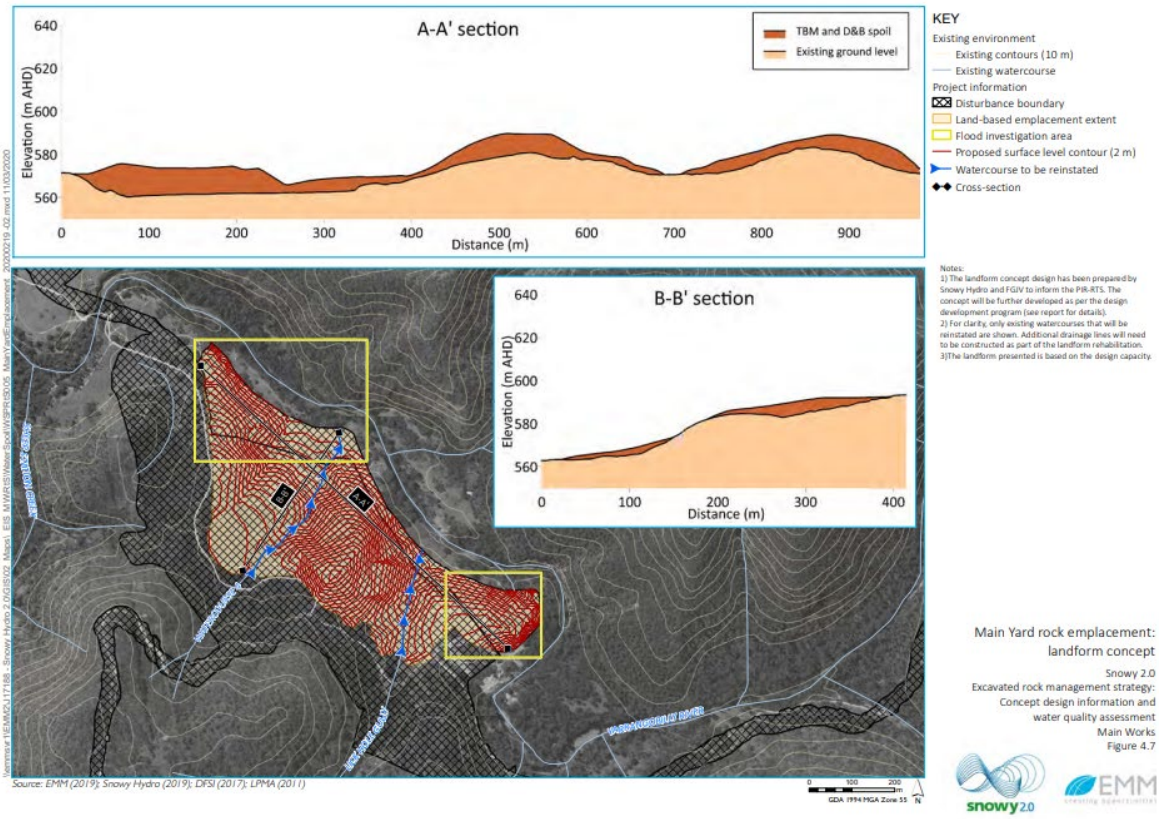

Figure 4-1: Lobs Hole landform concept (following construction) (EMM preferred excavated rock strategy dated 24 March 2020)

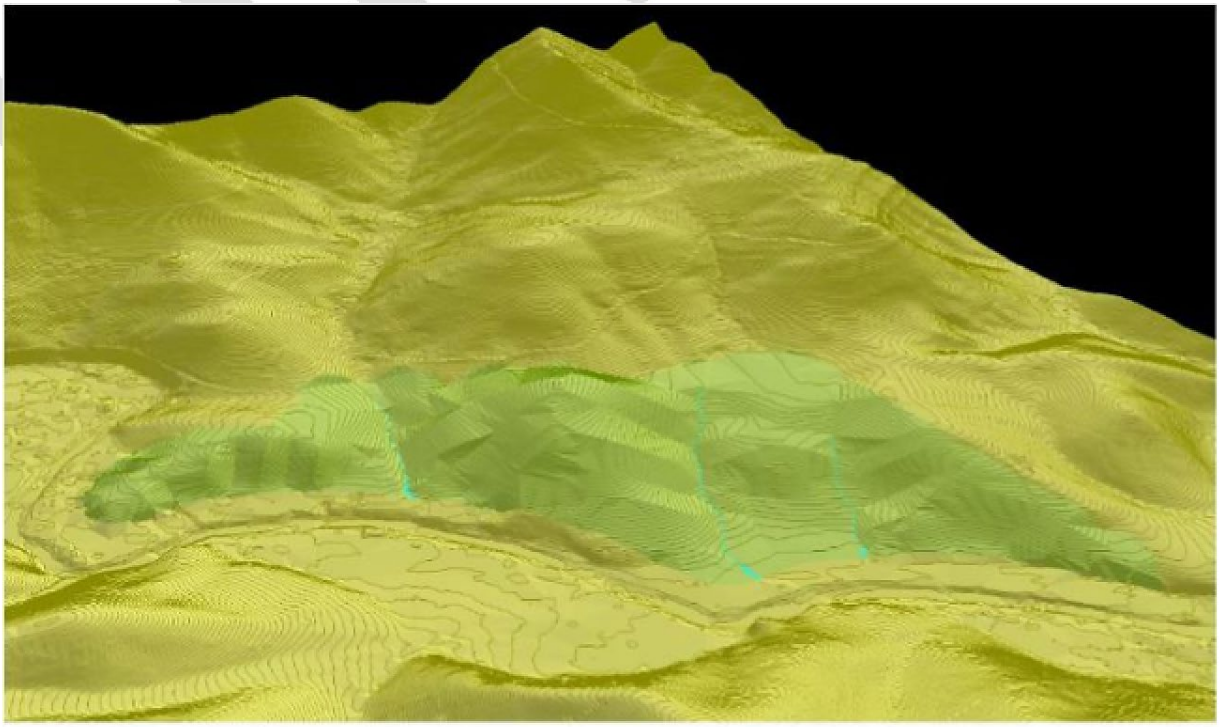

Figure 4-2: Lobs Hole geomorphic impression (following construction)

4.1. Key risks for the successful completion and contingency measures

The key risks and contingency measures relevant to the transition of the Main Yard from a construction compound to the commencement of construction of the Lobs Hole emplacement area are identified in Table 4-1.

Design of the Lobs Hole permanent emplacement area (final design) will be developed during construction so as to comply with Design Objectives in schedule 3 condition 6 of the Infrastructure Approval. This plan (Appendix F of the SMP) will be updated for approval prior to commencing final placement works over the Main Yard construction footprint and will include risks and contingencies associated with the successful completion of the Lobs Hole emplacement area at that time.

Table 4-1: Key risks and contingency measures for successful completion of Lobs Hole emplacement area

Risk	Contingency
The timing of construction stages prevents adequate spoil volume or spoil quality being available for development of the final landform	The Main Yard will be progressively decommissioned as areas within the facility are no longer required to support construction. In the unlikely event that material is no longer available direct from tunnelling or other nearby surface works, spoil can be sourced from GF01 or Ravine Bay emplacement areas (or both) if required.
The timing of construction stages results in excess spoil needing to be retained at the Lobs Hole emplacement areas, contrary to the requirement of schedule 3, condition 6 of the Infrastructure Approval	The Main Yard will be progressively decommissioned as areas within the facility are no longer required to support construction. Material can be drawn down progressively and diverted to GF01 or Ravine Bay (or both). Ravine Bay emplacement area has approximately 2 million m^3 spare capacity. Excess material can be directed to Ravine Bay if required.

Risk	Contingency
Contamination caused by development or operation of Main Yard construction pads	Respond to incidents and execute remediation where required. Retain records to demonstrate either: • no residual risk from contamination; or • residual risk from contamination is not unacceptable.
Temporary foreign or unsuitable objects prevent effective filling and / or compaction	Upon completion of use of area for purposes of supporting construction remove all foreign / unsuitable objects that are not proposed to form part of the Lobs Hole emplacement area final design. Undertake inspection of each area within the Main Yard facility that is being decommissioned. Retain records.
Soil and water impacts during removal of controls supporting Main Yard as a construction compound and development of the site for emplacement	Develop and maintain specific erosion and sediment control plans based on risk for each transition (e.g.: removal of hardstand, removal of basins, regrading). Implement and maintain the controls as specified by the erosion and sediment control plans.
The Main Yard temporary works design and execution are unable to be modified upon completion and result in risk for landform's future intended use.	Include check of Main Yard temporary works against criteria and objectives in the design for final emplacement area, the Rehabilitation Management Plan and the Recreation Management Plan. Ensure work with potential to undermine the proposed outcomes from the final works are avoided.

Note: The key risks and contingencies relate only to the transition from Main Yard as a construction compound to the commencement of construction of Lobs Hole emplacement area as a final landform; after which is to be dealt with through the update of this plan.

4.2. Completion criteria, performance indicators and criteria for triggering remedial action

The Main Yard is being developed to establish safe working construction pads and does not have completion criteria or performance indicators relevant to it being a permanent emplacement area. These metrics will be developed prior to commencing final emplacement works.

APPENDIX G – GF01 EMPLACEMENT AREA

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX G – GF01 EMPLACEMENT AREA

S2-FGJV-ENV-PLN-0019

AUGUST 2022

Schedule 3, condition 7(e) of the Infrastructure Approval requires detailed plans for each of the permanent spoil emplacement (PSE) areas to be prepared prior to placement of material at each site. This plan has been prepared to address these requirements of condition 7(e) for the GF01 (PSE) area

Revision Record

Rev.	Date	Reason for Issue	Responsible	Accountable	Endorsed
I	20.07.2022	Updated to address EPA comments	J. Adams	E. Porter	M. Franceschi

Document Verification

RACIE Record

R esponsible:	Name: Jessica Adams Job Title: Environmental Approvals Coordinator  Signed: Date: 22.08.2022
A ccountable:	Name: Ellen Porter Job Title: Environmental Manager Signed:  Date: 22.08.2022
C onsulted:	See distribution list on Page 3.
I nformed:	See distribution list on Page 3.
E ndorsed:	Name: Massimo Franceschi Job Title: Project Director Signed:  Date: 23/08/2022

RACIE Terms

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A	**Accountable** The person who has the answer for success or failure of the quality and timeliness of the document.
C	**Consulted** Those who must be consulted before the document is published.
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***(1) OHC** – Original Hard Copy / **EC**–Electronic Copy / **HC** – Hard Copy / **Aconex** –Electronic Document Management System*

Revision Tracking

Rev.	Date	Description of Revision
A	22.12.2020	Initial draft for Snowy Hydro review
B	17.02.2021	Updates to represent latest designs, submitted to Snowy Hydro for review
C	20.07.2021	Updates to represent latest designs and Snowy Hydro comments, submitted to Authorities for review
D	12.08.2021	Updated to reflect EPA, NPWS and TfNSW comments
E	28.01.2022	Updated to reflect EPA and NPWS comments
F	14.04.2022	Updated to reflect DPE comments
G	25.05.2022	Updated to address DPE comments
H	08.06.2022	Updated to address DPE comments
I	20.07.2022	Updated to address EPA comments

CONTENTS

TABLES

FIGURES

1. INTRODUCTION

1.1. Background

Schedule 3, Condition 7(e) of the Infrastructure Approval requires detailed plans for each of the Permanent Spoil Emplacement areas (PSE) to be prepared prior to placement of material at each site. This plan has been prepared to address these requirements of Schedule 3, Condition 7(e) for the GF01 PSE (GF01), including adherence to Schedule 3, Condition 4 and the design objectives in Table 2.

GF01 forms part of the Talbingo Scheme, receiving spoil from the Talbingo Adit (permanent operational pads and structures), the Main Access Tunnel (MAT) and Emergency Egress, Cabling and Ventilation Tunnel (ECVT).

The general location of GF01 is shown in Figure 1-1.

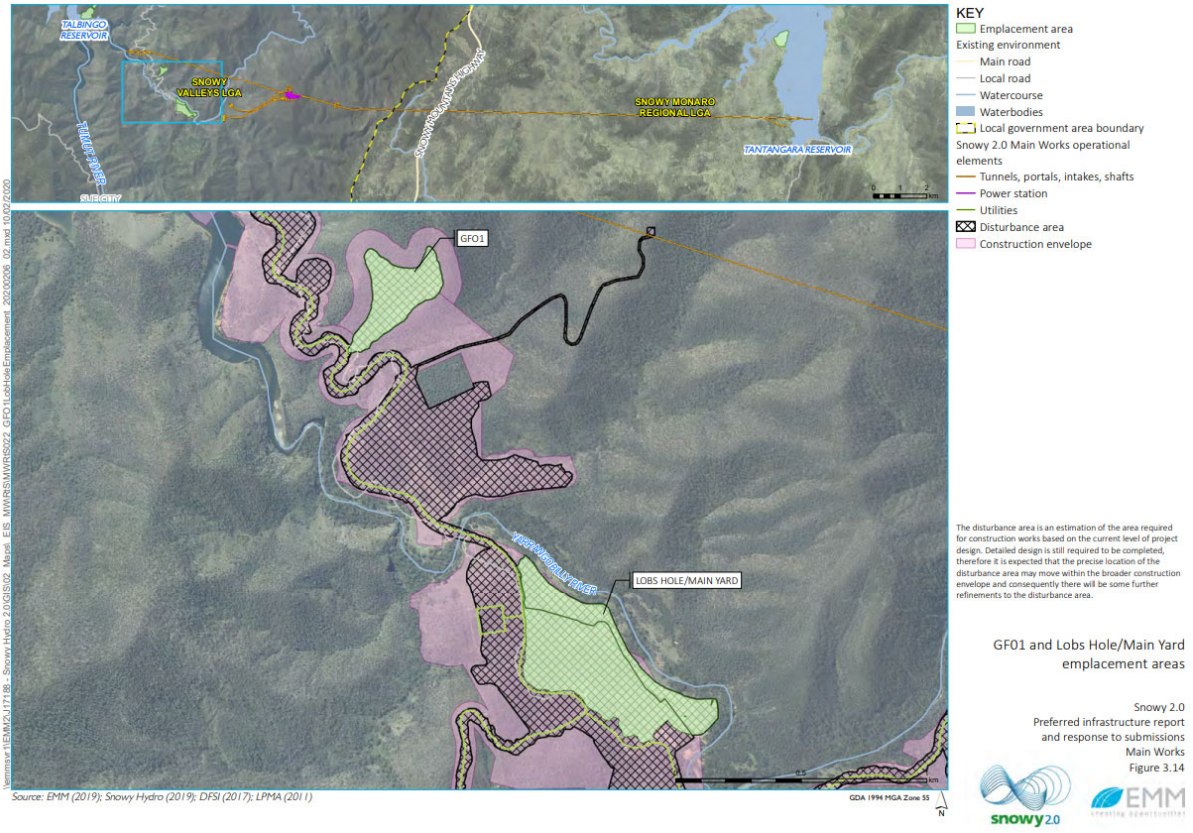


Figure 1-1 GF01 and Main Yard permanent emplacement area location (EMM, 2020)

1.2. Requirements

Schedule 3, condition 7(e) of the Approval requires detailed plans for each of the permanent spoil emplacement areas to be prepared using both analogue and erosional-based methods. Plan requirements are provided in Table 1-1 below.

Table 1-1: Conditions of Approval Relevant to Spoil Emplacement

Requirement	Where addressed
Schedule 3, condition 7	
(e) detailed plans for each of the permanent spoil emplacement areas that have been prepared using both analogue and erosional-based methods: these plans must:	
• describe how the development of each emplacement area would be co-ordinated with the rehabilitation of the site in accordance with the approved Rehabilitation Management Plan;	Section 4.2
• describe the measures that would be implemented to comply with the spoil management requirements in condition 4 and the design objectives in condition 6 (Table 2) of the Infrastructure Approval;	Table 4-2
• include a topsoil strategy outlining the measures that would be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target PCTs in the long term, having regard to the approved strategy in the Rehabilitation Management Plan;	Section 4.3
• identify the key risks for the successful completion of each emplacement area and the contingency measures that would be implemented to address these risks; and	Table 4-1
• include detailed completion criteria and performance indicators for each emplacement area, including criteria for triggering remedial action (if necessary).	Table 4-2

The application of the design objectives from Schedule 3, Condition 6 (Table 2) of the Approval are set out in Table 1-2.

Table 1-2: Design Objectives

Aspect	Objective	Notes
Landforms	As natural as possible, including minimising the use of linear or engineered structures	-
	Sympathetic with the landforms in the surrounding area, particularly from a visual, water management and ecological perspective	The landform design has included potential for diversity of habitat. Ecological aspects are still being finalised and will be included in the Rehabilitation Management Plan.
	Suitable drainage density	-
	Safe, long-term stable and non-polluting	-
	Where feasible, gradients along the water line of the reservoirs that could be exposed under normal conditions (i.e., above the minimum operating level) must be suitable for safe recreational use and consistent with the approved Recreation Management Plan	This is not applicable to GF01 as it is remote from the reservoirs.
	Provide suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting with slopes typically spaced at around 200 metres measured on the slope to allow for spraying from vehicles, or as approved by the NPWS	Access tracks have not yet been indicated – these will be added during construction using the as-built surfaces. See Section 3.4 for ongoing NPWS access approval requirements.
Water management	Integrate the drainage of the emplacement area with the surrounding drainage network, including any upstream flows and residual run-on water	-
	Minimise downstream water flows and velocities with any changes to be quantified and addressed though suitable design	-

Aspect	Objective	Notes
	Minimise valley infill	GF01 is a valley infill, necessary due to the timing of works precluding taking material to Ravine Bay which require a long and substantial access road to be cut into the landscape.
	Create natural drainage lines that are long-term sustainable having regard to the selection of suitable underlying materials, including rock sizing and grading	-
	Minimise the use of large rocks in drainage lines	-
	Minimise the concentration of water on landforms unless this is consistent with accepted drainage density and geomorphic design practices	-
	Minimise the generation and dispersion of sediment in the Talbingo Reservoir, Tantangara Reservoir, or other waterways	Monthly water monitoring downstream of emplacement area will be undertaken in accordance with the project EPL. If required, and in accordance with Appendix A, Annexure A of the Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107-F), Trigger Action Response Plans will be followed.
Erosional stability	Minimise steep slopes, particularly slopes that will be difficult to access and maintain (such as slopes over 18° or 1V:3H)	There is a portion of slopes greater than 18° - currently this is approximately 30% of the area. These steeper slopes average 20.8° and do not exceed 100m in length. Options are being considered to see if the extent of these slopes can be reduced.
	The final surface of the landform must be long-term sustainable with sufficient topsoil (or some other suitable growth medium) to maintain a soil water profile and sustain vegetation	Topsoil (or other growth medium) requirements will be detailed in the Rehabilitation Management Plan.
	Maximise the revegetation of the final surface	-
	Ensure areas subject to wave action are suitably protected or the slopes are flattened to limit wave action	This is not applicable to GF01 as it is remote from the reservoirs.
Land Use	Native vegetation and habitat must be consistent with the approved Rehabilitation Management Plan	This plan will be reviewed for consistency with the Rehabilitation Management Plan.
	Recreational facilities and use must be consistent with the approved Recreation Management Plan	This plan will be reviewed for consistency with the Recreation Management Plan.

