Department of Planning, Housing and Infrastructure

Our ref: SSI-9687-PA-254

Nicola Fraser
Post Approvals
Snowy Hydro Limited
By email

01/10/2025

Subject: Snowy 2.0 Main Works Spoil Management Plan

Dear Ms Fraser

I refer to your submission dated 20th August 2025, requesting approval of the Spoil Management Plan (Version V, August 2025). I also acknowledge your response to the Department's review comments and request for additional information.

I note the Spoil Management Plan:

- has been prepared in consultation with Environment Protection Authority and National Parks and Wildlife Service;
- has been reviewed by the proponent and no issues have been raised with the Department; and
- contains the information required by the conditions of approval.

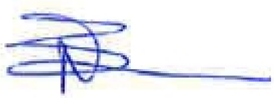
The Department has carefully reviewed the document and is satisfied that it meets the requirements of the relevant conditions in approval (SSI-9687).

You are reminded that if there are any inconsistencies between the Spoil Management Plan and the conditions of approval, the conditions prevail.

Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Anthony Ko on (02 8217 2022) or at anthony.ko@planning.nsw.gov.au.

Yours sincerely



Nicole Brewer
Director
Energy Assessments
As nominee of the Planning Secretary

future generation

webuild | clough | lane

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN

S2-FGJV-ENV-PLN-0019

REV V

AUGUST 2025

ABSTRACT
This Spoil Management Plan (SMP or plan) forms part of FGJV'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

V	20.08.2025	Updated to address EPA and NPWS comments and include Marica Spoil Management Plan	N. Bernardini	E. Porter	F. Lazzarin D. Drummond
Rev.	Date	Reason for Issue	Responsible	Accountable	Endorsed

Document Verification

RACIE Record

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I nformed:	See distribution list on Page 3.	
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Revision Tracking

Rev.	Date	Description of Revision
A	29.11.2019	Initial draft for SHL 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
Q	15.08.2024	Updated to include Ravine Bay Spoil Management Plan (Appendix H)
R	21.10.2024	Updated to include Rock Forest Spoil Management Plan (Appendix I)
S	25.11.2024	Updated to reflect SHL Comments
T	15.01.2025	Updated to reflect SHL Comments
U	01.02.2025	Updated to reflect SHL comments and to include approved rock Forest Spoil MP
V	20.082025	Updated to address EPA and NPWS comments and include Marica Spoil 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
FGJV	Future Generation Joint Venture
FGJV-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)
SHL	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
VENM	Virgin Excavated Natural Material

Acronym	Definition
WAL	Works Access Licence
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
Waste Classification Guidelines	*Waste Classification Guidelines,* NSW Environmental Protection Authority, 2014

1. INTRODUCTION

1.1. Context

1.1.1. Overview

Snowy Hydro Limited (SHL) 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 2,200 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 (FGJV) 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.

HIGH SUMMARY PROGRAMME AS OF SEP 2024

ID	Task Name	Forecast_24 Start	Forecast_24 Finish	AUG-24 Start	AUG-24 Finish	Variance (FOR-24) In Months
1	**Milestones**					
2	Notice to Proceed for Main Works		28 Aug '20		28 Aug '20	0
3	Notice of Commencement for Main Works		21 Oct '20		21 Oct '20	0
4	**Access Adit & Tunnels**					
5	**Main Access Tunnel**					
6	Portal + Cradle Works	11 Nov '19	15 Oct '20	11 Nov '19	15 Oct '20	0
7	Assembly of TBM	15 Oct '20	18 Mar '21	15 Oct '20	18 Mar '21	0
8	Substation Rectification / TBM SAT / Blind Ring Installation	8 Apr '21	4 Jun '21	8 Apr '21	4 Jun '21	0
9	Employer's Notice for Work Stoppage at MAT	4 Jun '21	22 Jun '21	4 Jun '21	22 Jun '21	0
10	Main Access Tunnel to Crown of Machine Hall	22 Jun '21	15 Jun '23	22 Jun '21	15 Jun '23	0
11	**ECVT**					
12	ECVT Portal + Cradle Works	26 Oct '20	20 Aug '21	26 Oct '20	20 Aug '21	0
13	Assembly of TBM	17 Jul '21	3 Dec '21	19 Jul '21	3 Dec '21	0
14	ECVT to Crown of Machine Hall	16 Dec '21	1 Sep '23	16 Dec '21	1 Sep '23	0
15	**Tantangara Portal**					
16	Tantangara Portal + Cradle Works	14 Nov '20	26 Sep '21	16 Nov '20	26 Sep '21	0
17	Assembly of TBM	26 Sep '21	21 Mar '22	27 Sep '21	21 Mar '22	0
18	**Waterways Tunnels**					
19	Tail Race Tunnel (Including TBM Dismantling)	18 Jul '23	7 Aug '25	18 Jul '23	22 Oct '25	-2.53
20	Tail Race Tunnel - D&B Tunnel + Lining (with Junction + Adit Plug)	5 Jul '23	23 Mar '27	5 Jul '23	18 Mar '27	0.17
21	Upstream Surge Shaft	18 Oct '22	26 Nov '27	18 Oct '22	10 Dec '27	-0.47
22	Talbingo Intake	24 Jan '22	23 Jul '27	24 Jan '22	3 Aug '27	-0.37
23	Tantangara Intake	23 Feb '22	1 Aug '27	23 Feb '22	11 Jul '27	0.7
24	Inclined Pressure Shaft + HRT upto Ch. 17+000 (including TBM Dismantling)	17 May '23	16 May '26	17 May '23	29 May '26	-0.43
25	Head Race Tunnel (Tantangara & TBM3 + Tant. Junction + Adit Plug)	6 Dec '23	12 Nov '27	6 Dec '23	17 Feb '28	-3.23
26	Head Race Tunnel (Marica Adit & TBM 04 Tunneling + TBM Dismantling + D. Chamber)			17 Jan '25	12 Jul '27	
27	Head Race Tunnel (Secondary Lining + Marica Junction + Adit Plug)			8 Feb '27	17 Feb '28	
28	**Power Station Complex**					
29	**Construction**					
30	Machine Hall Excavation	16 Jun '23	6 Aug '25	16 Jun '23	27 Oct '25	-2.73
31	Concrete + E&M Installation works (Dry Commisisoned)	28 Jul '25	25 Jul '28	1 Apr '25	16 Jul '28	0.3
32	Commissioning - All Units	17 Dec '27	11 Apr '29	23 Mar '28	31 Dec '28	3.37
33	Demobilization	11 Apr '29	9 Oct '29	1 Jan '29	30 Jun '29	3.37
34	Project Completion		9 Oct '29		30 Jun '29	3.37

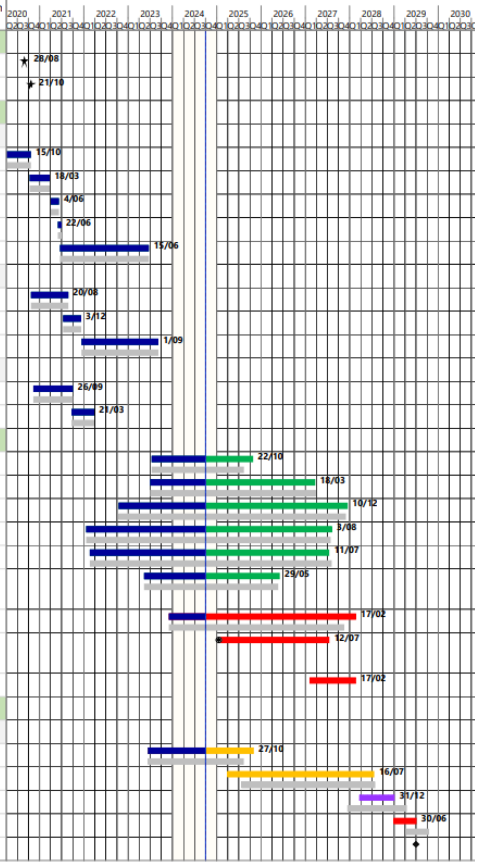


Figure 1-1: Timing of Snowy 2.0 Main Works

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.

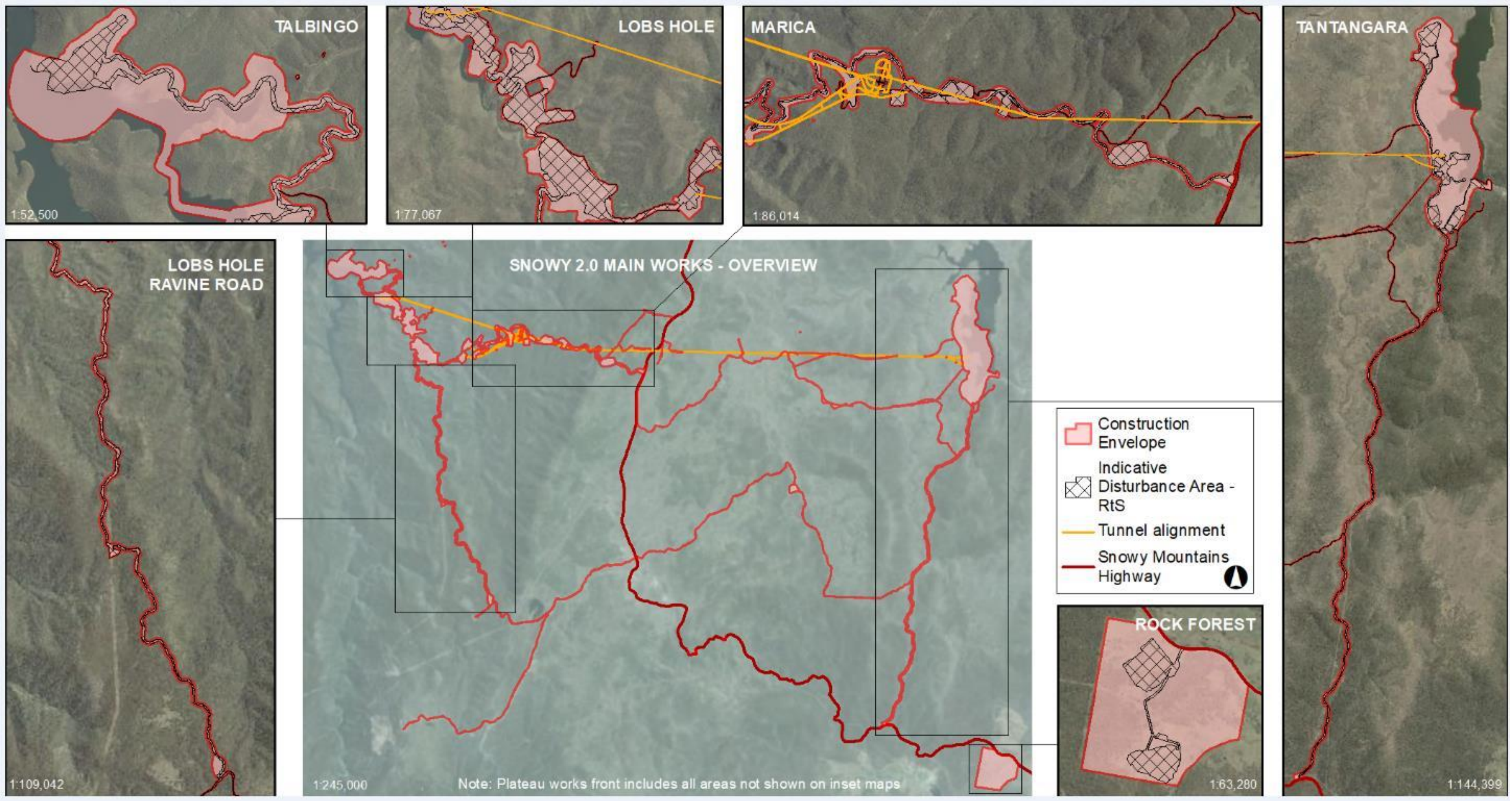


Figure 1-2: Snowy 2.0 Main Works work areas

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.

On 27 January 2022, a modification to CSSI-9687 was granted under Section 2.22 and clause 20 of Schedule 1 of the EP&A Act (CSSI-9687-Mod 1) The scope of the modification included horizontal directional drilling (HDD) to establish water and electricity services between the Lobs Hole and Marica areas of the Project.

On 29 November 2023, a second modification to CSSI-9687 was granted under S5.25 of the EP&A Act (CSSI-9687-MOD2) approving the undertaking of sinkhole rectification works near the adit portal at Tantangara, inclusive of geotechnical investigations and remediation

A subsequent planning application (MOD 3 – SSI-9687) was approved on 16 December 2024 to permit the construction of an additional adit and launching of a fourth tunnel boring machine at Marica West to facilitate excavation of a section of the headrace tunnel (HRT) through the long plain fault zone (LPFZ). The LPFZ is the most geologically complex section of the HRT and represented a significant risk to the overall project completion date. The application was approved in accordance with section 5.25 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act)."

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

<table>
<tr><th>Term</th><th>Definition</th><th>Reasoning</th></tr>
<tr><td>Project area</td><td>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.</td><td>The project area does not represent a footprint for the construction works, but rather indicates an area that was investigated during environmental assessments.</td></tr>
<tr><td>Construction envelope</td><td>The envelope within which the disturbance area of the development may be located.</td><td rowspan="2">As detailed design continues, final siting of the infrastructure (i.e. the disturbance 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.</td></tr>
<tr><td>Disturbance area</td><td>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.</td></tr>
</table>

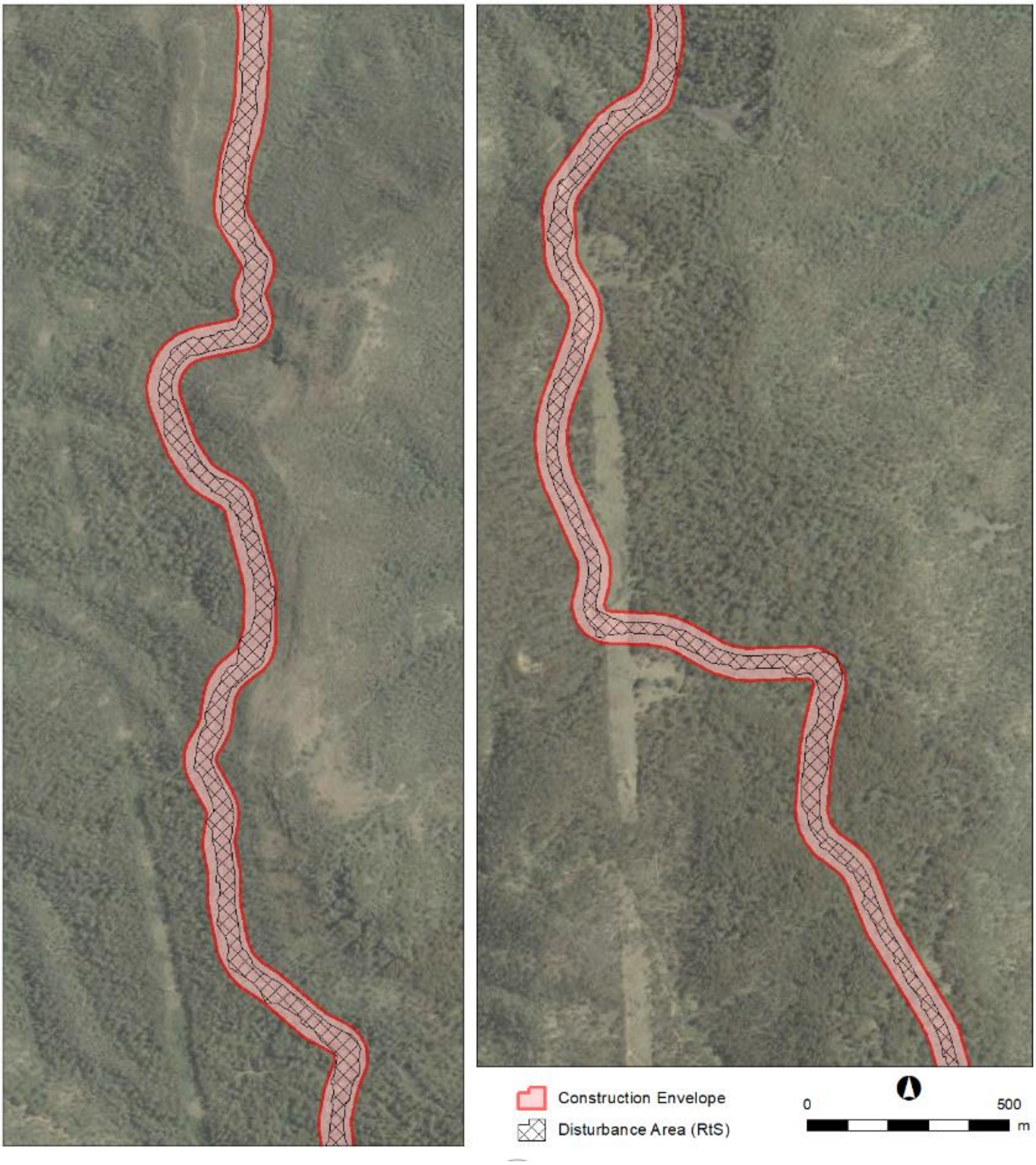


Figure 1-3 Disturbance area and construction envelope

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 (FGJV-PMS) and will include any requirements specified in the contract documents, where appropriate. All FGJV-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 FGJV'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.

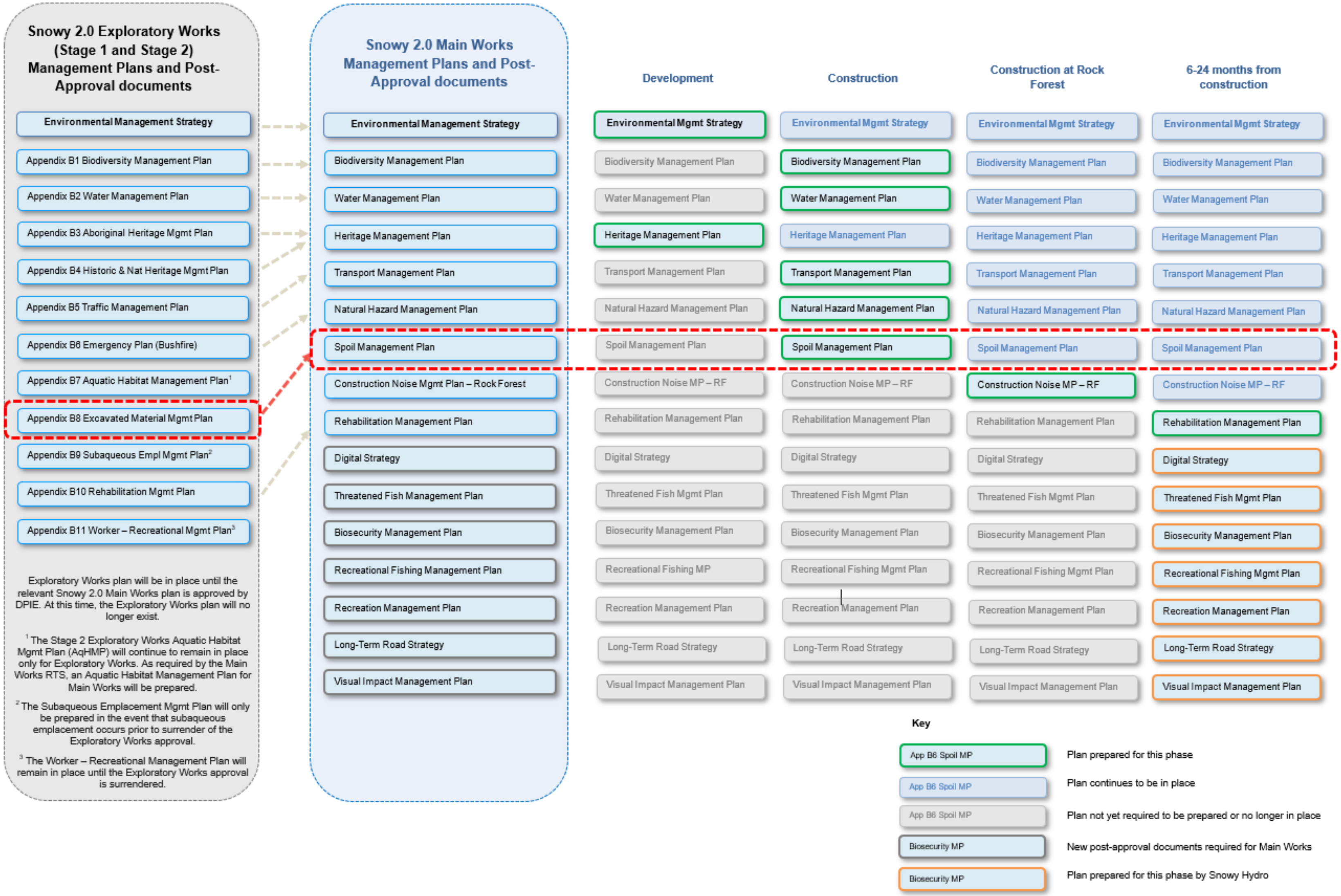


Figure 1-4 Management plans and post-approval documents with SMP indicated

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*;
- the Main Works Snowy 2.0 – Modification 1 Assessment Report;
- the Main Works Snowy 2.0 – Modification 2 Assessment Report
- the Main Works Snowy 2.0 – Modification 3 Assessment Report;
- 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 2-1 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 8 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 Figure 1-5 through Figure 1-10. Note that:

- stages are not necessarily sequential and may be timed concurrently;
- the body of this plan and Appendix A - Appendix E will generally remain unchanged from Stage 1, once approved by the Planning Secretary. Appendix F – Appendix K 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 – Appendix 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 6	• Final placement of spoil at Lobs Hole emplacement area.	Appendix F	Consult on and obtain approval of updates to Appendix F prior to commencement of this activity

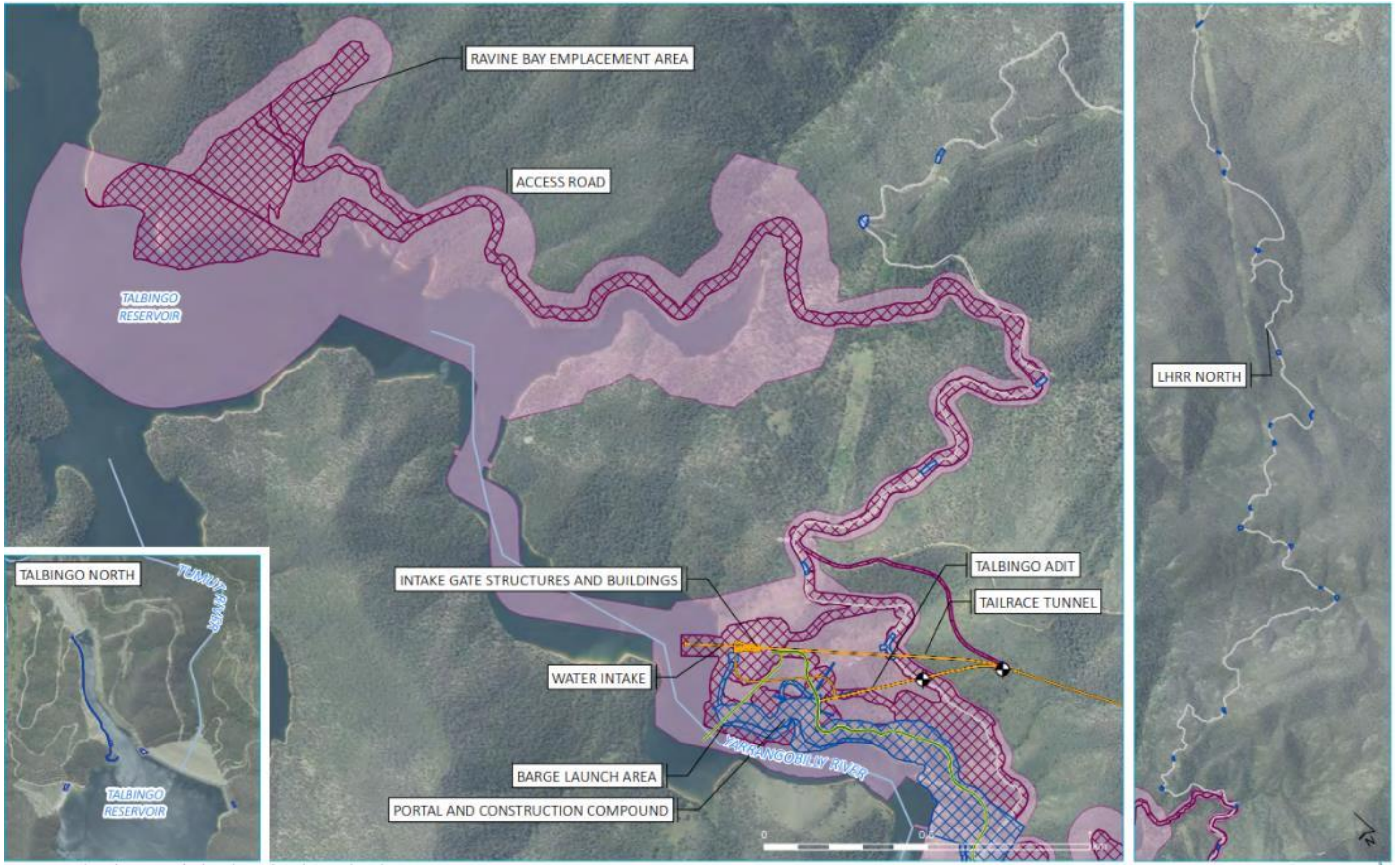


Figure 1-5 Scope and staging of this plan – Talbingo area

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]

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.

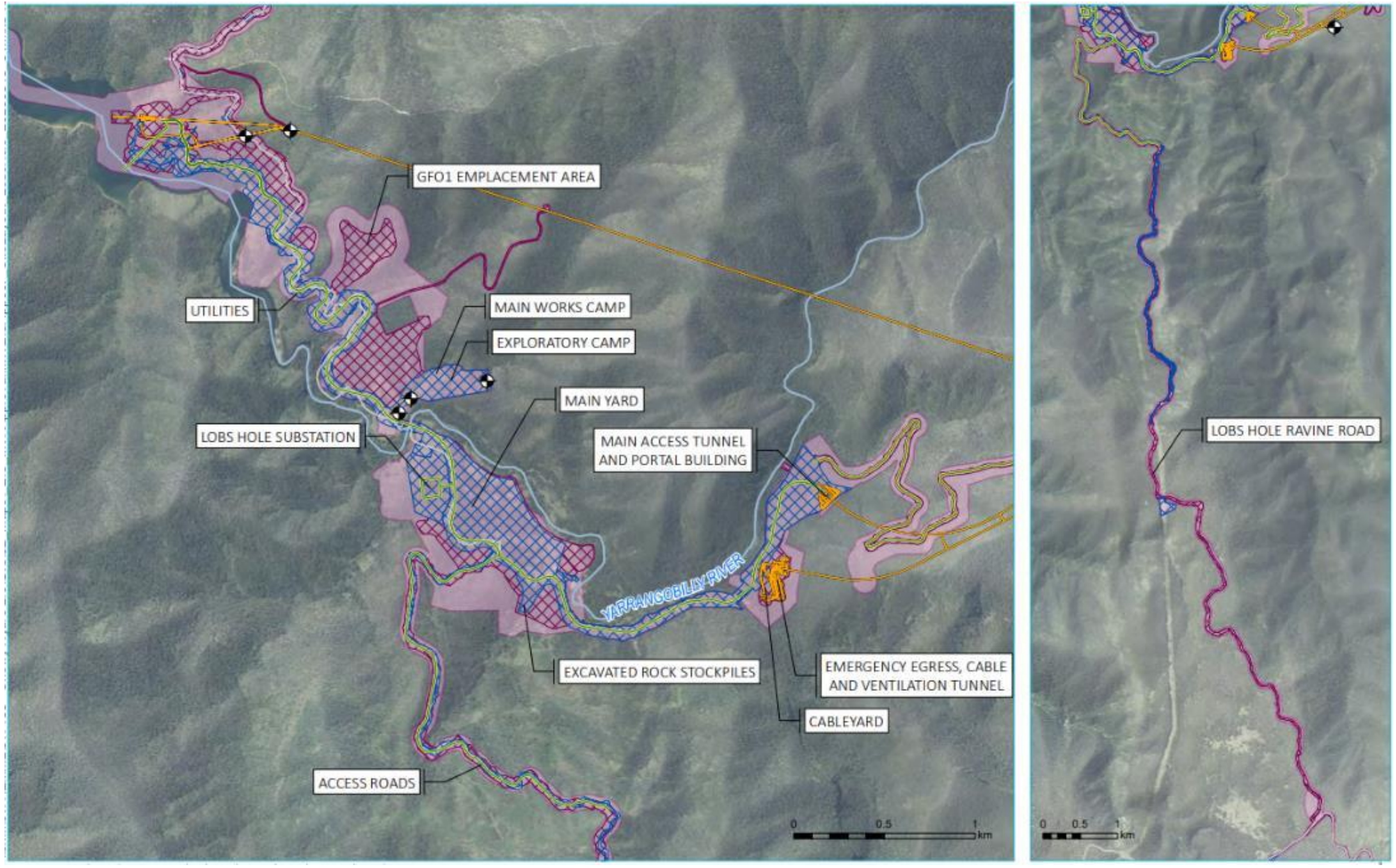


Figure 1-6 Scope and staging of this plan – Lobs Hole and GF01

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]

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.

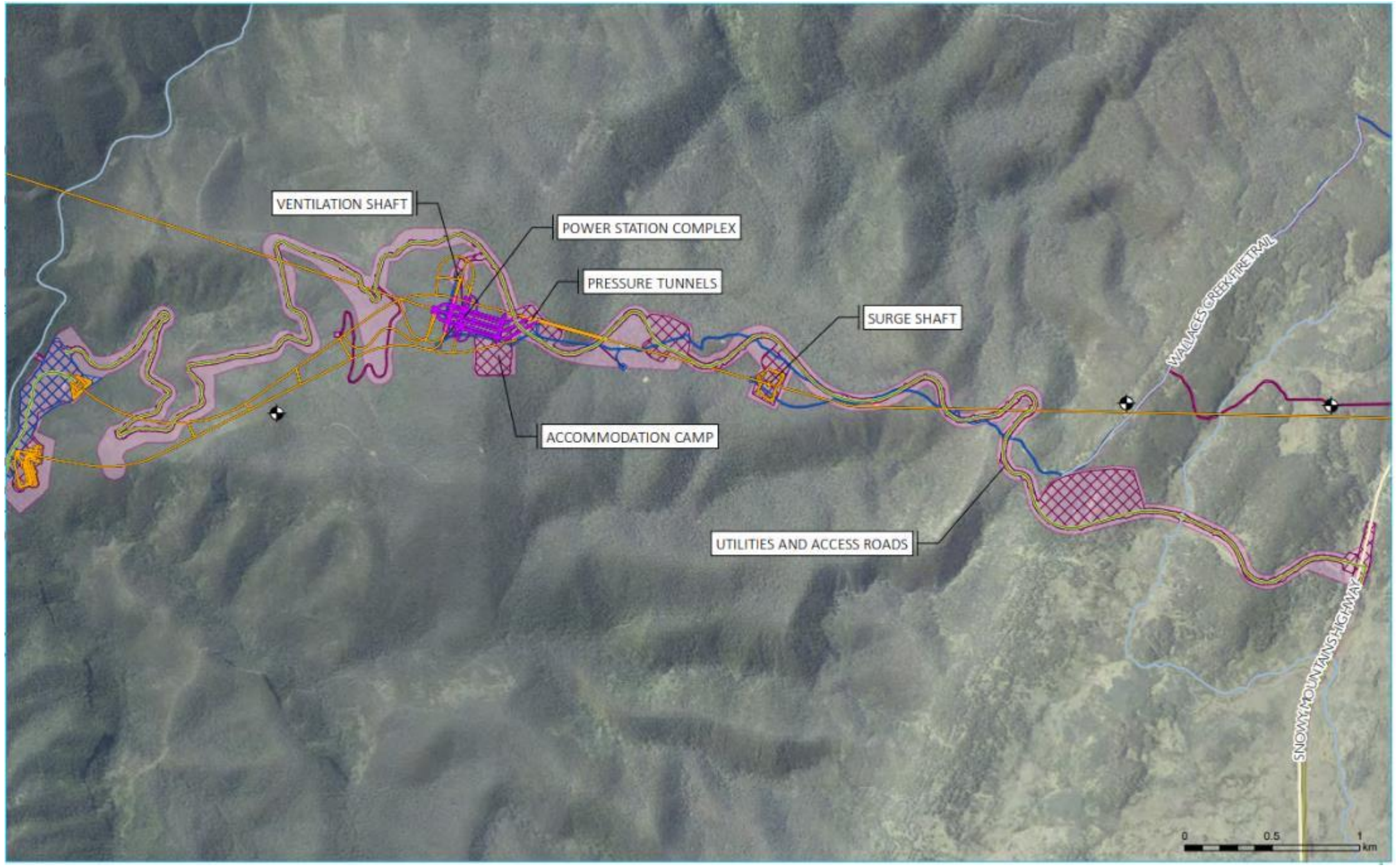


Figure 1-7 Scope and staging of this plan – Marica

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.

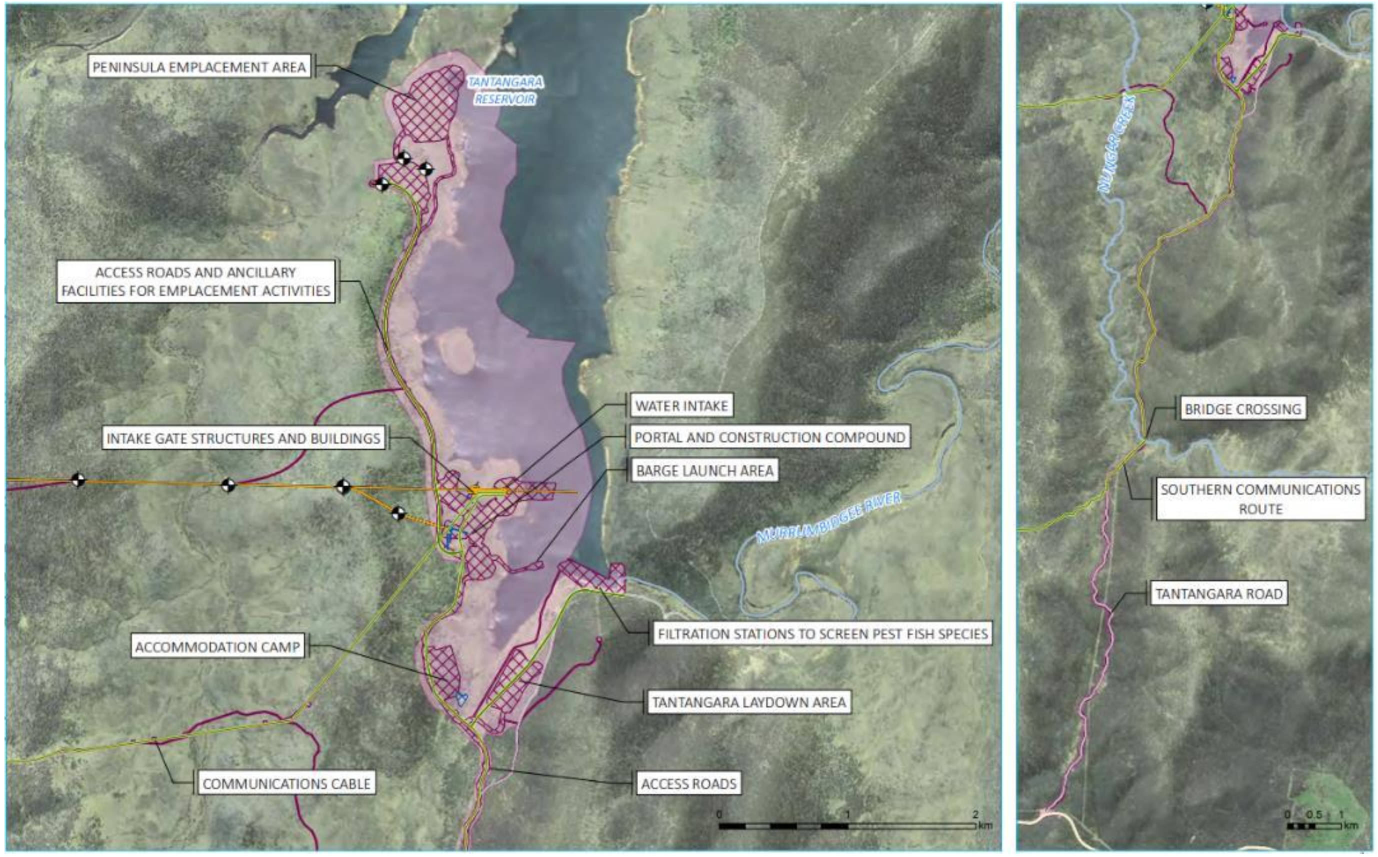


Figure 1-9 Scope and staging of this plan – Tantangara

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]

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]

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;
- NSW Department of Primary Industries (DPI); and
- Transport for NSW (TfNSW).

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. 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.	-
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.

Date	Consultation	Outcomes
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. FGJV 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	-
20 July 2020	NPWS online meeting to discuss FGJV'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. FGJV will be providing detailed as built documentation to SHL. Provision of as built documentation from SHL 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

Date	Consultation	Outcomes
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. FGJV will ensure that NRAR is consulted on the detailed plans for each emplacement area. Furthermore, FGJV will ensure that the licenses (if required) are obtained prior to the triggering works commencing.
		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

Appendix F to K (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. Comments from consultation have been incorporated into this plan where appropriate. Comments are summarised in Table 1-4.

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	-
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, Appendix D and Appendix 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 were transcribed to Appendix H where relevant.
16 December 2021	Verbal online consultation held with EPA and NPWS regarding Appendix I – Tantangara.	-

Date	Consultation	Outcomes
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.
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 and Appendix 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	
20 July 2022	Formal correspondence addressing final comments on GFO1 appendix	GFO1 spoil management appendix accepted
3 August 2022	EPA response to proposed leachate detection procedure	EPA confirmed the proposed leachate detection for GF01 is satisfactory

Date	Consultation	Outcomes
2 September 2022	Online consultation with EPA to discuss leachate detection procedure	
7 September 2022	EPA response to proposed leachate detection procedure and Spoil Management Plan for Tantagra	EPA confirmed the proposed leachate detection for Tantangara is satisfactory and approved Tantangara spoil management Plan appendix
29 February 2024	Formal correspondence addressing final comments on Ravine Bay Spoil Management Plan appendix	Final acceptance of Ravine Bay Spoil Management Plan
16 October 2024	Online joint agency presentation of revised Rock Forest Spoil Management Plan appendix	Comments received from EPA and TfNSW that were incorporated into the plan prior to submission to DPHI for approval.
7 November 2024	Online joint agency presentation of revised Spoil Management Plan and Marica appendix	Management Plan updated to address agency comments.
01 February 2025	Updated document to include modification 3 works and the approved Rock Forest Spoil Management Plan	Management Plan updated to include agencies comments and the Marica Temporary Spil Management Plan.

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 1.7of 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 - Appendix E 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 Appendix E of this plan Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0037) Waste Management Plan

Condition	Requirement	Where addressed
		(S2-FGJV-ENV-PLN-0048)
	(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 Appendix 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 Dand Appendix 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

Condition	Requirement	Where addressed
	(g) maximise the use of the permanent spoil emplacement areas	Section 6 of this plan
	(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, Section 8, Section 9 and Appendix C, Appendix E and Appendix F –of this plan Surface Water Management Plan (S2-FGJV-ENV-PLN-0011)
	(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 - of this plan
Schedule 3, condition 8	The Proponent must implement the approved Spoil Management Plan for the development.	Section 8 and Section 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	REHAB01	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; • 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	Section 7 and Appendix F – J of this Plan. SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010)
Creation of new landforms	REHAB02	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. SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010)
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. Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0049)
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.	Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0049) Waste Management Plan S2-FGJV-ENV-PLN-0048
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 (S2-FGJV-ENV-PLN-0049)
Excavated rock waste management and transport	CONTAM04	Material which has been assessed as not suitable for reuse on land 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	Section 5.6 and 6.7 of this Plan. Contaminated Land Management

Impact	Ref #	Revised environmental management measure	Where addressed
		the project, to an appropriately licensed facility. Excavated material may be subject to treatment and application on site.	Plan. (S2-FGJV-ENV-PLN-0049) Waste Management Plan (S2-FGJV-ENV-PLN-0048)
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 S2-FGJV-ENV-REP-0019
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 (S2-FGJV-ENV-REP-0019)
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,	

Impact	Ref #	Revised environmental management measure	Where addressed
		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 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. (S2-FGJV-ENV-PLN-0049)
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.	SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010)
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	Section 6.4 and Appendix B of this Plan SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010)
		• topsoil management measures including stripping and stockpiling procedure.	
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 (S2-FGJV-ENV-PLN-0011)
Soil capability	SOIL04	The Rehabilitation Management Plan (refer to REHAB01) will be implemented and will include measures to minimise: • loss of soil;	Section 9 and Appendix F – J of this Plan
		• loss of organic matter and nutrient decline;	

Impact	Ref #	Revised environmental management measure	Where addressed
		• 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	SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010)

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 SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010)
		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;	Section 6.4 and 6.5 and Appendix B and C of this Plan SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010)

Impact	Ref #	Environmental management measure	Where addressed
		• 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.	
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 (S2-FGJV-ENV-PLN-0011) and Groundwater Management Plan (S2-FGJV-ENV-PLN-0012)
		• management measures which include: – stockpile designs will incorporate benching and bunding to avoid mobilisation of sediment and rock; – controls to avoid the risk of acid or metal laden run off into the Yarrangobilly River; – progressive verification of the adequacy of 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.	Section 6.5 and 6.9 and Appendix E and F of this Plan
	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 (S2-FGJV-ENV-PLN-0048)
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 (S2-FGJV-ENV-PLN-0010)
	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

Impact	Ref #	Environmental management measure	Where addressed
	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 to prevent environmental harm. Refer to Sections 6, 8 and Appendix E and F of this Plan Refer Water Management Plan
	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. 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.	
	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.	
	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
Impacts to aquatic habitat and biota during dredging and	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;	

Impact	Ref #	Environmental management measure	Where addressed
subaqueous placement	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;	commencement of construction in these locations. Refer Section 6 and Appendix H and I of this Plan (once prepared).
	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);	
	EECO15-6	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 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, 2014a)
- *Waste Classification Guidelines - Part 2 Immobilizing Waste* (NSW EPA, 2014b)

- *Waste Classification Guidelines - Part 3 Waste Containing Radioactive Material* (NSW EPA, 2014c)
- *Waste Classification Guidelines - Part 4 Acid Sulfate Soils* (NSW EPA, 2014d)
- *Waste Classification Guidelines - Addendum to Part 1 Classifying Waste* (NSW EPA, 2016)
- *The Excavated Natural Material (ENM) Order* (NSW EPA, 2014e)
- *The Excavated Public Road Material Order* (NSW EPA, 2014f)
- *The Recovered Aggregate Order* (NSW EPA, 2014g)
- *The Treated Drilling Mud Order* (NSW EPA, 2014h)
- *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, 1998;
- *National Environment Protection (Assessment of Site Contamination) Measure,* (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;*
- *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 main regulations, guidelines, specifications and policy documents relevant to NOA management include:

- *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 20182014.*
- *Code of Practice: How to manage and control of asbestos in workplaces (SafeWork NSW, 2022)*
- *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 Part 1 - Application (NSW EPA, 2022);*
- *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).*

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). Although not stated in the main works EIS there is also the potential for nitrate and ammonia contamination resulting from blasting activities.

The Lobs Hole area was previously the site of a copper mine from 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 space) 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 works 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 5.6 of this Plan and the Waste Management Plan (S2-FGJV-ENV-PLN-0048). The management of nitrogen compounds on the site is managed in accordance with the Nitrogen Management Plan (S2-FGJV-ENV-PLN-0367).

3.6. Naturally Occurring Asbestos (NOA)

The Snowy 2.0 Geomechanical Model summarised in Figure 3-1 lists the geological units along the tunnel alignment that are:

- Unlikely to contain NOA
- Likely to contain NOA based on the petrographic analysis
- NOA confirmed from the drill core samples

3.6.1. Geological Units Likely to Contain NOA

The following geological units are unlikely to contain NOA:

- Kelly Plains Volcanics (Dulk), Chainage: 0,500 – 1,710 metres
- Peppercorn Formation (Scpp), Chainage: 1,710 – 1,840 metres
- Tantangara Formation (Syaa), Chainage: 1,840 – 7,544 metres
- Ravine Beds East (Suer), Chainage: 15,575 – 17,572 metres – HRT Part 4
- Boraig Group (Dba), Chainage: 17,572 – 18,600 metres – Pressure Shaft
- Ravine Beds West (Suer), Chainage: 18,600 – 25,500 metres – Tailrace Tunnel

Note: “Unlikely” does not denote the absence of risk of intersecting NOA in these strata, particularly along faults and geological boundaries.

3.6.2. Geological Units Likely to Contain NOA

The following geological units are considered as likely to contain NOA based on the petrographic analysis:

- Temperence Formation (Okit_t), Chainage: 7,544 – 8,747 metres
- Boggy Plains Suite (Sbp_i), Chainage: 8,747 – 9,459
- Temperence Formation (Okit_t), Chainage: 9,459 – 9,992 metres

3.6.3. Geological Units Confirmed to Contain NOA

The following geological units are considered as likely to contain NOA confirmed from the occurrence in drill core samples:

- Gooandra Volcanics (Okig), Chainage: 9,992 – 14,261 metres
- Shaw Hill Gabbro (Ouos), Chainage: 14,261 – 14,580 metres
- Gooandra Volcanics (Okig), Chainage: 14,580 – 15,575 metres

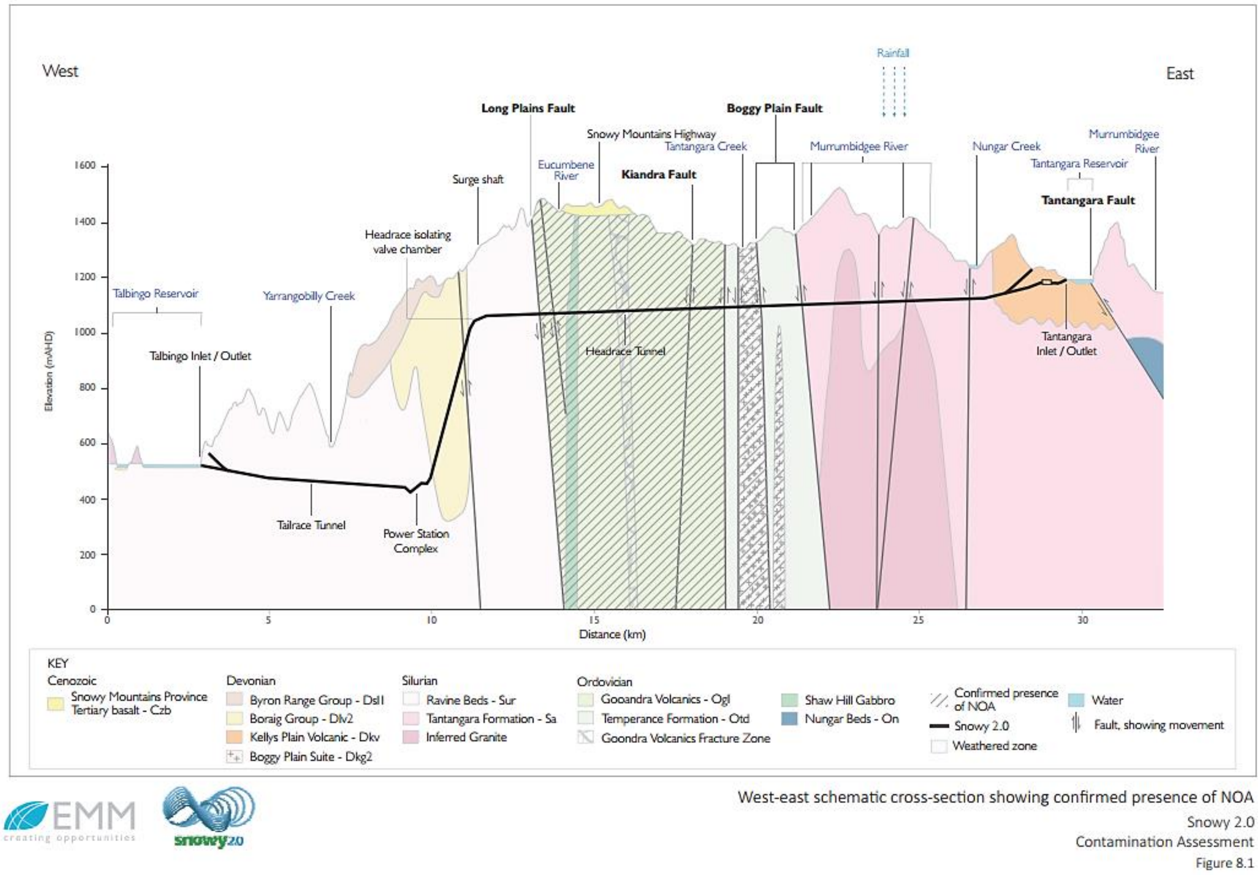


Figure 3-1: SMEC west-east cross section showing confirmed presence of NOA

The NOA impacted spoil excavated during the tunnelling operations will be relocated to the specially constructed cell at Tantangara Spoil Emplacement Area. The total volume of ‘Likely’ and ‘Confirmed’ NOA impacted in situ material in the tunnel alignment is 845,000 m^3.

Further information provided by SHL indicates that 7.5% of the predicted total to be NOA impacted, which is equivalent to 62,300 m3 of in situ rock. This volume will be further refined as excavation in the area progresses.

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; and
- 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 during the EIS.

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

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 3-3 (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 found 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 3-3.

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.

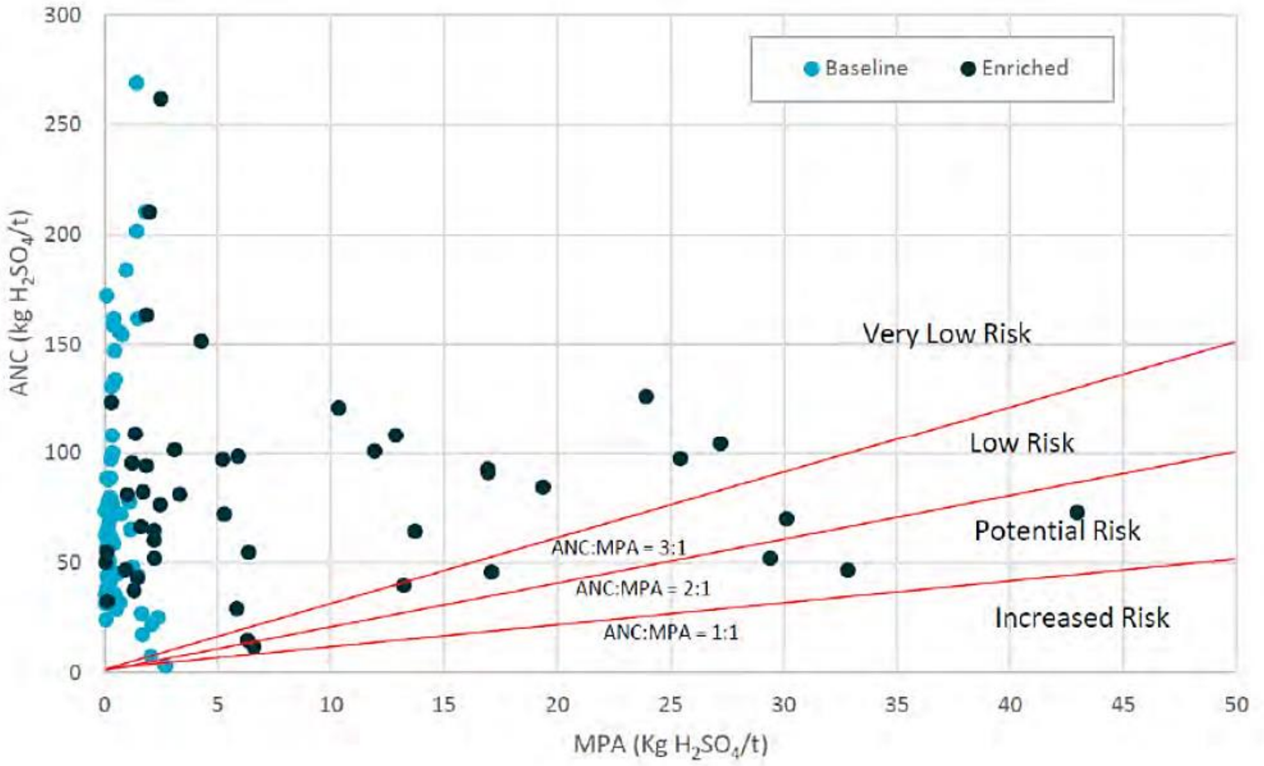


Figure 3-3: Categorisation of ANC versus MPA risk (source: EIS Appendix L, Annexure B)

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 3-4 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 3-4: 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 Water Quality Objectives (WQO), 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 Figure 4-1 to Figure 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: a pad constructed using Geosynthetic Clay Liner (GCL) and leachate ponds. Combined D&B and TBM spoil will be placed on the pad.
  - 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. A temporary storage area of excavated natural material from excavation works involved in the Transgrid shallow connection transmission works is being stored on a temporary basis for the purpose of rehabilitation for the Project.
- 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. MOD 3 – SSI-9687, permitted the construction of an additional adit and launching of a fourth TBM at Marica West to facilitate excavation of a section of the HRT;

- 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: a pad constructed using a pad constructed using Geosynthetic Clay Liner (GCL) . It is noted that this pad will be constructed above the typical reservoir operating levels (FSL) 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 SHL for use as a logistics site during construction as well as a permanent emplacement area for spoil. Excess spoil from the MOD 3 – SSI-9687 excavation will be emplaced here. The Permanent Spoil Emplacement area will be designed to minimise the potential for contaminated soil and rock materials in accordance with EPL 21266 and regulatory requirements. .

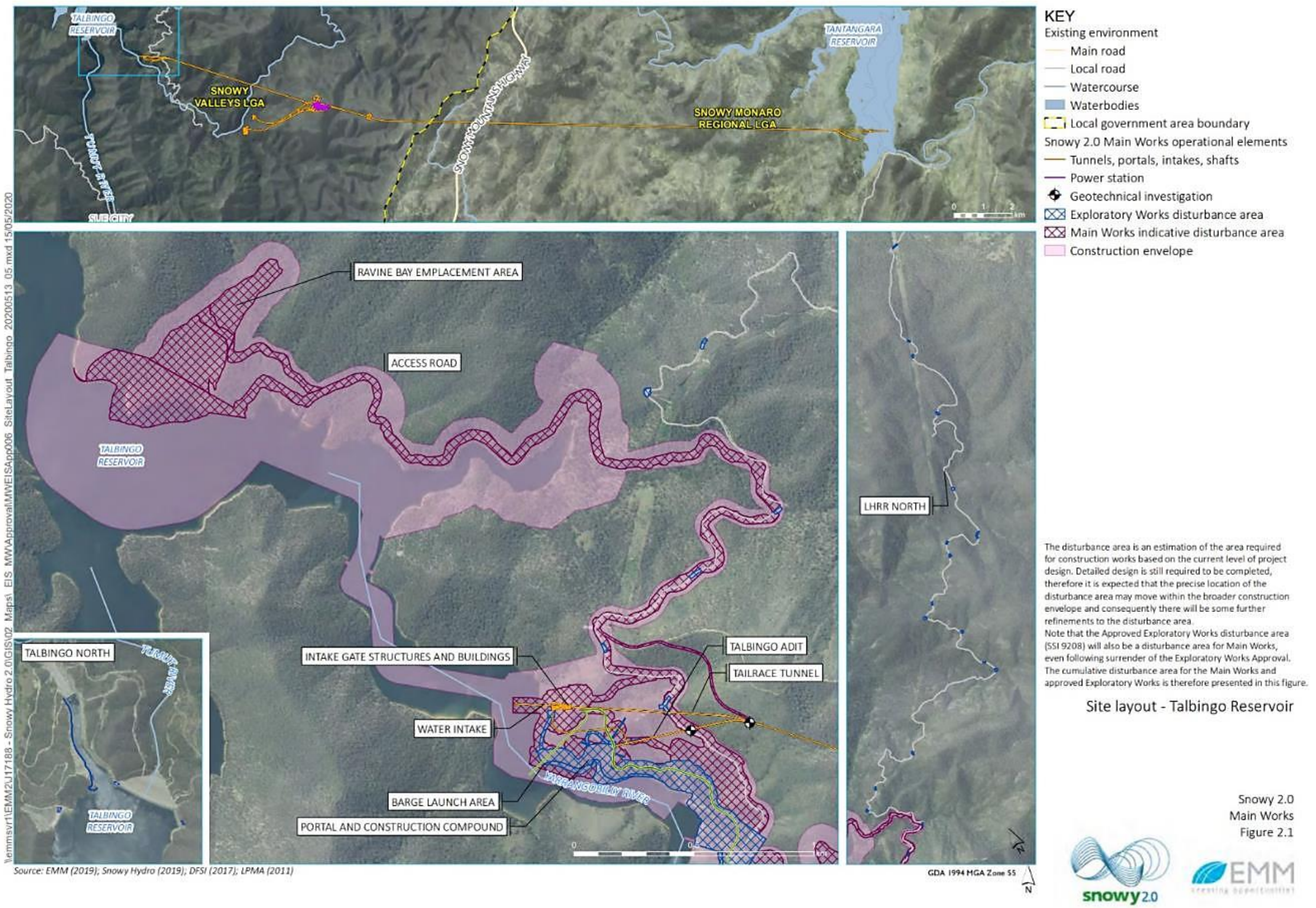


Figure 4-1: Construction areas – Talbingo (Infrastructure Approval Appendix 2)

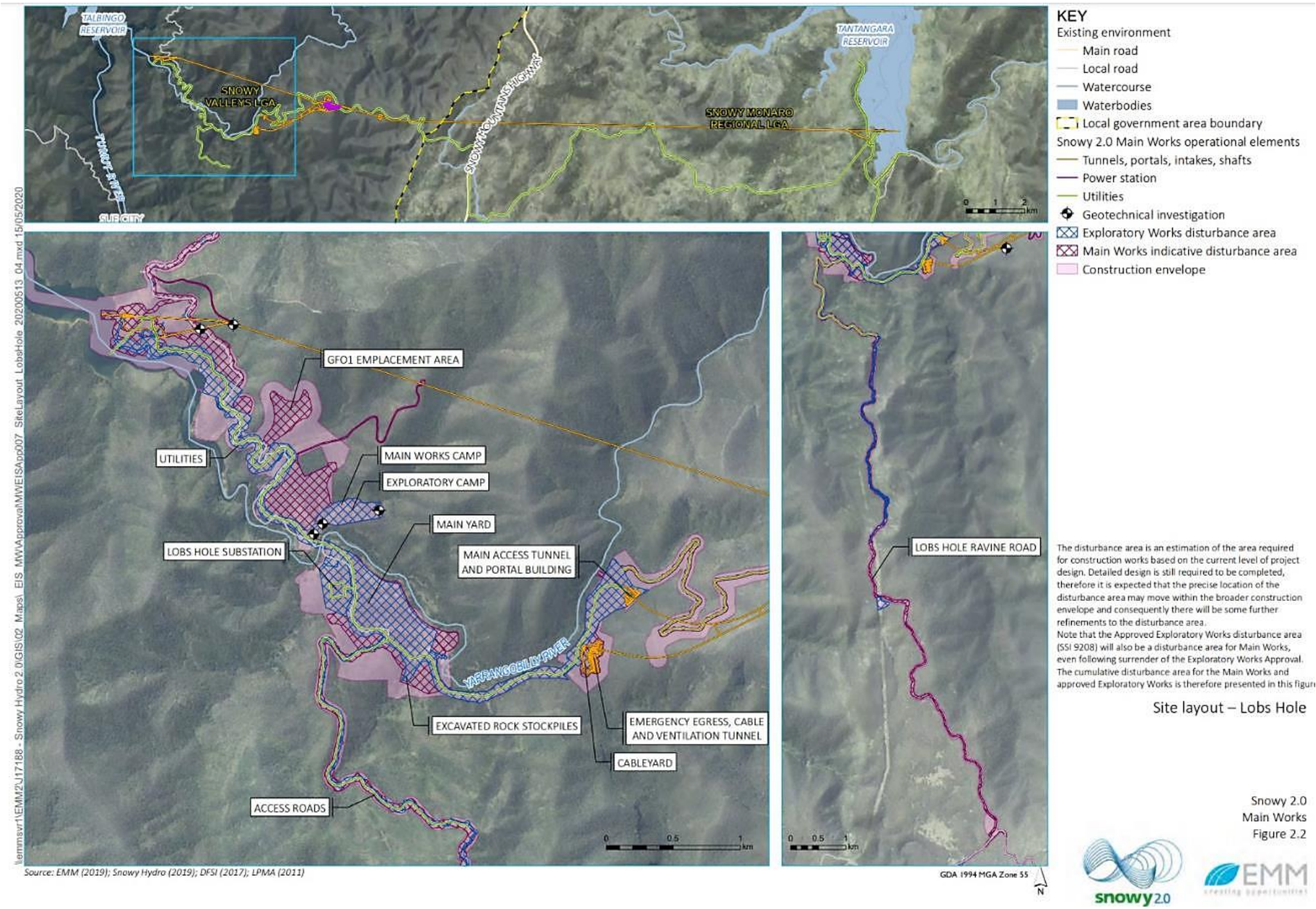

TALBINGO RESERVOIR
SNOWY VALLEYS LGA
SNOWY MOUNTAINS HIGHWAY
SNOWY MONARO REGIONAL LGA
TANTANGARA RESERVOIR
TUMUT RIVER
KEY
Existing environment
Main road
Local road
Watercourse
Waterbodies
Local government area boundary
Snowy 2.0 Main Works operational elements
Tunnels, portals, intakes, shafts
Power station
Utilities
Geotechnical investigation
Exploratory Works disturbance area
Main Works indicative disturbance area
Construction envelope
GFO1 EMPLACEMENT AREA
UTILITIES
MAIN WORKS CAMP
EXPLORATORY CAMP
MAIN YARD
LOBS HOLE SUBSTATION
MAIN ACCESS TUNNEL AND PORTAL BUILDING
YARRANGOBILLY RIVER
EXCAVATED ROCK STOCKPILES
EMERGENCY EGRESS, CABLE AND VENTILATION TUNNEL
CABLEYARD
ACCESS ROADS
LOBS HOLE RAVINE ROAD
The disturbance area is an estimation of the area required for construction works based on the current level of project design. Detailed design is still required to be completed, therefore it is expected that 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 figur
Site layout – Lobs Hole
Snowy 2.0
Main Works
Figure 2.2
Source: EMM (2019); Snowy Hydro (2019); DFSI (2017); LPMA (2011)
GDA 1994 MGA Zone 55