Aspect	Objective	Notes
Constructability	The emplacement area must be constructible having regard to the: - availability of suitable material, including topsoil - erosion and sediment control; - access; - initial shaping of natural ground; - progressive rehabilitation; - shapes and benching; and - safety around water	Safety around water – not applicable to GF01 as it is remote from the reservoirs. Progressive rehabilitation on GF01 is not practical until dumping is completed due to the confined space available.

2. DEVELOPMENT

Development of the emplacement area will occur over several years, with continual reference to and assessment against the design objectives described Table 1-2, using the design methodologies and criteria described in Section 3 and the completion criteria described in Section 4.

It is anticipated that roughly two-thirds of the spoil filling GF01 will come from the MAT and ECVT and the other third will come from Talbingo. This emplacement area is intended to hold approximately 752,000 m^3 of spoil once fully filled and compacted and will be predominantly filled between mid-2022 and late-2023.

GF01 will broadly be developed as follows (dates are indicative only and are provided to describe sequencing). To note, Lobs Hole Main Yard and Talbingo Adit / Portal sites will be used for temporary storage of spoil prior to placement at GF01 as necessary:

- Second Half 2022:
  - Pre-construction works including identifying environmental avoidance areas and marking them within the approved disturbance footprint.
  - Clean water diversion drains will be established, and appropriate sedimentation controls set in place.
  - The topsoil will be stripped and stockpiled temporarily in accordance with Appendix B and C of the Spoil Management Plan.
  - An access road shall be built to GF01 from Lobs Hole Road.
- 2022 to 2023:
  - A D&B layer will be placed and compacted to act as the PAF / NAF barrier layer prior to emplacement of TBM spoil.
  - Non-acid forming (NAF) and acid neutralising capacity (ANC) material will be stockpiled so far as practicably possible, as standby material to be used for blending and encapsulation in the event of potential acid forming (PAF) material being identified.
  - TBM spoil excavated, temporarily stockpiled at the portals and tested, including testing from probe drilling where spoil is sufficient.
  - Spoil will be transported to the PSE area and stockpiled until NAG suite / ANC measurements results are obtained
  - Permanent base up, thin lift placement of excess spoil from Talbingo and Lobs Hole in accordance with the strategies developed for the management of poor-quality materials.
  - Progressive stabilisation throughout to minimise the extent of exposed / unconsolidated materials. Depending on the erodibility and dispersivity of the material, a layer of drill and blast (D&B) material will be placed as a protective layer.
- 2022 to 2023:
  - The material generated from tunnel boring machines (TBM) increases rapidly during this period, it is anticipated that approximately two-thirds of the spoil filling GF01 will be from the MAT and ECVT, with one-third from Talbingo.
- 2023 to 2026:
  - Demobilisation of temporary topsoil stockpiles and infrastructure such as haul roads no longer required.

- Construction of permanent placement formation and progressive rehabilitation commences in 2023 and continues to end of 2026.

The scheduling of placement is presented graphically in Figure 2-1.

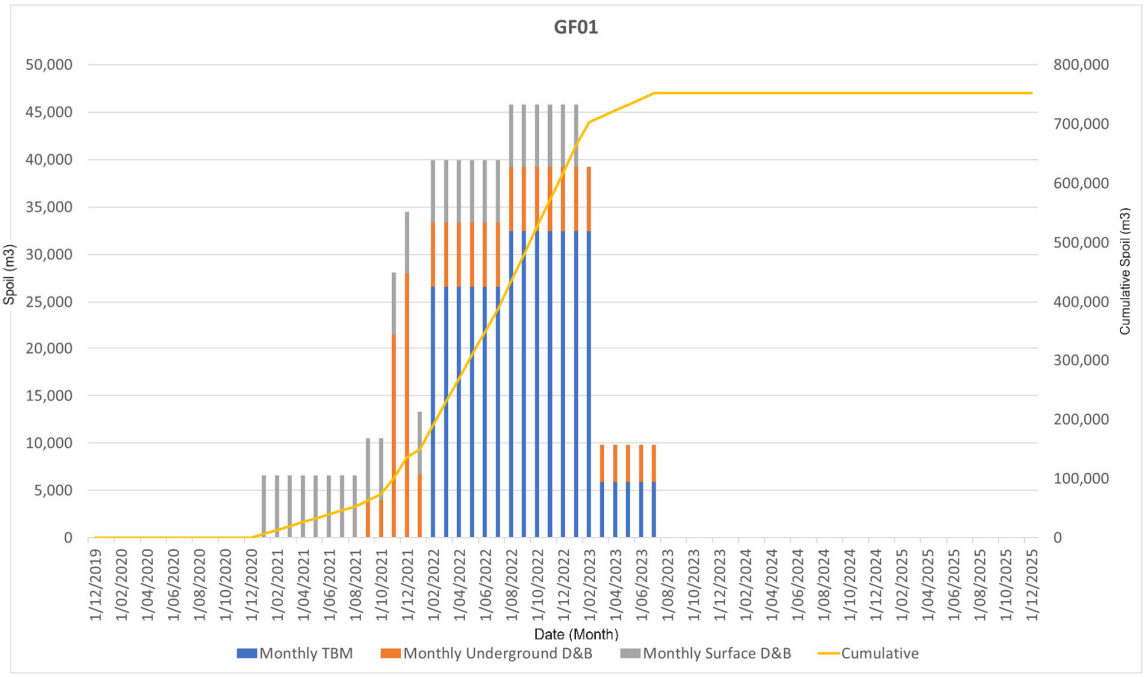


Figure 2-1 Planned monthly and cumulative placement of spoil at GF01

2.1. Installation of environmental controls

In accordance with the Biodiversity Management Plan (S2-FGJV-ENV-PLN-0028), pre-construction surveys and pre-clearing activities will be completed in order to facilitate the egress of fauna. Environmental avoidance areas will be identified and marked within the approved disturbance footprint, including the EIS boundary and the progressive disturbance footprint where staged clearing and grubbing is required.

A clean water drainage network will be installed directing any surface water away from the construction area via a clean water diversion drain. The clean water diversion drain will consist of an earth bund. Sediment bearing flows from earth worked areas will be directed to a designated basin.

All measures and controls implemented throughout construction including the basin, will be undertaken in compliance with the Surface Water Management Plan (SWMP) (S2-FGJV-ENV-PLN-0011) and at a minimum the Managing Urban Stormwater series (the Blue Book). A comprehensive surface water inspection and monitoring program will be implemented, in accordance with the SWMP and the Main Works Environment Protection Licence (EPL).

Sensitive Area Plans and Erosion and Sediment Control Plans will be prepared and implemented, consistent with the SWMP to manage specific environmental aspects at all sites.

In accordance with the SWMP, basins will be installed with a design rainfall depth of 85th percentile 5-day rainfall event as a minimum with consideration given to increasing basin and drain size at locations where sufficient space is available and / or topography does not constrain the basin size.

To manage potential leachate seepage from the PSE, the Leachate Detection Procedure will be implemented and followed (S2-FGJV-ENV-PRO-0055). The LDP was prepared in consultation with EPA who have since confirmed they are satisfied with the procedure. Monitoring via surface

water and ground water sampling will continually assess if leachate is occurring from the spoil emplacement. The data and information gathered during monitoring will to feed into management processes that seeks to minimise the Project's impact on surface and groundwater. Potential seepage and runoff will be collected in a leachate basin downstream of the treatment emplacement area. Collected water will be tested for potential contamination which will be guided by the EPL. Water will be irrigated to the spoil emplacement area (to promote evaporation) or, where the water quality is not suitable for reuse, treated in the process water treatment plant. Should the water treatment plant have insufficient capacity to treat the water, the water will be classified and will be disposed on offsite at a facility licensed to accept the classification of water.

The above controls, and others deemed necessary, will be developed, and workshopped in consultation with the NSW EPA to ensure best practice emplacement area management and will be monitored under the Project EPL.

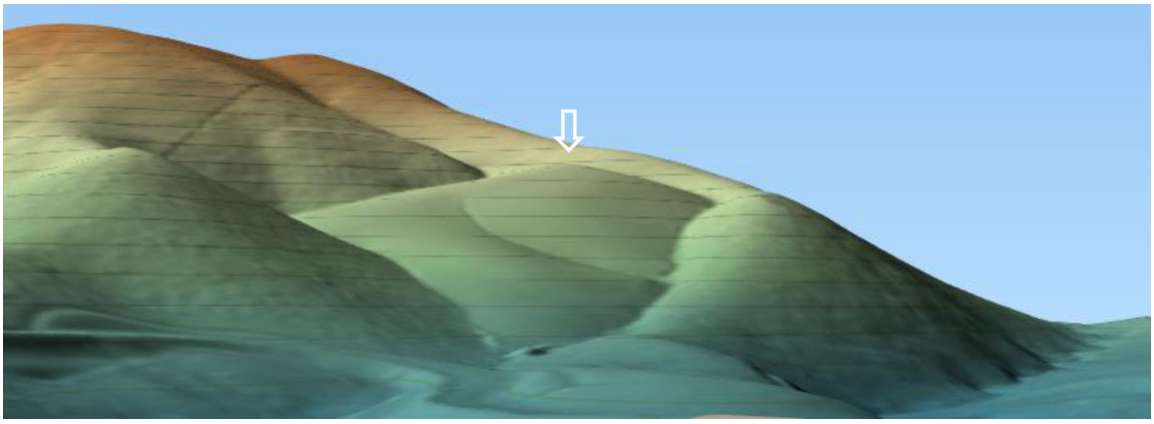


Figure 2-2 Indicative view.

2.2. Expected geology

Lobs Hole is located in the Ravine area, west of the Long Plain Fault Zone. The following table is a summary of the geochemical acid base accounting characteristics relevant to two key Lobs Hole geological units. The summary is based on the Geotechnical Baseline Report for Snowy Hydro 2.0 (2019), which indicates the low risk of AMD.

Table 2-1: Count and average geochemical material characteristics

	NAF count	PAF count	Avg %S	Avg ANC (kg H2SO4/t)	Avg MPA (kg H2SO4/t)	NPR
Boraig Group	23	0	0.03	42.8	0.8	53.1
Ravine Beds	229	26	0.15	27.1	4.5	6.0

2.3. Testing

Tunnelling works commenced at the MAT in July 2021, and at ECVT in January 2022. Testing on the MAT and ECVT material has been carried out in accordance with the overarching Spoil Management Plan consisting of the following:

- XRF testing, NAG pH suite, pH, and EC screening
- Validation by a NATA accredited laboratory

The results of the testing carried out to date are outlined in the following table and are reflective of the Ravine Bed geological unit.

Table 2-2: Spoil characterisation testing

	Avg XFR S%	Avg Total S%	Avg Chromium Reducible Sulfur (S%)	Avg Net Acid Production Potential (NAPP)	Avg Acid Neutralising Capacity - as H2SO4	Avg Acid Neutralising Capacity - as CaCO3	Avg pH After oxidation
ECVT	0.12	0.11	0.03	-24.41	25.06	2.57	8.98
MAT	0.11	0.11	0.07	-23.12	25.22	2.59	8.91

2.3.1. Kinetic Testing

Previous geochemical studies undertaken have shown that the material from the different units can potentially be reactive and leach acid, salinity and metals. Geochemical kinetic testing, using the humidity cell test (HCT), will be run on selected material from the key lithological units. The outcomes will be used to better understand the reactivity of sulfides in excavated rocks, the release rates of contaminants, and the water quality evolution in response to long-term oxidation and weathering that may affect the design of the final landforms and the quality of surface and groundwater.

These tests will be run for a minimum of six months before assessing the need to continue the test. Tests will be run on each of the seven lithologies of interest that have been identified in previous works. Lithologies with identified range of PAF and NAF materials (e.g., Gooandra Volcanics and Ravine Beds), will be better represented with two tests per lithology.

Samples to be used in the HCTs were selected by reviewing the geology database and existing borehole logs with a focus on the description of the lithological units and the sulfur content.

3. DESIGN

3.1. Landform Design Method

Landform design methodologies tend to fall into three distinct categories including:

- Empirical type design approaches, using historically proven stable slopes or designs. These designs tend to use linear slopes combined with engineering interventions such as contour banks and/or drop structures.
- Analogue methods, typically using the characteristics of relevant stable natural landforms in the local environment and applying these characteristics to the design of new landforms of similar materials. Examples of this approach are found in publications by Swatsky and Beersing, or the GeoFluv™ methodology developed by Bugosh. The GeoFluv™ method has commercially available software (Natural Regrade®) in support of the design of non-linear landforms and typically incorporates drainage density, that is, the landform is designed with the appropriate number of dendritic drainage lines aligning with the upslope and downslope drainage lines.
- Erosional based methods that focus on the erodibility of soils to be used on the outer surface. At the simplest level, the approach may rely on methods such as the Revised Universal Soil Loss Equation. (RUSLE). More commonly on larger projects in Australia, two-dimensional analysis such as that used in the Water Erosion Prediction Project (WEPP) model is used to develop a non-linear concave landform. Alternatively, more complex three-dimensional landforms with drainage lines can be developed using Landscape Evolution Models (LEM) in an iterative design approach.

The landform approach used by Golder is based on an approach developed in the Hunter Valley, NSW since 2012. The approach uses analogue methods for the design of larger catchments using alluvial analogues where practical, based on the GeoFluv™ methodology. These landforms do not (in theory) require any rock armouring.

However, there is unlikely to be any or part of the PSE that is flat enough to allow for the use of an alluvial analogue.

For areas steeper than alluvial analogues, a combination of analogue and erosional based methods is used. This approach uses a dendritic drainage system with the number of drainage lines based on both analogues and practical limitations, with the intent to ensure that the surfaces outside of the drainage lines are largely stable without the need for additional armouring. Rock armouring or combinations of armouring and planting strategies are then utilised where needed to stabilise the drainage lines.

The approach is always precautionary – alluvial analogues are used where appropriate and for all larger catchments. Where rock is required, the number of drainage lines is intended to limit tractive stresses, flow depth, and erosion risk.

Importantly, while the initial erosional risk assessment in the design process can be based on experience obtained in the Hunter Valley, NSW, and adapted for the erosivity of the rainfall and typical vegetation of the Kosciusko National Park, more complex LEM modelling will be undertaken to demonstrate long term sustainability. Requirements for LEM modelling will be detailed in the Rehabilitation Management Plan.

As such, there is no threshold in terms of erosion risk that will drive the need for an LEM model such as SIBERIA or CAESAR, but rather the need to demonstrate long term sustainability to the Regulator. It is proposed that this work be undertaken once it is clear what material will be used on the outer surface, which will be dependent on the availability of suitable topsoil or similar growth mediums.

3.2. Design Life

Most engineering structures are designed for a specific design life, beyond which the risk of failure increases significantly. Typically, the required design life is based on assessment of risk. It has been suggested (Chapman & Kemp, 2019) that landforms should be designed for a design life of between 300 to 1000 years (low to high risk respectively). This life span is particularly significant for designs that have the potential for significant risk once the design life is exceeded, such as landforms that have elevated ponds that contain both runoff and sediment.

For geomorphic landforms designed using an alluvial analogue in the local environment, the expectation is that the landform will have no finite or defined design life. The natural analogues on which the design is based have developed over geological time periods (in some cases) and will have experienced numerous very extreme rainfall events. Provided the soils and rehabilitated vegetation of the analogue and rehabilitated landform are comparable, the risk of failure is likely to be 'low' and does not change with time for the same typical climatic conditions.

For landforms designed using a geomorphic approach but incorporating the use of rock armouring, the risk of failure is again not expected to change with time, unless climate change or other factors substantially change the occurrence of extreme events. However, the design process needs to incorporate a specific extreme event to size the rock armouring, and in most mining applications in NSW, the rock would be sized for a particular storm event, typically the 1% Annual Exceedance Probability (AEP) risk, or a 1 in 100 year Average Recurrence Interval (ARI) storm event. While the risk of this event occurring in any one year does not change, the longer the structure is part of the landscape, the greater the probability that an event greater than the design event will occur.

A design event of around 1% AEP is considered reasonable as flood events of this magnitude generally cause widespread damage to both natural and man-made structures, and some risk of erosion under this event is considered reasonable.

As part of the design process three scenarios are evaluated, the initial landform without vegetation, the final landform with minor vegetation, and the final vegetated landform with vegetation in drains. For each scenario, the rock size and drain base width are checked against the risk of failure. If necessary, the drain will be widened, rock size increased and/or additional gravel added adjacent to the drain for very extreme events.

LEMs will be undertaken to demonstrate the overall design life of the landform to the Regulator, since the design methods used here cannot quantify the extent of erosion over long periods with a high degree of confidence. Requirements for LEM modelling, including topsoil and vegetation inputs, will be detailed in the Rehabilitation Management Plan.

3.3. Adopted Landform Design Criteria

The interpretation of the existing completion criteria into specific design criteria has been provided in Table 3-1. It is important that the design criteria be sufficiently detailed to ensure that the final landform is able to be measured to demonstrate that it is meeting or has met the required objectives.

The design criteria have been developed to provide precise benchmarking for the purpose of achieving the design objectives in Table 1-2. Deviations from these criteria will trigger remedial action, described in Table 4-2.

3.4. Consultation and Revision

In accordance with the Main Works Approval, this Plan, and the governing Spoil Management Plan (SMP) must be prepared in consultation with the NPWS, EPA, Water Group, NRAR, NSW DPI and TfNSW, prior to approval by the Department of Planning Industry and Environment (DPIE).

At 6-month internals from the date of approval of this Plan, this Plan will be reviewed, and relevant agencies consulted on progress and upcoming milestones for design and implementation including but not limited to design changes, internal procedures, placement methodologies and spoil characterisation procedures.

In addition, site specific controls including compaction rates, water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management.

In accordance with Schedule 3, Condition 6 (Table 2) of the Main Works Approval, suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting will be provided at around 200 metres measured on the slope. NPWS will be consulted on permanent access routes and, if required approval will be sought where the 200-metre requirement cannot be provided, prior to finalisation of design.