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

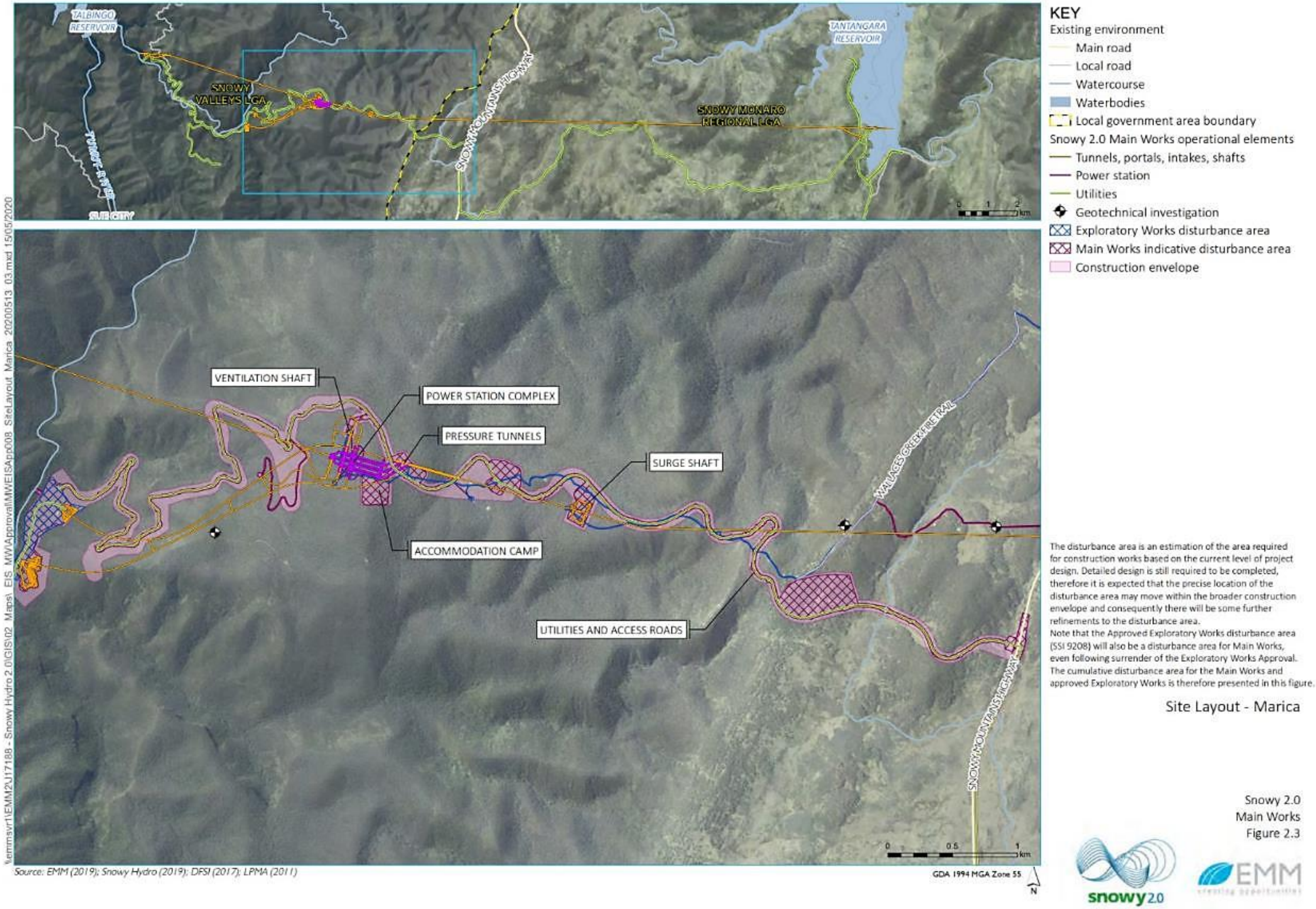


Figure 4-3: Construction areas – Marica (Infrastructure Approval Appendix 2)

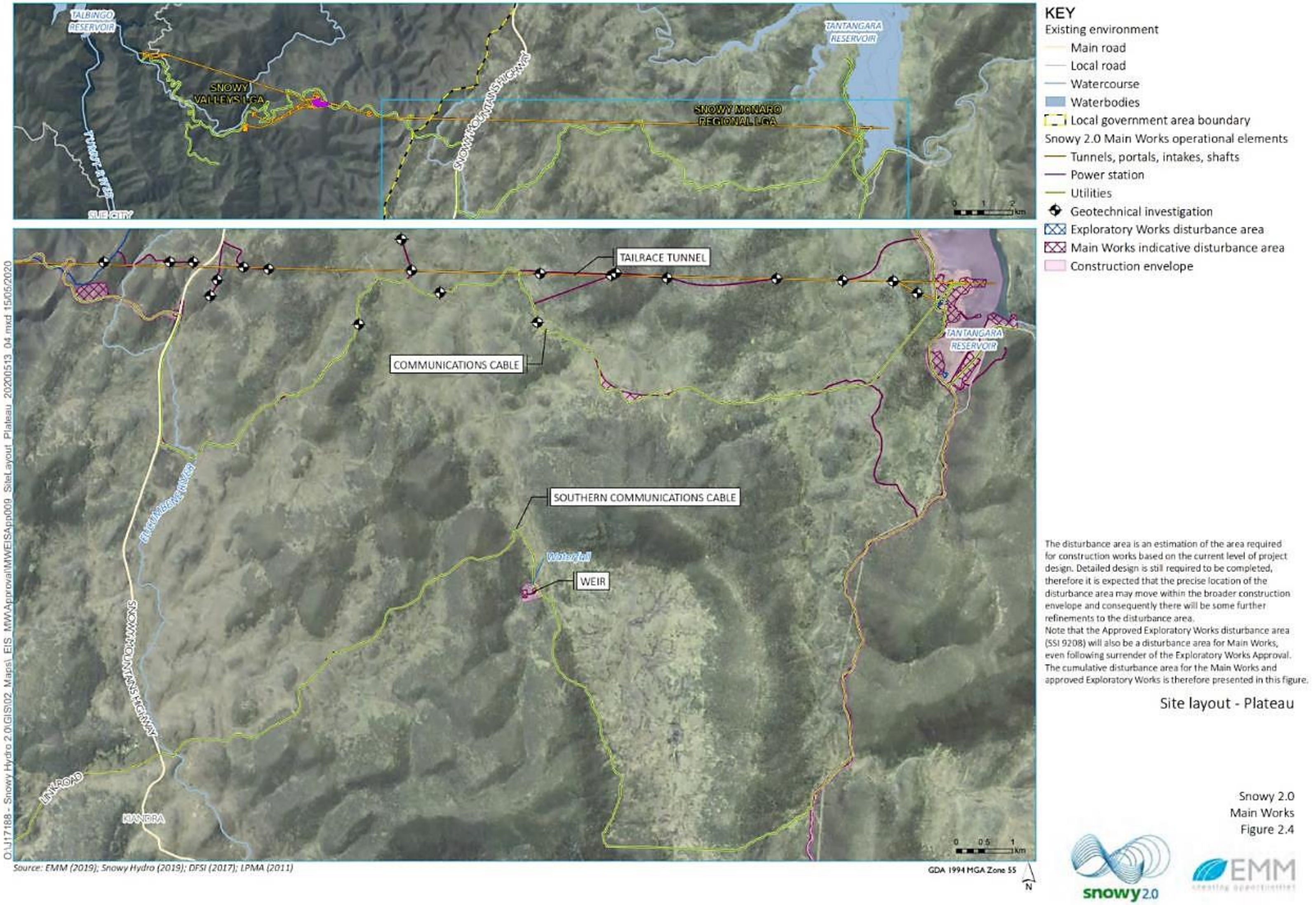


Figure 4-4: Construction areas – Plateau (Infrastructure Approval Appendix 2)

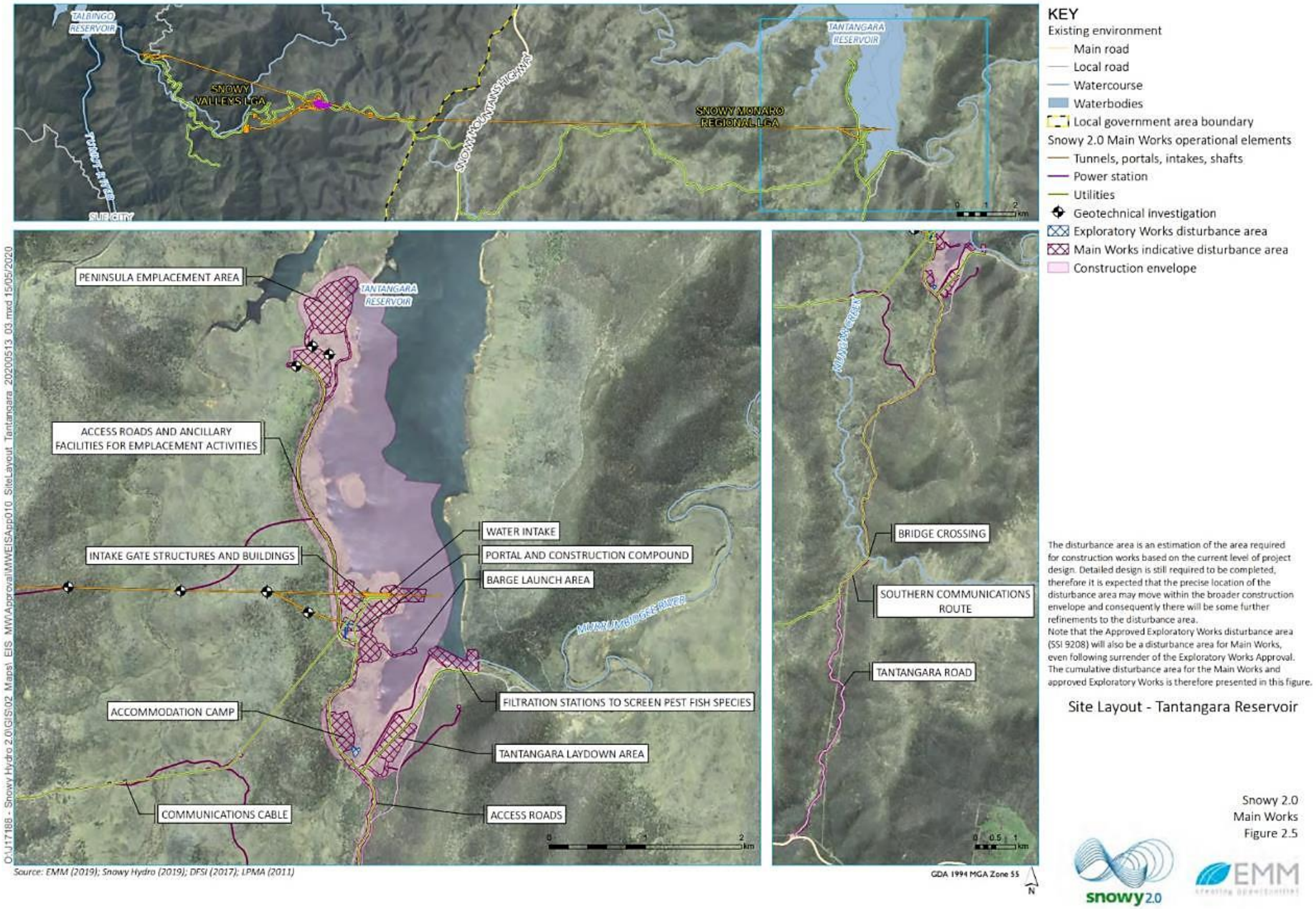


Figure 4-5: Construction areas – Tantangara (Infrastructure Approval Appendix 2)

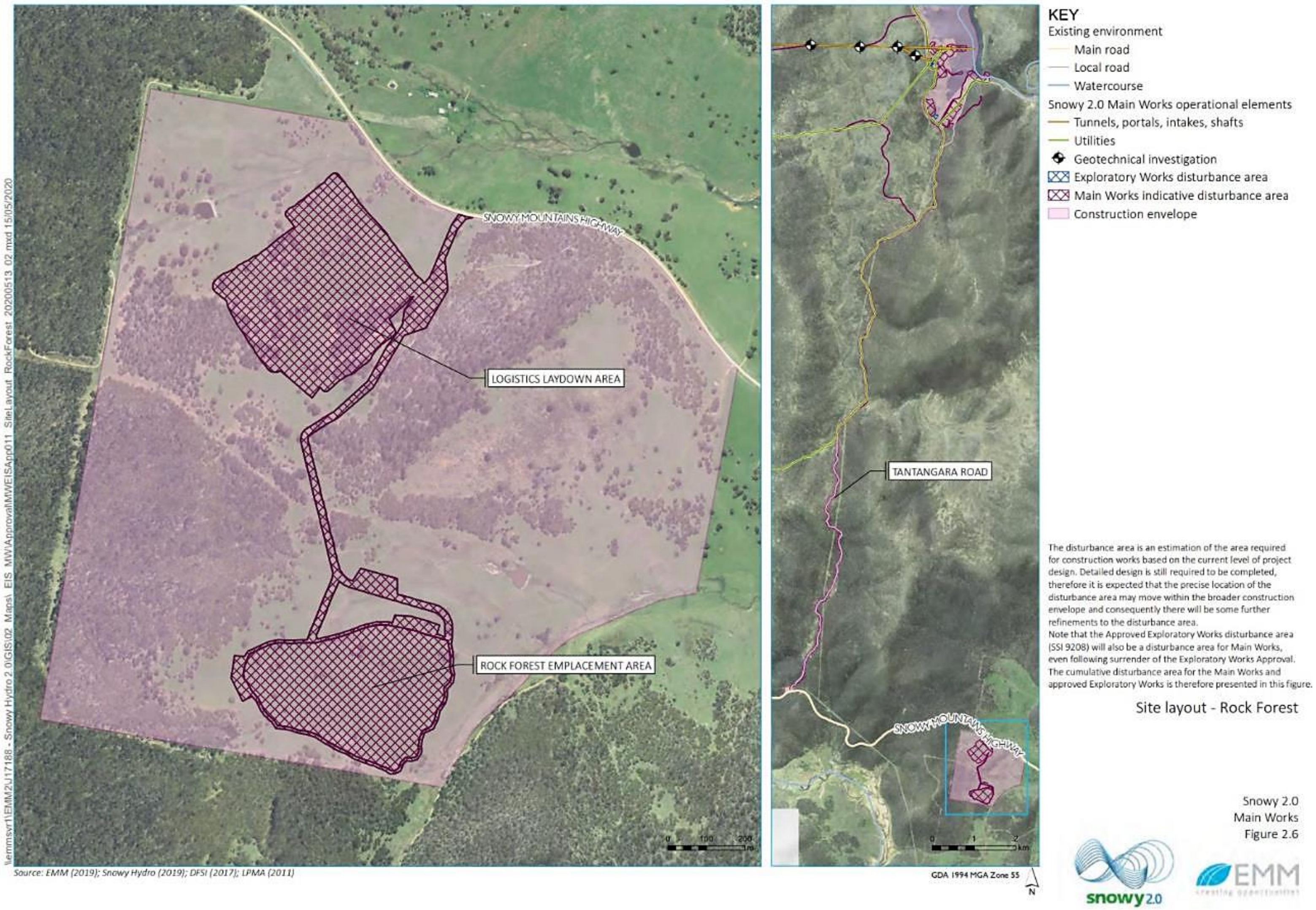


Figure 4-6: Construction areas – Rock Forest (Infrastructure Approval Appendix 2)

4.2. 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 FGJV.

4.3. Excavation and tunnelling methods

4.3.1. 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.

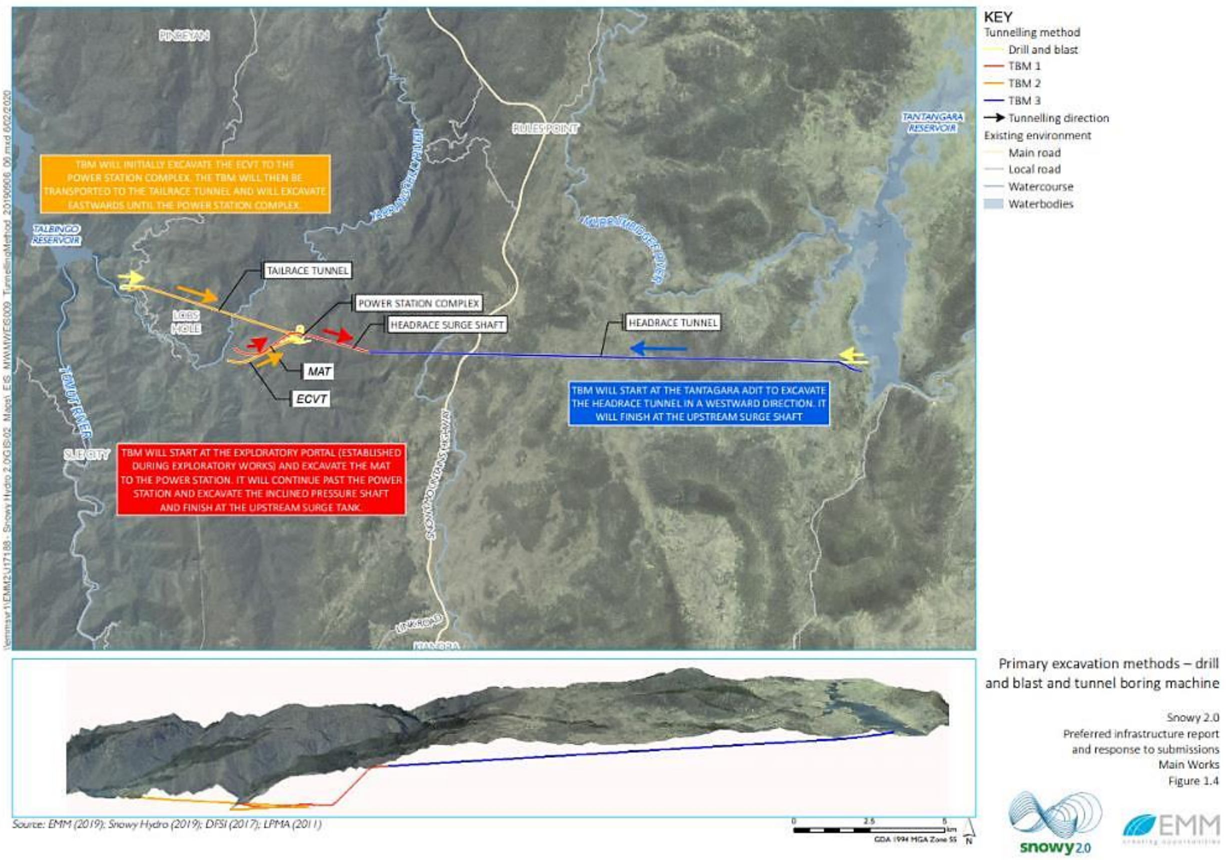


Figure 4-7: Primary excavation methods (RTS, EMM)

4.3.1.1. 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.

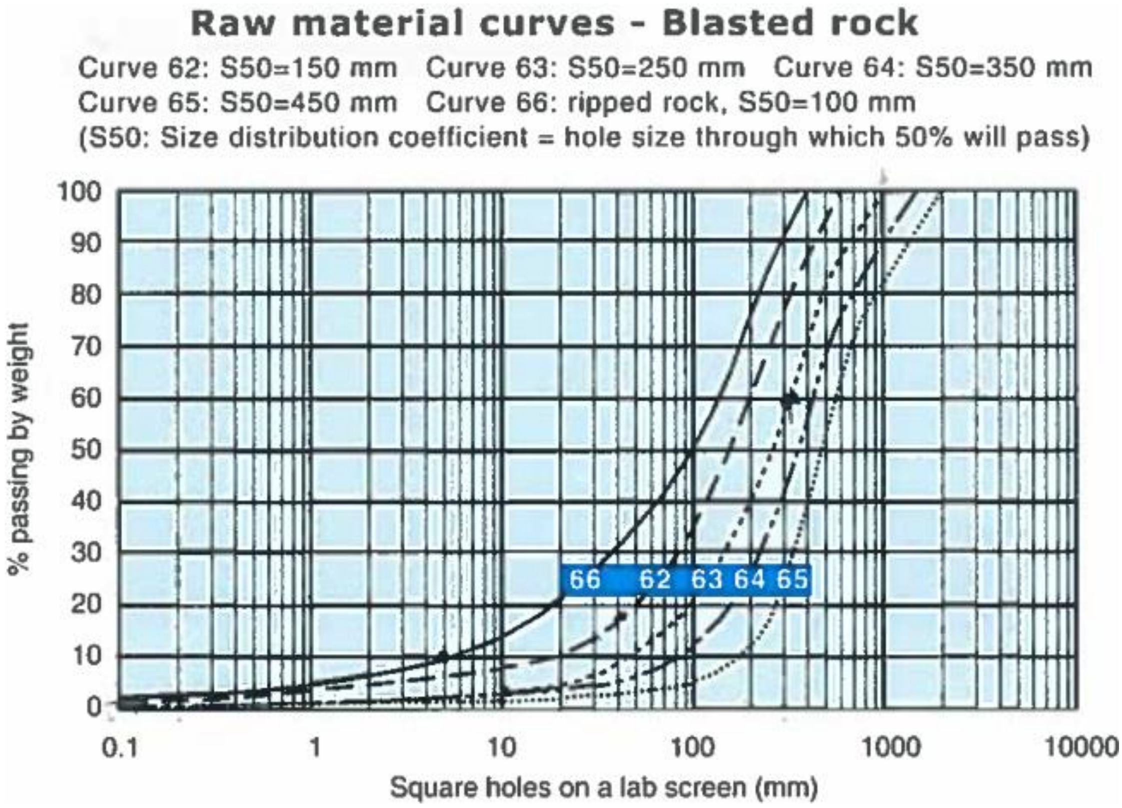


Figure 4-8: Raw material curves for drill and blast (Bellopede R et al 2011)

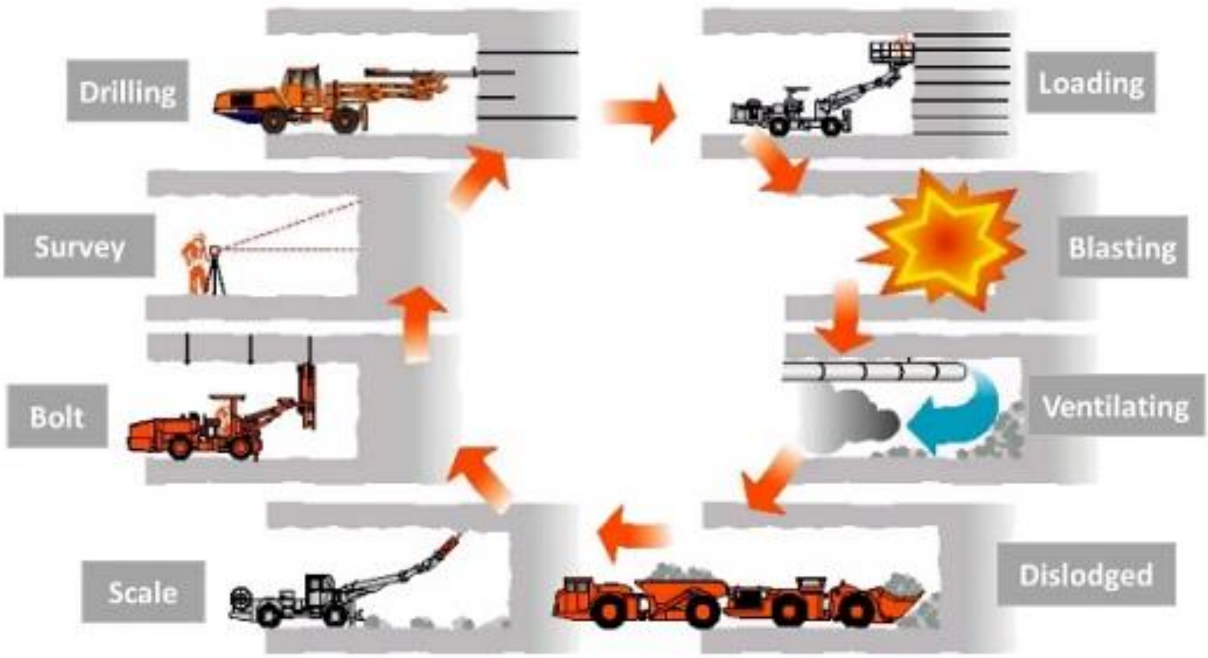


Figure 4-9: Indicative D&B sequence

4.3.1.2. 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 with TBM 4 (Mod 3) having an excavation diameter of 12.14M, however this may increase an additional 100-200 mm. Each machine will be fully equipped to perform the excavation, ventilation, lining and removal of spoil. TBM's which may encounter NOA are equipped for NOA management.

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.

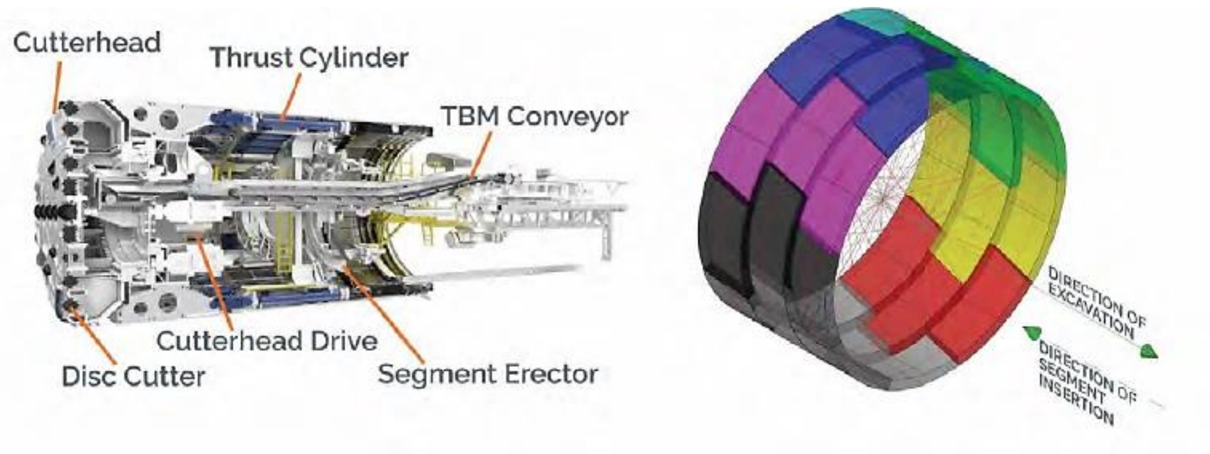
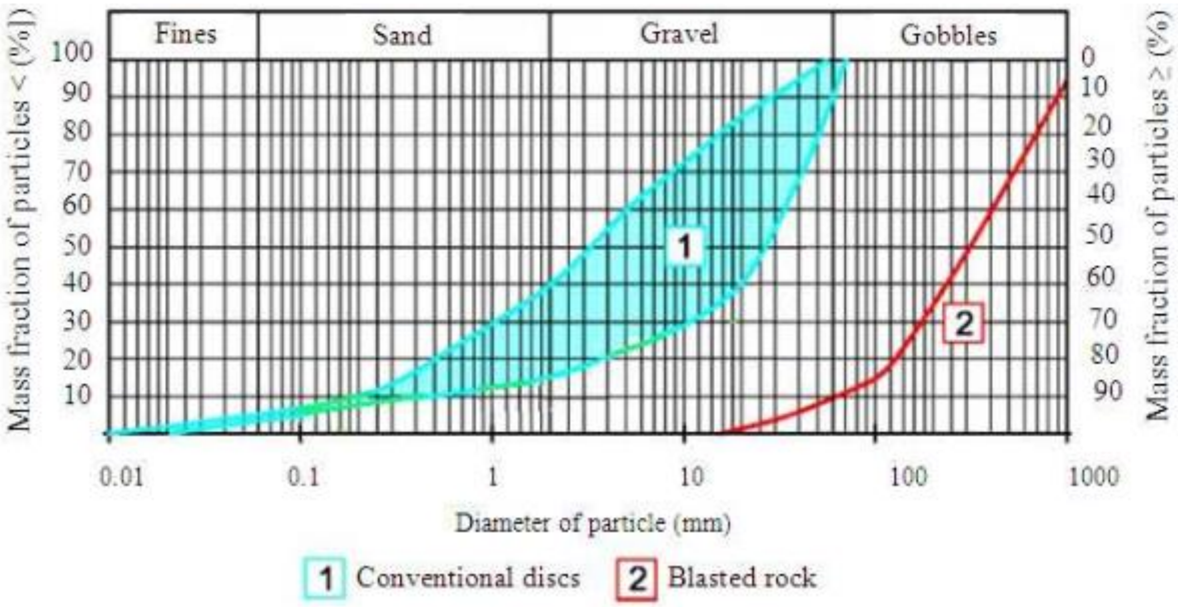


Figure 4-10: Example Tunnel Boring Machine

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 Section 6 to Section 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)

4.3.1.3. 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.

4.3.2. Open cut excavation

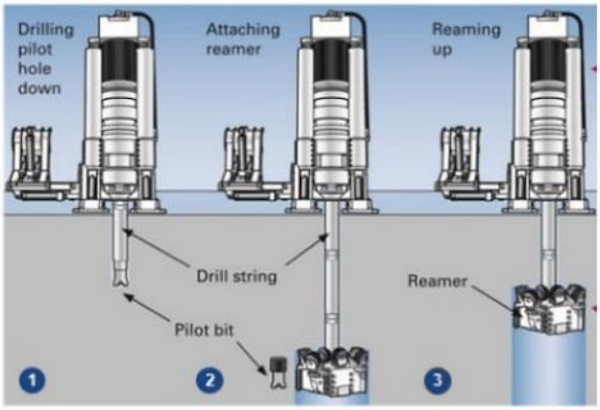
Conventional open cut excavation is the method used at open excavation of soil and rippable hard material (not rock). Open cut excavation involves the removal of soil or rock from a site to form an open face, hole or cavity using tools, machinery or explosives. It involves excavating down to below ground 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.

4.3.3. Vertical boring

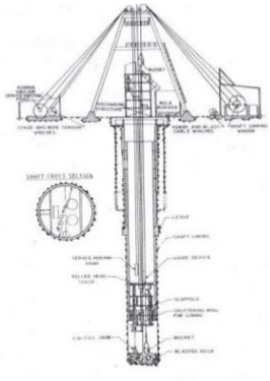
Vertical boring is the most efficient method of vertical shaft excavation. Two methods will be adopted: raise boring and blind sinking. Both are described below and graphically shown in Figure 4-12.

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)

4.3.4. 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.

4.4. 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.

Site transport management plans 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 from Marica to Rock Forest via the public road network. Details on external truck movements are presented in the Transport Management Plan (S2-FGJV-LOG-PLN-0008) and will be complied with throughout construction.

NOA will be transported as per the Transport Management Plan (S2-FGJV-LOG-PLN-0008) and Natural Occurring Asbestos (NOA) Management Plan (S2-FGJV-ENV-PLN-0019).

5. SPOIL CHARACTERISATION

5.1. Spoil characterisation overview

FGJV have developed a spoil characterisation program based on relevant guidelines presented in Section 2.5.

Spoil reuse characterisation will be undertaken according to Appendix A of this Spoil Management Plan and the Nitrogen Management plan (S2-FGJV-ENV-PLN-0367), which, depending on the Spoil nature (Blasting or TBM), will include but not be limited to nutrients.

Spoil characterisation is summarised in Table 5-1 and is presented in Appendix A.

Table 5-1: Overview of spoil characterisation program

Aspect	Approach
Contamination	Material that has been tested and classified as 'contaminated' in accordance with the NSW EPA Waste Classification Guidelines. A Specific Sampling, Analysis and Quality Plan (SAQP) will be prepared to inform the scope, method and sampling frequency in accordance with the relevant testing guidelines.
Spoil (D&B and TBM)	Characterisation of D&B and TBM probe spoil to ensure PAF spoil 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.
	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.
Onsite Reuse - 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.
Offsite Reuse	Material may be assessed for its potential to be used offsite. For the material to be reused offsite it must be assessed as: • Virgin Excavated Natural Material (VENM) in accordance with the POEO Act; or • Excavated Natural Material (ENM) in accordance with the ENM Order (2014).
Offsite Disposal	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 if requested by NPWS.
- **Reactive** spoil suitable for use or placement within the project with appropriate treatment 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** Material determined by engineering not suitable for engineering or constructability purposes.

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

5.2. Onsite laboratory

An onsite material testing laboratory will be established for soil and rock characterisation purposes, this will include;

- PAF testing including Net Acid Generation (NAG) testing; and
- NOA testing including asbestos presence absence testing.

Offsite facilities will also be used to supplement the onsite laboratory. 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 FGJV's Quality system and checked by SHL's quality system.

5.3. Contamination investigations

Details on further contamination investigations are presented in the Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0049). 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.

Residual nitrogen compounds have been observed on some spoil materials. The investigation of these analytes is ongoing and is explored further in the Nitrogen Management Plan (S2-FGJV-PLN-0367).

5.4. AMD assessment

The AMD testing program includes:

- Net Acid Generation (NAG) testing undertaken by the onsite laboratory to screen Potentially Net Acid Forming material from Non-Acid Generating material;
- Net Acid Generation (NAG) testing undertaken by the offsite laboratory to confirm the material is NAG or NAF.
- Sequential NAG testing will be conducted as required.
- Geochemical kinetic testing was undertaken over a 12 month period and indicated very low risk of acid formation. The neutralizing capacity of the spoil is expected to be sufficient to mitigate acid formation

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.

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.

Further details on the management of PAF is presented in Appendix A and Appendix E.

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

Geological testing has identified that NOA is ‘likely’ to be encountered in the HRT from chainage 7,544 to 9,992 metres (2,448 metres) based on petrography analysis, and ‘confirmed’ to be present from chainage 9,992 metres to 15,575 metres (5,583 metres).

Further details on the management of NOA is provided in Appendix A and Appendix D.

5.6. Unsuitable material

The material will be classified as unsuitable when it cannot be used for construction or any other purpose. 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.

If material is unsuitable for use within the project:

- The material will be assessed for its ability to be used in an offsite location provided that it meets the definition of VENM or a relevant Resource Recovery Order (RRO) such as the Excavated Natural Material (ENM) Order if requested by NPWS.
- If 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.

FGJV'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 Section 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 SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010), 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.

Figure 6-1 to Figure 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.

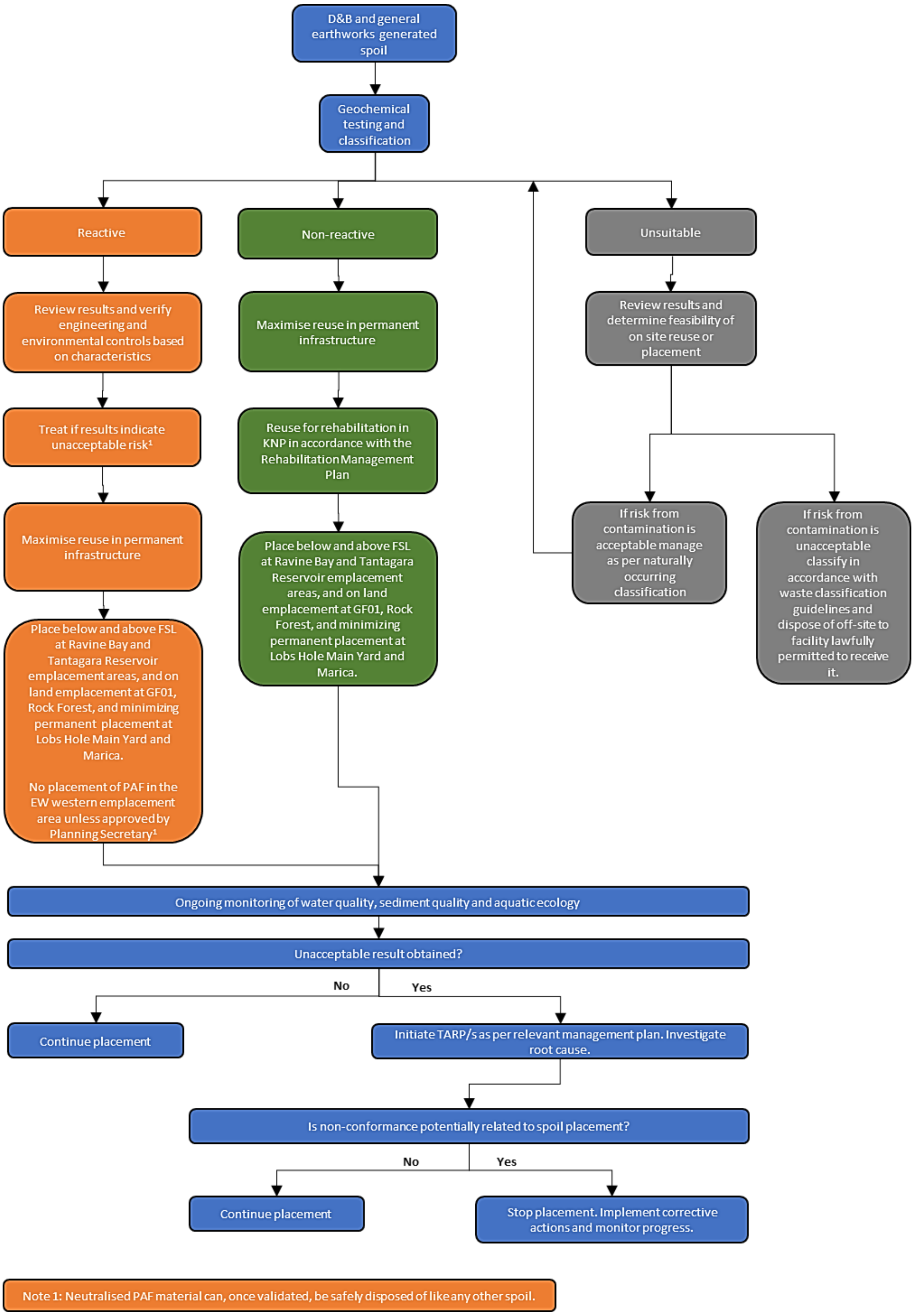


Figure 6-1: D&B and earthworks generated material flow chart

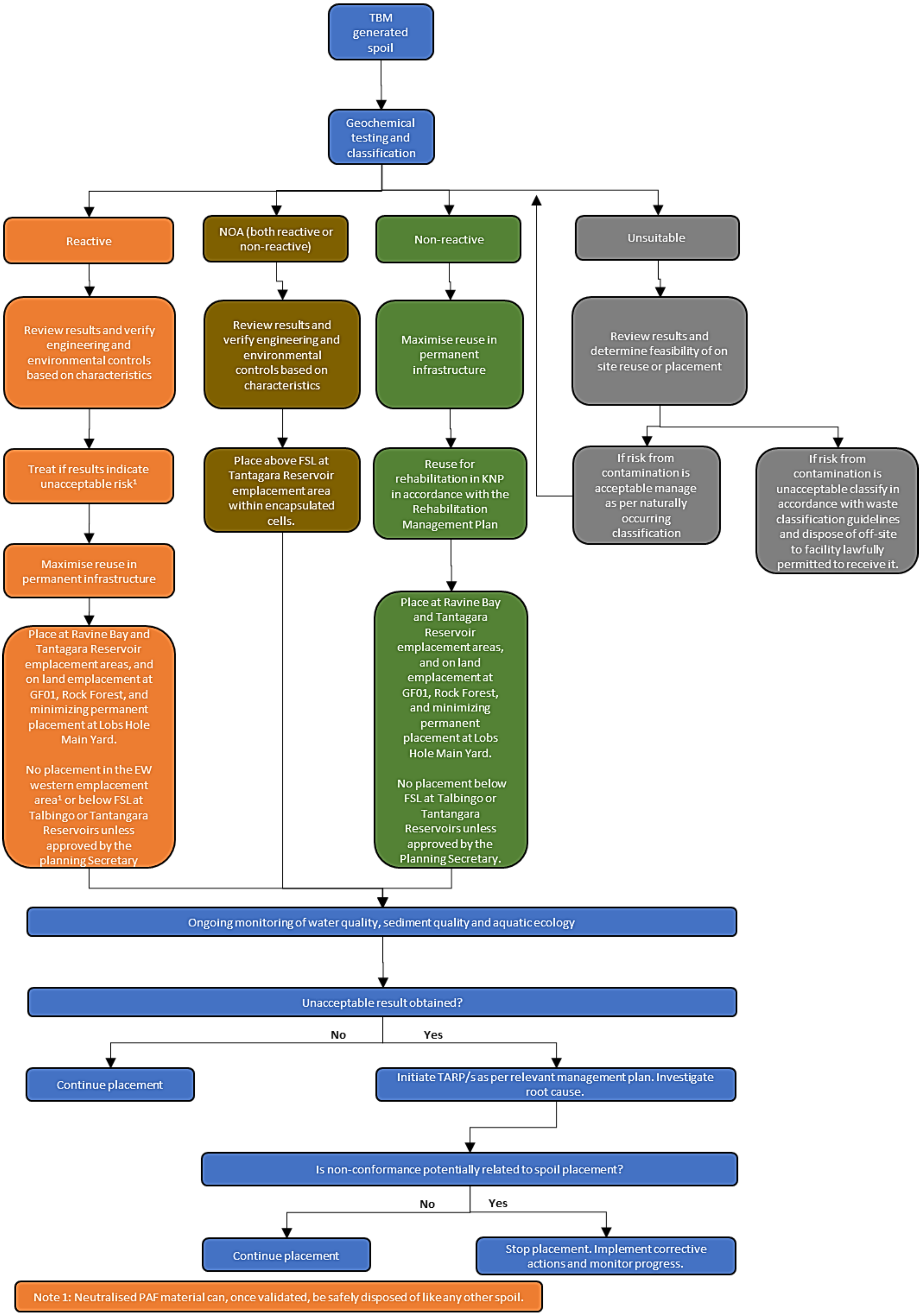


Figure 6-2: TBM generated material flow chart

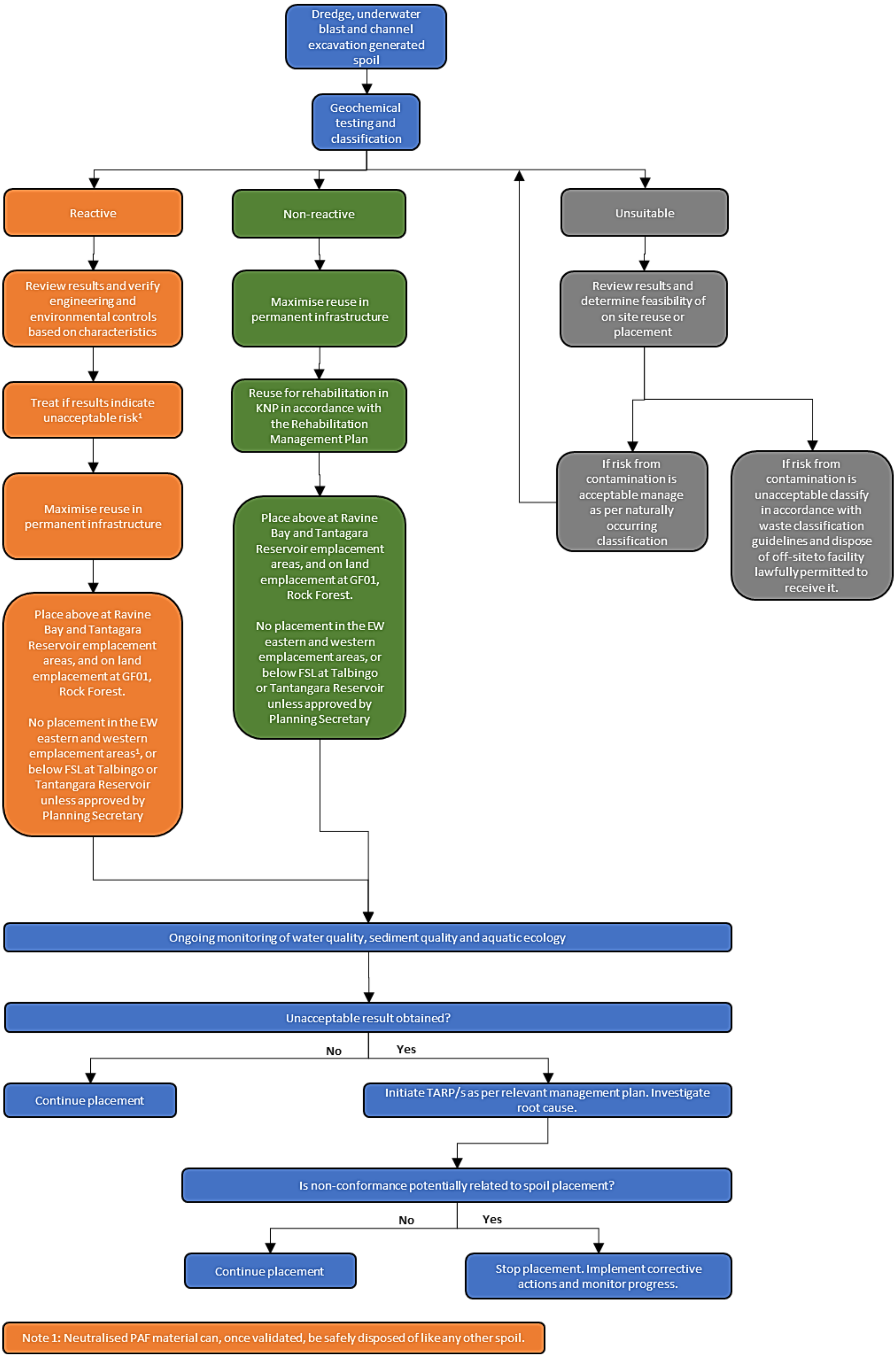


Figure 6-3: Dredge, underwater blasting and channel excavation generated material flow chart

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	Land spoil emplacement within the approved areas with the relevant environmental controls according to the approvals conditions and Environmental licence No. 21266unless 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.	-	-	-	-	0.7
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	Land spoil emplacement within the approved areas with the relevant environmental controls according to the approvals conditions and Environmental licence No. 21266 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, any excess spoil can subsequently be transported to Rock Forest.

6.2. Minimisation and beneficial reuse

6.2.1. Minimisation

FGJV 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

FGJV 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

FGJV'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 Appendix F.. The detailed plans must be approved prior to any construction occurring in the relevant emplacement area.

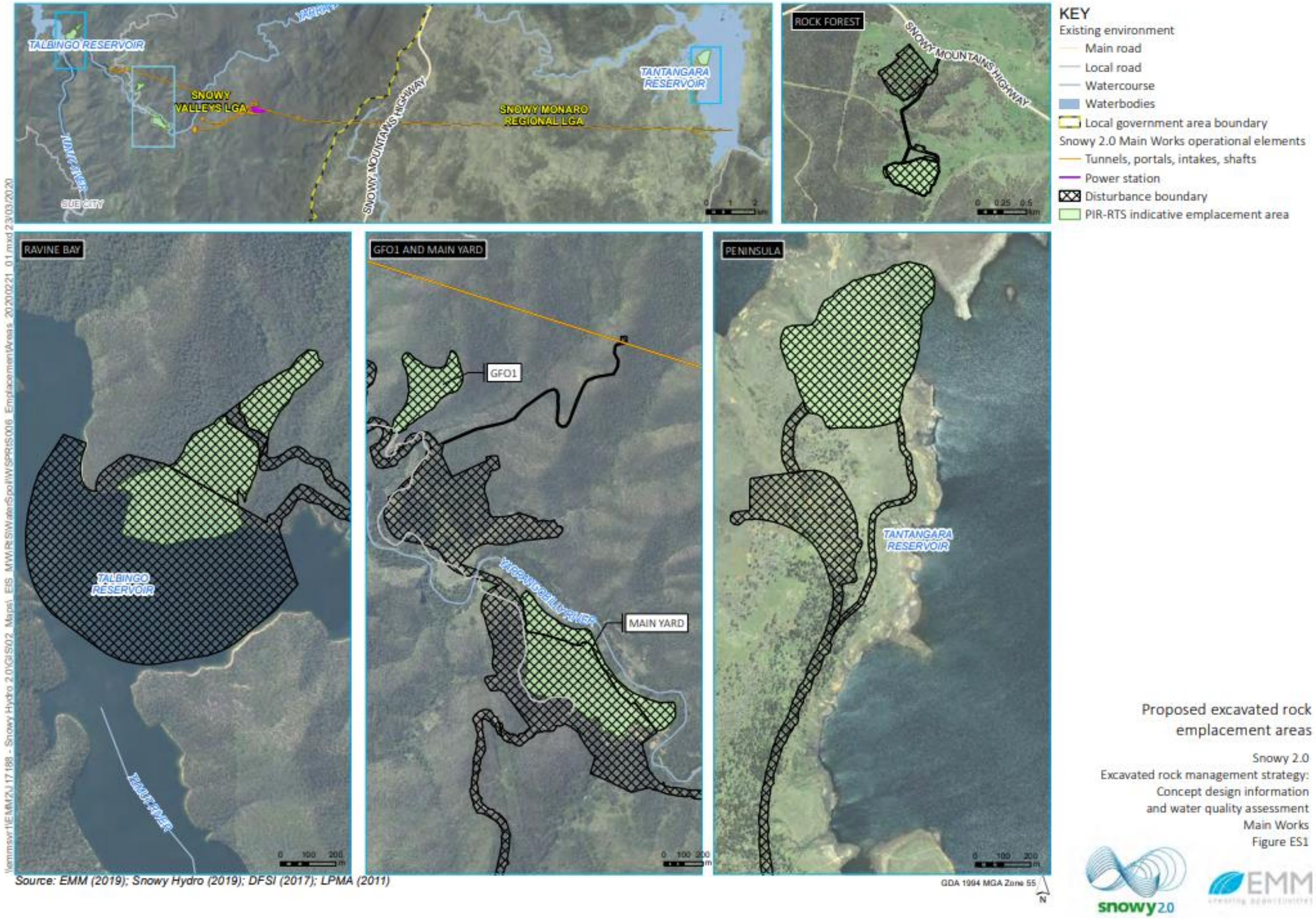


Figure 6-4: Spoil emplacement areas (EMM, 2020)

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 Plant Community Type (PCT) 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 SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010) 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 SHL for the further actions and remediation (if required);
- SHL 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 and will be managed in accordance with the stockpile management procedure presented in Appendix C;
- 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 in the Contaminated Land Management Plan (S2-FGJV-ENV-PLS-0049) will be implemented in the event previously unidentified contamination is encountered during works.

6.7. Waste management

FGJV 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 anthropogenically 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 Section 6.8, Section 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 reused or disposed offsite. Key management measures to be implemented are:

- waste disposal is to be in accordance with the POEO Act and the 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 section 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 section 143 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 Waste Locate 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:

- FGJV 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:

- FGJV 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 has been developed and will be implemented as part of the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011). 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 FGJV to evaluate the performance of surface water controls;
- Trigger Action Response Plans (TARPs) have been developed and included as part of the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011) 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.

Site specific leachate detection procedures have been prepared in consultation with the EPA for the spoil emplacement areas as per the below:

- S2-FGJV-ENV-PRO-0055 GF01
- S2-FGJV-ENV-PRO-0057 Tantangara
- S2-FGJV-ENV-PRO-0059 Main Yard
- S2-FGJV-ENV-PRO-0061 Rock Forest
- S2-FGJV-ENV-PRO-0062 Ravine Bay
- S2-FGJV-ENV-PRO-0065 Marcia

7. PROGRESSIVE REHABILITATION AND EMPLACEMENT DESIGN

The decommissioning, land-forming and landscaping proposed for the project is detailed in the SHL's approved Snowy 2.0 Rehabilitation Management Plan - Stage 1 (S2-SHL-ENV-PLN-0010). 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 Appendix F and Table 7-1once 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 18^{o} 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

Aspect	Objective
Land Use	• Native vegetation and habitat must be consistent with the SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010). • Recreational facilities and use must be consistent with the approved Recreation 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

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. A summary list of the documents that have been developed is displayed below:Spoil Management Plan S2-FGJV-ENV-PLN-0019
- Spoil characterisation program S2-FGJV-ENV-REP-0019
- Topsoil strategy S2-FGJV-ENV-PLN-0019
- Stockpile procedure S2-FGJV-ENV-PLN-0019
- Naturally Occurring Asbestos Management S2-FGJV-PLN-0019
- Acid and Metalliferous drainage Management Plan S2-FGJV-ENV-PLN-0019
- Lobs Hole Main Yard Emplacement Area S2-FGJV-ENV-PLN-0019
- GF01 emplacement area S2-FGJV-ENV-PLN-0019
- Ravine Bay spoil emplacement area S2-FGJV-ENV-PLN-0019
- Tantangara emplacement area S2-FGJV-ENV-PLN-0019
- Rock Forest spoil emplacement area S2-FGJV-PLN-0019
- Water Management Plan S2-FGJV-ENV-PLN-0010
- Surface Water Management Plan S2-FGJV-ENV-PLN-0011
- Ground water Management Plan S2-FGJV-ENV-PLN-0012
- Transport Management Plan S2-FGJV-LOG-PLN-0008

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.	FGJV	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).	FGJV	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.	FGJV	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.	FGJV	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).	FGJV	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.	FGJV	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.	FGJV	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.	FGJV	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.	FGJV SHL	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.	FGJV	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.	FGJV	Schedule 3 condition 4
SM12	The beneficial reuse of non-reactive spoil on the project will be maximised where possible.	FGJV	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).	FGJV SHL	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.	FGJV	Schedule 3 condition 4
SM15	Spoil left at Lobs Hole, Marica and Tantangara for incorporation into the final landform should be minimised.	FGJV	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.	FGJV	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.	FGJV SHL	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	FGJV SHL	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.	FGJV	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.	FGJV	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.	FGJV	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.	FGJV	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.	FGJV	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.	FGJV SHL	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.	FGJV	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	FGJV	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.	FGJV	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.	FGJV	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.	FGJV	Schedule 3 condition 7 MW REMM SOIL02 EW REMM SOIL01

ID	Measure / Requirement	Responsibility	Source document
SM30	A hold point process will be established and implemented requiring approval by the FGJV 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.	FGJV	Schedule 3 condition 4(k) and DPIE comments
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.	FGJV	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).	FGJV	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.	FGJV	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 SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010). Operational controls that require ongoing management following completion of construction would be of no impost the NPWS.	FGJV	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 SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010). Operational controls that require ongoing management following completion of construction would be of no impost the NPWS.	FGJV	EW REMM WM8.6

ID	Measure / Requirement	Responsibility	Source document
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 SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010).	FGJV	EW REMM WM8.7
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 SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010).	FGJV	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.	FGJV	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.	FGJV	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*).	FGJV	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.	FGJV FGJV	MW REMM REHAB02

ID	Measure / Requirement	Responsibility	Source document
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 SHL's approved Snowy 2.0 Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010); • 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 SHL's approved strategy in the Snowy 2.0 Rehabilitation Management Plan – Stage 1(S2-SHL-ENV-PLN-0010); • 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)	FGJV	Schedule 3 condition 7
SM43	The SHL's approved Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010) will be implemented for the new landforms at Tantangara Reservoir, Lobs Hole and Talbingo Reservoir.	FGJV	MW REMM REHAB01
SM44	Mitigations will be included in the SHL's approved Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010) to minimise impacts to Alpine humus soils and peat bogs/fens.	FGJV	MW REMM SOIL01
SM45	The SHL's approved Rehabilitation Management Plan – Stage 1 (S2-SHL-ENV-PLN-0010) (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.	FGJV	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.	FGJV	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)	FGJV	Inspection report	For duration of construction of this activity
Tunnel excavated spoil	Daily workplace inspections	FGJV	None – observation only	For duration of construction of this activity
	TBM probing during tunnelling as described in Appendix A.	FGJV	Inspection report Laboratory test report	
	Laboratory testing of spoil sampled and tested as described in Appendix A.	FGJV	Laboratory test report	
Temporary Stockpiles	Weekly inspection of stockpile areas (refer Section 9.1.2)	FGJV	Inspection report	All
Emplacement area	Weekly inspection of stockpile areas (refer Section 9.1.2)	FGJV	Inspection report	For duration of construction of this activity
	Daily workplace inspections	FGJV	None – observation only	
Off-site transport (if required)	Truck movement run sheets for each truck transporting spoil off site (outside the project)	FGJV	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

FGJV 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 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 as a minimum to the standards prescribed inhe *Blue Book* (Landcom, 2004) and all relevant mitigation measures in the Surface Water Management Plan (S2-FGJV-ENV-PLN-0011). 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.

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.

9.2. Training

All site personnel will undergo the FGJV 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 will be completed and made publicly available in accordance with schedule 3 condition 7 (f) of the Infrastructure Approval and requirements under EPL 21266. (Condition R-4.5, 4,6 and4.7)

Reports will align with the reporting frequency as outlined in EPL 21266 and will include information such as:

- Volume of spoil excavated from tunnelling;
- Volume of spoil placed at each emplacement area;
- Volume disposed offsite;
- Volume reused elsewhere in the KNP;
- Volume of AMD material treated; and
- Volume of NOA excavated and emplaced at Tantangara PSE.

Appendix A. CHARACTERISATION PROGRAM

MANAGEMENT PLAN

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

S2-FGJV-ENV-PLN-0019

FEBRUARY 2025

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 spoil.

Revision Record

Rev.	Date	Reason for Issue	Responsible	Accountable	Endorsed
L	01/02/2025	Updated to address SHL comments	K. Koning	N. Bernardini	D. Drummond

Document Verification

RACIE Record

R esponsible:	Name: Kane Koning Job Title: Spoil Advisor Signed: Date: 02/02/2025
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C onsulted:	See distribution list on Page 3.
I nformed:	See distribution list on Page 3.
E ndorsed:	Name: Dave Drummond Job Title: QHSE Director Signed: Date: 3 Feb 2025

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.
C	**Consulted** Those who must be consulted before the document is published.
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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
J	21/10/2024	Updated to address Hibbs comments and incorporate S2-FGJV-HAS-PLN-0032
K	25/11/2024	Updated to address SHL comments
L	01/02/2025	Updated to address SHL comments

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ABBREVIATIONS AND DEFINITIONS

Acronym	Definition
ABA	Acid Base Accounting
ANC	Acid Neutralising Capacity
AMD	Acid Mine Drainage
AD	Alkaline Drainage
APP	Acid Production Potential
AS	Australian Standard
CoPC	Contaminants of Potential Concern
CRS	Chromium Reducible Sulfur
CSIRO	Commonwealth Scientific and Industrial Research Organisation
D&B	Drill and Blast
EC	Electrical Conductivity
EIS	Environmental Impact Statement
ENM	Excavated Natural Material
IVMS	Integrated Vehicle Management System
KNP	Kosciuszko National Park
NAG	Net Acid Generation
NAPP	Net Acid Producing Potential
NATA	National Association of Testing Authorities
NMD	Neutral and Metalliferous Drainage
NOA	Naturally Occurring Asbestos
NPR	Neutralisation Potential Ratio
NPWS	National Parks and Wildlife Service
MPA	Maximum Potential Acidity
PAF	Potentially Acid Forming
QA	Quality Assurance
QC	Quality Control
RRO	Resource Recovery Order
SD	Saline Drainage
TBM	Tunnel Boring Machine
VENM	Virgin Excavated Natural Material
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence

1. INTRODUCTION

1.1. Context

Preliminary investigations completed during the Environmental Impact Statement (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 (PAF) material;
- Materials containing Naturally Occurring Asbestos (NOA); and occasionally
- 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:
    - Onsite reuse or emplacement within the project footprint;
    - Offsite disposal to a receiving site or licensed landfill in accordance with applicable waste classification guidelines; or
    - Offsite reuse in accordance with applicable Resource Recovery Order (RRO), 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. All documents aim to address the conditions from the Infrastructure Approval relevant to spoil management.

The program is summarised in Table 1-1.

Table 1-1 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 NMD, SD and AD; 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 Drill and Blast (D&B) and Tunnel Boring Machine (TBM) spoil from stockpile or probe chips to ensure potential AMD, NMD and SD is correctly classified. Align sampling and analysis procedures with relevant guidelines. Include both rapid field testing and periodic laboratory analysis of D&B and TBM spoil in the program.

Aspect	Approach
	Characterise D&B and TBM generated spoil to verify the presence of NOA. Align sampling and analysis with relevant parts of DECCEEW, 2013 and AS5370.
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 Australian Standard (AS) 1141, AMD Guidelines, DECCEEW, 2013 and AS2370-2024.
Offsite Disposal	Classify waste material to be disposed of off-site to ensure lawful transport and disposal. Classify and test waste material in accordance with NSW EPA, 2014e, NSW EPA, 2014f, NSW EPA, 2014g and NSW EPA, 2014h.
Offsite Reuse	Classify material in accordance with an applicable RRO such as the NSW EPA, 2014a or have the material classified as Virgin Excavated Natural Material (VENM) in accordance with the POEO Act.