During development and consultation of the Rehabilitation and Recreation Management Plans, this Plan will be reviewed for consistency and to ensure effective coordination of rehabilitation.

Following completion of the project and compliance with the Approval, PSEs will be handed back to NPWS for management. As a result, NPWS will be provided with relevant project documentation for information including, but not limited to, geotechnical assessments, erosion and sediment control plans and design drawings. Documentation will be provided following internal review processes.

Table 3-1: Landform Design Criteria

Objective	Design Criteria Proposed	Notes
Final landforms are compatible with the landscape	• Use of Golder software to smoothing surfaces generated by the Natural Regrade® software, or generation of surfaces similar targeted outcomes to Natural Regrade® but including tools such as erosional risk assessments based on the SIBERIA LEM, and flow tracking. This is then combined with flow modelling, using in-house software that incorporates some of the flood modelling routines used in the CAESAR-Lisflood LEM software. The final surfaces are then checked by LEM modelling and traditional flood modelling tools such as XP-RAFTS.Use of armouring and size of rock to be limited to D50 of typically maximum of 600 mm, except where boulders are used as a landscape feature.	Golder software and methodologies will produce a non-linear surface compatible with the local landscape. See note on rock sizing design event below.
Landforms are erosionally stable	• Use topography factor (catchment X slope ^n1) based on experience in the Hunter Valley adjusted for KNP conditions, n1 being the catchment area / slope relationship used in the SIBERIA equation. • Rock to be sized for the 1% AEP storm event. Consequences of larger storms to be considered and mitigated where practical. • Soil loss range of between 5 and 20 t/ha/year measured at any time within the next 500 years, but with a target overall soil loss measured in the long term of less than or equal to 10 t/ha/year.	Soil loss range will be demonstrated using an LEM. Soils testing of the outer capping layer including flume tests will be undertaken as soon as appropriate soils are available.
Landforms are geotechnically stable	• Minimise extent of steep slopes to be 18° (1V:3H) or flatter for both ease of construction and geotechnical stability. • Factor of safety locally on the landform >1.5 under long-term static loading or as motivated by geotechnical engineer. • Factor of safety overall including the underlying founding conditions and possible groundwater / fluctuating dam water levels >1.5 under long-term static loading or as motivated by geotechnical engineer. • Factor of safety ≥1.0 after a 1:10,000 annual exceedance probability (AEP) seismic event or as motivated by geotechnical engineer.	Geotechnical stability for the landform will be assessed by Golder using material properties provided.
Landforms are appropriate for intended land use	• Provide suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting to allow for spraying from vehicles (at around 200 metres measured on the slope, or as approved by the NPWS) • Minimise slopes over 18° (1V:3H).	Landforms to be rehabilitated with natural vegetation communities as described in the rehabilitation strategy. The extent of rehabilitation will also be dependent upon the final recreational use of the area. See Section 3.4 for ongoing NPWS access consultation requirements.

Objective	Design Criteria Proposed	Notes
Landform to be suitable and safe for access	• At areas of proposed recreational area, site specific requirements such as formation of attractive features in the landform to be considered. These could include rocky lined rapids, the use of ponds or rock formations.	Requirements of Rehabilitation Management Plan to be applied where relevant to the landform. Rehabilitation and Recreational Plans to be prepared in consultation with NPWS.
Landform to limit impacts on water quality	• Provide temporary drainage during construction for the perched aquifer at GF01 and maximise flow on surface of this water post construction. • Sediment control to be formed upstream of sensitive receptors. At GF01, all of the landform drains to the sediment dam which is located upstream of sensitive receptors.	Site specific controls including water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management.
Landform revegetation	• Not detailed here – the surface will be revegetated with appropriate natural plant community types.	To be addressed in the Rehabilitation Management Plan.
Landform constructability	• Include areas 1V:4H or flatter where practical for topsoil storage. • Include temporary sediment control measures in the design sized based on the NSW Blue Book (Soils and Construction, Landcom, NSW).	Assess temporary construction access and provide temporary benching layouts. Ensure the design provides a surface that can be progressively rehabilitated where practical and when space permits. Progressive rehabilitation on GF01 is not practical until dumping is completed due to the confined space available (see Section 4.2).

4. FINAL PLACEMENT AND REHABILITATION

4.1. Placement

Figure 4-2 represents the general arrangement of GF01 during construction. The GF01 PSE will be built-in stages as soon as the spoil becomes available from the various working fronts.

In general terms the construction of the embankments is a base-up, thin lift approach undertaken with conventional earthmoving techniques. This will include:

- Stage 1: Trimming vegetation and topsoil ahead of spoil placement. In some areas including at the base of the landform, this stripping could be relatively thick, probably at least 150 mm depending on the value of the material in situ. On the side slopes, the thickness of usable material may be quite limited and stripping relatively difficult, and the material will be assessed as construction proceeds and the steeper sides of the valley become accessible for construction equipment. Topsoil or other usable material will be stockpiled in accordance with applicable procedures. Installation of clean water diversions around the emplacement area. Watering monitoring points will be set up as per the Leachate Detection Procedure (S2-FGJV-ENV-PRO-0055).
- Stage 2: Spoil will be placed in horizontal layers. With the possibility that PAF material could be placed into GF01, it is important to limit air ingress. Ideally this will involve compaction. However, for the construction at GF01, which is both relatively steep and constrained, material has to be placed in benches which are later bulldozed down over the haul road during the final shaping. Treated PAF material will be placed from the base up in thin lifts of 300 – 500 mm thick, encapsulated between NAF material, which may be placed in thicker layers to act as a neutralising layer. If necessary to achieve an NPR of >3, further blending can be carried out through ripping. NAF and ANC material will be placed in known locations to manage the neutralising processes if PAF is present. If no ANC of appropriate NAF material is accessible at the required time, another material such as lime may be used to neutralise the PAF material in accordance with Appendix A (S2-FGJV-ENV-PLN-0019). It is proposed that:
    - A D&B layer will be placed and compacted to act as the PAF / NAF barrier layer prior to emplacement of spoil. Compaction testing will be carried out to ensure barrier layer has achieved the required level. A compaction assessment will be carried out via nuke testing to ascertain a compaction level of 70% has been achieved. 70% is compaction level that can be achieved using the TBM and D&B material.
    - The required density for the materials being excavated will be assessed in view of the geochemical data obtained for GF01, both at the current time, and as updated through ongoing geochemical testing.
    - On site, an assessment will be made of the compaction achieved through the trafficking of equipment used for the bulk shaping for areas that will not be reshaped through bulldozing. Where necessary, material that will not be reshaped through bulldozing will be compacted using an appropriate roller and layer thickness to achieve the required density (e.g. PAF material). Note that these areas are largely within the GF01 PSE and not on the outer edges where air ingress will occur.
    - Placement strategy will be approached from the base up with small lifts at 300 – 500 mm thick.
    - The need for additional compaction and NAF placement to ensure PAF coverage on the outer edges during and after dozing will then be reviewed, particularly focussing on the outer edges.

  - Options to achieve additional compaction as required will then be assessed. Compaction on steep slopes can be challenging, and options such as the size of roller, type of roller and preferred strategy will be evaluated to determine the optimal approach.
  - Compaction rates and the geotechnical/geochemical integrity will be progressively workshopped with the EPA.

- Stage 3: Once the final landform is formed and shaped, the outer layer will be placed. Depending on the results of erodibility assessments for the topsoil to be placed, the outer layer may be a mix of D&B material and topsoil, or soley topsoil. Stage 4: Prior to revegetation, deep ripping to a depth of approximately 0.5 m is currently proposed, this ripping is to be undertaken either on the contour or with a slight gradient towards the drains (but less than 2 per cent). The site will then be handed over to the rehabilitation team for placement of ameliorants.

Vehicles shall traverse the access road and utilize the turnaround bay to dump spoil. The movement of spoil from the Talbingo construction area to the GF01 PSE will be internal to the site and will involve no movement of material along the state/classified road network. The spoil material will be placed in benches typically 5 m high and nominally compacted by the trafficking of the surface. Benches will be places allowing access up into the valley. The haul road zig zags up the front of the benches at a slope of around 1V:10H. The benches will then be dozed down to form the final surface.

As the spoil area is built up, the diversion drain shall be progressively raised to open up a greater area. Cut-off drains shall be implemented at stages throughout different stages of placement by building ramps around the outer edges. Compaction will be performed and tested at intervals to ensure anticipated compaction results have been achieved.

Spoil will be generated 24 hours per day; it is anticipated that 24-hour dumping operations will be utilised. However, the maximum import of spoil into GF01 is approximately 1,500 m^3 per day. It is anticipated that 12-hour compaction operations are sufficient to spread and compact this volume of spoil.

The final spoil layer will be shaped and potentially capped with a 1 m layer of coarser D&B material prior to placing topsoil. The final surface will then be ripped approximately 0.6 m deep by a dozer to maximise ingress prior to vegetation establishing. Methods for surface preparation for rehabilitation, including shaping of swales and drains will be included within the Rehabilitation Management Plan.

Lighting will be set up along the haul route and in the dumping area as required. This will allow for safe, continuous operations throughout the night hours. All lighting will be in accordance with the Approval and the *Dark Sky Planning Guideline* (DPE 2016).

The spoil area shall be shaped from the top-down. Typical staging drawings for this are presented in Figure 4-1. These are conceptual sketches which demonstrate where the reshaping is conducted once GF01 has been filled. Currently, it is anticipated that each layer would be shaped to final geomorphic design as it has finished with the exception of the access ramps, which are anticipated to be shaped in final closure.

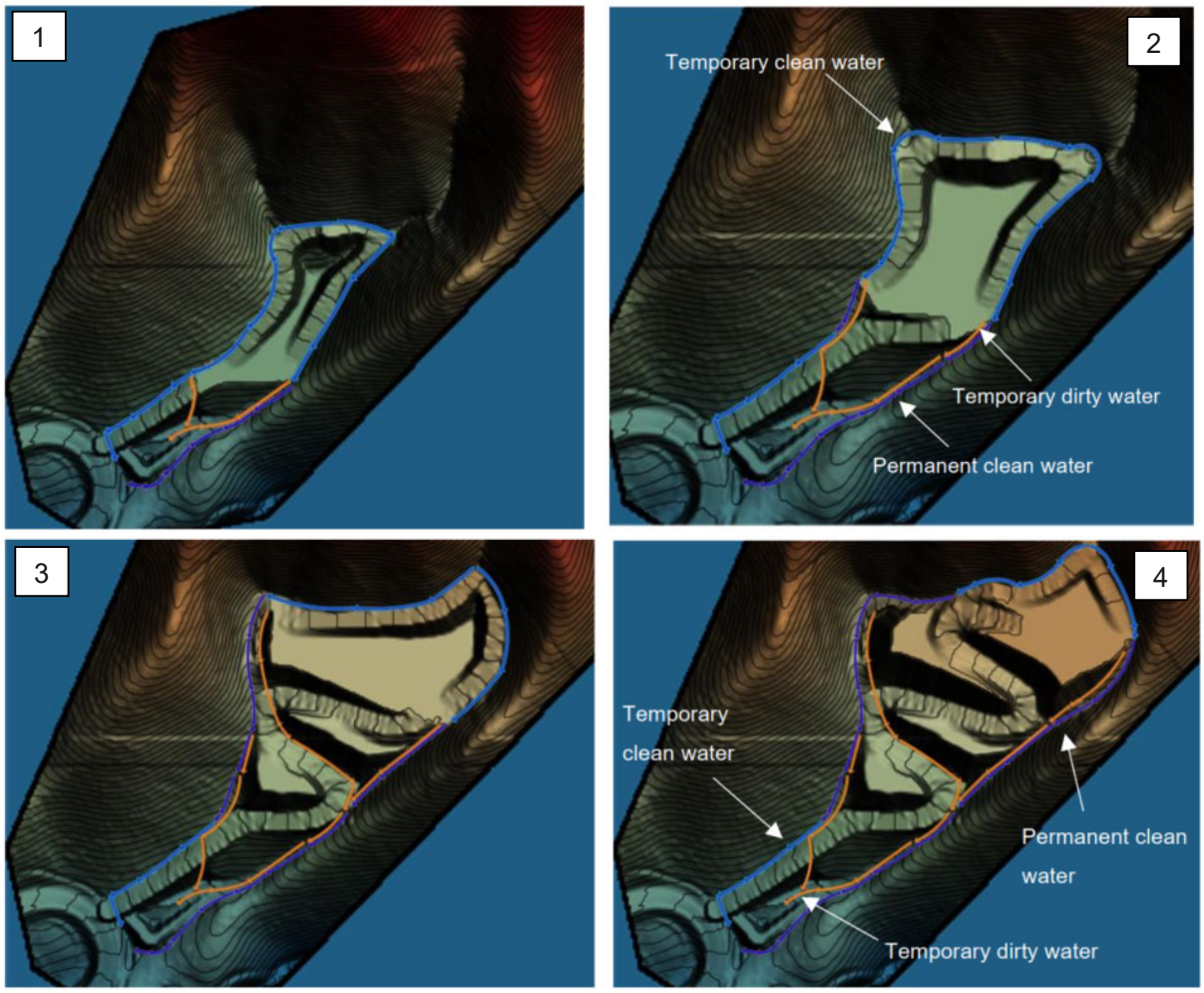


Figure 4-1 Indicative construction sequencing

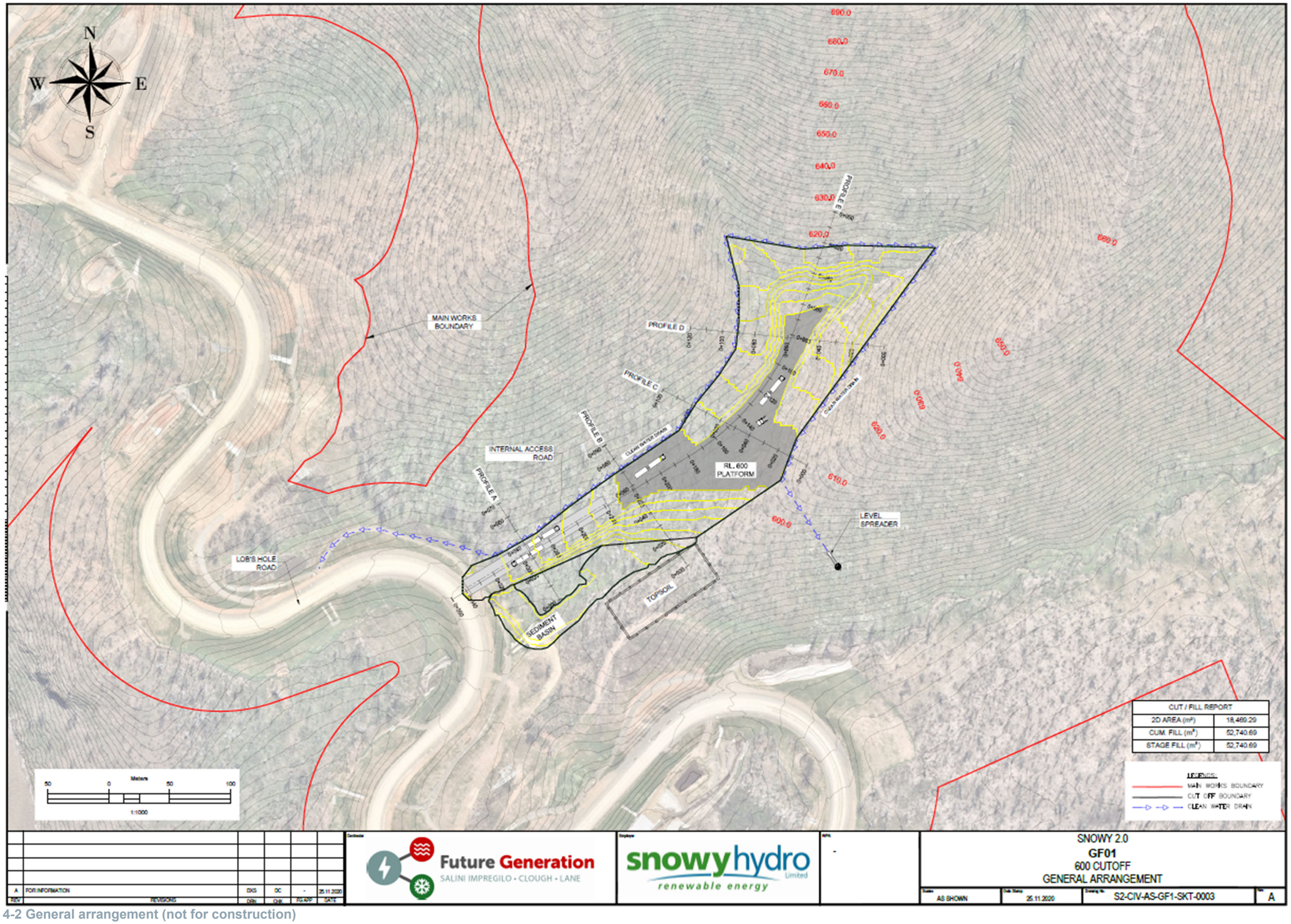


Figure 4-2 General arrangement (not for construction)

4.2. Rehabilitation

On completion of the construction works, the permanent structure will be rehabilitated consistent with project approval requirements (Schedule 3, Condition 9 and 10) and the Rehabilitation Management Plan. For other areas which were only required temporarily for construction, the site will be decommissioned, appropriately land-formed and planted consistent with project approval requirements (Schedule 3, Condition 9 and 10) and the Rehabilitation Management Plan. The GF01 Spoil Emplacement area has been designed to minimise erosion and provide landforms suitable for rehabilitation. This includes minimising the extent of run-on from adjacent upstream catchments. The Rehabilitation Management Plan is currently being prepared. A Topsoil Strategy is presented as Appendix B of the Spoil Management Plan that outlines rehabilitation principles.

Suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting will be provided at around 200 metres measured on the slope, or as approved by NPWS, in accordance with Schedule 3, Condition 6.

All areas will be left in a stable and safe condition, consistent with project approval requirements (Schedule 3, Condition 9 and 10) and the Rehabilitation Management Plan.

The Rehabilitation Management Plan will be implemented and will include measures to minimise:

- loss of soil;
- loss of organic matter and nutrient decline;
- soil structural decline; and
- compaction.

Note that the confined space available at GF01 means that the entire landform will need to be constructed with benches prior to dozing down of the outer surface. This is because flattening the benches earlier would either block or remove part of the haul road which winds its way up the surface and is very constrained. Effectively there will not be any progressive rehabilitation on GF01 until emplacement is completed due to the confined space available and the need to doze down the outer surface.