1.2. Legislative Guidance

The following legislative guidance has been considered in the development of this plan:

- 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).

1.3. Consulted Guidelines

This document has been developed based on the guidance below:

- Acid Sulfate Soils Manual (Acid Sulfate Soil Management Advisory Committee, 1998)
- ARD Test Handbook (AMIRA International, 2002)
- Australian Standard 4482.1 Guide to the Sampling and Investigation of Potentially Contaminated Soil (AS 4482.1)
- Australian Standard 5370-2024, Method for the qualitative identification of asbestos in bulk samples (AS 5370)
- Australian Standard 1141.3.1 Methods for Sampling and Testing Aggregates (AS 1141.3.1)
- Consultants Reporting on Contaminated Land (NSW EPA, 2020)
- National Environment Protection (Assessment of Site Contamination) Measure (DECCEEW, 2013)
- Preventing Acid and Metalliferous Drainage Leading Practice Sustainable Development Program for the Mining Industry, Department of Industry 2016 (DoI, 2016)
- The Excavated Natural Material (ENM) Order (NSW EPA, 2014a)

- The Excavated Public Road Material Order (NSW EPA, 2014b)
- The Recovered Aggregate Order (NSW EPA, 2014c)
- The Treated Drilling Mud Order (NSW EPA, 2014d)
- Sampling Design Part 1 – Application (NSW EPA, 2022)
- Waste Classification Guidelines - Part 1 Classifying Waste (NSW EPA, 2014e)
- Waste Classification Guidelines - Part 2 Immobilizing Waste (NSW EPA, 2014f)
- Waste Classification Guidelines - Part 3 Waste Containing Radioactive Material (NSW EPA, 2014g)
- Waste Classification Guidelines - Part 4 Acid Sulfate Soils (NSW EPA, 2014h)
- Waste Classification Guidelines - Addendum to Part 1 Classifying Waste (NSW EPA, 2016)

2. EXPECTED SOIL AND ROCK DOMAINS

2.1. Natural Rock Domains

There are various natural rock domains or lithologies within the Project Area which each have their own characteristics and associated risks including:

- Reactive materials capable of generating AMD, also known as PAF material;
- Materials containing NOA; and occasionally
- Reactive materials capable of generating NMD, SD and AD.

The characteristics listed above determine which analytes will be considered when assessing the material. Additional Contaminants of Potential Concern (CoPC) may be considered based on an assessment by a suitability qualified individual.

A summary of the natural rock domains expected within the Project Area and their associated characteristics is presented in Figure 2-1 and Figure 2-2.

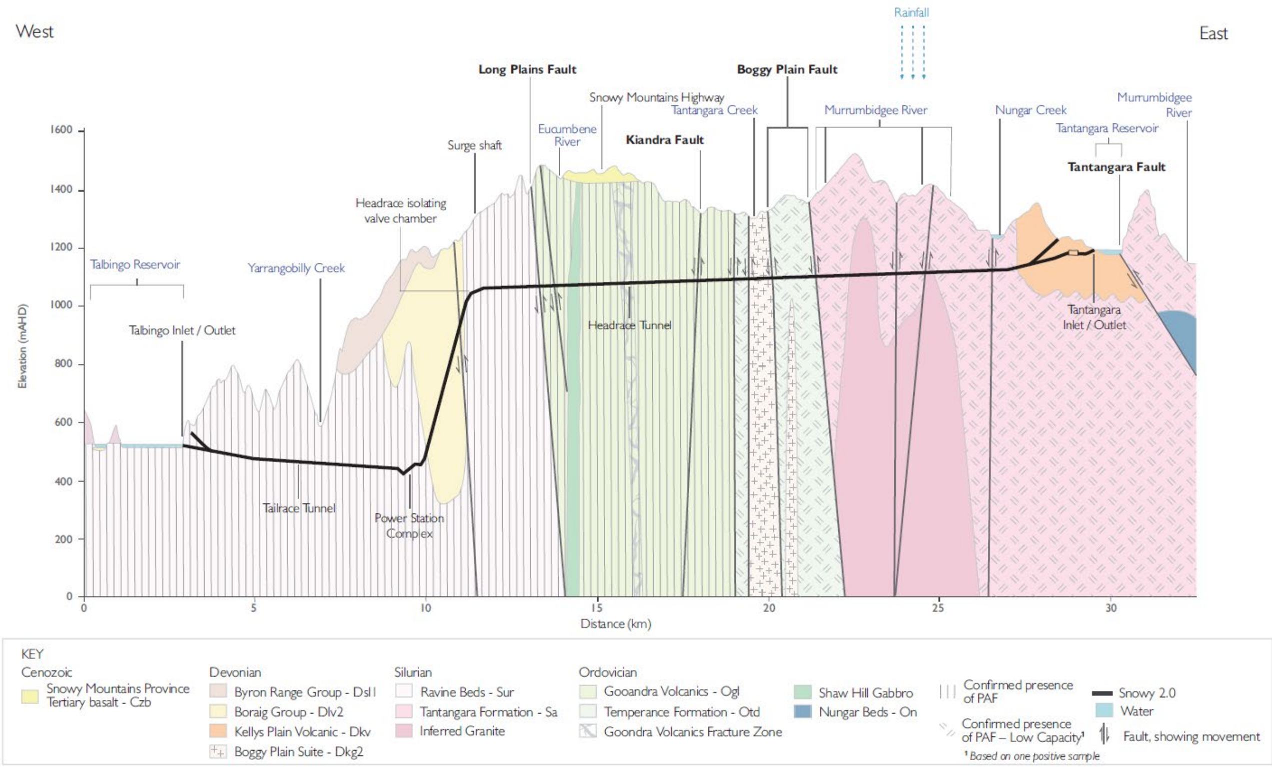


Figure 2-1 Natural Rock Domains Showing Confirmed Presence of PAF

Figure 2-1 shows that PAF may be encountered throughout the Project Area except for some small areas including the Kelly Plain Volcanics geological unit. Where the lithology has undergone significant oxidation such as the case for residual soil and highly weathered rock the material would have a low risk for PAF. As shown in Figure 2-2 NOA has been identified in some sections of the Gooandra Volcanics geological unit and is considered likely to be present within the Temperance and Boggy Plains geological units based on petrography analysis.

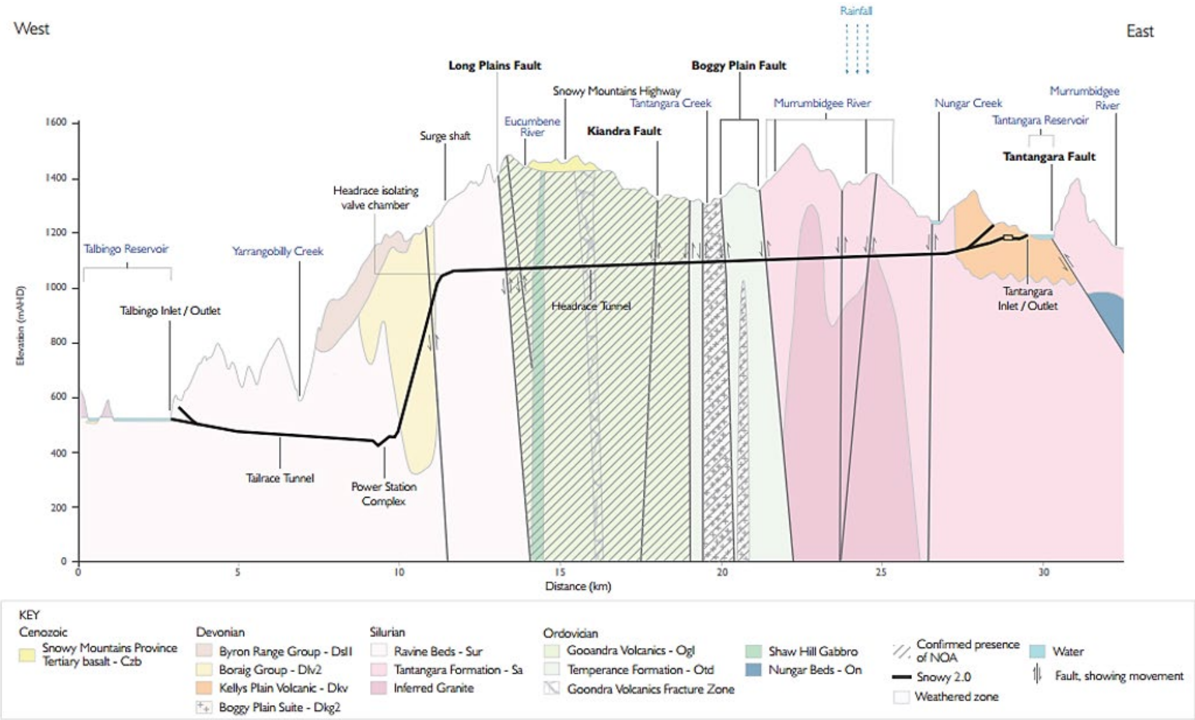


Figure 2-2 Natural Rock Domains Showing Confirmed Presence of NOA

2.2. Natural Soil Domains

A summary of Acid Sulfate Soil Risk is provided in Section 4.9 of Appendix N.2 of the EIS – Snowy 2.0 Main Works. The project area in general has a low risk of potential acid sulfate soils based on geomorphic conditions.

Although unlikely, soil materials may be screened for PAF should there be visual or olfactory signs that the material may be acid forming.

2.3. Anthropogenic Domains

Based on contamination investigations (main Works EIS), there is a risk of encountering pre-existing contaminated soil from previous land use activities. Although not stated in the main works EIS there is a potential to encounter elevated concentrations of nitrates and ammonia from onsite blasting.

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.

Anthropogenic domains should generally be assessed and screened CoPC to determine the material suitability for the proposed use or disposal.

Any contaminated materials encountered during works will be managed in accordance with the following documents where applicable:

- Contaminated Land Management Plan (S2-FGJV-ENV-PLN-0049);
- Waste Management Plan (S2-FGJV-ENV-PLN-0048); and
- Nitrogen Management Plan (S2-FGJV-ENV-PLN-0367).

3. SAMPLING

3.1. Sampling Frequency

3.1.1. Natural Soil and Rock Domains

Sampling frequencies have been adopted based on a risk-based approach considering results obtained on the project thus far. The current sampling density is presented below:

- For natural rock domains which are potentially reactive as per Figure 5-1 at least one composite sample per 1,000 m^3 of excavated material to assess the PAF properties of the material.
  - An average of one composite sample daily for each emplacement area where fresh material has been deposited. This sample will be used for Quality Assurance (QA) and Quality Control (QC) purposes.
- Further information on the NOA the sampling density is presented in Appendix D of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019).

3.1.2. Anthropogenic Domains

Sample frequencies for anthropogenic domains will be undertaken in accordance with relevant guidance including NSW EPA, 2022 and/or DECCEEW, 2013 where applicable.

3.2. Excavation Sampling

3.2.1. Sampling of Drill and Blast material

Air-percussive probe drilling (in advance of the excavation face) is typically 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 for geo-technical sampling.
  - Sampling for spoil characterisation purposes (including but not limited to AMD sampling) can be undertaken in such a way that there is no duplicate sample for a given chainage. This process ensures that sampling density requirements are not complicated by the management of the overlapping sections themselves;
- Collecting all surplus material following geological/geotechnical testing requirements and combine to create a composite; and
- Suspending excavation activities (as required), and repeating probing.

Chip samples are normally 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 1,000 m^3.

3.2.2. 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 up to 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; and
- 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 1,000 m^3 of material, representing an advance of approximately 10 m.

3.3. 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 after placement of fresh material to verify that no reactive material has been incorrectly placed in a non-reactive emplacement; and
- Sampling of Mixed/Treated reactive material emplacements after treatment has occurred.

Sampling of the material placed on the emplacements must be undertaken in accordance with AS 1141-3.1 or equivalent. An average of one composite sample will be taken daily for each permanent emplacement area where fresh material has been deposited.

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 emplacement area (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.

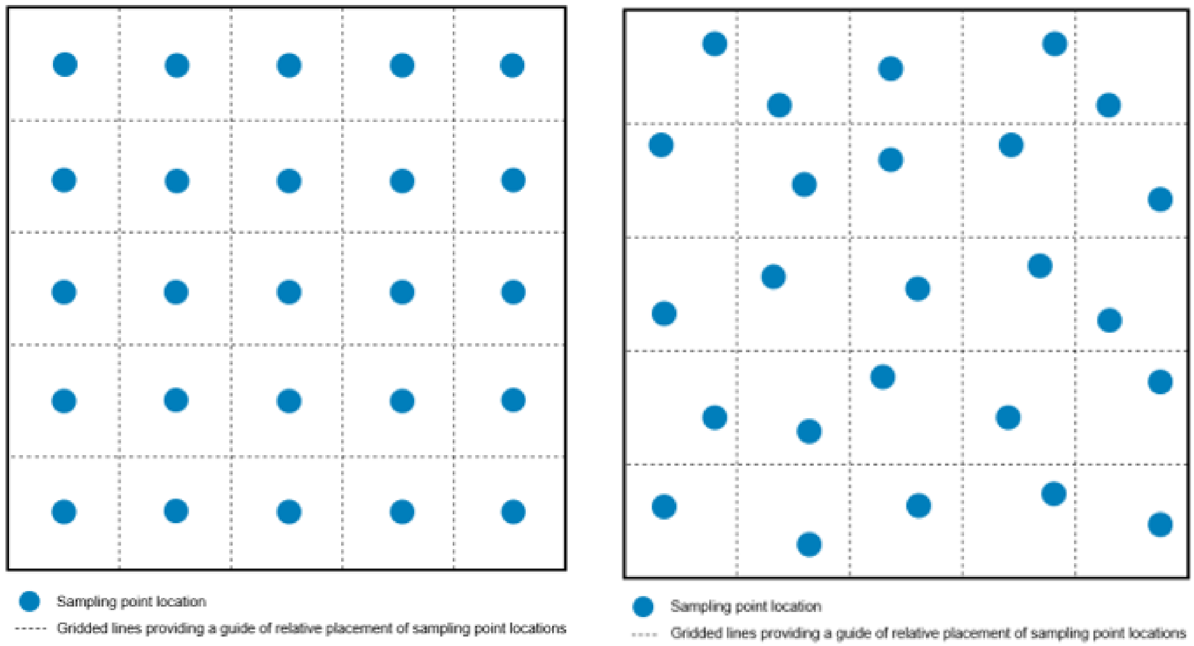


Figure 3-1 Example of Emplacement Area Sampling

Quantity movements will be informed by aerial drone surveys as well as Integrated Vehicle Management System (IVMS) data as required.

4. ANALYSIS PLAN

4.1. PAF Analysis Plan

4.1.1. 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; and
- Stage 2: More elaborate analyses undertaken at a National Association of Testing Authorities (NATA) accredited laboratory which is used to validate the site data, where necessary.

4.1.2. Stage 1 - Onsite Analysis

4.1.2.1. On-site NAG pH

The on-site Net Acid Generation (NAG) pH test is a static test developed to predict the generation of AMD during and after the mining operation. This test is based on the reaction of a sample with hydrogen peroxide, which accelerates the oxidation of sulfide minerals in the sample. During the test, acid generation and acid neutralisation reactions occur simultaneously, with the result representing a direct measurement of the net amount of acid generated by the sample.

At the environmental laboratory on Snowy 2.0 the NAG pH for spoil materials is determined based on the 'Single addition NAG test' as per AMIRA methodology. The method of testing involves dissolving 2.5 g of pulverized material (less than 75 µm) sample in a mixture of 250 ml of 15% (m/V) H_2O_2, which is then allowed to react overnight for a minimum of 8 hours. This reaction mixture is then boiled for approximately 2 hours. After cooling to room temperature, the pH ("NAG pH") is measured. These results are then cross verified against the results obtained from NATA accredited laboratory for quality assurance purposes, where necessary. These NAG pH results obtained are used by the Spoil advisors for effective control and management of the spoil.

4.1.2.2. Assessment Criteria

On-site NAG pH results will be used as the primary method for identifying NAF and PAF materials (i.e AMD classification assessments).

- Samples returning a NAG pH equal to or below 4.5 are considered as PAF and will have the result confirmed by a NATA accredited laboratory as per Section 4.1.3
- Samples returning a NAG pH between 4.5 and 6.5 are considered as NAF and will have the result confirmed by a NATA accredited laboratory as per Section 4.1.3
- Samples returning a NAG pH equal to or above 6.5 are considered as NAF and will not require confirmation by a NATA accredited laboratory as per the rationale provided in Section 4.1.5.

4.1.3. Stage 2 - NATA Accredited Laboratory

For QA/QC 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 between the onsite and external 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 deemed necessary.

4.1.3.1. Summary of Analytical Suites

ABA analyses suite typically consists of:

- Net Acid Generation Suite
    - Net Acid Generation: NAG (initial to pH 4.5)
    - Net Acid Generation: NAG (pH 4.5 - pH 7.0)
    - pH After Oxidation (pH NAG)
- Net Acid Producing Potential (by Chromium Reducible Sulfur (CRS))
    - Acid Neutralising Capacity (as $CaCO_3$)
    - Acid Neutralising Capacity (as H_2SO_4/t)
    - Acid Production Potential (by CRS)
    - Chromium Reducible Sulfur (s-SCr) (NLM-2.1)
    - Net Acid Production Potential (NAPP) by CRS

4.1.3.2. Net Acid Production Potential

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 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:

- NAPP =
    - Acid Producing Potential (APP) (Determined by CRS) – Acid Neutralising Capacity (ANC); or
    - Maximum Potential Acidity (MPA) (Determined by S%) – ANC
- NPR =
    - ANC / APP
    - ANC / MPA

Note that of the two above formulae for NAPP, MPA is based on S% which results in a more conservative estimate of potential acidity, i.e. also taking into consideration the presence of non-acid producing forms of sulfur/ sulfide such as organic sulfur compounds, while APP is based on CRS which provides a more accurate indicator of NAPP.

If the APP 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 APP exceeds the ANC, then the NAPP is positive, indicating that the material may be net acid-generating following complete oxidation. The ANC/APP 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 4-1). The plot shows the distribution of samples between the higher and lower risk (of generating a net acidic pH) domains.

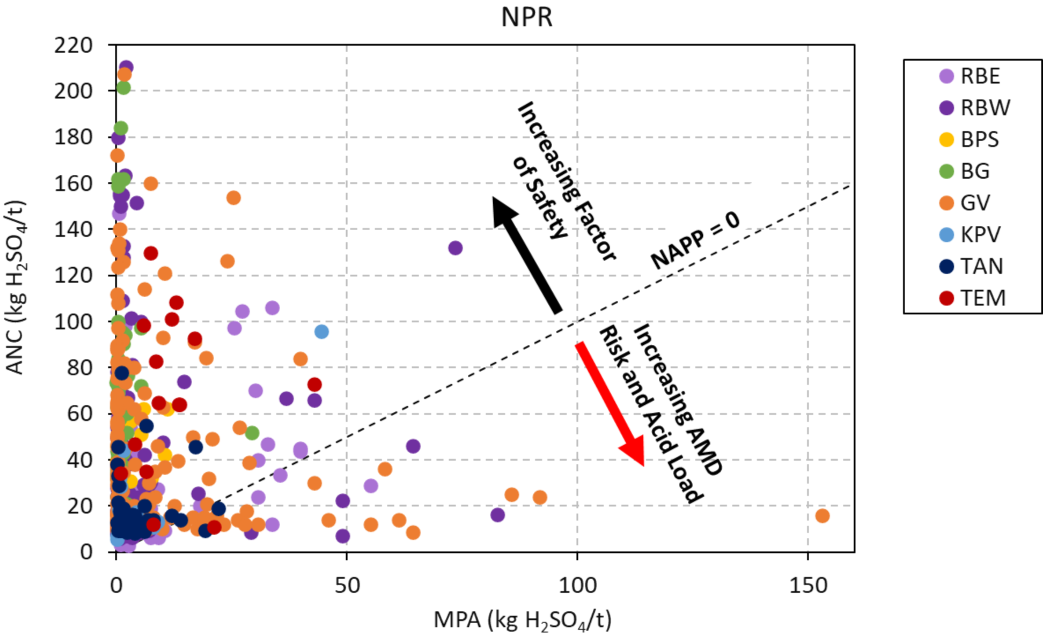


Figure 4-1 ABA plot for the samples collected to mid-January 2022

4.1.3.3. Net Acid Generation

The NAG suite includes NAG pH 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 NAF, PAF characteristics of the material, with samples being classed as NAF, PAF or Uncertain following the AMIRA International, 2002 classification. The outcome of the NAG tests for samples collected as part of the EIS is presented in Figure 4-2.

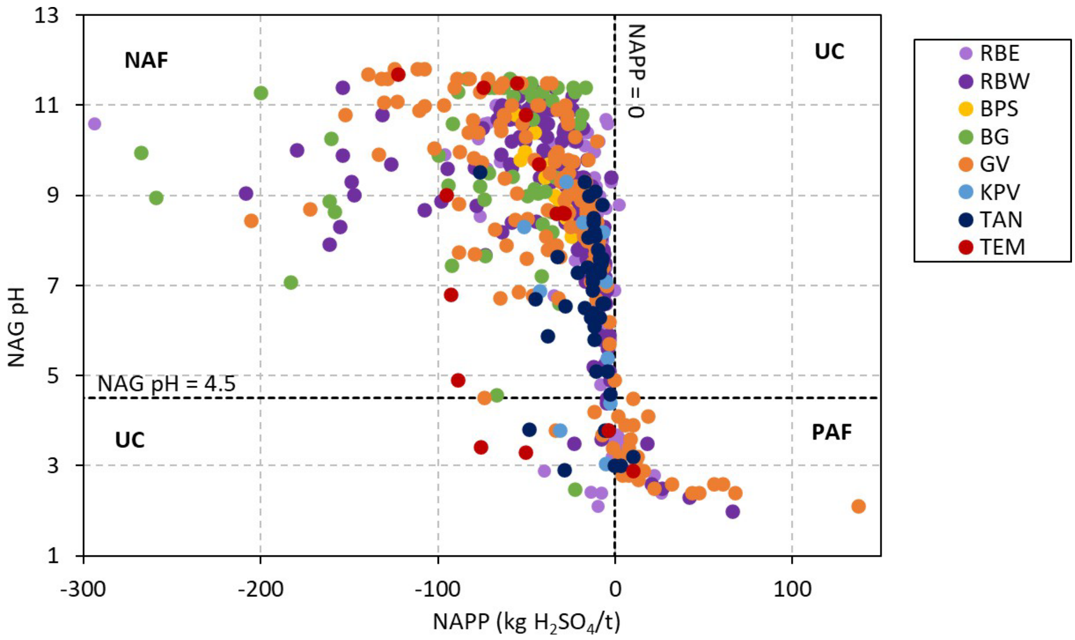


Figure 4-2 Classification for each geological unit using AMIRA International, 2002

4.1.3.4. 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). 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;
- Mineralogical assessment by X-ray diffraction (XRD); and
- pH and Electrical Conductivity (EC).

4.1.4. Analysis Plan for Treated PAF

Following treatment of PAF the material should be assessed for the analytes listed in Section 4.1.3 with an NPR of 3 indicating that the material has been sufficiently treated.

4.1.5. On-site vs off-site NAG pH

A significant number of samples have so far been analysed on the Snowy 2.0 project which has allowed for an assessment of the variability between the onsite NAG pH results and the NATA accredited offsite NAG pH results.

A comparison between the onsite and offsite laboratory results for NAG pH was undertaken for one thousand, six hundred and fifteen (1,615) samples collected between 1 January 2024 and 2 September 2024. The results of this investigation are presented below:

- One hundred and twenty-three (123) samples (8.2%) returned an onsite laboratory result greater than 1 pH unit higher than the offsite laboratory result;

- Twenty (20) samples (1.2%) returned an onsite laboratory result greater than 2 pH units higher than the offsite laboratory result; and
- Four (4) samples (0.2%) returned an onsite laboratory result greater than 3 pH units higher than the offsite laboratory result.

Based on the above results, if the onsite NAG pH result is above 6.5 there is a high level of confidence that the NATA accredited NAG pH result will indicate that the material is NAF. Where the onsite NAG pH result is greater than 6.5 the utility of running the sample for NAG pH at the external NATA accredited laboratory is limited.

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

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.

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

4.2. NOA Analysis Plan

For NOA the sampling density adopted will be as per the Naturally Occurring Asbestos Management Plan found in Appendix D of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019).

4.3. Anthropogenic Domains Analysis Plan

The analysis plan for anthropogenic domains will be undertaken in accordance with relevant guidance including NSW EPA, 2022 and/or DECCEEW, 2013 where applicable.

5. MATERIAL CLASSIFICATION

5.1. Correlation and modelling

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

- Laboratory analysis be compared to/correlated with X-Ray Fluorescence (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.

5.2. AMD classification

The criteria outlined in Table 5-1 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 The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and presented in Figure 5-1. The data is continuously being updated.

Table 5-1 AMD Classification Criteria

General AMD risk classification	Laboratory validation tests
PAF	NAG pH ≤ 4.5
NAF	NAG pH > 4.5

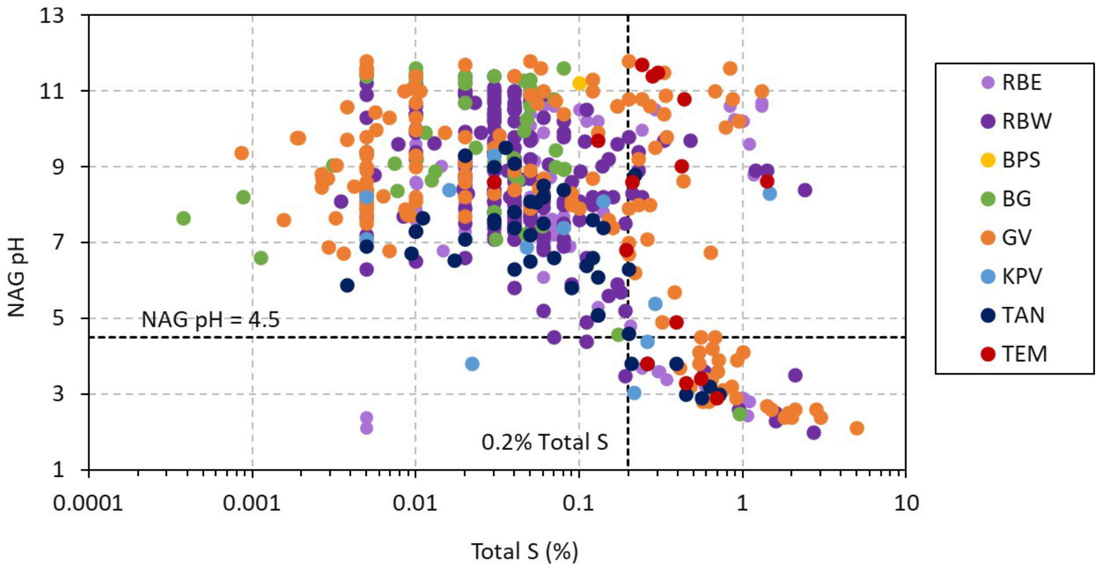


Figure 5-1 Site sulfur cut-off based on NAG pH 4.5

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

5.3. NOA classification

NOA will be characterised in accordance with the Naturally Occurring Asbestos Management Plan found in Appendix D of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019).

5.4. Off-Site Disposal

Where investigations and testing demonstrate that the excavated material is not appropriate for reuse on the project, elsewhere in Kosciusko National Park (KNP) (as requested by National Parks and Wildlife Service (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 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 (S2-FGJV-ENV-PLN-0048).

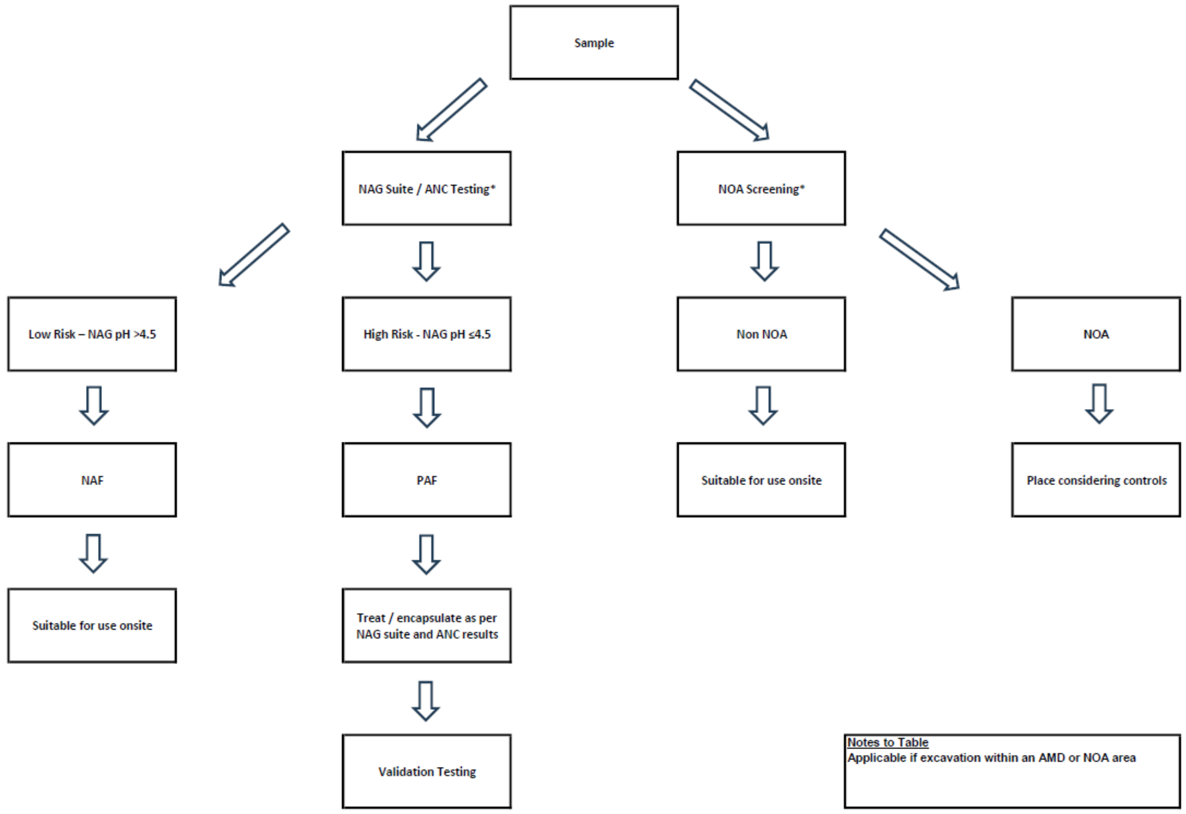
5.5. Off-Site Reuse

In most scenarios, when spoil is generated by the spoil producer and that spoil is taken offsite, the spoil receiver needs to hold an environment protection licence to receive that waste.

In certain cases, the NSW EPA has the power to grant an exemption from licencing requirements for material which is proposed for off-site reuse if the waste producer can demonstrate that a waste can be safely and effectively used for another purpose with no harm to the environment or human health.

Spoil which is classified as VENM or ENM may be reused off-site.