Depending on the erodibility and dispersity of the material, a layer of D&B material will be placed as a protection layer.

Following completion of the spoil emplacement, the PSE will be left in a condition that is safe, suitable and non-polluting as well as being suitable for the emplacement area to sustain target PCTs. The requirements for PSE handover, including required depths of surface materials such as topsoil will be established and approved within the Rehabilitation Management Plan, in accordance with Schedule 3, Condition 9 and 10.

4.3. Topsoil strategy

Topsoil will be stripped from the footprint and stockpiled along the ridge just to the east of GF01 as per Figure 4-2. Topsoil will be screened or sorted to remove stumps, roots, clay lumps or stones and stockpiled no higher than 2.5 m to minimise the risk of compaction and to maintain the viability of the spoil seed bank. Topsoil will not be compacted so as to minimise soil structural decline. Subsoils will also be maintained following stripping and managed as follows:

- Subsoil will be removed and stockpiled separately from topsoil
- Areas will be compacted to an appropriate density following backfilling with subsoil
- Excess displaced subsoil (e.g. on trenches) will be prevented from mixing with topsoil;
- Excess subsoil will be stockpiled separately for disposal/re-use by appropriate methods. This may include burial in voids, or, if tested and found suitable, as fill; and

- Inspections for dispersion and erosion of subsoil stockpiles will be undertaken, particularly on moderately dispersive soils. Suitable measures will be applied to reduce erosion potential as required.

Prior to reuse of topsoil, the soil will be tested by a NATA accredited laboratory to ascertain its suitability for use in revegetation works. The soil test certificate will contain the date of testing and details of the types of tests undertaken and their results, including cation analysis, pH values, salt content, particle analysis and any recommendations on the use of the topsoil. If the soil test certificate indicates any stockpiled topsoil to be unsuitable for use in revegetation works, the measures recommended in the soil test certificate to improve the stockpiled topsoil will be implemented as agreed to by Snowy Hydro and NPWS. To assist in preventing possible dispersion of soilborne pathogens, topsoils will be used in the general area from which they were sourced where possible.

The full Topsoil Strategy is presented in Appendix B of the Spoil Management Plan. Further criteria for the surface of the PSE will be described in the Rehabilitation Management Plan.

4.4. Key risks for the successful completion and contingency measures

The key risks and contingency measures relevant to the transition of GF01 as a designated permanent spoil emplacement area are provided in Table 4-1 below.

Table 4-1: Key risks and contingency measures for successful completion of GF01 emplacement area

Risk	Contingency
The works deviate from the design criteria specified.	The design criteria form the Basis of Design (BoD) and these will be used to ensure the achievement of the objectives. Measurement tools are in place to ensure the construction does not deviate from these design criteria. This will be managed through the FGJV technical team design review process. Where concept design changes or deviation from the design criteria is expected, agencies will be consulted.
The timing of construction stages results in insufficient or excessive spoil volume being available for development of the final landform.	GF01 is to be utilised for on-land material placement before there is access to the other emplacement areas. Should less material be placed into GF01 than expected, the landform can be constructed to a lower level or with flatter slopes.
Material placed into GF01 contains contamination (other than PAF and NOA material).	Respond to incidents as per the Unexpected Finds Protocol and Section 6.6 of the Spoil Management Plan.
Temporary foreign or unsuitable objects prevent effective filling and / or compaction	Ensure only spoil is placed in the area. Undertake inspections of spoil being laid and compacted. Retain records. These are considered “business as usual” controls.
Soil and water impact(s) during construction	Develop and maintain specific erosion and sediment control plans throughout construction based on risk for each of the spoil layers. Implement and maintain the controls as specified by the erosion and sediment control plans.
GF01 design is modified, and this results in changes to the landform’s future intended use, or approved form.	Check any changes to the GF01 design against criteria and objectives in the design for the final emplacement area, the Rehabilitation Management Plan and the Recreation Management Plan. Any changes required need to align with the currently proposed outcomes.
Rehabilitation is inadequate and does not achieve the required outcomes	Ensure that the Rehabilitation Management Plan is followed, including requirements for topsoil placement and surface finishing prior to rehabilitation, ensuring a successful handover.
Volumes of topsoil are inadequate	Topsoil volume requirements will be calculated and if there is not enough topsoil within the site that can be reused, topsoil and other required materials may be ordered from an external source to meet the demand.
Material placed has a higher risk of erosion than expected.	Although an outer topsoil layer will be placed over the excavated tunnel material, there is the risk that the TBM material will be highly erodible due to the possible percentage of silt sized particles. It may be necessary to place a layer of coarser D&B material over the final surface before topsoiling. The surface will then be ripped to increase infiltration and form a coarser final surface.
PAF presence	To be treated as per characterisation program (Appendix A of the SMP) and the Lobs Hole Material Characterisation Procedure outlined in Attachment A of this plan. Site specific controls including compaction rates, water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management and will be monitored under the Project EPL.

Risk	Contingency
Rock drainage lines not constructed correctly or rock too small and experiences erosion.	Ensure robust rock sizing for drainage lines, use of suitable rock with the correct grading, and proper construction controls. Implement and maintain the controls as specified by the erosion and sediment control plans.
Soil and water impact(s) during removal of controls	The basin can remain in place until rehabilitation is completed and an acceptable water quality achieved.
Long term stability not demonstrated	Undertake LEM to confirm long term stability and address any areas of higher erosion risk.
Climate change changing the occurrence of extreme events	Design, including rock armouring, accounts for the 1% Annual Exceedance Probability (AEP) risk, or a 1 in 100 year Average Recurrence Interval (ARI) storm event.
Leachate from the spoil emplacement	A spoil characterisation program has been prepared involving XRF, NAG suite analysis, pH and EC screening and validation testing by a NATA accredited laboratory (Appendix A of the SMP) to ensure material is neutralised prior to placement. A leachate basin will be constructed on site and tested for potential contamination prior to reuse on the stockpile. The basin will be sized to be over 85th and 5 day and will include no spill way, to maximise containment. Attachment A – GF01 Material characterisation program outlines the steps to ensure material neutralisation and actions in the circumstance contamination is detected. If water quality in the leachate basin shows compounds of concerns, testing on the spoil emplacement will be carried out to determine the source of the compounds of concern e.g. test pits / bore holes. Once the source has been determined, the material will be treated to ensure neutralisation. I.e. excavate and treat with lime, or inject a lime slurry. Kinetic testing as it becomes available will be used to ascertain the rate of reactivity of the spoil material and the appropriate treatment measures. Site specific controls including compaction rates, water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management and will be monitored under the Project EPL.
Neutral mine drainage	Kinetic testing has been carried out to understand the reactivity of the excavated rock. The outcomes will be used to better understand the reactivity of sulfides in excavated rocks, the release rates of contaminants, and the water quality evolution in response to long-term oxidation and weathering that may affect the design of the final landforms and the quality of surface and groundwater. Site specific controls including compaction rates, water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management and will be monitored under the Project EPL.

Note: The key risks and contingencies relate only to the transition from GF01 as a land-based gully between Ravine Bay and Lobs Hole to the GF01 permanent emplacement area as a final landform.

4.5. Completion criteria, performance indicators and criteria for triggering remedial action

Using the design approach described in Section 3 of this plan, Future Generation has developed designs for GF01 that satisfy the requirements from infrastructure approval Schedule 3, Condition 6 (Table 2). The outcomes are detailed below.

Completion criteria for the whole of project have been developed, and those relevant to landform design have been identified and are presented in Table 4-2. These criteria will form the basis of specific landform design criteria used to measure achievement of the objectives listed in Table 1-2. This will be an iterative process informed by the design criteria in Table 3-1 and continually assessed and revised as the design progresses.

The completion criteria will also be aligned with the existing environmental impact register in the Environmental Management Strategy for the Main Works phase where relevant and practical (FGJV, 2020a).

Table 4-2: Completion Criteria

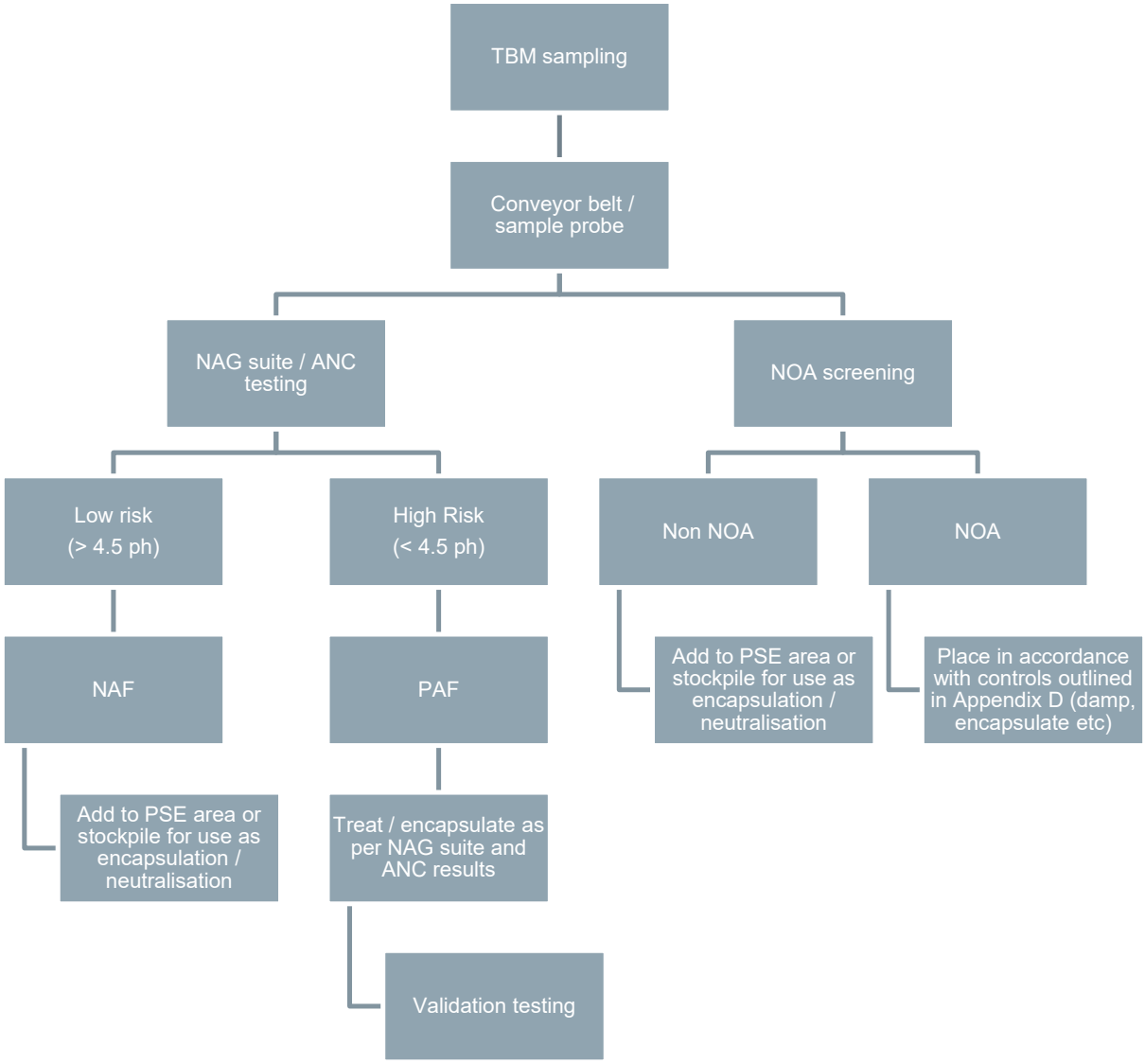
Aspect	Objective	Performance Indicators	Measurement Tools
Final landforms are compatible with the landscape	• As natural as possible, including minimising the use of linear or engineered structures. • Sympathetic with the landforms of the surrounding area, particularly from a visual, water management and ecological perspective. • Minimise the use of large rocks in the drainage lines (taken to be rocks typically with a D50 or median diameter of over 600mm in diameter).	• Final landform is representative of typical landforms in the area (but still appropriate to the materials on the outer surface). • Rocky drains blend into the overall landscape	• Visual assessment via 3D models. • Long sections and cross sections show smooth integration with adjacent natural surface. • Max rock size to be appropriate to the channel width.
Landforms are erosionally stable	• Suitable drainage density to limit overland flow lengths. • Safe, long-term and non-polluting. • Integrate the drainage of the emplacement area with the surrounding drainage network, including any upstream flows and residual run-on water. • Create natural drainage lines that are long-term sustainable having regard to the selection of suitable underlying materials, including rock sizing and grading. • Minimise valley infill. • Minimise the concentration of water on landforms unless this is consistent with accepted drainage density and geomorphic design practices. • Minimise changes to stream power and velocities above and below the landforms.	• Soil loss range of between 5 and 20t/ha/year measured at any time within the next 500 years, but with a target overall soil loss measured in the long term of less than or equal to 10t/ha/year. This value is subject to review during the use of an LEM to ensure it is reasonable for a long-term stable surface in this location. • Erosion/deposition processes within parameters of surrounding landscape and similar landforms relative to materials present	• As built design reports including erosion risk assessment (qualitative). • LEM (such as SIBERIA or CAESAR) will confirm acceptable future outcomes. This will be a requirement for the regulator to demonstrate long term sustainability and compliance. • While we would normally benchmark acceptable erosion rates against natural landforms of similar materials within the existing landscape bounds, this is unlikely to be practical as the material being placed differs from the dominant landforms of the KNP. We propose to use generally accepted erosion rates as indicated in the completion criteria together with a review of the landform performance as determined by the LEM.
Landforms are geotechnically stable	• Ensure placed material for the landform is stable geotechnically by ensuring slopes within the final surface are appropriate to the materials being used (excludes material underlying the PSE).	• Slopes to be geotechnically stable as assessed by a competent geotechnical engineer. • Any slopes with a lower factor of safety to require individual sign off based on a risk assessment for that feature.	• Slope stability within the landform itself. • Most of the landforms are inherently stable if the founding conditions are adequate because the slopes are typically flatter than 1V:3H, although there are some localised areas slightly steeper than this primarily at GF01.

Aspect	Objective	Performance Indicators	Measurement Tools
	• Ensure overall geotechnical stability considering the strength of materials underlying the PSE, bedding angles, and the possible impact of groundwater on the overall stability.	• Overall landform to be geotechnically stable as assessed by a competent geotechnical engineer. • Any overall landforms with a lower factor of safety to require individual sign off based on a risk assessment for that feature.	• Slope stability analyses for the overall PSEs including the footprint and accounting for groundwater conditions
Landforms are appropriate for intended land use	• Landform to be safe for access • Provide suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting to allow for spraying from vehicles (at around 200 metres measured on the slope, or as approved by the NPWS) • Minimise steep slopes that will be difficult to access and maintain (such as slopes over 18deg (1V:3H)).	• Landform to meet capability classes. • Slopes to be no steeper than 18deg (1V:3H) except where steeper slopes are required to tie into the existing natural landform. • Access tracks to be left in the landform.	• Land capability assessment to be undertaken where needed – in this environment this may focus more on the soil capping and revegetation than the landform itself. • Slopes and access to be documented in the design report.
Landform to be suitable and safe for access	• Recreational facilities and use must be consistent with the approved Recreation Management Plan.	• Requirements of Recreation Management Plan to be applied where relevant to the landform.	• Document to include details on how the requirements of the Recreation Management Plan have been addressed.
Landform to limit impacts on water quality	• Minimise the generation and dispersion of sediment in the Talbingo Reservoir, Tantangara Reservoir or other waterways. • Outer surface to be geochemically benign to not impact on water quality in the reservoirs. • Groundwater ingress to be managed where needed to limit impact on water quality.	• Surface water quality from runoff off the landforms to remain within the agreed parameters. • Groundwater associated with perched aquifers flowing on to surface of landforms to be incorporated into the landform surface water management.	• Design reporting and refinement. • Design report to document sediment control measures such as sediment ponds immediately downstream of the landform. • Design report to flag construction issues and management as they arise. • Monthly EPL monitoring downstream of emplacement area. If required, and in accordance with Appendix A, Annexure A of the Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107-F), Trigger Action Response Plans will be followed.

Aspect	Objective	Performance Indicators	Measurement Tools
Landform revegetation	• The final surface of the landform must be long-term sustainable, including sufficient topsoil (or some other suitable growth medium and amelioration, if required) to maintain a soil water profile and sustain vegetation. • Maximise the revegetation of the final surface. • Native vegetation and habitat must be consistent with the approved RMP	Revegetation performance indicators to be detailed in the Rehabilitation Management Plan.	Revegetation measurement tools to be detailed in the Rehabilitation Management Plan.
Landform constructability	The emplacement area must be constructible having regard to the: • construction methodology accounting for PAF and NOA materials management • availability and storage of suitable materials, including topsoil. • erosion and sediment control. • access. • initial shaping of the natural ground. • shapes and benching. • progressive rehabilitation.	• Landform design to include areas for topsoil storage. • Adequate temporary sediment control measures to be provided where needed. • Temporary benches for the final surface to be provided. • Design to allow for safe access during construction, and progressive rehabilitation.	Design report to document: • Areas designated for PAF and NOA materials outside of drainage highlighted in the design report. • Areas of the landform flatter than 1V:4H to be highlighted in the design report for topsoil storage. • Temporary features including sediment control and benches. • High level access planning.

ATTACHMENT A – GF01 MATERIAL CHARACTERISATION AND HANDLING STRATEGY (TBM)

Indicative Material Characterisation and handling strategy – TBM / Manual



Note:

- NAG suite testing will be carried out on site from 30 June 2022. ANC testing will be carried out on site from 31 December 2022.
- NOA screening will be carried out in areas of confirmed or potential NOA.

APPENDIX H – RAVINE BAY EMPLACEMENT AREA

TO BE DEVELOPED AND SUBMITTED FOR APPROVAL PRIOR TO COMMENCING CONSTRUCTION

APPENDIX I – TANTANGARA EMPLACEMENT AREA

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX I – TANTANGARA EMPLACEMENT AREA

S2-FGJV-ENV-PLN-0019

SEPTEMBER 2022

Schedule 3, Condition 7(e) of the Infrastructure Approval requires detailed plans for each of the permanent spoil emplacement (PSE) areas to be prepared prior to placement of material at each site. This plan has been prepared to address these requirements of Condition 7(e) for the Tantangara (PSE) area

Revision Record

Rev.	Date	Reason for Issue	Responsible	Accountable	Endorsed
I	07.09.2022	Updated based on DPE comments	Jessica Adams	Ellen Porter	Massimo Franceschi

Document Verification

RACIE Record

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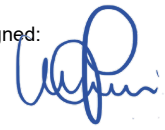
E ndorsed:	Name: Massimo Franceschi Job Title: Project Director Signed:  Date: 06/09/2022

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Revision Tracking

Rev.	Date	Description of Revision
A	30.09.2021	Initial draft for Snowy Hydro review
B	06.12.2021	Draft for submission to agencies
C	25.02.2022	Updated to reflect NPWS, TfNSW and EPA comments
D	09.03.2022	Updated to reflect EPA comments and amended method of NOA extraction
E	14.04.2022	Updated to reflect DPE comments
F	25.05.2022	Updated to address DPE comments
G	08.06.2022	Updated to address DPE comments
H	22.07.2022	Updated to address EPA and NPWS comments
I	07.09.2022	Updated to address DPE comments

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1.1. Background

Schedule 3, Condition 7(e) of the Infrastructure Approval requires detailed plans for each of the Permanent Spoil Emplacement areas (PSE) areas to be prepared prior to placement of material at each site. This plan has been prepared to address these requirements of Schedule 3, Condition 7(e) for the Tantangara PSE area, including adherence to Schedule 3, Condition 4 and the design objectives in Table 2.

The Tantangara PSE area will receive spoil from the Tantangara Intake, Headrace Tunnel, Tantangara Adit, Tantangara Gate Shaft, Tantangara Camp, and the Tantangara Adit Portal.

The general location of Tantangara PSE is shown in Figure 1-1.

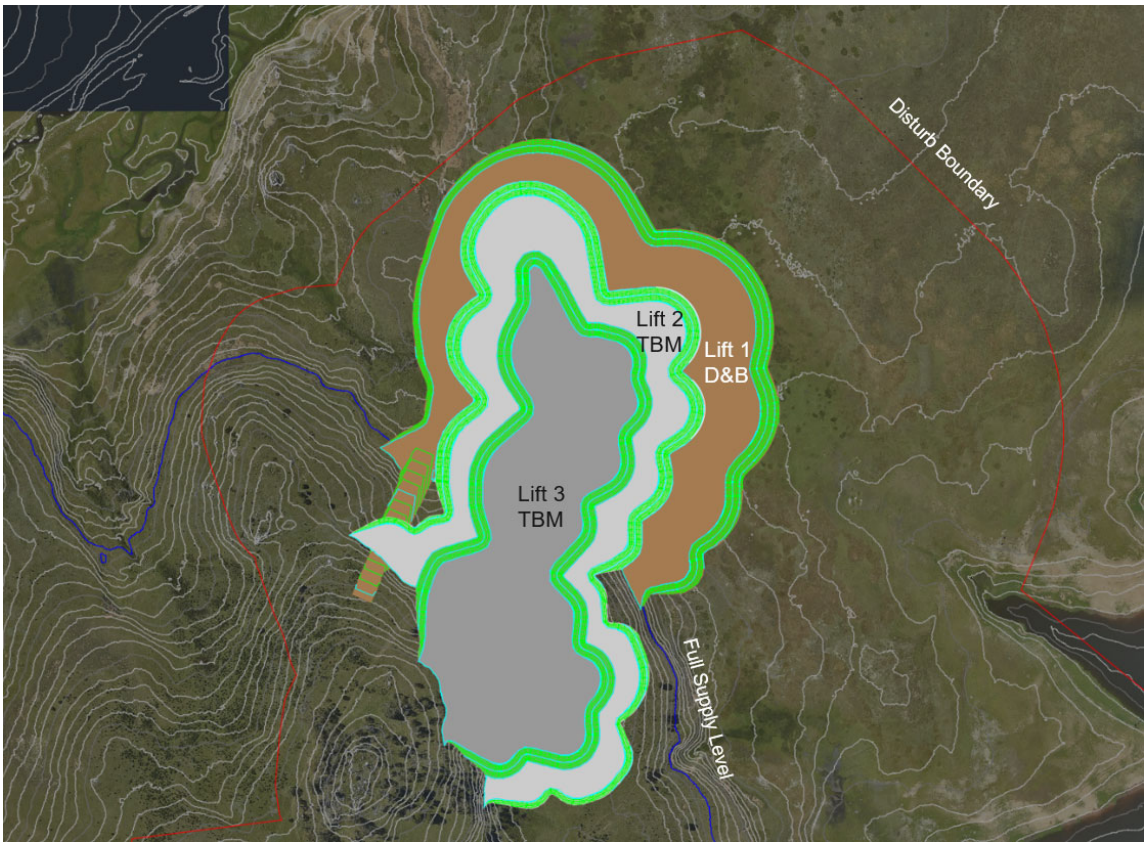


Figure 1-1 Tantangara PSE area location (Golder, 2021)

1.2. Requirements

Schedule 3, Condition 7(e) of the Infrastructure Approval requires detailed plans for each of the PSE areas to be prepared using both analogue and erosional-based methods. Plan requirements are provided in Table 1-1 below.

Table 1-1: Conditions of approval requirements

Requirement	Where addressed
Schedule 3, condition 7	

Requirement	Where addressed
(e) detailed plans for each of the permanent spoil emplacement areas that have been prepared using both analogue and erosional-based methods: these plans must:	
• describe how the development of each emplacement area would be co-ordinated with the rehabilitation of the site in accordance with the approved Rehabilitation Management Plan;	Section 4.2
• describe the measures that would be implemented to comply with the spoil management requirements in Condition 4 and the design objectives in Condition 6 (Table 2) of the Infrastructure Approval;	Table 4-2
• include a topsoil strategy outlining the measures that would be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target PCTs in the long term, having regard to the approved strategy in the Rehabilitation Management Plan;	Section 4.3
• identify the key risks for the successful completion of each emplacement area and the contingency measures that would be implemented to address these risks; and	Table 4-1
• include detailed completion criteria and performance indicators for each emplacement area, including criteria for triggering remedial action (if necessary).	Table 4-2

The application of the design objectives from Schedule 3, Condition 6 (Table 2) of the Infrastructure Approval are set out in Table 1-2.

Table 1-2: Design objectives

Aspect	Objective	Notes
Landforms	As natural as possible, including minimising the use of linear or engineered structures	
	Sympathetic with the landforms in the surrounding area, particularly from a visual, water management and ecological perspective	The landform design has included potential for diversity of habitat. Ecological aspects are still being finalised and will be included in the Rehabilitation Management Plan.
	Suitable drainage density	-
	Safe, long-term stable and non-polluting	-
	Where feasible, gradients along the water line of the reservoirs that could be exposed under normal conditions (i.e. above the minimum operating level) must be suitable for safe recreational use and consistent with the approved Recreation Management Plan	Gradients have been flattened to 1V:7H and 1V:8H below Full Supply Level (FSL).
	Provide suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting with slopes typically spaced at around 200 metres measured on the slope to allow for spraying from vehicles, or as approved by the NPWS	Access tracks have not yet been indicated – these will be added during construction using the as-built surfaces. See Section 3.4 for ongoing NPWS access requirements.
Water management	Integrate the drainage of the emplacement area with the surrounding drainage network, including any upstream flows and residual run-on water	This applies to the edges of the PSE.
	Minimise downstream water flows and velocities with any changes to be quantified and addressed though suitable design	No downstream creeks. The Tantangara PSE sheds directly into the Tantangara Reservoir.

Aspect	Objective	Notes
	Minimise valley infill	Not located in a valley but adjacent to the Reservoir.
	Create natural drainage lines that are long-term sustainable having regard to the selection of suitable underlying materials, including rock sizing and grading	-
	Minimise the use of large rocks in drainage lines	-
	Minimise the concentration of water on landforms unless this is consistent with accepted drainage density and geomorphic design practices	-
	Minimise the generation and dispersion of sediment in the Talbingo Reservoir, Tantangara Reservoir or other waterways	Monthly water monitoring downstream of emplacement area will be undertaken in accordance with the project EPL. If required, and in accordance with Appendix A, Annexure A of the Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107-F), Trigger Action Response Plans will be followed.
Erosional stability	Minimise steep slopes, particularly slopes that will be difficult to access and maintain (such as slopes over 18 degrees or 1V:3H)	1V:3H slopes have been largely excluded. Approximately 0.3 ha or 1.2% of the site will be at or close to a 1V:3H gradient.
	The final surface of the landform must be long-term sustainable with sufficient topsoil (or some other suitable growth medium) to maintain a soil water profile and sustain vegetation	Topsoil (or other growth medium) requirements will be detailed in the Rehabilitation Management Plan.
	Maximise the revegetation of the final surface	
	Ensure areas subject to wave action are suitably protected or the slopes are flattened to limit wave action	Gradients have been flattened to 1V:7H and 1V:8H below Full Supply Level (FSL)
Land Use	Native vegetation and habitat must be consistent with the approved Rehabilitation Management Plan	This plan will be reviewed for consistency with the Rehabilitation Management Plan.
	Recreational facilities and use must be consistent with the approved Recreation Management Plan	This plan will be reviewed for consistency with the Rehabilitation Management Plan.
Constructability	The emplacement area must be constructible having regard to the: - availability of suitable material, including topsoil - erosion and sediment control; - access; - initial shaping of natural ground; - progressive rehabilitation; - shapes and benching; and - safety around water	-

2. DEVELOPMENT

Development of the emplacement area will occur over several years, with continual reference to and assessment against the design objectives described Table 1-2, using the design methodologies and criteria described in Section 3 and the completion criteria described in Section 4.

It is estimated that roughly 2.3 Mm^3 will fill the Tantangara PSE. Tantangara PSE will broadly be developed as follows (dates are indicative only and are provided to describe sequencing):

- Second Half 2022:
  - Pre-construction works including identifying environmental avoidance areas and marking them within the approved disturbance footprint.
  - Clean water diversion drains will be established, and appropriate sedimentation controls set in place.
  - The topsoil will be stripped and stockpiled temporarily in accordance with Appendix B and C of the Spoil Management Plan.
- 2022 to 2024:
  - Permanent placement of excess spoil from Tantangara Intake, Headrace Tunnel, Tantangara Adit, Tantangara Gate Shaft, Tantangara Camp, and the Tantangara Adit Portal in accordance with the strategies developed for the management of poor-quality materials.
  - Testing from probe drilling where spoil is sufficient
  - TBM spoil excavated, temporarily stockpiled at the portals and tested
  - Spoil will be transported to the PSE area and stockpiled until NAG suite / ANC measurements results are obtained
  - Spoil will be placed in accordance with the NAG suite / ANC results, including base-up thin layers to create benches that will be levelled
  - Progressive stabilisation throughout to minimise extent of exposed / unconsolidated materials. Depending on the erodibility and dispersivity of the material, a layer of D&B material will be placed as a protection layer.
- 2023 to 2024:
  - The material generated from tunnel boring machines (TBM) increases rapidly during this period, it is anticipated that all spoil will come out of the TBM Headrace Tunnel.
- 2024 to 2026:
  - Demobilisation of temporary topsoil stockpiles and infrastructure such as haul roads no longer required.
  - Construction of permanent placement formation and progressive rehabilitation commences in 2024 and continues to end of 2026.

The scheduling of placement is presented graphically in Figure 2-1 below.

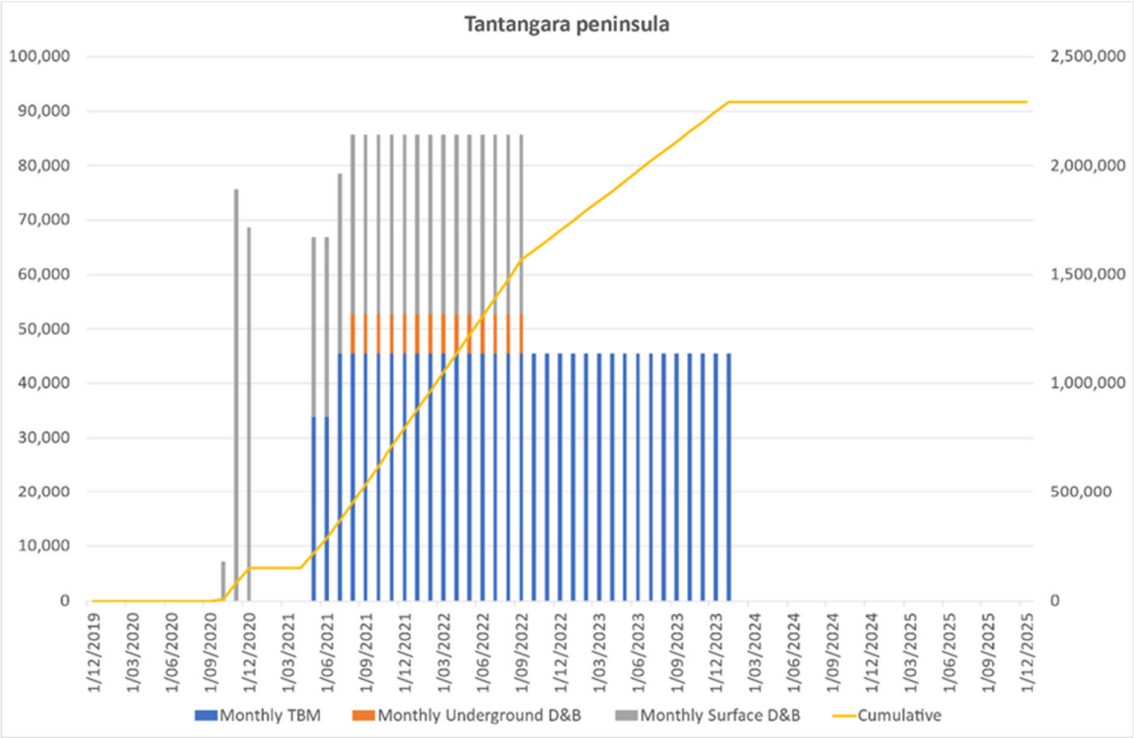


Figure 2-1 Planned monthly and cumulative placement of spoil at Tantangara PSE

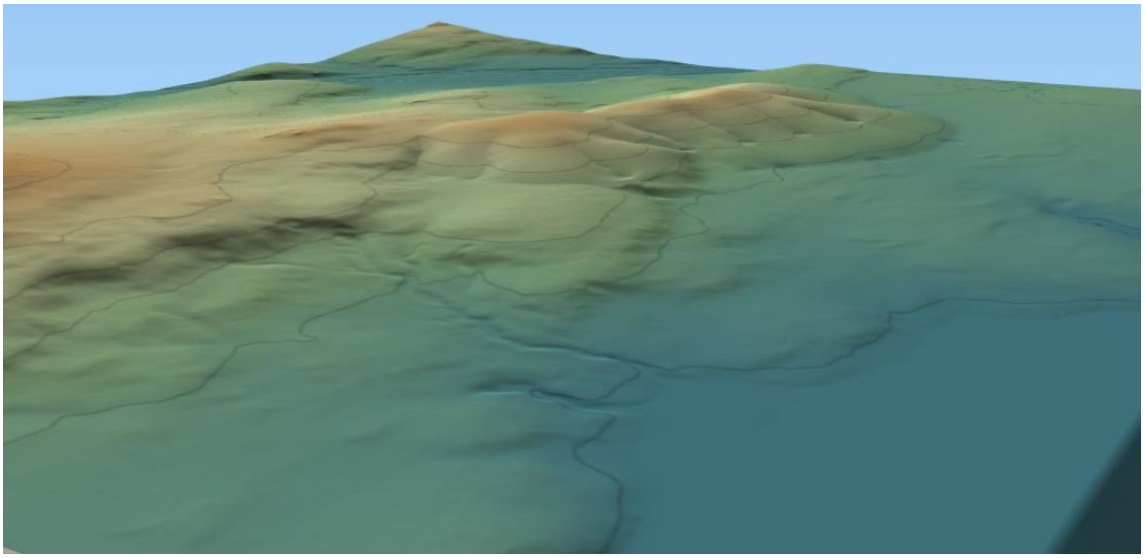


Figure 2-2 Indicative view from southeast of Tantangara PSE

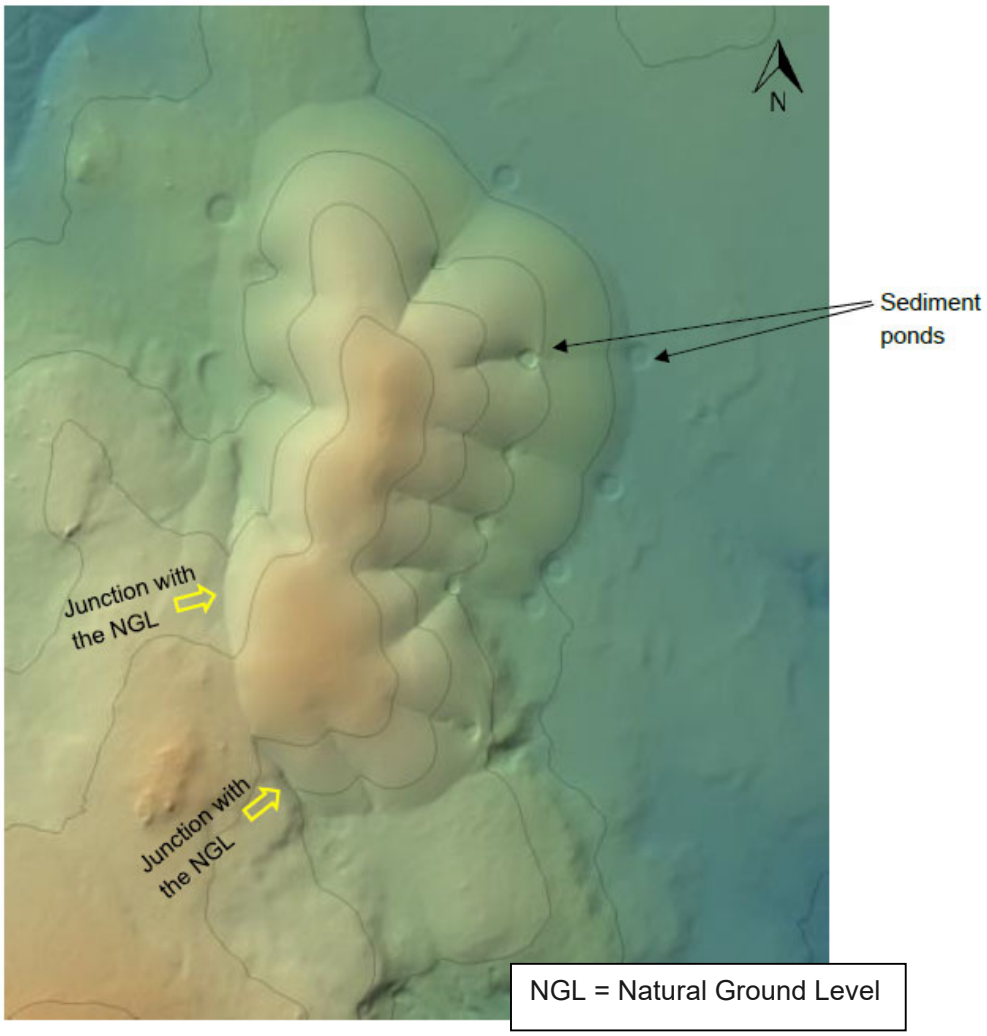


Figure 2-3 Indicative Tantangara PSE Layout

2.1. Installation of environmental controls

In accordance with the Biodiversity Management Plan (S2-FGJV-ENV-PLN-0028), pre-construction surveys and pre-clearing activities will be completed in order to facilitate the egress of fauna. Environmental avoidance areas will be identified and marked within the approved disturbance footprint, including the EIS boundary and the progressive disturbance footprint as staged clearing and grubbing is required.