APPENDIX A. NATURAL SPOIL CHARACTERISATION STRATEGY



Appendix B. TOPSOIL STRATEGY

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX B – TOPSOIL STRATEGY

S2-FGJV-ENV-PLN-0019

NOVEMBER 2024

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

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B	25/11/2024	For issue	S. McKenney	N. Bernardini	D. Drummond

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E ndorsed:	Name: Dave Drummond Job Title: QHSE Director Signed: pp. Ellen Porter Date: 25/11/2024

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A	01/05/2024	Update to address EPA and SHL comments
B	25/11/2024	General update and to change template

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ABBREVIATIONS AND DEFINITIONS

Acronym	Definition
EMS	Environmental Management System
KNP	Kosciuszko National Park
NATA	National Association of Testing Authorities
NPWS	National Parks and Wildlife Service
PCT	Plant Community Type

1. INTRODUCTION

1.1. 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 Plant Community Type (PCT) 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 a rehabilitation management plan in accordance with Schedule 3, Condition 10 e) of the Infrastructure Approval.

1.2. 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 natural assets and values of the Kosciuszko National Park (KNP);
- 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 NSW National Parks and Wildlife Service (NPWS); and
- minimise visual impact of construction works from significant public viewpoints.

1.3. 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 Environmental Management System (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 the Biodiversity Management Plan (S2-FGJV- ENV-PLN-0008). 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;
- 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; and
- 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.

1.4. 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 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 National Association of Testing Authorities (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
- The rehabilitation management plan will guide the long-term rehabilitation of the site including establishment of native plant species.

Appendix C. STOCKPILING PROCEDURE

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX C – STOCKPILE PROCEDURE

S2-FGJV-ENV-PLN-0019

NOVEMBER 2024

The strategy for stockpiling (an appendix to the Main Works Spoil Management Plan) outlines techniques that will be applied to stockpiles to minimise degradation to topsoils and subsoils and potential impacts on the surrounding environment. This procedure should be implemented in conjunction with the site Stockpile Management Procedure (S2-FGJV-ENV-PRO-0011).

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25/11/2024	EC	Haofei Zhi – Environmental Scientist	FGJV	All

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CONTENTS

ABBREVIATIONS AND DEFINITIONS 5

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ABBREVIATIONS AND DEFINITIONS

Acronym	Definition
AEP	Annual Exceedance Probability
ESCP	Erosion and Sediment Control Plans

1. INTRODUCTION

1.1. Introduction

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.

1.2. Stockpiling

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.

- 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% Annual Exceedance Probability (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 Spoil Management Plan (S2-FGJV-ENV-REP-0019). 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 Spoil Management Plan (S2-FGJV-ENV-REP-0019).

Appendix D. NATURALLY OCCURING ASBESTOS MANAGEMENT PLAN

MANAGEMENT PLAN

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

S2-FGJV-ENV-PLN-0019

DECEMBER 2024

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 manage Naturally Occurring Asbestos (NOA) containing spoil.

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B	12/06/2020	Updated to address SHL comments
C	21/07/2020	Updated to reflect agency comments
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
F	04/12/2024	Updated to address Hibbs comments and incorporate relevant aspects of S2-FGJV-HSA-PLN-0032 - NOA and Fibrous Minerals Management Plan

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ABBREVIATIONS AND DEFINITIONS

Acronym	Definition
D&B	Drill and Blast
EIS	Environmental Impact Statement
IWTS	Integrated Waste Tracking Solution
HAZID	Hazard Identification
HRT	Head Race Tunnel
HSE	Health Safety and Environment
EPA	Environmental Protection Authoriry
FGJV	Future Generation Joint Venture
FSL	Full Service Level
HEPA	High Efficiency Particulate Air
MOD 3	Modification to Infrastructure Approval SSI 9687
NATA	National Association of Testing Authorities
NOA	Naturally Occurring Asbestos
NOAMP	Naturally Occurring Asbestos Management Plan
PPE	Personal Protective Equipment
PSE	Permanent Spoil Emplacement
RPE	Respiratory Protective Equipment
SWMS	Safe Work Method Statement
TBM	Tunnel Boring Machine
WES	Workplace Exposure Standard
WHS	Workplace Health and Safety
VENM	Virgin Excavated Natural Material

1. INTRODUCTION

1.1. Context

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 assess, characterise, and manage Naturally Occurring Asbestos (NOA) containing spoil. For further details on NOA and Fibrous mineral management not covered here, please refer to:

- S2-FGJV-HSA-PLN-0032 - NOA & Fibrous Minerals Management Plan which outlines how Future Generation Joint Venture (FGJV) will identify and manage the risk of exposure of the workforce to NOA and fibrous minerals during the excavation of the Head Race Tunnel (HRT) where presence of NOA is considered likely, and

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.

It is anticipated that some NOA may be encountered during Tunnel Boring Machine (TBM) excavations throughout the HRT at the following chainages:

- NOA has been confirmed in minor quantities within the exploration drill core samples in the Gooandra Volcanics and Shaw Hill Gabbro units from chainage 9,992 metres to 15,575 metres (5,583 metres); and
- NOA is likely to be present in the Temperence Formation and the Boggy Plans units 7,544 to 9,992 metres (2,448 metres).

It is expected that NOA may be aggregated around fault zones and as such it is unlikely that NOA would be present throughout the entire lithological domain as listed above.

The total combined volume of 'Likely' and 'Confirmed' NOA impacted in situ material in the tunnel alignment is 845,000 m^3. Further information provided by Snowy Hydro indicates that 7.5% of the predicted total may be NOA impacted, which is equivalent to 62,300 m^3 of in situ rock. The exact volume of NOA is however largely unknown prior to excavation.

The likely and confirmed locations of NOA is presented in Appendix A.

1.1.1. Modification 3

Modification to Infrastructure Approval SSI 9687 (MOD 3) involves the introduction of a new TBM (TBM 4) which will be launched from the Marica Adit Portal and will move in an easterly direction towards Tantangara.

MOD 3 will result in additional spoil generated at the Marica site as detailed in Table 1-1. The additional spoil generated at Marica will largely be due to a reduction in spoil generated from the Tantangara site.

Prior to MOD 3 it is anticipated that all NOA would be excavated by TBM 3 which was launched from Tantangara. Following the acceptance of MOD 3 it is possible but deemed unlikely that NOA may be excavated by TBM 4 at the Marica Site, dependant on the relevant progress of TBM 3 and the lithology of the various geological units which the head race tunnel passes through.

Spoil volumes expected as part of MOD 3 are presented in Table 1-1.

Table 1-1 Spoil Volumes from Proposed Modification

Spoil Source	NOA Containing	Estimated Spoil Volume Unbulked m^3
Marica Adit[1]	Unlikely	183,000
HRT0**1-02** (CH17+049 to CH15+400) – 1.65 km of tunnel[1]	Unlikely	199,000
HRT01-02 (CH15+0400 to CH13+720) – 1.68 km of tunnel[2]	Likely	223,100
Total Produced		**605,100**

Notes to Table

1 – Ravine Beds Group, not expected to contain NOA

2 – Gooandra Volcanics, potentially containing NOA

1.2. Management options

After careful consideration on the options to manage NOA (off-site disposal, subaqueous placement, on-land placement), on-land placement at Tantangara Permanement Spoil Emplacement (PSE) Area was determined to be the option that provides the least risk and impact on people and the environment.

This 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 as well as the NOA and Fibrous Minerals Management Plan (S2-FGJV-HSA-PLN-0032).

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 2014.

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, 2022)
- 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
- Australian Standard AS 1715 Selection, use, and maintenance of respiratory protective devices
- Consultants reporting on contaminated land, Contaminated Land Guidelines (NSW EPA, 2020)
- 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 Part 1 - Application (NSW EPA, 2022)
- 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).

2.3. Further reference:

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

3. NOA MANAGEMENT

3.1. Excavation

3.1.1. Expected NOA

Geological testing has identified that NOA is ‘likely’ to be encountered in the HRT from chainage 7,544 to 9,992 metres (2,448 metres) based on petrography analysis, and ‘confirmed’ to be present in minor quantities within the exploration drill core samples from chainage 9,992 metres to 15,575 metres (5,583 metres). Therefore, it is considered likely that most NOA will be excavated by TBM 3 and mucked out of the Tantangara Adit. With the acceptance of MOD 3, it is also considered possible but unlikely that some NOA may be excavated by TBM 4 launched from Marica.

It is expected that all NOA encountered will be excavated by TBM 3 and / or TBM 4 advancing though the HRT.

3.1.2. Open vs Closed Mode

With regards to TBM excavation, operational and materials handling, Open Mode mining is considered to be the most practical and effective method available. Transitioning from Open Mode mining to Slurry Mode mining is time consuming and very labour intensive. Consequently, the general strategy will be to operate the TBM in Open Mode where possible, only transitioning to Slurry Mode if the criteria described in the following sections are exceeded. The criteria, in conjunction with the controls, are designed to be sufficiently protective and only trigger the change in mode when confirmed NOA impacted strata is encountered.

3.2. Trigger Criteria for Confirmed NOA Impacted Spoil

Results generated from NOA monitoring will be evaluated both individually and collectively by the FGJV Project Geologist and Project Occupational Hygiene Consultant using the criteria outlined below. Recommendations will be provided to the Project Team on the requirement to transition from Open Mode mining to Slurry Mode mining, if deemed necessary.

Criteria for confirming the presence of NOA impacted spoil are outlined below:

3.2.1. Predictive Criteria

- Tunnel Face Inspection: Visible seams of NOA are present at >0.05% of the exposed tunnel face (i.e. >500 cm2) for two (2) successive inspections 2 metres apart (i.e. two ring builds), and
- Probing Ahead – Rotary Hammer: Material recovered from probing ahead indicate the presence of NOA at levels that exceed the predetermined trigger level of 0.01% w/w (Reporting Limit of AS 5370) for the next 50 metres.

3.2.2. Reactive Criteria

- Static Asbestos Air Monitoring (TBM and tunnels): The levels of airborne respirable asbestos fibres measured through Control Monitoring consistently (for 5 days straight) exceeds 50% of the Workplace Exposure Standard (WES) (i.e. 0.05 fibres/ml)
- Spoil Testing on the TBM: NOA is consistently identified within spoil (collected on the TBM) for 20 consecutive metres of advancement, at levels that exceed the predetermined trigger level of 0.01% w/w (Reporting Limit of AS 5370); and;

- Spoil Testing at the Spoil Mucking Shed: NOA is consistently identified (20 metres of mining) in the spoil (collected on the TBM) at levels that exceed the predetermined trigger level of 0.01% w/w (Reporting Limit of AS 5370).

3.3. Trigger Criteria for Confirmed Non-NOA Impacted Spoil

Consideration may be given to transition from Slurry Mode mining to Open Mode mining if the levels of NOA in the spoil are consistently less than the Reporting Limit of AS 5370, being 0.01%. To ensure the absence of strata significantly impacted by NOA, this would need to be 50 consecutive metres of advancement.

The recommendation to transfer from Slurry Mode mining to Open Mode mining will be made to the Project Team jointly by SHL, the FGJV Project Geologist, and Project Occupational Hygiene Consultant.

3.4. Spoil Mucking Shed

Following TBM excavation the spoil is transferred to the Spoil Mucking Shed which will be used as an intermediate storage location for spoil generated from the strata that has been determined to be 'Likely' and 'Confirmed' for NOA impacted material, pending the results of inspection and testing.

It is considered an Asbestos Operational Area and will be constructed as a fully sealed dust-tight structure with:

- An entry point for spoil from the TBM;
- Personnel entry / exit point (connected to the decontamination facility), and
- Access for heavy plant and equipment.

The layout and typical drawings of the Spoil mucking Shed is presented in Figure 3-1, with a detailed design included in S2-FGJV-HSA-PLN-0032; Annex F.

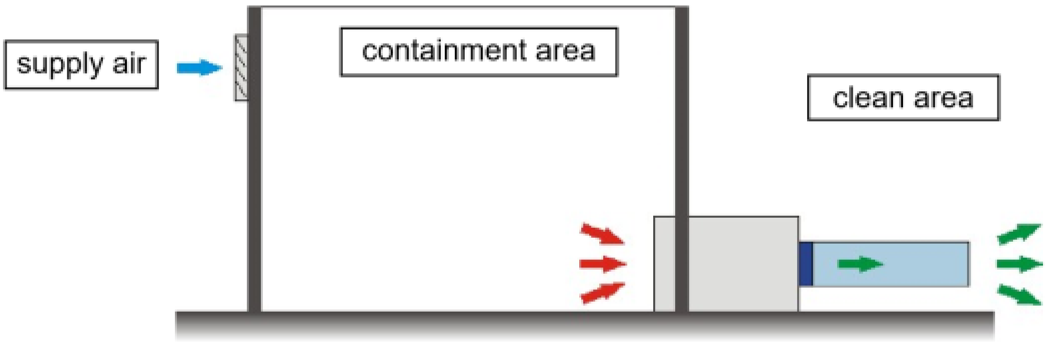


Figure 3-1 Schematic of Spoil Mucking Shed

3.4.1. Storage Bays

The Spoil Mucking Sheds shall have sufficient capacity to store approximately 4 days of spoil production. It is currently designed with 4 bays, each of at least sufficient capacity to store spoil generated each 12 hour shift. The bays shall be of sufficient size (capacity) to permit easy access for the purpose of inspection and testing.

3.4.2. Heavy Plant Access

Heavy vehicle access will be via a roller shutter at the front of the Spoil Mucking Shed. As it will not be possible to maintain a negative pressure differential when the roller shutter is opened, the shutter will be opened for the minimum amount of time for heavy vehicles to enter / exit and closed immediately after. The fine mist spray system shall be operated for 5 minutes before the roller shutter is opened, with a further 5 minutes for the extraction system to clear the air. The air should be visibly clean before the roller shutter is opened.

3.5. Loading and Transport

The trucks will be loaded inside the Spoil Mucking Shed by excavator or loaders, and the bucket fitted with a fine mist spray system to suppress dust. The NOA impacted spoil must be sufficiently wet to minimise dust generation during tipping at the Spoil Emplacement Area. It must not be overly wet to avoid:

- Free flowing (and potentially contaminated) water to drain from the load during transport; and
- Liquefaction of the load during transport resulting in a destabilising load shift and possible roll-over of the truck.

Once the filling phase has been completed, the truck bucket will be covered with a mechanically operated closing sheet to prevent the loss of material during transport.

- The spoil inside the tipper body must be distributed in such a way as to allow the closing sheet to unfold without obstruction.
- The trucks will pass through the truck wash bay to remove the potentially contaminated NOA spoil before exiting the Spoil Mucking Shed.

3.5.1. Transportation

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

3.6. Emplacement

3.6.1. Containment Cell

The NOA impacted spoil will be disposed of in an engineered containment cell in the Tantangara Spoil Emplacement Area.

The location on site for the containment cell will be selected based on:

- Minimising the haul distance for NOA excavated spoil
- Avoiding future disturbance
- The location being positioned at a suitable depth below the final landform level to ensure the material will remain covered
- The finished location presenting a negligible risk to human health or the environment
- 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 Drill and Blast (D&B) and / or 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 on top of the geomorphic surface and would be rehabilitated in accordance with the Rehabilitation Management Plan (S2-FGJV-ENV-PLN-0023)

3.6.2. Temporary and Final Coverage

The requirements for temporary and final coverage of the NOA contaminated material at the Tantangara Spoil Emplacement Area is summarised in Sections 3.7.3. and 4.3.3 of the NOA and Fibrous Minerals Management Plan (S2-FGJV-HSA-PLN-0032). Notwithstanding those requirements outlined in the abovementioned section, the temporary coverage will be as follows:

- Dust suppression by water spray during the day and a 0.5 metre coverage by Virgin Excavated Natural Material (VENM) at the end of each day. These requirements will be assessed during the works and strengthened as required. The requirements may also vary depending on the season and weather conditions (dry / wet / snow / wind), and
- The layers of material (NOA contaminated spoil / VENM) will be compacted to ensure the stability of the fill when completed. This will be conducted in conjunction with the geotechnical engineer.

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 outlined below and per Figure 3.2:

- The base layers of the Tantangara PSE area would be installed. The base layers comprise D&B and TBM material, with D&B material placed below the Full-Service Level (FSL) and TBM material placed above the FSL.
- In cell formations, NOA would be placed on top of an inert foundation layer comprising TBM spoil material. The NOA would be 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 water in order to prevent dust generation and prevent creation of surface run-off, as far as reasonably practicable
    - 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 regularly, and
    - Stopping work in strong winds.

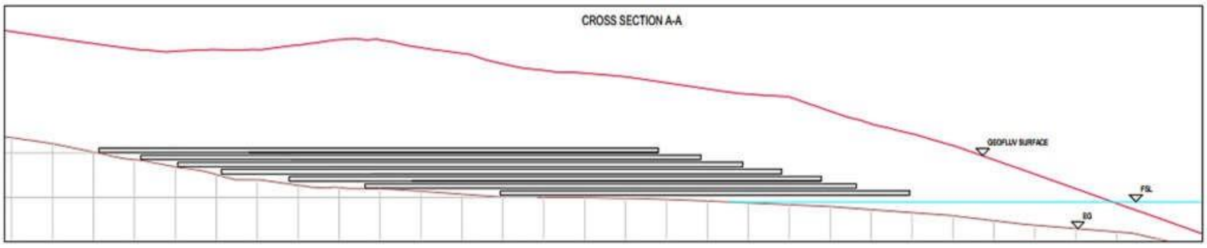


Figure 3-2 NOA encapsulation at Tantangara PSE Area

3.7. 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) as well as the criteria outlined in the NOA and Fibrous Minerals Management Plan (S2-FGJV-HSA-PLN-0032).

4. HEALTH SAFETY AND ENVIRONMENTAL CONTROL

4.1. Introduction

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.

The NOA and Fibrous Minerals Exposure Control Plan (S2-FGJV-HSA-PLN-0032) should be relied upon primarily for health and safety obligations, the section below provides a summary of the NOA and Fibrous Minerals Exposure Control Plan only and may be subject to change should the NOA and Fibrous Minerals Exposure Control Plan be amended.

4.2. 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 the NOA and Fibrous Minerals Management Plan (S2-FGJV-HSA-PLN-0032).

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.

4.3. Safe Work Method Statements

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 Workplace Health and Safety (WHS) laws using the Hazard Identification (HAZID) methodology and details in the Health Safety and Environment (HSE) Risk Management Procedure.

Upon request, FGJV 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.

4.4. Safe Work Practices

4.4.1. Personal protective equipment

The PPE requirements for work involving NOA are to be based on the NOA and Fibrous Minerals Exposure Control Plan. Furthermore, Operational Staff, Support Staff, Ancillary Staff, and Visitors are defined in Section 1.7. of the aforementioned plan. The Personal Protective Equipment (PPE) requirements will be dependent on the workgroup and activities undertaken.

Operational Staff and Support Staff will be required to wear the following PPE as a minimum requirement:

- Respiratory Protective Equipment (RPE)
- Protective clothing:
    - Synthetic re-usable coveralls
    - Personal issue waterproof safety boots (steel cap gumboots)

Ancillary Staff, and Visitors will be required to wear the following PPE as a minimum requirement:

- RPE – disposable respirator
- Protective clothing:
  - Disposable coveralls
  - Personal issue waterproof safety boots (steel cap gumboots)

4.4.2. 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 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 High Efficiency Particulate Air (HEPA) filter
  - HEPA filter (efficiency 99.997%) to remove sub-micron particulate matter,
  - in-built air-conditioning system to ensure comfortable cabin temperature, and
- 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 Spoil Mucking Shed and the landfill area for dump trucks transporting NOA contaminated spoil.

4.4.3. Vehicle cabin periodical cleaning

At the end of each work shift, all vehicles, plant, and equipment operating in the Asbestos Operational Areas and the trucks transporting spoil will be cleaned. The seats and floors shall be vacuum cleaned to remove loose dust followed by wet wiping with a clean cloth.

4.4.4. Asbestos material labelling and signage

A labelling system must be maintained on site to enable the visual and legible identification of all asbestos work areas.

The labels used should comply with AS 1319 Safety Signs for the Occupational Environment, and a competent person is to determine their required location. The entrances to the tunnel, Spoil Mucking Shed, and potentially contaminated areas will be signposted to indicate the presence of potential presence of asbestos and that the use of PPE/RPE is mandatory in this area.

4.4.5. Air monitoring

The measures to control airborne particulates and fibres described in NOA and Fibrous Minerals Management Plan (S2-FGJV-HSA-PLN-0032) shall be implemented during the excavation, handling and placement of NOA.

A comprehensive asbestos fibre air monitoring programme shall be developed and implemented by the Occupational Hygienist to assess:

- Personal exposures to airborne respirable asbestos fibres and compliance with the WES

- Adequacy of dust suppression and engineering controls in the Asbestos Operational Area
- Adequacy of RPE; and
- Compliance with the requirements of the Control Monitoring Action Levels presented in Table 5-1.

The asbestos fibre air monitoring will be performed in accordance with the National Occupational Health and Safety Commission 'Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres, 2nd Edition [NOHSC: 3003(2005)], April 2005'.

The air monitoring programme shall be developed and implemented by the Project Occupational Hygienist Consultant. The on-site monitoring (sample collection) shall be conducted by a qualified person. The sample analysis and issue of National Association of Testing Authorities (NATA) Endorsed Certificates of Analysis shall be conducted by an Approved Counter and Signatory authorised by the Project Occupational Hygienist Consultant.

Table 5-1 NOA air monitoring control actions

Result (fibres/ml)	Action
<0.01	No action required
0.01 to 0.02	Shift supervisor to review processes and controls to assess compliance with the specified procedures. The outcome of the review is to be reported to the Project Occupational Hygienist
>0.02 to 0.05	Project Occupational Hygiene Consultant and shift supervisor to review processes and controls to assess compliance with the specified procedures and determine the source of the elevated airborne fibre level.
Greater than 0.05	• Personnel working in the area where the elevated level was measured to wear disposable P1 respirator as a minimum requirement (until the source has been identified and rectified). • Project Occupational Hygiene Consultant and shift supervisor to conduct detailed review processes and controls to assess compliance with the specified procedures and determine the source of the elevated airborne fibre level. Where possible, positive confirmation of the source should be established. This may require additional testing / assessment (e.g. smoke test). • The area where the elevated level was measured and adjacent areas is to be cleaned by vacuuming and damp wiping of all surfaces by persons wearing personal protective equipment. • Additional air monitoring to be conducted in the areas where the elevated level was recorded to confirm successful identification of the source and clean-up.

4.5. Unexpected finds of NOA

It is possible that previously unidentified NOA will be encountered during the project. An unexpected finds procedure for NOA and legacy asbestos contamination has been incorporated into the Chemical, Hazardous, and Fibrous Materials Management Plan (S2-FGJV-HSA-PLN-0004).

5. ASBESTOS DISPOSAL

5.1. Introduction

The approach to spoil characterisation will be undertaken in accordance with the waste hierarchy with material to be managed in order of the preference presented below:

1. Onsite Reuse
2. Offsite Reuse
3. Offsite Disposal

It is expected that most of the NOA containing material generated on Snowy 2.0 Main Works will be suitable for beneficial reuse onsite, specifically within the designated NOA cells within the Tantangara PSE. In this scenario the material is not transported offsite and as such is not subject to waste transport requirements per the Protection of the Environment Operations (Waste) Regulation nor is the NSW Environmental Protection Authority (EPA) Integrated Waste Tracking Solution relevant here.

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, and
- 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.

5.2. Offsite Waste Disposal

NOA is considered 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 FGJV ensures compliance with its obligations under the POEO (Waste) Regulation 2014. Waste tracking documentation must be completed with appropriate copies being retained. The NSW EPA's Integrated Waste Tracking Solution (IWTS) is required to be utilised for the transport of asbestos waste from the site to its disposal destination.

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, FGJV 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).

Further information pertaining to offsite waste disposal is provided in the NOA and Fibrous Minerals Exposure Control Plan.

6. COMPLIENCE MANAGEMENT

6.1. Training

As noted in Section 3.2, the Work Health and Safety Regulation 2017: Regulation 434 and Regulation 445 requires training on the hazards and risks associated with NOA for workers who carry out work where NOA is likely to be found. The Work Health and Safety Regulation 2017: Regulation 445 Sub-regulations (1) requires:

"In addition to the training required by Division 1 of Part 3.2, a person conducting a business or undertaking must ensure that workers engaged by the person, whom the person reasonably believes may be involved in asbestos removal work or in the carrying out of asbestos-related work, are trained in the identification and safe handling of, and suitable control measures for, asbestos and ACM."

The level of training required will depend on the activities being undertaken and areas accessed by the subject personnel. Three levels of training will be provided:

- Basic Asbestos Awareness: conducted in conjunction with the project induction for all project personnel
- Ancillary staff:
  - spoil disposal area staff
  - truck drivers, plant operators (e.g. excavator, dozer, etc.) who work in a ventilated cabin and have a low potential for direct contact with asbestos or NOA contaminated spoil
  - More detailed than the basic asbestos awareness, but less detailed than for Operational Staff
- Head Race Tunnel Operational Staff:
  - Supervisory personnel
  - Tunnel workers whose job requires them to operate equipment or conduct regular maintenance works inside the tunnels
  - Staff in Asbestos Operational Areas or whose tasks/activities could bring them into direct contact with materials potentially contaminated with NOA, and
  - Support Staff: maintenance personnel that enter the tunnels infrequently for specific maintenance tasks, vehicle maintenance staff, laundry staff, and cleaning/Support Staff.

The skills required for, and the level of risk to, the operators in the Asbestos Operational Area (and potentially coming into direct contact with NOA) is comparable to that of an asbestos removal worker. Accordingly, we recommend that more detailed and "appropriate training" (than asbestos awareness training) be provided to these operators and the supervisory staff.

This section provides a summary of compliance management only. The primary source of this information is the NOA and Fibrous Minerals Exposure Control Plan which may be amended from time to time.

6.2. Inspections and monitoring

Inspections of the project will occur in accordance with Section 9 of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019) 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 EPL.

6.3. Consultation and Revision

In accordance with the Main Works Approval, this Plan, and the governing Spoil Management Plan (S2-FGJV-ENV-PLN-0019) must be prepared in consultation with the NPWS, EPA, Water Group, NSW DPI, and TfNSW, prior to approval by the Department of Planning, Housing, and Infrastructure (DPHI).

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.

6.4. Review and Auditing

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

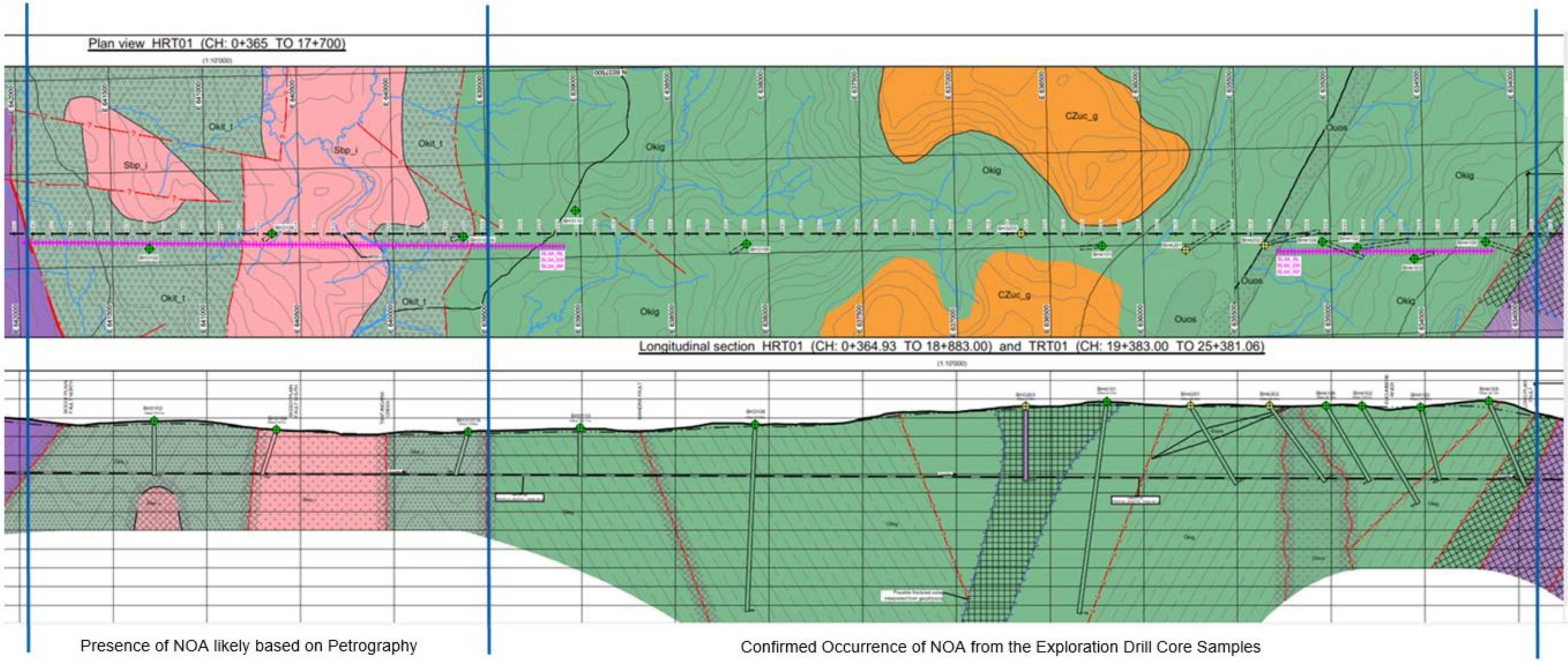
Audit requirements are detailed in Section 8 of the EMS.