A clean water network will be installed directing any surface water away from the construction area via a clean water diversion drain. The clean water diversion drain will consist of an earth bund. Sediment bearing flows from earth worked areas will be directed to the basins.

It is important to note that for much of the construction period the PSE will comprise a series of terraces linked by haul roads on to which material will be tipped and shaped. Drainage from the terraces will tend to be significant due to the compaction of material but will be managed by incorporating temporary ponds where these terraces shed water, typically at the toe of the ramps from one terrace to another. Temporary bunding will also be placed on the outer edge of the terraces to prevent uncontrolled overspill over the outer edges. At the point where the terraces

shed back to natural ground, water will either be directed to the ponds on the toe of the landform (Figure 2-3) or contained by temporary ponds within the disturbance footprint. All measures and controls implemented throughout construction including the basins, will be undertaken in compliance with the Surface Water Management Plan (SWMP) (S2-FGJV-ENV-PLN-0011) and at a minimum the Managing Urban Stormwater series (the Blue Book). A leachate detection program (S2-FGJV-ENV-PRO-0056) will be implemented which identifies the analytes, frequency and location of monitoring.

In accordance with the SWMP basins will be installed with a design rainfall depth of 85th percentile 5-day rainfall event as a minimum with consideration given to increasing basin size at locations where sufficient space is available and / or topography does not constrain the basin size. Where increasing the sediment basin size is not possible, a secondary bund will be installed downstream of the basin. The management of basins, including the treatment, reuse or disposal of basin water will be included in the relevant Tantangara spoil emplacement site procedures.

Sensitive Area Plans and Erosion and Sediment Control Plans will be prepared and implemented, consistent with the SWMP to manage specific environmental aspects at each of the Construction sites.

Ponds will remain in place until the site is rehabilitated such that the sediment loading, and suspended solids are suitable for discharge to the reservoir. Basins can then be removed or left to naturally fill with sediment.

To manage potential leachate seepage from the PSE, the Leachate Detection Procedure (LDP) will be implemented and followed (S2-FGJV-ENV-PRO-0057). The LDP was prepared in consultation with EPA who have since confirmed they are satisfied with the procedure. Monitoring via surface water and ground water sampling will continually assess if leachate is occurring from the spoil emplacement. The data and information gathered during monitoring will to feed into management processes that seeks to minimise the Project's impact on surface and groundwater. Any subsurface waters which come into contact with the spoil emplacement area will be treated as leachate. Management includes potential seepage and runoff being collected in a leachate basin downstream of the treatment emplacement area. Collected water will be tested for potential contamination which will be guided by the EPL. Water will be irrigated to the spoil emplacement area (to promote evaporation) or, where the water quality is not suitable for reuse, treated in the process water treatment plant. Should the water treatment plant have insufficient capacity to treat the water, the water will be classified and will be disposed on offsite at a facility licensed to accept the classification of water.

The above controls, and others deemed necessary, will be developed, in consultation with relevant agencies or as directed by the EPA through the Environmental Protection Licensing mechanism to ensure best practice emplacement area management and protection of water quality.

2.2. Expected geology

Tantangara is located on the Kiandra Tablelands. The HRT intersects several geological units, with the lithologies described in the Geotechnical Baseline Report for Snowy Hydro 2.0 (2019):

- **Kelly's Plain Volcanics (0 to 1830):** terrestrial volcaniclastic deposits, including dacite, ignimbrite, tuff, agglomerate, rhyolite, and porphyritic monzogranite.
- **Tantangara Formation (1830 to 7543):** deep marine siliciclastic deposits, including sandstone, siltstone, shale, and quartzite.
- **Temperance Formation (7543 to 8789 and 9459 to 9848):** deep marine volcaniclastic deposits with a variety of lithologies and several mafic intrusive units.
- **Boggy Plains Suite (8789 to 9459):** igneous intrusive rocks, including diorite with some altered dacite and pyroxenite.

- **Gooandra Volcanics (9848 to 15404):** deep marine extrusive volcanics that have been extensively deformed and affected by low grade metamorphism. Includes metabasalt, basalt breccia, amphibolite, chloritic schists, feldspathic sandstone.
- **Shaw Hill Gabbro (14260 to 14579):** a series of mafic to ultramafic igneous intrusions into the Gooandra Volcanics. Includes gabbro, diorite, pyroxenite.

The material extracted from the Tantangara HRT portal (up to chainage 15400) has a variable risk of AMD, with a mix of Non-Acid Forming (NAF) and Potentially Acid Forming (PAF) material. The NAF material, mostly found in the Boggy Plains suite, has enough Acid Neutralising Capacity (ANC) to neutralise sulfide oxidation. The PAF material is mainly found in the Gooandra Volcanics.

There is geochemical variation within each of the geological formations, as shown in Table 2-1 and this needs to be considered during operation.

Table 2-1 Count and average geochemical material characteristics

Unit	Sample count NAF/PAF	%S low/mean/high	ANC ($kg\ H_2SO_4/t$) Low/Mean/High	MPA ($kg\ H_2SO_4/t$) Low/Mean/High	Mean NPR
Kelly's Plain Volcanics	3/2	0.03 / **0.16** / 0.29	10.8 / **16.4** / 28.7	0.9 / **4.9** / 8.9	3.3
Tantangara Formation	25/6	0.005 / **0.12** / 0.63	8.3 / **13** / 21.6	0.2 / **3.6** / 19	3.6
Boggy Plains Suite	8/1	0.005 / **0.1** / 0.36	28 / **43.7** / 62	0.2 / **3** / 11	14.8
Temperence Formation	1/6	0.13 / **0.33** / 0.69	11 / **58.9** / 130	4 / **10.3** / 21	5.7
Gooandra Volcanics, Shaw Hill Gabbro	55/49	0.005 / **0.43** / 5	8.7 / **33.9** / 160	0.2 / **13** / 150	2.6

Notes: NAF/PAF ratios were calculated using a 0.2% total sulfur cut-off value.
MPA = Maximum Potential Acidity
Mean NPR values were calculated from mean ANC and MPA values

2.3. Kinetic Testing

Previous geochemical studies undertaken have shown that the material from the different units can potentially be reactive and leach acid, salinity and metals. Geochemical kinetic testing, using the humidity cell test (HCT), will be run on selected material from the key lithological units. The outcomes will be used to better understand the reactivity of sulfides in excavated rocks, the release rates of contaminants, and the water quality evolution in response to long-term oxidation and weathering that may affect the design of the final landforms and the quality of surface and groundwater.

These tests will be run for a minimum of six months before assessing the need to continue the test. Tests will be run on each of the seven lithologies of interest that have been identified in previous works. Lithologies with identified range of PAF and NAF materials (e.g., Gooandra Volcanics and Ravine Beds), will be better represented with two tests per lithology.

Samples to be used in the HCTs were selected by reviewing the geology database and existing borehole logs with a focus on the description of the lithological units and the sulfur content.

3. DESIGN

3.1. Landform Design Method

Landform design methodologies tend to fall into three distinct categories, including:

- Empirical type design approaches, using historically proven stable slopes or designs. These designs tend to use linear slopes combined with engineering interventions such as contour banks and/or drop structures.
- Analogue methods, typically using the characteristics of relevant stable natural landforms in the local environment and applying these characteristics to the design of new landforms of similar materials. Examples of this approach are found in publications by Swatsky and Beersing, or the GeoFluv™ methodology developed by Bugosh. The GeoFluv™ method has commercially available software (Natural Regrade®) in support of the design of non-linear landforms and typically incorporates drainage density, that is, the landform is designed with the appropriate number of dendritic drainage lines aligning with the upslope and downslope drainage lines.
- Erosional based methods that focus on the erodibility of soils to be used on the outer surface. At the simplest level, the approach may rely on methods such as the Revised Universal Soil Loss Equation (RUSLE). More commonly on larger projects in Australia, two-dimensional analysis such as that used in the Water Erosion Prediction Project (WEPP) model is used to develop a non-linear concave landform. Alternatively, more complex three-dimensional landforms with drainage lines can be developed using Landscape Evolution Models (LEM) in an iterative design approach.

The landform approach used by Golder is based on an approach developed in the Hunter Valley, NSW since 2012. The approach uses alluvial analogues for large catchment areas that are suitably flat to allow the use of these analogues, and the use of erosionally based methods for steeper sites. All of the Tantangara PSE is steeper than an alluvial analogue permits, and the design approach has been as follows:

- The use of dendritic drainage lines spaced at around 200 m to ensure an appropriate drainage density and to limit the overland flow distances.
- These concave drainage lines are located between convex ridge lines, and runoff tracking and erosion risk assessments are used in the design to facilitate long term stability for the vegetated final surface.
- The use of rock armouring in the drainage lines as and where required to limit the risk of erosion, typically based on the tractive stress, velocity and flow depth for the 100year Average Recurrence Interval (ARI) storm.
- The use of flatter slopes below the Full Supply Level (FSL) of the Tantangara Reservoir to limit the likely erosion due to wave action, as discussed further below.
- Erosion risk below FSL will be checked once grading of drill and blast material is established. Where modelling indicates a risk of erosion, further coarse rock would be applied if needed.

Importantly, while the initial erosional risk assessment in the design process can be based on experience obtained in the Hunter Valley, NSW, and adapted for the erosivity of the rainfall and typical vegetation of the KNP, more complex LEM modelling will be undertaken to demonstrate long term sustainability. Requirements for LEM modelling will be detailed in the Rehabilitation Management Plan.

As such, there is no threshold in terms of erosion risk that will drive the need for an LEM model such as SIBERIA or CAESAR, but rather the need to demonstrate long term sustainability to the Regulator. It is proposed that this work be undertaken once it is clear what material will be used

on the outer surface, which will be dependent on the availability of suitable topsoil or similar growth mediums.

3.2. Design Life

Most engineering structures are designed for a specific design life, beyond which the risk of failure increases significantly. Typically, the required design life is based on assessment of risk. It has been suggested (Chapman & Kemp, 2019) that landforms should be designed for a design life of between 300 to 1000 years (low to high risk respectively). This life span is particularly significant for designs that have the potential for significant risk once the design life is exceeded, such as landforms that have elevated that contain both runoff and sediment.

For geomorphic landforms designed using an alluvial analogue in the local environment, the expectation is that the landform will have no finite or defined design life. The natural analogues on which the design is based have developed over geological time periods (in some cases) and will have experienced numerous very extreme rainfall events. Provided the soils and rehabilitated vegetation of the analogue and rehabilitated landform are comparable, the risk of failure is likely to be 'low' and does not change with time for the same typical climatic conditions.

For landforms designed using a geomorphic approach (as the Tantangara PSE is), but incorporating the use of rock armouring, the risk of failure is again not expected to change with time, unless climate change or other factors substantially change the occurrence of extreme events. However, the design process needs to incorporate a specific extreme event to size the rock armouring, and in most mining applications in NSW, the rock would be sized for a particular storm event, typically the 1% Annual Exceedance Probability (AEP) risk, or a 1 in 100-year ARI storm event. While the risk of this event occurring in any one year does not change, the longer the structure is part of the landscape, the greater the probability that an event greater than the design event will occur.

A design event of around 1% AEP is considered reasonable as flood events of this magnitude generally cause widespread damage to both natural and man-made structures, and some risk of erosion under this event is considered reasonable.

As part of the design process two key aspects are evaluated:

- The landform surface not exposed to concentrated flow: As discussed above, for landforms designed using a geomorphic approach (as Tantangara is), erosion rates and risk should reduce with time as soils and vegetation establish and improve. However, actual life span and erosion rates will be assessed using LEM modelling with inputs including characteristics of the material used and the likely vegetation cover that will be achieved. The expectation is that the design life could be in excess of 500 years once substantive vegetation is achieved.
- Areas exposed to concentrated flow: These areas will be rock armoured and as indicated above, the proposed design is for a 1% AEP flood event. However, this includes a factor of safety, and the design intent is to limit velocities to approximately 3 m/s for extreme events so that vegetation can establish in the rock drains and further reduce risk of failure. This should allow the drains to also have a design life in excess of 500 years, although with a higher risk of failure immediately after construction when vegetation is still being established and higher runoff occurs from the PSE surface.

LEMs will be undertaken to demonstrate the overall design life of the landform to the Regulator, since the design methods used here cannot quantify the extent of erosion over long periods with a high degree of confidence.

3.3. Adopted Landform Design Criteria

The interpretation of the existing completion criteria into specific design criteria has been provided in Table 3-1. It is important that the design criteria be sufficiently detailed to ensure that the final

landform is able to be measured to demonstrate that it is meeting or has met the required objectives.

The design criteria has been developed to provide precise benchmarking for the purpose of achieving the design objectives in Table 1-2. Deviations from this criteria will trigger remedial action, described in Table 4-2 Where design changes occur, agencies will be consulted in line with Section 3.4 below.

3.4. Consultation and Revision

In accordance with the Main Works Approval, this Plan, and the governing Spoil Management Plan (SMP) must be prepared in consultation with the NPWS, EPA, Water Group, NRAR, NSW DPI and TfNSW, prior to approval by the Department of Planning Industry and Environment (DPIE).

At 6-month intervals from the date of approval of this Plan, this Plan will be reviewed, and relevant agencies consulted on progress and upcoming milestones for design and implementation including but not limited to design changes, internal procedures, placement methodologies and spoil characterisation procedures.

In addition, site specific controls including compaction rates and potential pollution controls for the protection of water quality will be developed in consultation with relevant agencies or as directed by the EPA through the Environmental Protection Licensing mechanism to ensure effective site management.

In accordance with Schedule 3, Condition 6 (Table 2) of the Main Works Approval, suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting will be provided at around 200 metres measured on the slope. NPWS will be consulted on permanent access routes and, if required approval will be sought where the 200-metre requirement cannot be provided, prior to finalisation of design.

During development and consultation of the Rehabilitation and Recreation Management Plans, this Plan will be reviewed for consistency and to ensure effective coordination of rehabilitation.

Following completion of the project and compliance with the Approval, PSEs will be handed back to NPWS for management. As a result, NPWS will be provided with relevant project documentation for information including, but not limited to, geotechnical assessments, erosion and sediment control plans and design drawings. Documentation will be provided following internal review processes.

Table 3-1: Landform design criteria

Objective	Design Criteria Proposed	Notes
Final landforms are compatible with the landscape	• Use of Golder software to smoothing surfaces generated by the Natural Regrade® software, or generation of surfaces similar targeted outcomes to Natural Regrade® but including tools such as erosional risk assessments based on the SIBERIA LEM, and flow tracking. This is then combined with flow modelling, using in-house software that incorporates some of the flood modelling routines used in the CAESAR-Lisflood LEM software. The final surfaces are then checked by LEM modelling and traditional flood modelling tools such as XP-RAFTS. • Use of armoring and size of rock to be limited to D50 of typically maximum of 600 mm, except where boulders are used as a landscape feature	Golder software and methodologies will produce a non-linear surface compatible with the local landscape.
Landforms are erosionally stable	• Use topography factor (catchment X slope ^n1) based on experience in the Hunter Valley adjusted for KNP conditions, n1 being the catchment area / slope relationship used in the SIBERIA equation. • Rock to be sized for the 1% AEP storm event. Consequences of larger storms to be considered and mitigated where practical. • Soil loss range of between 5 and 20 t/ha/year measured at any time within the next 500 years, but with a target overall soil loss measured in the long term of less than or equal to 10 t/ha/year. • Wave zone be evaluated for 1% AEP storm event including provision for wave run-up for the 10 per cent wind event (ANCOLD low risk guideline).	Soil loss range will be demonstrated using an LEM. Soils testing of the outer capping layer including flume tests will be undertaken as soon as appropriate soils are available.
Landforms are geotechnically stable	• Minimise extent of steep slopes to be 18° (1V:3H) or flatter for both ease of construction and geotechnical stability • Factor of safety locally on the landform >1.5 under long-term static loading or as motivated by geotechnical engineer. • Factor of safety overall including the underlying founding conditions and possible groundwater / fluctuating dam water levels >1.5 under long-term static loading or as motivated by geotechnical engineer. • Factor of safety ≥1.0 after a 1:10,000 annual exceedance probability (AEP) seismic event or as motivated by geotechnical engineer.	Geotechnical stability for the landform will be assessed by Golder using material properties provided. The overall landform stability will include an assessment of groundwater impacts and the fluctuating water levels within the reservoir where applicable.

Objective	Design Criteria Proposed	Notes
Landforms are appropriate for intended land use	• Provide permanent access tracks at spacing 200 metres or as approved by the NPWS • Minimise slopes over 18º (1V:3H).	Landforms to be rehabilitated with natural vegetation communities as described in the rehabilitation strategy. The extent of rehabilitation will also be dependent upon the final recreational use of the area. See Section 3.4 for ongoing NPWS access consultation requirements.
Landform to be suitable and safe for access	• Gradients along the dam water line to be typically 1V:7H or flatter so they can be safely accessed by boats in an emergency. This slope (1V:7H) will be validated in conjunction with the protective measures required for wave action. Approximately 1% of the Tantangara PSE water line has a gradient of greater than 1V:7H, located at rock lined drains. • NSW boat ramp facility guidelines indicates that "The slope of a boat ramp should be steep enough so that a tow vehicle does not need to enter the water to launch a boat and not so steep that the tow vehicle is unable to pull the boat and trailer safely from the water." In line with those guidelines, it is proposed that the slope of dedicated boat ramps be within the range of "1V:9H to 1V:7H with a preferred slope of 1V:8H" (NSW, 2015) • At areas of proposed recreational area, site specific requirements such as formation of attractive features in the landform to be considered.	Requirements of Rehabilitation Management Plan to be applied where relevant to the landform. Permanent boat launch areas considered in Tantangara Reservoirs. See Section 3.4 for ongoing NPWS consultation requirements.
Landform to limit impacts on water quality	• Provide a containment bench above the full supply level at Tantangara Reservoir to allow sediment control until fully rehabilitated. This bench will then be potentially reshaped to blend into the overall landform. • Sediment controls to be formed upstream of sensitive receptors. All of the landform drains to Tantangara sediment dams are located upstream of sensitive receptors. When the water level is below FSL but above the toe line, there is a portion of the landform that will drain directly into the reservoir, however this area is small.	Sediment dams are located on the toe of the PSE with sediment fencing and local channels used to ensure sediment control occurs upstream of the reservoir. When the toe is flooded, the sediment dams at the full supply level will act as the primary sediment control mechanism. Site specific controls including water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management.
Landform revegetation	Not detailed here – the surface will be revegetated with appropriate natural plant community types.	These issues to be addressed in the Rehabilitation Management Plan.