6.5. Reporting

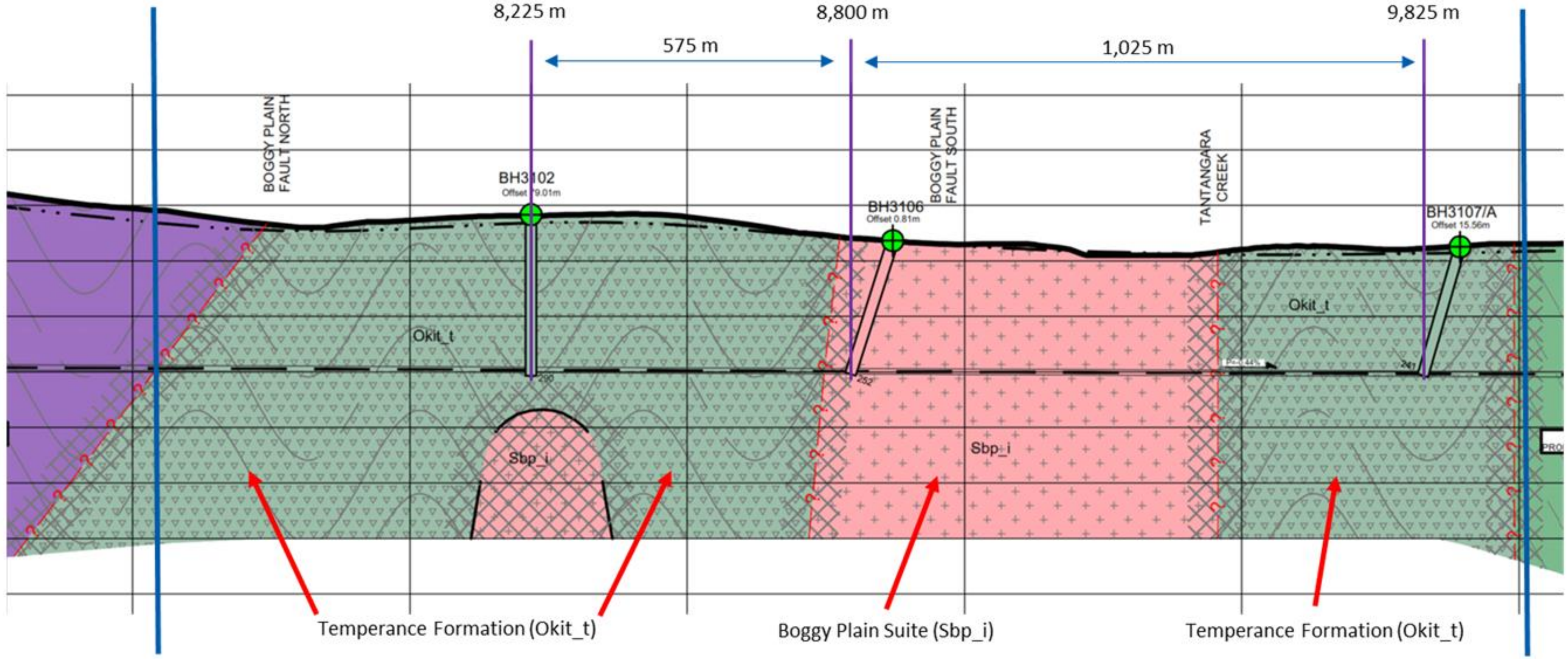
Reporting will include monthly internal project reports. Reporting requirements and responsibilities are documented in Section 9.5 of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019) and Section 8.4 of the EMS

APPENDIX A. GEOLOGICAL MAPS

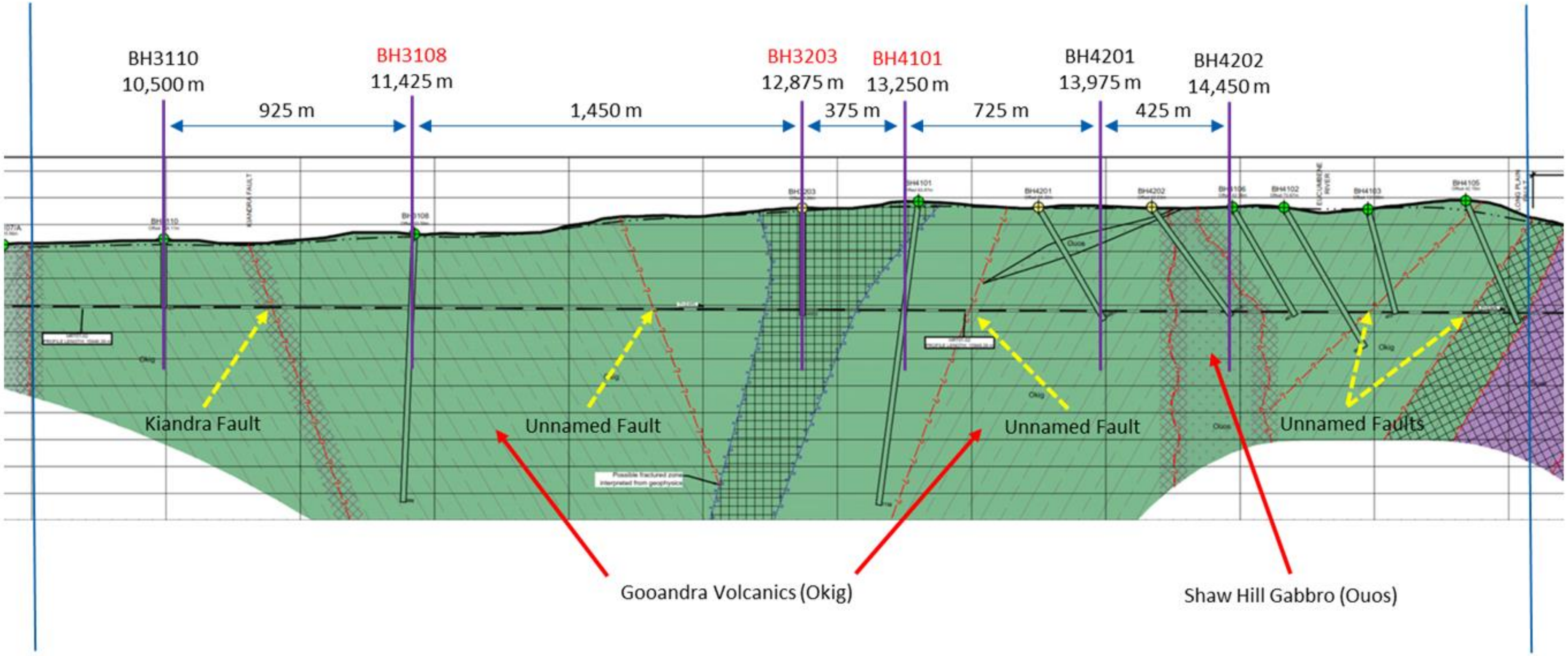
A.1. Headrace Tunnel Likely and Confirmed NOA



A.2. Headrace Tunnel Likely NOA - 7,544 to 9,992 metres (2,448 metres)



A.3. Headrace Tunnel Confirmed NOA - 9,992 metres to 15,575 metres (5,583 metres)



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

NOVEMBER 2024

The plan sets out the measures to be undertaken to appropriately handle and place Acid Mine Drainage (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.

Revision Record

Rev.	Date	Reason for Issue	Responsible	Accountable	Endorsed
H	25/11/2024	For issue	S. McKenney	N. Bernardini	M. Franceschi

Document Verification

RACIE Record

R esponsible:	Name: Steven McKenney Job Title: Environmental Approvals Manager Signed: Date: 04/12/2024
A ccountable:	Name: Nicholas Bernardini Job Title: Spoil Manager Signed: pp. Ellen Porter Date: 04/12/2024
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: 4/12/2025

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.
C	**Consulted** Those who must be consulted before the document is published.
I	**Informed** Those who must be informed after the document is published.
E	**Endorsed** Those who must approve the document before publication.

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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 updated made on App A
F	25/05/2022	Addressing DPE comments
G	09/06/2022	Addressing DPE comments
H	25/11/2024	Updated for currency

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ABBREVIATIONS AND DEFINITIONS

Acronym	Definition
AC	Acid Consuming
AEP	Annual Exceedance Probability
AMD	Acid and Metalliferous Drainage
AMDMP	Acid and Metalliferous Drainage Management Plan
ANC	Acid Neutralising Capacity
ARD	Acid Rock Drainage
DPIE	Department of Planning Industry and Environment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	Environmental Protection Authority
EPL	Environmental Protection Licence
GARD	Global Acid and Metalliferous Drainage
NAF	Non Acid Forming
NAG	Net Acid Generating
NPR	Neutralisation Potential Ratio
PAF	Potentially Acid Forming
PAF-LC	Potentially Acid Forming Low Capacity
PPE	Personal Protective Equipment
PSE	Permanent Spoil Emplacement
SAM	Sensitive Area Map
TARP	Trigger Action Response Plan
UC	Uncertain

1. INTRODUCTION

Acid and Metalliferous Drainage (AMD) has traditionally been referred to as 'acid mine drainage' or 'Acid Rock Drainage' (ARD) and refers to the potential for rock to be Net Acid Generating (NAG) through exposure of sulfide minerals, most commonly iron sulfide (pyrite FeS_2) with oxygen and water. This reaction generates acidic water which may react with minerals in the surrounding rock material creating a metal rich discharge. Whether rock is Potentially Acid Forming (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 Acid Neutralising Capacity (ANC) of the material.

The contamination assessment within the Environmental Impact Statement (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:

- PAF;
- PAF – Low Capacity (PAF-LC);
- NAF;
- Uncertain (UC); and
- 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.

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

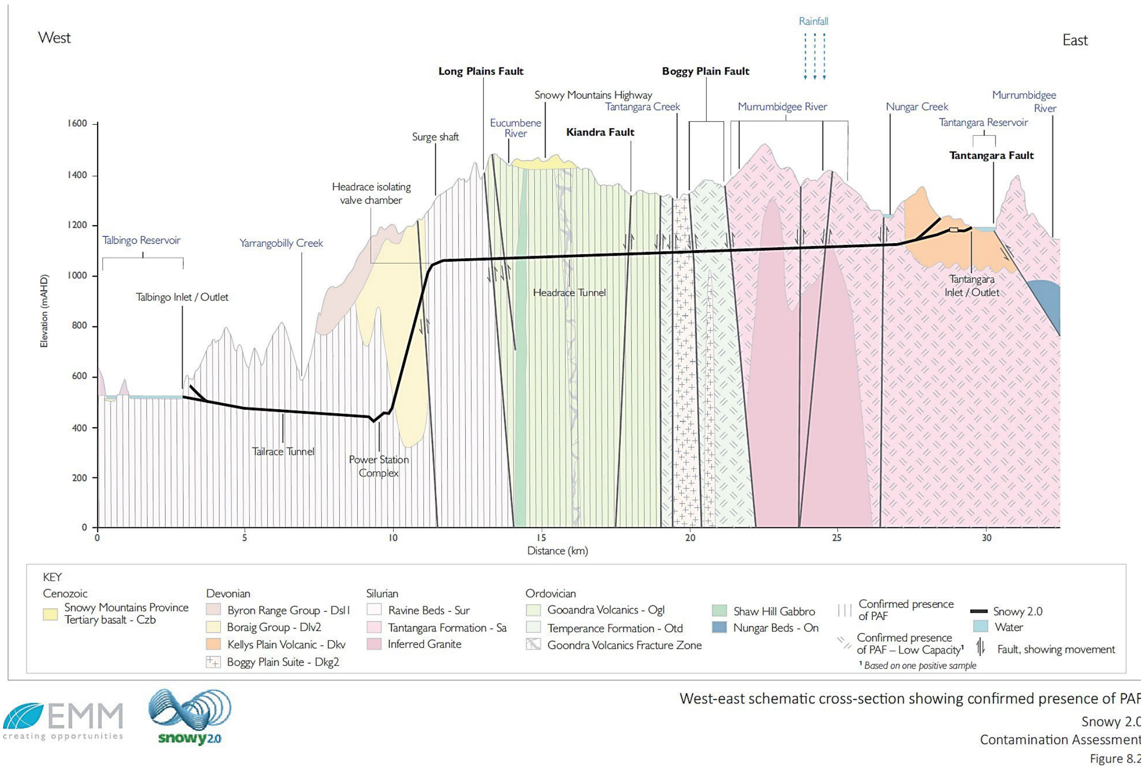

Figure 1-1 West-East cross section showing confirmed presence of PAF material

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)
- 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)

2.3. 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 2-1 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. The data is continuously being updated and used to inform on site procedures.

Table 2-1 AMD Classification Criteria

General AMD risk classification	Laboratory validation tests
PAF	NAG pH ≤ 4.5
NAF	NAG pH > 4.5

Table 2-2 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 2-2 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

3. PAF MATERIAL MANAGEMENT

3.1. 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.

3.2. Placement

Further to characterisation and validation, PAF 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 3-1. 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 Permanent Spoil Emplacement (PSE) area, and covered with NAF material. Site specific rates of compaction and other PSE area specific controls will be developed in consultation with relevant government agencies.

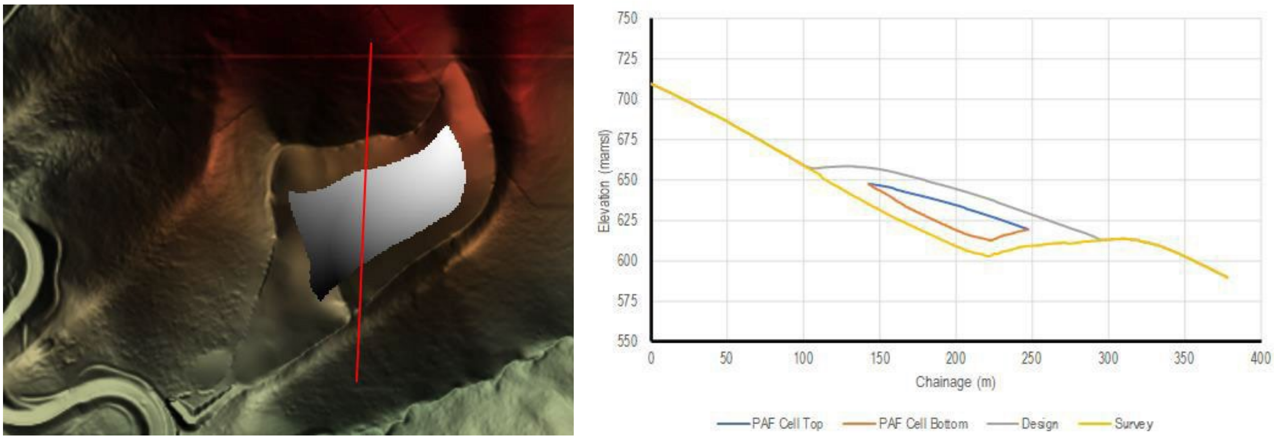

Figure 3-1 Example of PAF Material Placement at GF01

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.

3.3. 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 for quality control purposes. 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 identifies PAF material is within the defined central area as shown in Figure 3-1, 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 layer with externally sourced high ANC material (e.g., Aglime); or
- Relocate material, potentially off-site.

All PAF material must undergo post-treatment testing to validate that the material has been effectively neutralised, sampling will be undertaken in accordance with relevant guidancematerial..

3.4. 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 Environmental Protection Authority (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% Annual Exceedance Probability (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 Map (SAM). 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 Environmental Protection Licence (EPL) 21266, 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 (TARP) 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).

3.5. 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.

3.6. Contingency Measures for Excess Material

As set out in 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.

4. COMPLIANCE MANAGEMENT

4.1. 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 Environmental Management System (EMS).

4.2. Inspections and monitoring

Inspections of the project will occur in accordance with Section 9 of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019) 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 EPL.

4.3. Consultation and Revision

In accordance with the Main Works Approval, this Plan, and the governing Spoil Management Plan (S2-FGJV-ENV-PLN-0019) must be prepared in consultation with the NPWS, EPA, Water Group, NSW DPI, and TfNSW, prior to approval by the Department of Planning, housing and Infrastructure (DPHI).

At 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.

4.4. 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.

4.5. Reporting

Reporting will include monthly internal project reports. Reporting requirements and responsibilities are documented in Section 9.5 of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019) 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	

Document Revision Table		
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 .

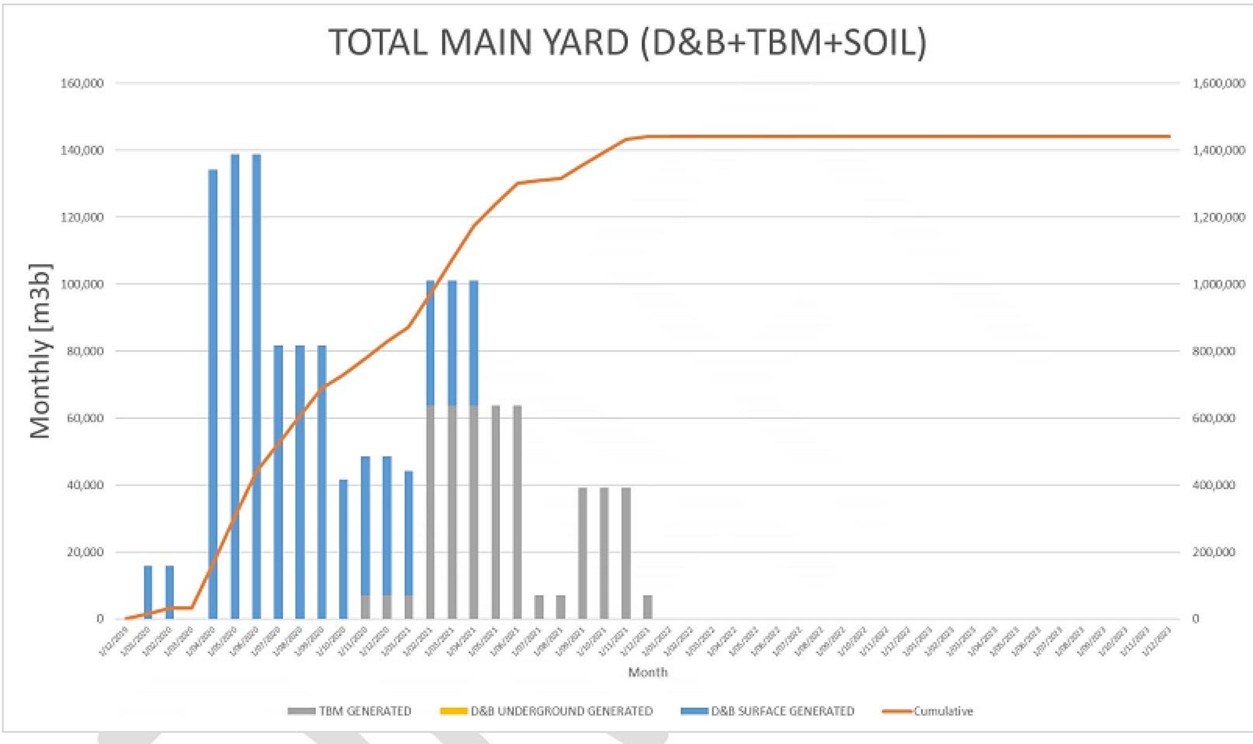

Figure 2-1 Planned monthly and cumulative placement of spoil at the Lobs Hole Main Yard

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.

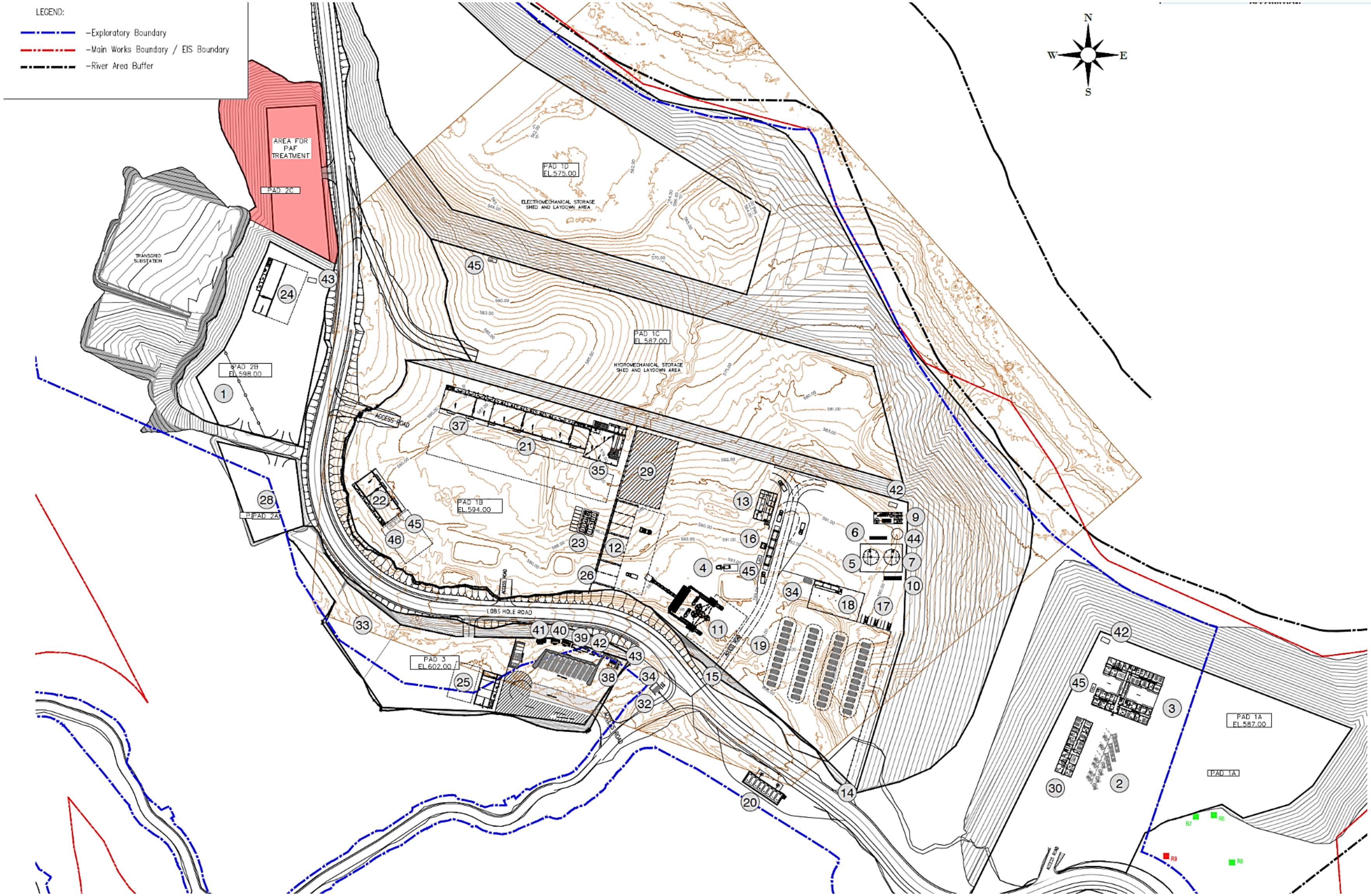

Figure 3-1: Main Yard general layout (indicative – not for construction)

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.

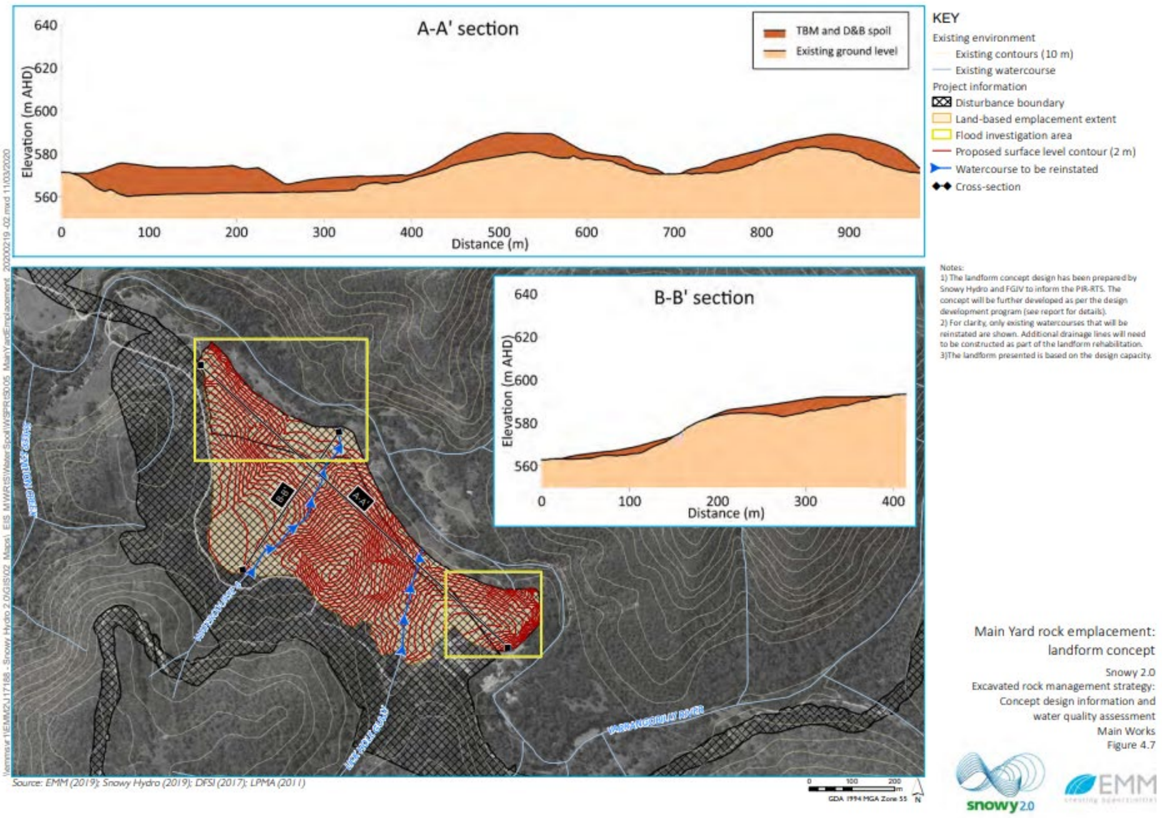

Figure 4-1: Lobs Hole landform concept (following construction) (EMM preferred excavated rock strategy dated 24 March 2020)

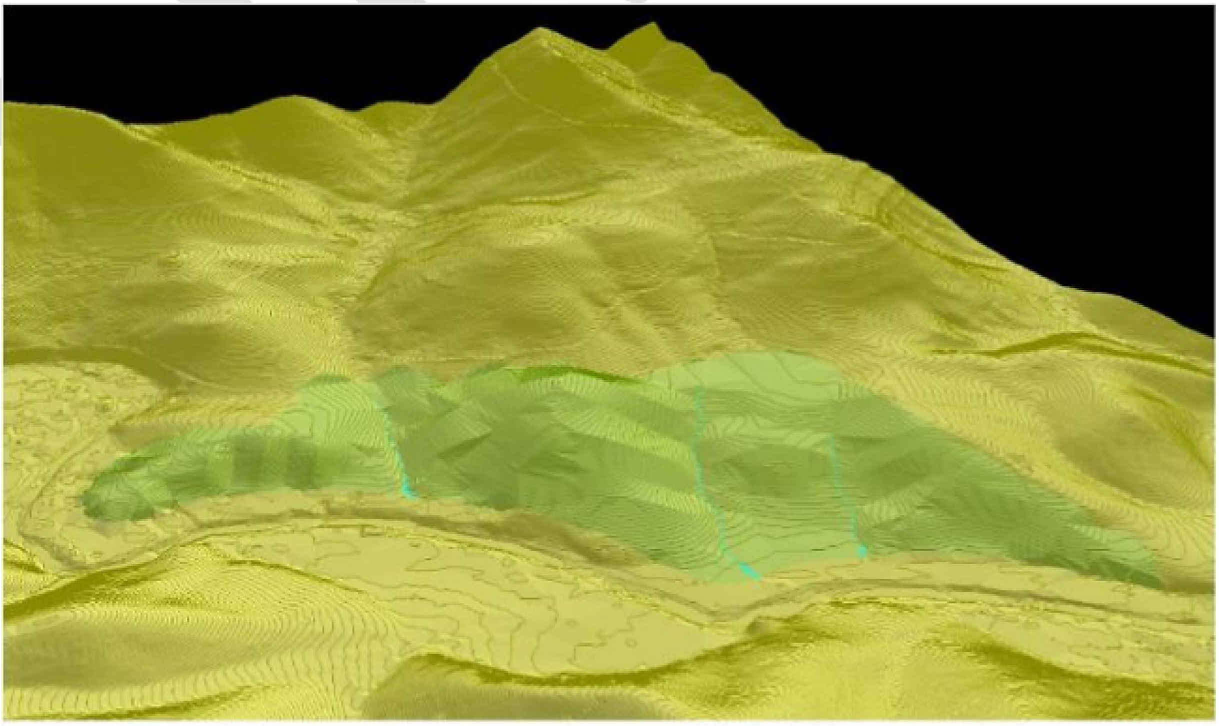

Figure 4-2: Lobs Hole geomorphic impression (following construction)

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

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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.
C	**Consulted** Those who must be consulted before the document is published.
I	**Informed** Those who must be informed after the document is published.
E	**Endorsed** Those who must approve the document before publication.

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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

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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.

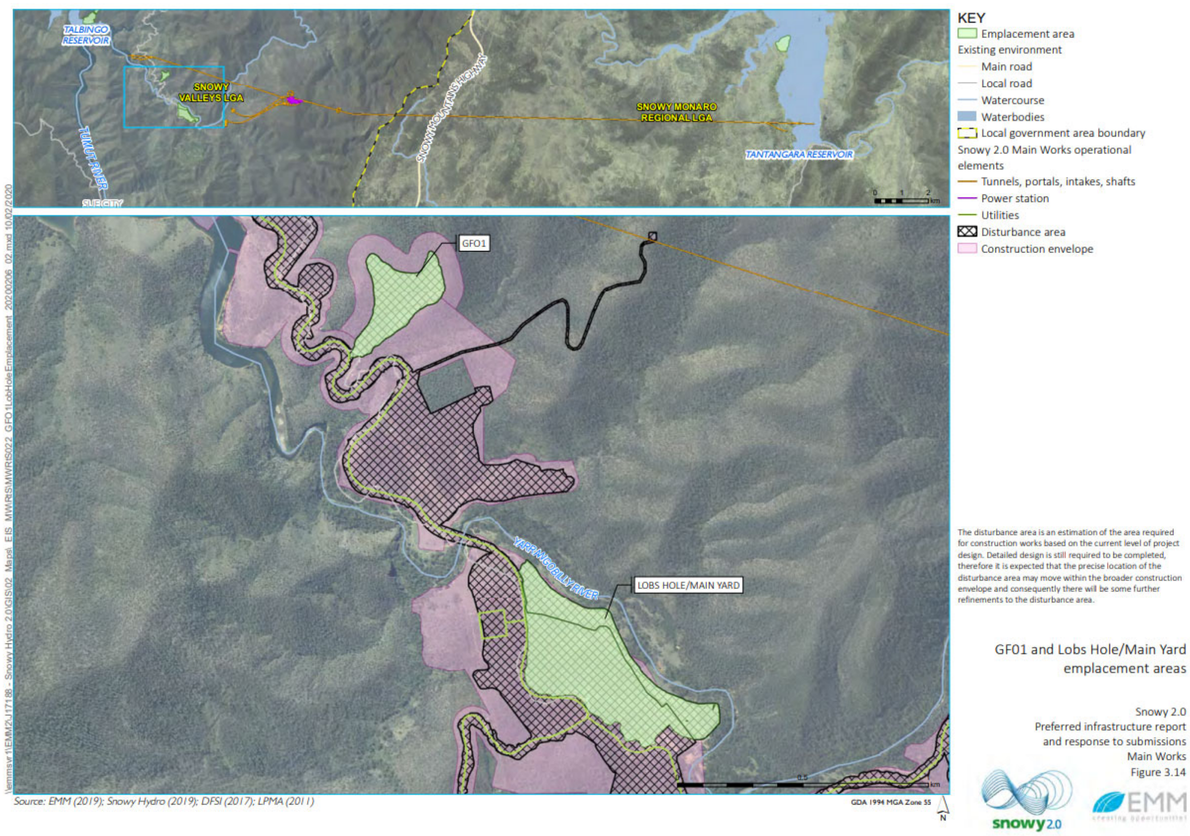


Figure 1-1 GF01 and Main Yard permanent emplacement area location (EMM, 2020)

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.