Objective	Design Criteria Proposed	Notes
Landform constructability	• Include areas 1V:4H or flatter where practical for topsoil storage. • Include temporary sediment control measures in the design sized based on the NSW Blue Book (Soils and Construction, Landcom, NSW). • Provide a bench just above the full supply level during construction to ensure dozers are not operating directly towards water without an adequate buffer zone.	Assess temporary construction access and provide temporary benching layouts. Ensure the design provides a surface that can be progressively rehabilitated where practical and when space permits e.g. outer edges.

4. FINAL PLACEMENT AND REHABILITATION

4.1. Transport

The Tantangara PSE area will receive spoil from the Tantangara Intake, Headrace Tunnel, Tantangara Adit, Tantangara Gate Shaft, Tantangara Camp, and the Tantangara Adit Portal. Tantangara spoil will be transported from its source destinations via truck using the internal road network only, no local or state roads will be utilised for the movement of Tantangara spoil.

Transport routes to the Tantangara Work Areas (A) to the Tantangara PSE (B) are summarised in Figure 4-1 below.

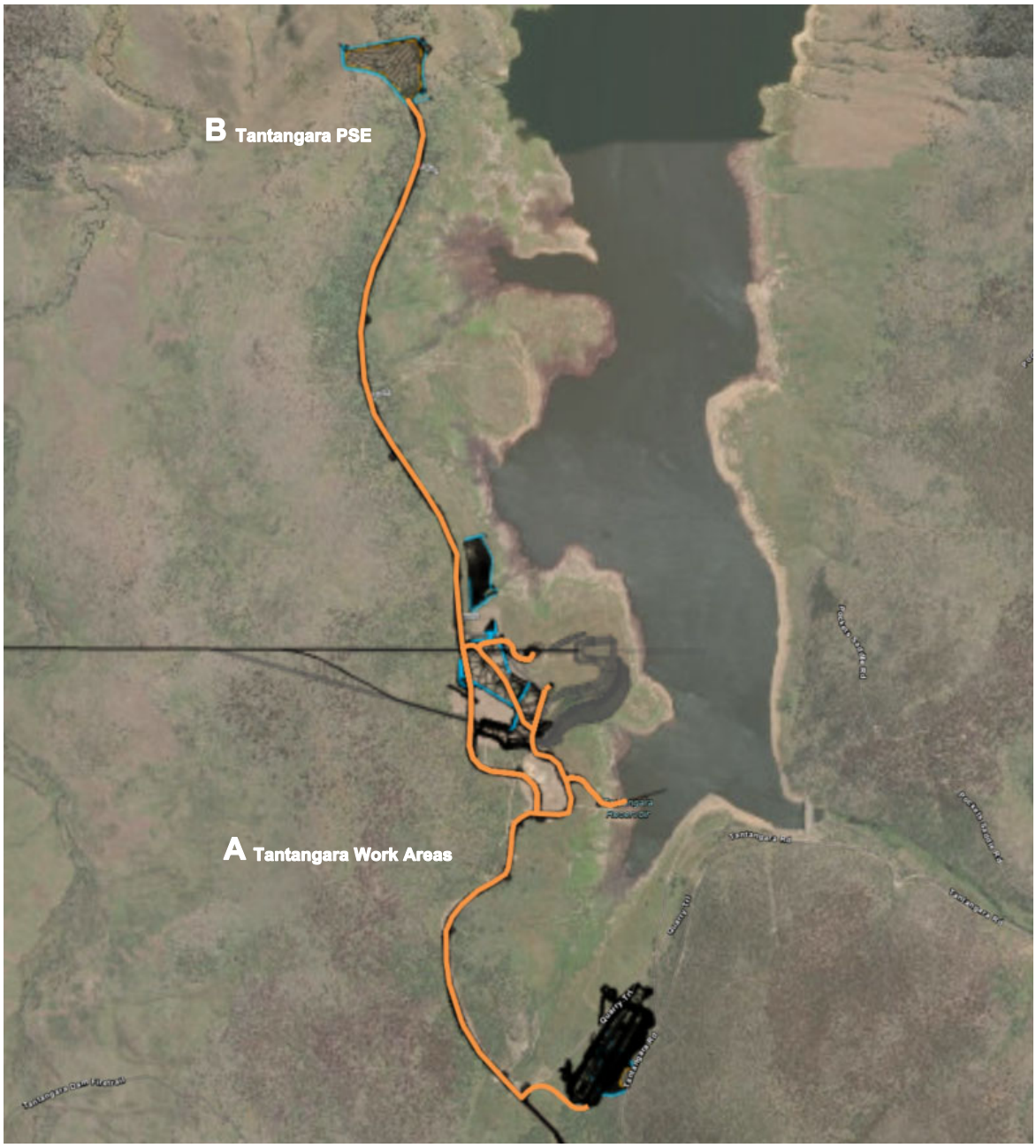


Figure 4-1 Tantangara PSE spoil transport routes

As described in the Main Works Transport Management Plan and Spoil Management Plan, Vehicle Management Plans will detail internal haulage routes, vehicle types and traffic controls to ensure the safe and efficient movement of vehicles across the project.

Spoil placement at the Tantangara PSE will not require water-based placement methods (barge etc.) and will be placed at the edge of the reservoir FSL using 'dry' land-based methods. Where marine support is required, appropriate controls will be used in accordance with the Marine Transport Management Plan, including Marine Traffic Control Plans (MTCPs) and Exclusion Zones. Where required, MTCPs will be developed in consultation with NSW Maritime, and Exclusion Zones will adhere to required licencing, notice and consultation.

Communication tools which will be used by the project to inform stakeholders and the community of periodic traffic related impacts, including the movement of OSOM vehicles and access impacts within the KNP. Further information is provided in the Transport Communications Strategy (Transport Management Plan Appendix E).

4.2. Placement

The Tantangara PSE is at the edge of the reservoir FSL, with a portion of the PSE located below the FSL of RL1229. While this means that the material placement below the FSL could potentially be directly into water, recent history suggests that the water level in the Tantangara Reservoir is generally kept well below the footprint of the PSE and even during wet periods, this is likely to be limited.

The Tantangara PSE has virtually no upstream catchment and is largely not impacted on by run-on from natural ground which also simplifies the material placement.

Early studies found that the higher fine content of the material excavated by the TBM could impact water quality in the Reservoir if tipped directly into the water. Because of this risk, only Drill and Blast (D&B) material will be placed below RL 1229. The placement strategy is therefore as follows:

- Appropriate sediment controls will be installed during periods of low reservoir levels to limit placement of D&B material directly into water and reduce sediment loading during placement. Watering monitoring points will be set up as per the Leachate Detection Procedure (S2-FGJV-ENV-PRO-0056).
- Initially D&B material will be placed into the footprint of the PSE that is below RL1229, gradually building up a base that is above FSL. During this time, any TBM material will be tipped on to the natural ground above the FSL.
- Once the D&B material is above RL 1229, the PSE above this level can be formed using TBM material.
- If there is insufficient space above RL 1229 for TBM material arriving at the PSE, material will have to be stockpiled. To avoid the need for stockpiling, the surface area of the D&B pad to RL 1229 will be maximised by initially placing material on the western side of the footprint where the natural ground is highest. Initial modelling of the time frame of the respective volumes of D&B and TBM indicates that stockpiling of TBM material should not be required.

It should be noted that there will be some settlement during construction which could impact the final level of the D&B pad, but this settlement is expected to be minor in the context of the placement levels.

The outer surface will be formed using NAF material to form benches tipped to angle of repose, these benches being temporary to facilitate access and construction.

Once the outer benches are at line and level, these can be dozed down to form the final surface. Note that the benches are non-linear so that the internal or concave corners (in plan view) become the drainage line, and the external or convex corners the ridge lines. Dozing down is then

undertaken perpendicular to the benches (i.e. straight down the slope) to form the geomorphic landform.

Figure 4-2 Indicative construction sequence, Tantangara PSE

Figure 4-2 represents the general arrangement of Tantangara PSE during construction. Tantangara PSE will be built-in stages as soon as the spoil becomes available from the various working fronts.

In general terms the construction of the embankments is a bottom-up approach undertaken with conventional earthmoving techniques. This will include:

- Stage 1: Trimming vegetation and topsoil where this is substantial, ahead of the placement. In some areas such as on the base of the landform, this stripping could be relatively thick, probably at least 150 mm depending on the value of the material in situ which might be very clayey and quite wet. Topsoil or other usable material will be stockpiled in accordance with the applicable procedures. Installation of clean water diversions around the emplacement area.

- It is noted that in some areas, especially after heavy rainfall, temporary springs may be present in adjacent formations. The reservoir water level is also often close to the invert level of the emplacement area, and water is found at a relatively shallow depth at Tantangara PSE. It is considered that this is largely a construction issue, with some of the D&B material expected to sink into some of the softer areas to form a stable terrace on which construction equipment can traverse. It is possible that rocky material may need to be placed over seepages to allow placement of fill over the areas of ingress.

  During the works, the need for any permanent drainage layers to manage a specific point of ingress will be evaluated, but it is largely expected that seepage that enters the PSE footprint will generally drain away on the interface with the overburden and natural ground.

- Stage 2: Spoil will be encapsulated in base-up horizontal layers. PAF material is expected to be placed into Tantangara, so it is important to limit air ingress. This will involve compaction. Material will be placed in benches which will then be dozed down. PAF material will be placed in thin layers, with thickness adequate to facilitate addition of alkaline additives or NAF material if and when required (300 mm – 500 mm thick). Blending will be carried out to convert PAF materials to NAF materials with a minimum ANC/MPA ratio of at least 3.

  NAF material may be placed in thicker layers adequate to facilitate suitable compaction and will be placed on standby to manage the neutralising processes, if PAF is present. The dozing down of a bench is a bulk earthworks process that cannot be easily done in thin layers with compaction which makes an alternative strategy important. It is proposed that:

  - The required density for the materials being excavated will be assessed in view of the geochemical data obtained for Tantangara, both at the current time, and as updated through ongoing geochemical testing.
  - On site, an assessment will be made of the compaction achieved through the trafficking of equipment used for the bulk shaping for areas that will not be reshaped through dozing. Where necessary, material that will not be reshaped through dozing will be compacted using an appropriate roller and layer thickness to achieve the required density. Note that these areas are largely within the Tantangara PSE and not on the outer edges where the air ingress will occur.
  - Placement strategy will be approached from the base up with small lifts at 300 – 500 mm thick.
  - The need for additional compaction and NAF material coverage for the outer edges during and after dozing will then be reviewed based on the density achieved on site, particularly focussing on the outer edges.
  - Options to achieve additional compaction as required will then be assessed. The outer slopes are generally much flatter than 1V:3H, and compaction would not be difficult, although the layer thickness control may require consideration. The size of roller, type of roller and preferred strategy will then be evaluated to determine the optimal approach.
  - Compaction rates and the geotechnical/geochemical integrity will be progressively workshopped with the EPA.

- Stage 3: The site will then be handed over to the rehabilitation team. Further detail of rehabilitation methodologies will be described in the Rehabilitation Management Plan. At this stage works still to be undertaken would include:

  - The rock drains would be shaped to ensure even widths and so that rock is bedded into the final surface. It will be necessary to remove any dispersive material that is within the trimmed final surface.

- Rock would then be placed into the drains as and where required, typically with a geotextile underlay.
- Depending on the nature of the material to be placed on to the outer surface, the final surface may be just topsoil, or some other combination of topsoil and D&B material or some other material. This would be placed in a layer on the outer surface.
- Ameliorants such as gypsum, compost and/or other additives would normally be placed prior to ripping of the outer surface.
- Prior to revegetation, deep ripping to a depth of around 0.5m is likely to be required, either on the contour or with a slight gradient towards the drains (but less than 2 per cent).
- The surface is then vegetated.

Vehicles will access the site via an access road and utilize a turnaround bay to dump spoil.

The management of runoff at Tantangara PSE is simplified by the absence of run-on from the natural catchment. However, water quality will be controlled at the lower benches and off the various ramps on the site prior to reshaping.

Lighting will be set up along the haul route and in the dumping area as required. This will allow for safe, continuous operations throughout the night. All lighting will be in accordance with the Infrastructure Approval:

- Schedule 3 Condition 17 (f); *minimise the light spill from night works, including using directional and LED lighting.*
- Schedule 3 Condition 53 (d); minimise the lighting impacts of the development, including ensuring that all external lighting associated with the development:
  - is consistent with the good lighting design principles in the Dark Sky Planning Guideline, (DPE 2016), or its latest version; and
  - complies with Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting, or its latest version

4.2.1. PAF Material

Details of the transport, emplacement, treatment and validation of PAF material are provided in the AMD Management Plan (SMP Appendix E) and onsite procedures including the Tantangara Material Characterisation Procedure. Further to characterisation and validation (Appendix A), PAF and/or NOA material will be placed in the central parts of the landforms, away from the final surface edges. The key objectives being:

- Achieving and maintaining an overall risk reduction approach by assigning PAF into the lower risk areas of the final landform;
- Reducing the potential need to rehandle material; and
- Providing a dedicated area in which to apply neutralising reagents (if required).

4.2.2. NOA Material

Details of the transport and emplacement of NOA material at the Tantangara PSE are provided in the NOA Management Plan (SMP Appendix D) and onsite procedures including the Tantangara Material Characterisation Procedure. NOA will be placed at the Tantangara PSE within a containment cell. The process for encapsulation and the management of material is provided in the NOA management plan and includes:

- In cell formations, NOA would be placed on top of an inert foundation layer comprising TBM spoil material. The NOA would be treated and / or covered to prevent fugitive emissions of dust and asbestos fibres.
- During NOA placement works, methods will be used to minimise the generation of airborne particulates, including enclosed conveying, temporary storing, treatment, and transport options with appropriate health and safety considerations.
- A highly visible marker layer would be overlayed on the NOA cells so that it can be positively identified in the future.
- A 3 m thick capping layer comprising a mixture of D&B and TBM material would be overlayed on top of the marker layer.

4.3. Rehabilitation

On completion of the construction works, the permanent structure will be rehabilitated consistent with project approval requirements (Schedule 3, Condition 9 and 10), the Rehabilitation Management Plan and Recreation Management Plan. For other areas which were only required temporarily for construction, the site will be decommissioned, appropriately land-formed and planted consistent with project approval requirements (Schedule 3, Condition 9 and 10),the Rehabilitation Management Plan and Recreation Management Plan. The Spoil Emplacement area has been designed to minimise erosion and provide landforms suitable for rehabilitation. This includes minimising the extent of run-on from adjacent upstream catchments. The Rehabilitation Management Plan is currently being prepared. A Topsoil Strategy is presented in Appendix B of the Spoil Management Plan that outlines rehabilitation principles.

Suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting will be provided at around 200 metres measured on the slope, or as approved by NPWS, in accordance with Schedule 3, Condition 6.

All areas will be left in a stable and safe condition, including access tracks which will be maintained, consistent with the Rehabilitation Management Plan required to be prepared in accordance with Schedule 3, Condition 9 and 10).

The Rehabilitation Management Plan will be implemented and will include measures to minimise:

- loss of soil;
- loss of organic matter and nutrient decline;
- soil structural decline; and
- compaction.

Small ponds will be installed above the FSL to limit sediment ingress to the Tantangara Reservoir from the shaped surfaces. The ponds are intended to function for the final rehabilitated surface, that is, capturing sediment from the shaped and topsoiled landform. Prior to final rehabilitation, runoff will pond on the temporary benches, and temporary measures will be required to ensure this water does not flow in an uncontrolled way to the Tantangara Reservoir.

While progressive rehabilitation is ideal to rehabilitate full sections of the landform (from toe to ridge) to avoid having temporary benches upslope of rehabilitated areas, rehabilitation is progressive from the toe moving upwards and the final dump levels are reached. The rehabilitation strategy at Tantangara will be dependant on how the actual volumes of PAF and NOA compare to the predicted volumes, which in turn will define which areas can be completed to final surface level first.

Following completion of the spoil emplacement, the PSE will be left in a condition that is safe, suitable and non-polluting as well as being suitable for the emplacement area to sustain target PCTs. The requirements for PSE handover, including required depths of surface materials such as

topsoil will be established and approved within the Rehabilitation Management Plan, in accordance with Schedule 3, Condition 9 and 10.

4.4. Topsoil strategy

Topsoil will be stripped and stockpiled to be retained for future use and rehabilitation.

Topsoil will be screened or sorted to remove stumps, roots, clay lumps or stones and stockpiled no higher than 2.5m to minimise the risk of compaction and to maintain the viability of the spoil seed bank. Topsoil stockpiles may be subject to application of weed-free mulch, from clearing activities on the project in the locality from which the topsoil was sourced (where possible), to manage nutrient decline. Topsoil stockpiles to be covered with weed-free mulch, jute mesh, geofabric or similar to assist with reducing temperature extremes and reducing weeds and helps to maintain its integrity for future use. Topsoil will not be compacted so as to minimise soil structural decline. Subsoils will also be maintained following stripping and managed as follows:

- Subsoil will be removed and stockpiled separately from topsoil
- Areas will be compacted to an appropriate density following backfilling with subsoil
- Excess displaced subsoil (e.g. on trenches) will be prevented from mixing with topsoil;
- Excess subsoil will be stockpiled separately for disposal/re-use by appropriate methods. This may include burial in voids, or, if tested and found suitable, as fill; and
- Inspections for dispersion and erosion of subsoil stockpiles will be undertaken, particularly on moderately dispersive soils. Suitable measures will be applied to reduce erosion potential as required.

Prior to reuse of topsoil, the soil will be tested by a NATA accredited laboratory to ascertain its suitability for use in revegetation works. The soil test certificate will contain the date of testing and details of the types of tests undertaken and their results, including cation analysis, pH values, salt content, particle analysis and any recommendations on the use of the topsoil. If the soil test certificate indicates any stockpiled topsoil to be unsuitable for use in revegetation works, the measures recommended in the soil test certificate to improve the stockpiled topsoil will be implemented as agreed to by Snowy Hydro and NPWS. To assist in preventing possible dispersion of soilborne pathogens, topsoils will be used in the general area from which they were sourced where possible.

The full Topsoil Strategy is presented in Appendix B of the Spoil Management Plan. Further criteria for the surface of the PSE will be described in the Rehabilitation Management Plan.

4.5. Key risks for the successful completion and contingency measures

The key risks and contingency measures relevant to the transition of Tantangara as a designated PSE area are provided in Table 4-1 below.

Table 4-1: Key risks and contingency measures for successful completion of Tantangara PSE

Risk	Contingency
Clearing and grubbing outside approved area.	Disturbance boundaries are set out on site with no-go areas demarcated.
The works deviate from the design criteria specified.	The design criteria form the Basis of Design (BoD) and these will be used to ensure the achievement of the objectives. Measurement tools are in place to ensure the construction does not deviate from these design criteria. This will be managed through the FGJV technical team design review process. Where concept design changes or deviation from the design criteria is expected, agencies will be consulted.
The timing of construction stages results in insufficient or excessive spoil volume being available for development of the final landform.	Sequencing is not relevant to Tantangara, and there is flexibility around landform volumes which can be increased or decreased fairly significantly by changing the slopes and adjusting the footprint.
Material placed into Tantangara contains contamination (other than the PAF and NOA material).	Respond to incidents as per the Unexpected Finds Protocol and Section 6.6 of the Spoil Management Plan.
Temporary foreign or unsuitable objects prevent effective filling and / or compaction	Ensure only spoil is placed in the area. Undertake inspections of spoil being laid and compacted. Retain records. These are considered ”business as usual” controls.
Soil and water impact(s) during construction	Develop and maintain specific erosion and sediment control plans throughout construction based on risk for each of the spoil layers. Implement and maintain the controls as specified by the erosion and sediment control plans.
Tantangara design is modified and this results in changes to the landform’s future intended use, or approved form.	Check any changes to the Tantangara design against criteria and objectives in the design for the final emplacement area, the Rehabilitation Management Plan, and the Recreation Management Plan. Any changes required need to align with the currently proposed outcomes.
Rehabilitation is inadequate and does not achieve the required outcomes	Ensure that the Rehabilitation Management Plan is followed, including requirements for topsoil placement and surface finishing prior to rehabilitation, ensuring a successful handover.
Volumes of topsoil are inadequate	Topsoil volumes requirements will be calculated and if there is not enough topsoil within the site that can be reused, topsoil and other required materials may be ordered from an external source to meet the demand.
Material placed has a higher risk of erosion than expected.	Although an outer topsoil layer will be placed over the excavated tunnel material, there is the risk that the TBM material will be highly erodible due to the possible percentage of silt sized particles. It may be necessary to place a layer of coarser D&B material over the final surface before topsoiling. The surface will then be ripped to increase infiltration and form a coarser final surface.
PAF presence to be managed	To be treated and placed in accordance with Appendices A and E of the SMP and the Tantangara Material Characterisation Procedure outlined in Attachment A of this plan. Site specific controls including compaction rates, water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management and will be monitored under the Project EPL.

Risk	Contingency
NOA presence to be managed	To be treated and placed in accordance with Appendices A and D of the SMP and the Tantangara Material Characterisation Procedure outlined in Attachment A of this plan.
Rock drainage lines not constructed correctly or rock too small and experiences erosion.	Ensure robust rock sizing for drainage lines, use of suitable rock with the correct grading, and proper construction controls. Implement and maintain the controls as specified by the erosion and sediment control plans.
Soil and water impact(s) during removal of controls	The basins can remain in place until rehabilitation is completed and an acceptable water quality achieved.
Long term stability not demonstrated	Undertake LEM to confirm long term stability and address any areas of higher erosion risk.
Final dozing occurs towards water	Final dozing will be undertaken either when water levels are suitably low to limit the risk of entering water, or a bench will be left between the water level and the area to be dozed to ensure the equipment cannot enter the water.
Post construction recreational use changes or is not achieved	The landform has been sloped to meet targets that are similar to natural slopes in the general area and should allow easy access. Rock has also been limited to ensure that passage on to the surface is easily achieved, although subject to confirmation by the wave action modelling.
The varying water level causes scour through wave action	Modelling of the wave action and erosion risk will be included in the detailed design. The use of appropriate vegetation in this zone and / or some rock if required will be considered as part of the design. Appropriate sediment controls will be implemented during periods of low reservoir levels to limit placement of D&B material directly into water and reduce sediment loading during placement. D&B benches below FSL will be dozed down as placed to ensure a low gradient is achieved.
Water rising (flooding) the area	Basins and surface water will be monitored regularly during routine site inspections, particularly prior to any shutdowns.
Public risks associated with the reservoir	Ensure appropriate exclusion zones and notifications to the community have been undertaken appropriately.
Climate change changing the occurrence of extreme events	Design, including rock armouring, accounts for the 1% Annual Exceedance Probability (AEP) risk, or a 1 in 100-year Average Recurrence Interval (ARI) storm event. Gradients have been flattened to 1V:7H and 1V:8H below Full Supply Level (FSL) and rock drainage included to manage erosion risks.
Leachate from the spoil emplacement	A spoil characterisation program has been prepared involving XRF, NAG suite analysis, pH and EC screening and validation testing by a NATA accredited laboratory (Appendix A of the SMP) to ensure material is neutralised prior to placement. A leachate basin will be constructed on site and tested for potential contamination prior to reuse on the stockpile. Attachment A – Tantangara Material characterisation program outlines the steps to ensure material neutralisation and actions in the circumstance contamination is detected. Site specific controls including compaction rates, water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management and will be monitored under the Project EPL.
Neutral mine drainage	Kinetic testing has been carried out to understand the reactivity of the excavated rock. The outcomes will be used to better understand the reactivity of sulfides in excavated rocks, the release rates of contaminants, and the water quality evolution in response to long-term oxidation and weathering that may affect the design of the final landforms and the quality of surface and groundwater. Site specific controls including compaction rates, water quality controls and erosion and sediment controls will be developed and workshopped with the NSW EPA to ensure effective site management and will be monitored under the Project EPL.

4.6. Completion criteria, performance indicators and criteria for triggering remedial action

Using the design approach described in Section 3 of this plan, Future Generation has developed designs for Tantangara PSE that satisfy the requirements from infrastructure approval Schedule 3, Condition 6 (Table 2). The outcomes are detailed below.

Completion criteria for the whole of project have been developed, and those relevant to landform design have been identified and are presented in Table 4-2. These criteria will form the basis of specific landform design criteria used to measure achievement of the objectives listed in Table 1-2. This will be an iterative process informed by the design criteria in Table 3-1 and continually assessed and revised as the design progresses.

The completion criteria will also be aligned with the existing environmental impact register in the Environmental Management Strategy for the Main Works phase where relevant and practical (FGJV, 2020a).

Table 4-2: Completion criteria

Aspect	Objective	Performance Indicators	Measurement Tools
Final landforms are compatible with the landscape	• As natural as possible, including minimising the use of linear or engineered structures. • Sympathetic with the landforms of the surrounding area, particularly from a visual, water management and ecological perspective. • Minimise the use of large rocks in the drainage lines (taken to be rocks typically with a D50 or median diameter of over 600mm in diameter).	• Final landform is representative of typical landforms in the area (but still appropriate to the materials on the outer surface). • Rocky drains blend into the overall landscape	• Visual assessment via 3D models. • Long sections and cross sections show smooth integration with adjacent natural surface. • Max rock size to be appropriate to the channel width.
Landforms are erosionally stable	• Suitable drainage density to limit overland flow lengths. • Safe, long-term and non-polluting. • Integrate the drainage of the emplacement area with the surrounding drainage network, including any upstream flows and residual run-on water. • Create natural drainage lines that are long-term sustainable having regard to the selection of suitable underlying materials, including rock sizing and grading. • Minimise valley infill. • Minimise the concentration of water on landforms unless this is consistent with accepted drainage density and geomorphic design practices. • Minimise changes to stream power and velocities above and below the landforms. • Ensure areas subject to wave action are suitably protected or the slopes are flattened to limit wave action.	• Soil loss range of between 5 and 20t/ha/year measured at any time within the next 500 years, but with a target overall soil loss measured in the long term of less than or equal to 10t/ha/year. This value is subject to review during the use of an LEM to ensure it is reasonable for a long term stable surface in this location. • Erosion/deposition processes within parameters of surrounding landscape and similar landforms relative to materials present	• As built design reports including erosion risk assessment (qualitative) including high level assessment of stability under wave action. • LEM (such as SIBERIA or CAESAR) will confirm acceptable future outcomes. This will be a requirement for the regulator to demonstrate long term sustainability and compliance. • While we would normally benchmark acceptable erosion rates against natural landforms of similar materials within the existing landscape bounds, this is unlikely to be practical as the material being placed differs from the dominant landforms of the KNP. We propose to use generally accepted erosion rates as indicated in the completion criteria together with a review of the landform performance as determined by the LEM. • Gradients have been flattened to 1V:7H and 1V:8H below Full Supply Level (FSL). These slopes are expected to be very stable with D&B material, even with fluctuating water levels.

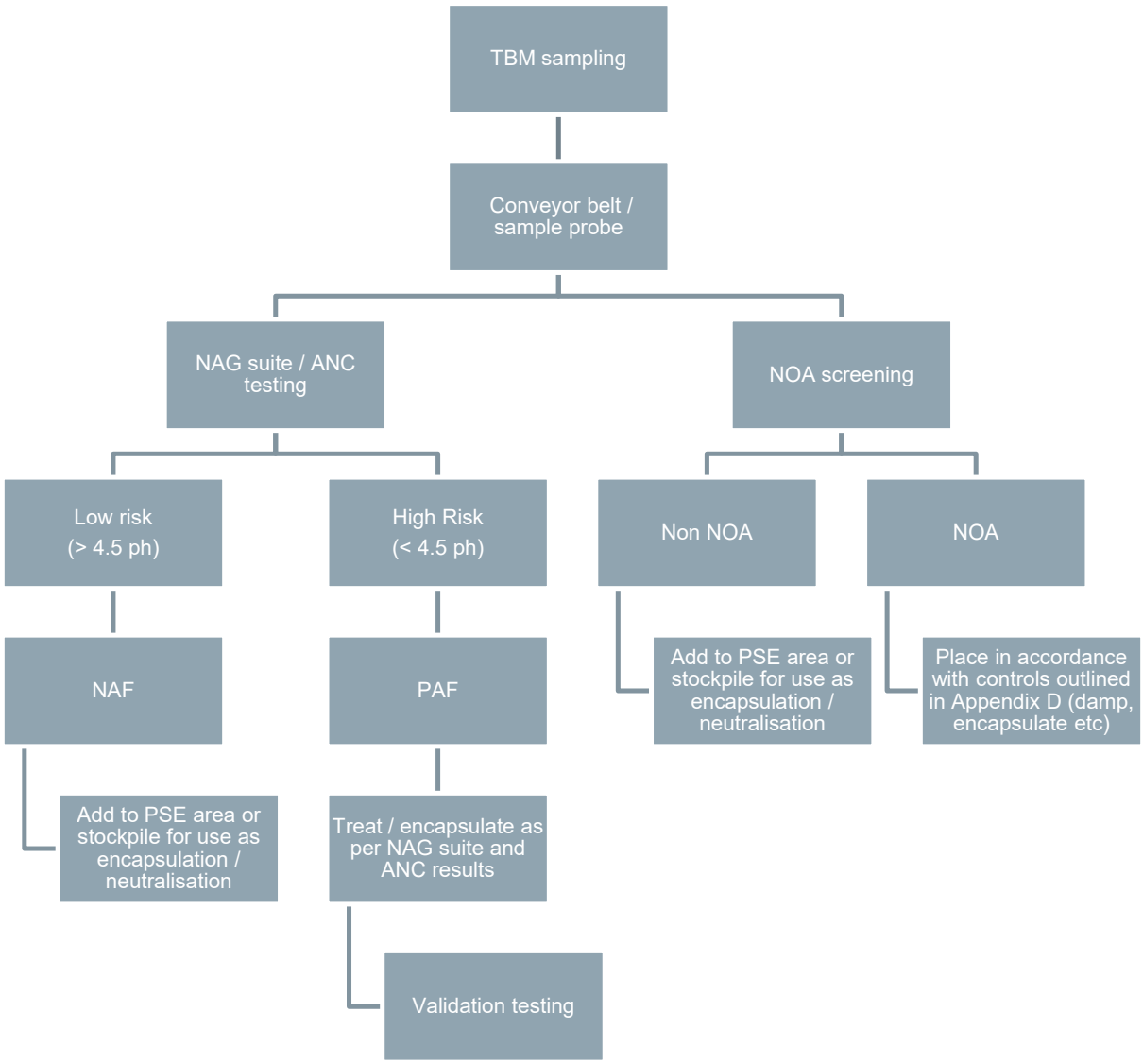
Aspect	Objective	Performance Indicators	Measurement Tools
Landforms are geotechnically stable	• Ensure placed material for the landform is stable geotechnically by ensuring slopes within the final surface are appropriate to the materials being used (excludes material underlying the PSE).	• Slopes to be geotechnically stable as assessed by a competent geotechnical engineer. • Any slopes with a lower factor of safety to require individual sign off by a suitably qualified professional, based on a risk assessment for that feature.	• Slope stability within the landform itself. • Most of the landforms are inherently stable if the founding conditions are adequate because the slopes are typically flatter than 1V:3H.
	• Ensure overall geotechnical stability considering the strength of materials underlying the PSE, bedding angles, and the possible impact of groundwater on the overall stability.	• Overall landform to be geotechnically stable as assessed by a competent geotechnical engineer. • Any overall landforms with a lower factor of safety to require individual sign off based on a risk assessment for that feature. • Groundwater seepage and fluctuating dam water level management strategy if required and where appropriate.	• Slope stability analyses for the overall PSEs including the footprint and accounting for groundwater conditions • Gradients have been flattened to 1V:7H and 1V:8H below Full Supply Level (FSL). These slopes are expected to be very stable with D&B material, even with fluctuating water levels. Monitoring of water levels after draw down will be undertaken through visual inspection to assess if perched aquifer conditions are persisting. Further geotechnical stability assessments and measures will be undertaken if required.
Landforms are appropriate for intended land use	• Landform to be safe for access. • Provide suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting to allow for spraying from vehicles (at around 200 metres measured on the slope, or as approved by the NPWS) • Minimise steep slopes that will be difficult to access and maintain (such as slopes over 18deg (1V:3H)).	• Landform to meet capability classes. • Slopes to be no steeper than 18deg (1V:3H) except where steeper slopes are required to tie into the existing natural landform. • Access tracks to be left in the landform.	• Land capability assessment to be undertaken – in this environment this may focus more on the soil capping and revegetation than the landform itself. • Slopes and access to be documented in the design report.
Landform to be suitable and safe for access	• Gradients along the dam water line will be appropriate for and in line with the approved Recreation Management Plan. • Recreational facilities and use must be consistent with the approved Recreation Management Plan.	• Appropriate slopes for safe boating, including access into and out of the water to be provided. • Requirements of Recreation Management Plan to be applied where relevant to the landform.	• Design report to document slopes and material to be used on the dam water line taking account of fluctuating water levels. • Document to include details on how the requirements of the Recreation Management Plan have been addressed.

Aspect	Objective	Performance Indicators	Measurement Tools
Landform to limit impacts on water quality	• Minimise the generation and dispersion of sediment in the Tantangara Reservoir, or other waterways. • Outer surface to be geochemically benign to not impact on water quality in the reservoirs. • Groundwater ingress to be managed where needed to limit impact on water quality.	• Surface water quality from runoff off the landforms to remain within the agreed parameters. • Groundwater associated with perched aquifers flowing on to surface of landforms or seepage from direct rainfall and infiltration into the landform to be incorporated into the landform surface water management where relevant.	• Design reporting and refinement • Design report to document sediment control measures such as ponds immediately downstream of the landform, temporary benching above full supply level at Tantangara. • Design report to flag construction issues and control of materials that could impact water quality but will not address construction issues in detail. • Overall geochemistry to be assessed through sampling of seepage where present on the toe. Trends and performance relative to anticipated qualities will be monitored and measured and if necessary, remedial measures implemented if required. • Monthly EPL monitoring downstream of emplacement area. If required, and in accordance with Appendix A, Annexure A of the Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107-F), Trigger Action Response Plans will be followed.
Landform revegetation	• The final surface of the landform must be long-term sustainable including sufficient topsoil (or some other suitable growth medium and amelioration, if required) to maintain a soil water profile and sustain vegetation. • Maximise the revegetation of the final surface. • Native vegetation and habitat must be consistent with the approved RMP	Revegetation performance indicators to be detailed in the Rehabilitation Management Plan.	Revegetation measurement tools to be detailed in the Rehabilitation Management Plan.

Aspect	Objective	Performance Indicators	Measurement Tools
Landform constructability	The emplacement area must be constructible having regard to the: • construction methodology accounting for PAF and NOA materials management • availability and storage of suitable materials, including topsoil. • temporary erosion and sediment control measures. • construction access and temporary benching. • progressive rehabilitation. • safety around water.	• Landform design to include areas for temporary topsoil storage where practical. • Adequate temporary sediment control measures to be provided where needed. • Temporary benches for the final surface to be provided. • Design to allow for safe access during construction, and progressive rehabilitation. • Landform design to consider safety around water where appropriate.	Design report to document: • Areas designated for PAF and NOA materials outside of drainage and full supply extent lines highlighted in the design report. • Areas of the landform flatter than 1V:4H to be highlighted in the design report for topsoil storage. • Temporary features including sediment control and benches. • High level access planning (detail planning by others). • Strategies to manage dozing risk at Tantangara.

ATTACHMENT A – TANTANGARA MATERIAL CHARACTERISATION AND HANDLING STRATEGY (TBM)

Indicative Material Characterisation and handling strategy – TBM / Manual



Note:

- NAG suite testing will be carried out on site from 30 June 2022. ANC testing will be carried out on site from 31 December 2022.
- NOA screening will be carried out in areas of confirmed or potential NOA

APPENDIX J – ROCK FOREST EMPLACEMENT AREA

TO BE DEVELOPED AND SUBMITTED FOR APPROVAL PRIOR TO COMMENCING CONSTRUCTION