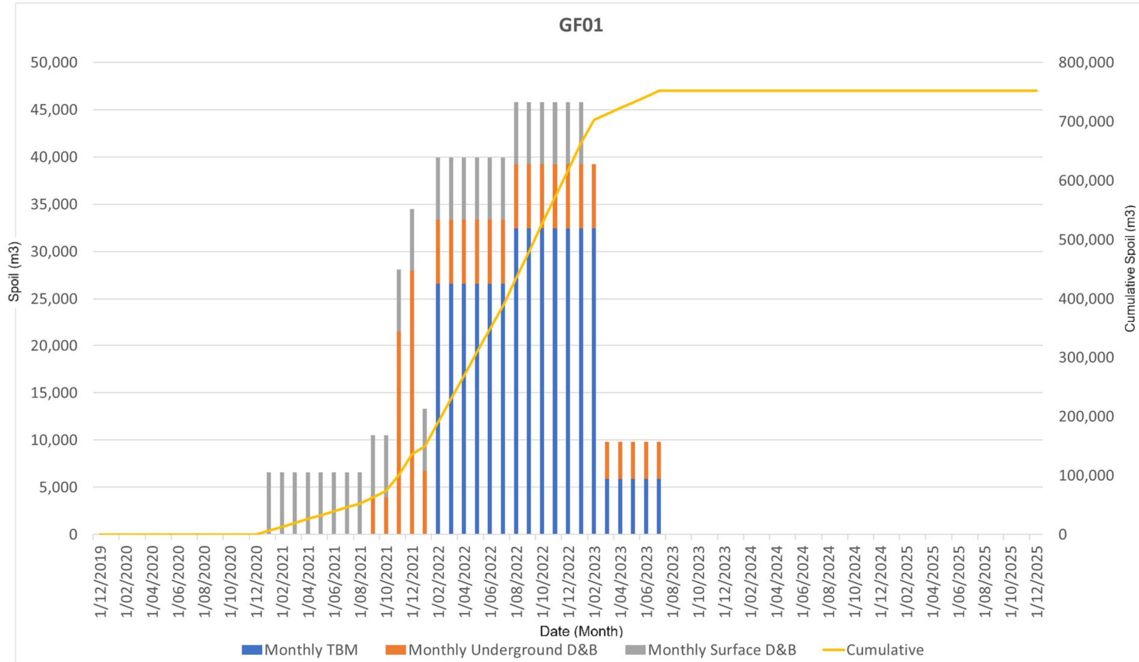


Figure 2-1 Planned monthly and cumulative placement of spoil at GF01

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.

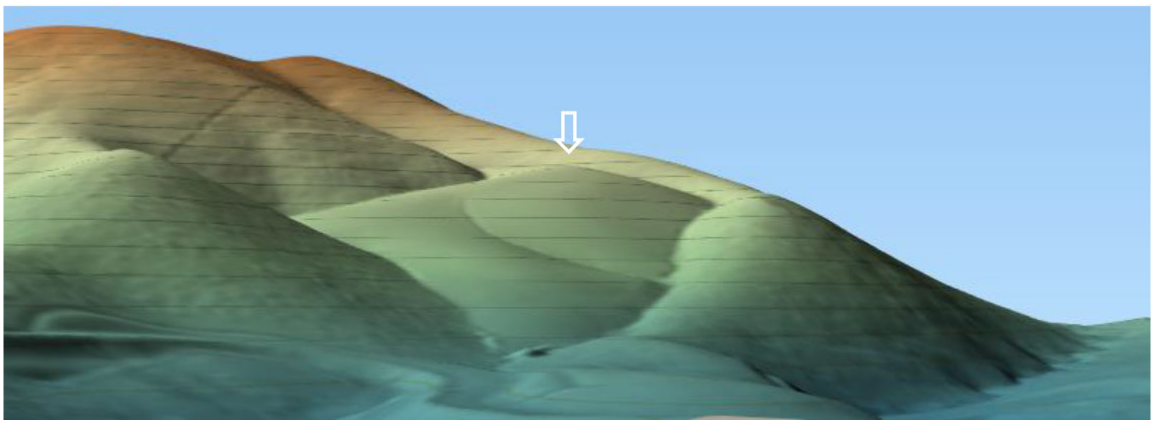


Figure 2-2 Indicative view.

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.

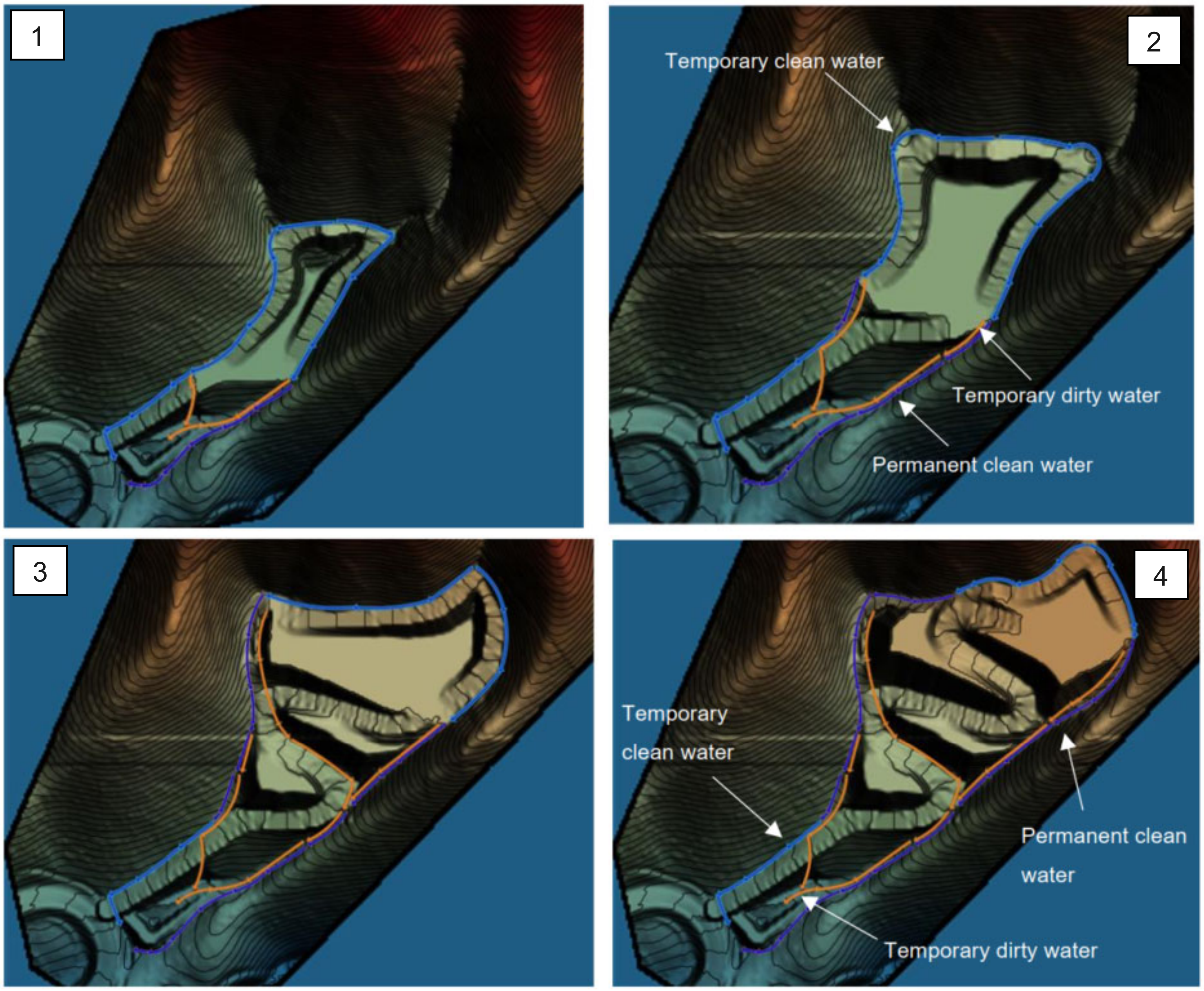


Figure 4-1 Indicative construction sequencing

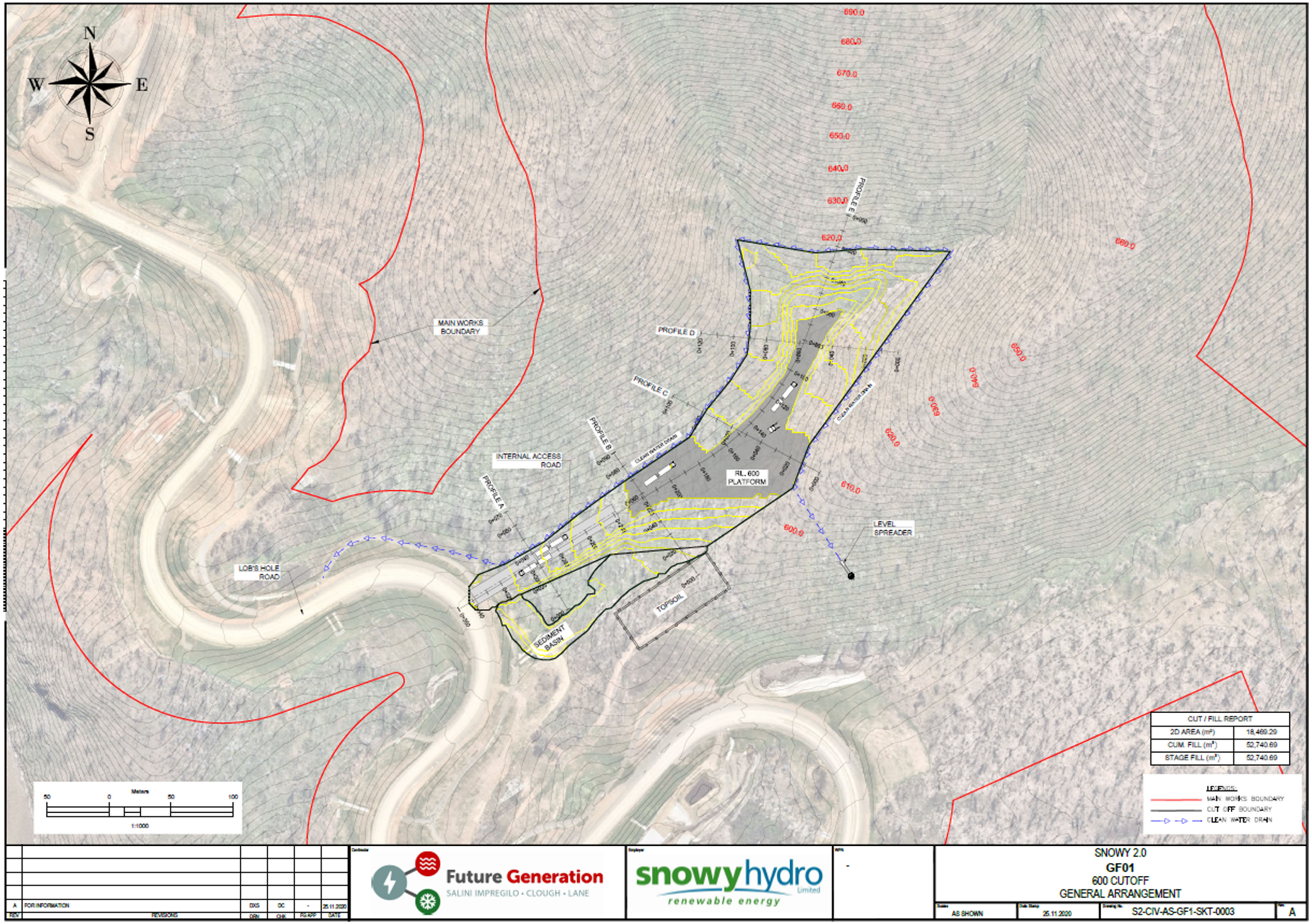


Figure 4-2 General arrangement (not for construction)

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

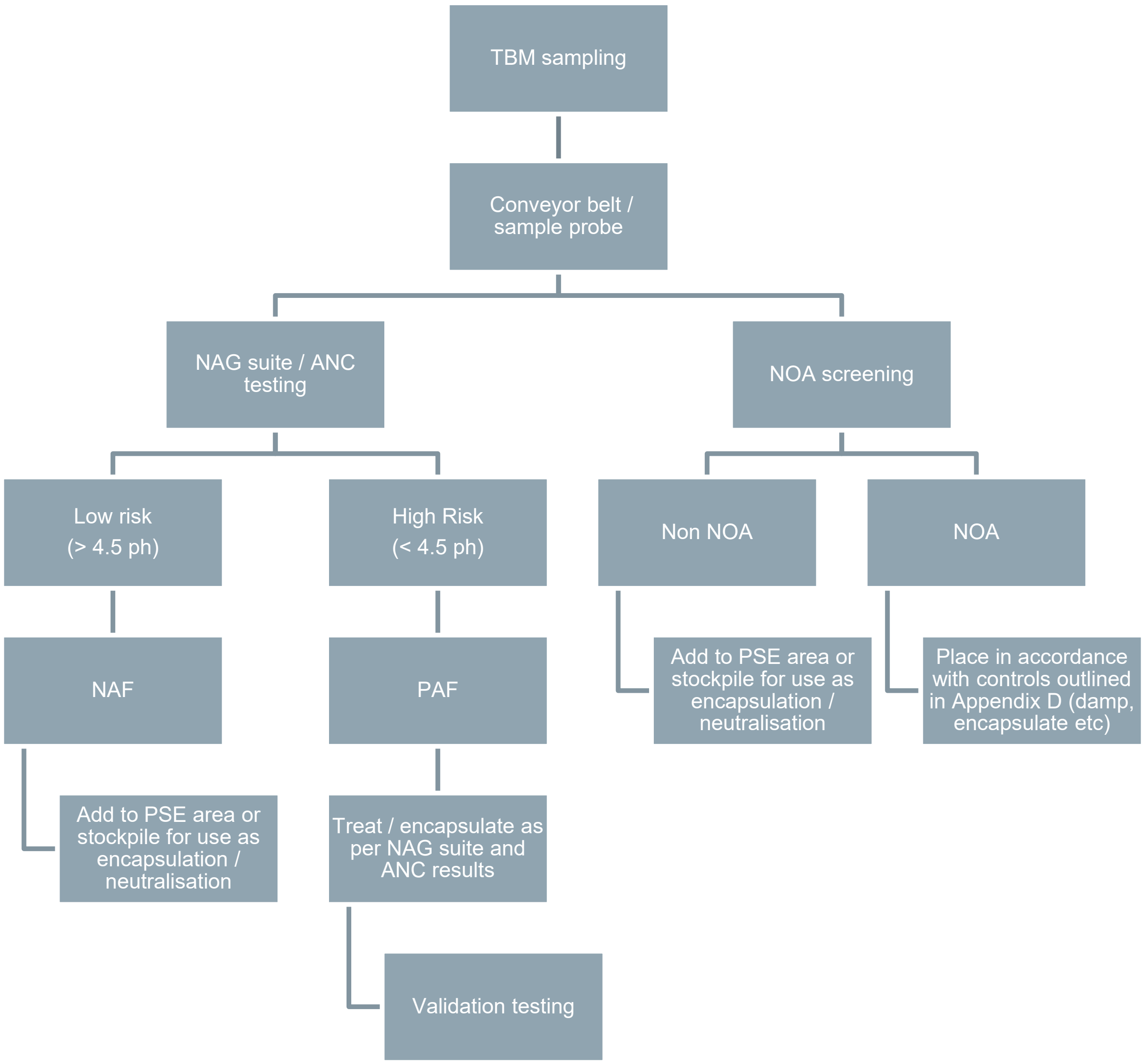
Aspect	Objective	Performance Indicators	Measurement Tools
Final landforms are compatible with the landscape	• As natural as possible, including minimising the use of linear or engineered structures. • Sympathetic with the landforms of the surrounding area, particularly from a visual, water management 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

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX H – RAVINE BAY EMPLACEMENT AREA

S2-FGJV-ENV-PLN-0019

APRIL 2024

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 Schedule 3, Condition 7(e) for the Ravine Bay (PSE) area.

Revision Record

Rev.	Date	Reason for Issue	Prepared by	Reviewed by
I	05.04.2024	Issued for approval	C. Pedraza E. Porter	E. Martin C. Buscall

Revision Tracking

Rev.	Date	Description of Revision
A	13.01.2022	Initial draft for Snowy Hydro review
B	10.11.2022	Updated to reflect consultation with NPWS, EPA, DPE and Snowy Hydro on the approved Tantangara and GF01 PSE Management Plans
C	13.02.2023	Updated to reflect Snowy Hydro comments and revised design and construction methodology
D	12.04.2023	Updated to reflect the detailed design
E	6.11.2023	Updated in response to DPE, EPA and NPWS comments
F	6.12.2023	Updated in response to DPE, EPA and NPWS meeting & design optimisations
G	19.01.2024	Updated in response to DPE, EPA and NPWS comments on Rev E
H	29.02.2024	Updated in response to NPWS and EPA comments on Rev G
I	5.04.2024	Updated in response to DPE comments on Rev G and DPE, NPWS and EPA comments on Rev H

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ABBREVIATIONS AND DEFINITIONS

Acronym	Definition
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AMD	Acid and metalliferous drainage
ANC	Acid neutralising capacity
APP	Acid producing potential
ASS	Acid Sulfate Soils
Blue Book	*Managing Urban Stormwater: Soils and Construction.* Landcom, (4th Edition) March 2004
CLM Act	*Contaminated Land Management Act 1997*
CLMP	Contaminated Land Management Plan
COA	Conditions of Approval
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)
DPE	NSW Department of Planning and Environment
D&B	Drill and blast
EC	Electrical conductivity
ECVT	Emergency egress, cabling and ventilation tunnel
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 Supply Level
Future Generation	Future Generation Joint Venture
Future Generation-PMS	Future Generation Project Management System
HCT	Humidity Cell Test
HRT	Head Race Tunnel
KNP	Kosciuszko National Park
LEM	Landscape Evolution Model
MAT	Main access tunnel
Main Works EIS	*Snowy 2.0 Main Works - Environmental Impact Statement*
MSL	Minimum Supply level
MTCP	Marine Traffic Control Plan
NAF	Non-acid Forming

Acronym	Definition
NAG	Net Acid-Generation
NAPP	Non-acid Producing Potential
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
OSOM	Over Size Over Mass vehicle
PAF	Potential acid forming material
PCT	Plant community type
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
PSE	Permanent spoil emplacement area
QMP	Quality Management Plan
REMMs	Revised environmental management measures
SAP	Sensitive Area Plans
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*
SWMP	Surface Water Management Plan
TBM	Tunnel boring machine
TfNSW	Transport for New South Wales
TSS	Total suspended solids
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
Waste Classification Guidelines	*Waste Classification Guidelines,* NSW Environmental Protection Authority, 2014
XRF	X-ray fluorescence

1. INTRODUCTION

1.1. Background

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 Ravine Bay PSE area including adherence to Schedule 3, Condition 4 and the design objectives in Table 1-2.

The Ravine Bay PSE area will receive spoil from the Talbingo Intake, Talbingo Haul Roads, Talbingo Spoil Road and Tailrace Tunnel. The general location of the Ravine Bay PSE is shown in Figure 1-1. While spoil will be placed within the nominated area outlined in Figure 1-1, at this stage all spoil emplacement will only be on land as further discussed in this plan.

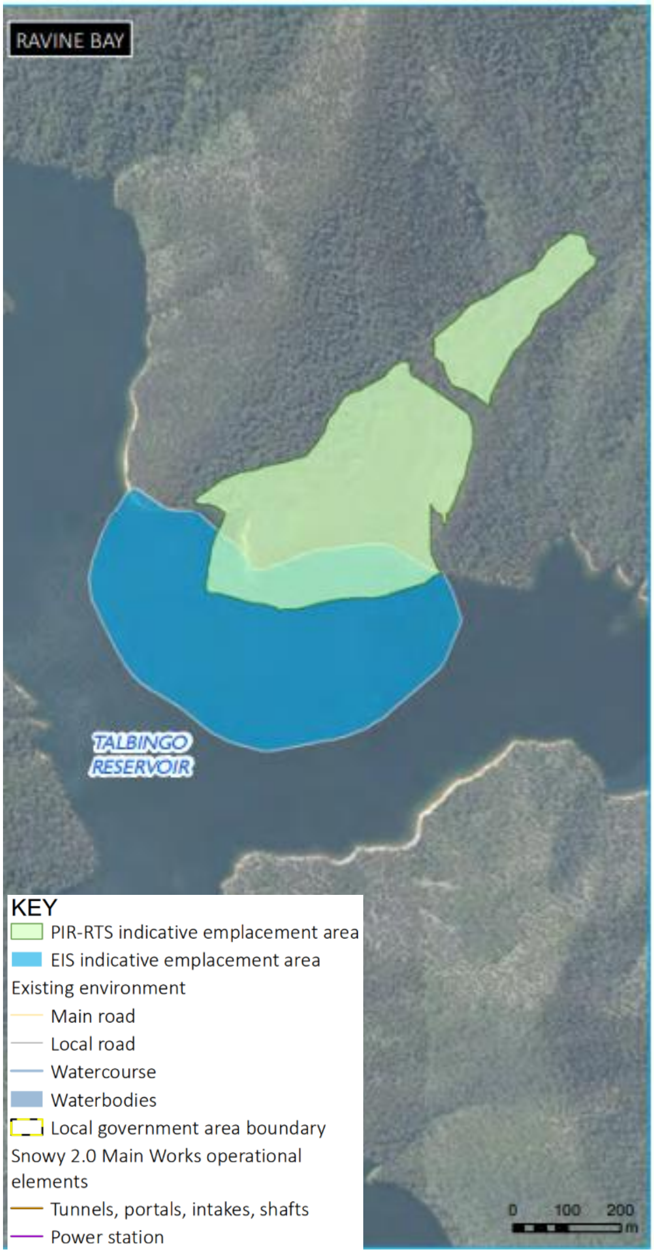


Figure 1-1 PIR-RTS indicative Ravine Bay PSE area location (EMM, 2020)

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		
(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 plant community types (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	Included in the design assessment in Section 2.1 and 2.2.
	Sympathetic with the landforms in the surrounding area, particularly from a visual, water management and ecological perspective	Included in the design assessment in Sections 2.1. 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	Drainage density discussed in Section 2.1
	Safe, long-term stable and non-polluting	Erosional stability discussed in Section 2.1.2 Non-polluting discussed in Section 2.1 and 2.2. Golder has only completed a desk top review pending access for further site observations and investigation (Report 20355010-012-TM-Rev0_Ravine Bay geotechnical desk top study). Prior to the emplacement being finalised and rehabilitation occurring, NSW EPA will be consulted regarding the capping layer of the landform.

Aspect	Objective	Notes
	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	All spoil placement for the initial stage of placement is located above FSL to minimise impacts to the reservoir and maximise safety.
	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 2.3 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	Upstream catchments are to be diverted into the drainage line on the eastern side of landform, see Section 2.1.4. Creek diversions, clean water drains, a drainage blanket and subsurface drains will divert existing clean catchment flows to nature creek lines. Drainage on the western edge of the PSE will be redirected across constructed landform to reconnect with the existing eastern creek. This will mimic natural flow regimes. Direct runoff from the PSE will be captured in dams.
	Minimise downstream water flows and velocities with any changes to be quantified and addressed though suitable design	Downstream water flows will be intercepted by the 4 dams that surround the PSE. Clean water drains and clean subsurface drains installed below the drainage blanket, will mimic natural flow regimes of the existing Ravine Bay.
	Minimise valley infill	Western edge of landform has infilled the natural drainage line. Flows have been redirected and slowed with the use of sediment dams.
	Create natural drainage lines that are long-term sustainable having regard to the selection of suitable underlying materials, including rock sizing and grading	Rock sizing addressed in Section 2.1.2.
	Minimise the use of large rocks in drainage lines	Rock sizing addressed in Section 2.1.2.
	Minimise the concentration of water on landforms unless this is consistent with accepted drainage density and geomorphic design practices	The design has largely confined higher erosion risk areas to the drainage lines. This information is outlined in Section 2.1.2.
	Minimise the generation and dispersion of sediment in the Talbingo Reservoir, Tantangara Reservoir or other waterways	Sediment control discussed in Section 3.1. All spoil will be placed on land. Monthly water monitoring downstream of emplacement area will be undertaken in accordance with the Main Works Environment Protection Licence (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.

Aspect	Objective	Notes
Erosional stability	Minimise steep slopes, particularly slopes that will be difficult to access and maintain (such as slopes over 18 degrees or 1V:3H)	The landforms at Ravine Bay are mostly flatter than 1V:4H. Target maximum slopes have been increased from 1V:3H to 1V:2.75H, to accommodate all of the material out of the reservoir. Extent of slopes steeper than 1V:2.75H has been limited as far as practical. Slopes discussed in Section 2.1.1.
	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	Once the Rehabilitation Management Plan is approved, this plan will be reviewed against the Rehabilitated Management Plan for consistency.
	Ensure areas subject to wave action are suitably protected or the slopes are flattened to limit wave action	This is not applicable at this stage.
Land Use	Native vegetation and habitat must be consistent with the approved Rehabilitation Management Plan	Once the Rehabilitation Management Plan is approved, this plan will be reviewed against the Rehabilitated Management Plan for consistency.
	Recreational facilities and use must be consistent with the approved Recreation Management Plan	Once the Recreation Management Plan is approved, this plan will be reviewed against the Recreation Management Plan for consistency.
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	In terms of constructability: • Vegetation will be mulched and topsoil and subsoils will be stripped and stockpiled to be retained for future use and rehabilitation. Further detail is provided in Section 4.4. • Sediment and erosion assessment and control has been incorporated into design. Further detail is provided in Section 2.1.2. • Slopes to be no steeper than 21deg (1V:2.75H) except where steeper slopes are required to tie into the existing natural landform. Access tracks will be maintained in accordance with the final landform design and rehabilitation management plan. • Natural ground requires only clearing prior to placement, and/or topsoil and subsoil stripping. • Progressive rehabilitation is planned for, but implementation will depend on the sequencing of TBM and D&B and the management of PAF / NOA materials. • Benches are temporary only; surface to be shaped post placement. • The toe of the landform will be near the reservoir edge and safe construction measures are addressed in construction documentation.

1.3. Staging

The work activity of In-reservoir spoil emplacement will require greater detail prior to commencement due to need to further assess the risk and impact of undertaking such an activity. Consequently, this plan will be updated, in consultation with relevant government agencies, and submitted to DPE prior to commencement of specific activities as detailed in Table 1-3.

Table 1-3: Activities that require update to this plan.

Activities	Timing
In-reservoir emplacement trial	• This SMP will be updated for approval prior to undertaking an in-reservoir spoil emplacement trial. This trial is currently under development.
In-reservoir emplacement	• This SMP will be updated for approval prior to undertaking full scale in-reservoir emplacement. This update will include a revised design which accounts for spoil already placed on land to date, in addition to revised management measures based on the results of the trial.

This plan will also be reviewed and updated if required following review as per Schedule 4 Condition 4. This plan will also be reviewed and updated if required following approval of Rehabilitation and Recreation Management Plans. Prior to the updating of this SMP to include the sub-aqueous spoil trial Snowy Hydro commits to engage pro-actively with the NSW EPA regarding the scope and boundaries of this activity. Due to the nature of this work it is acknowledged that there are concerns regarding such activities and that all reasonable and feasible options should be considered prior to the commencement of such trials.

2. DESIGN

2.1. Landform Design Method

The design methodology has been developed through the design and construction of geomorphic landforms in NSW since 2012, mainly on large open cut coal mines in the Hunter Valley. Currently there are approximately 20 sites constructing geomorphic landforms. Within these sites, the landform surfaces can be generally divided into two landform categories namely:

- Hydraulically flat landforms, with overall gradients from the ridge to the toe of the valley of around 5 to 6 per cent or flatter. Based on observation of natural analogues, these flatter catchments can be designed using the parameters derived from stable alluvial analogues in the local environment and should not need rock armouring. Ravine Bay PSE is generally too steep to be designed using alluvial analogues.
- Hydraulically steep landforms, which can be designed using the characteristics of geomorphic landforms, but which are likely to require rock armouring. The design intent is to limit the erosion risk on the areas of overland flow adjacent to the drainage lines so that these can be stabilised using vegetated soils, with the rock armouring only required in the drainage lines. Ravine Bay PSE falls into the hydraulically steep category.

The design still uses appropriate drainage densities and other geomorphic elements such as concave drainage lines and limit the overland flow lengths, but these landform aspects are then combined with erosion risk tracking to assess where rock armouring will be required.

The erosion risk tracking is based on equations used in the SIBERIA Landscape Evolution Model (LEM). The method used is not a full LEM and quantifies risk only without the progressive movement of sediment with time that is modelled within the LEM process. The methodology has been used in parallel with SIBERIA and CAESAR-Lisflood on other sites. It is a good indicator of erosional risk, provided it is calibrated against the actual soil or site data. It is based on successful trials, for example, the Hunter Valley.

Key elements applicable to Ravine Bay PSE include the following:

- The design is for 1.61 million m^3 total (1m D&B and 0.61m TBM material), significantly less than predicted in the EIS (2.8 million m^3) due to project optimisation and removal of scope items. Therefore, the 1.61 million m^3 that is currently expected will all fit on land. No spoil will be placed in the reservoir at this stage.
- The site was selected to limit the extent of run-on from adjacent upstream catchments. To achieve this, the toe of the landform does not extend into the adjacent natural creeks located on either side of the PSE. These natural creeks have a significant upstream catchment and are hydraulically steep.
- For practical construction purposes, the maximum slopes used it 1V:2.75H, with all slopes flatter than this other than a few small areas such where rock drains are cut in. This slope limitation allows cross-ripping of the surface using a dozer to increase infiltration prior to vegetation being established. Slopes flatter than 1V:4H simplify access using agricultural equipment, and a significant proportion of the landform is flatter than 1V:4H.
- Based on the restrictions for PAF placement being between NAF material, this issue has been addressed by ensuring the available footprint at each stage of the PSE development is large enough to allow for multiple tip heads and levels to limit the risk of double handing PAF material.
- The design has a liner as an approach to managing potential contaminants. The specifics of this potential liner (type, specification, extent, construction method and staging) have been refined to meet both the objectives of this plan and the requirements of the NSW EPA. The Project EPL has been updated to include this detail. Placement will not occur without meeting this conditions in the Project EPL.
- Clean water will be captured below this liner through a subsurface drainage system. This will ensure that seepage will flow on top of the liner and be directed to a sealed basin to mitigate water in the basin migrating to the groundwater table, while the clean water currently seeping into the base of the valley will be collected separately and directed off site. Prior to spoil being placed, the basins will be treated as normal sediment basins.
- The western extent of the PSE will impact directly on the natural creek line. Upstream tributaries west of this catchment have been redirected into constructed drains in the landform, and the upstream creek to the north has been redirected into the natural creek line.
- The site will not receive filter cake, wedge pit slurry, fish tank slurry, and balance tank slurry nor untreated water which are materials which have been found to have high levels of nitrates, unless results prove material is inert and non-reactive. Further detail can be found in the Nitrogen Management Plan.

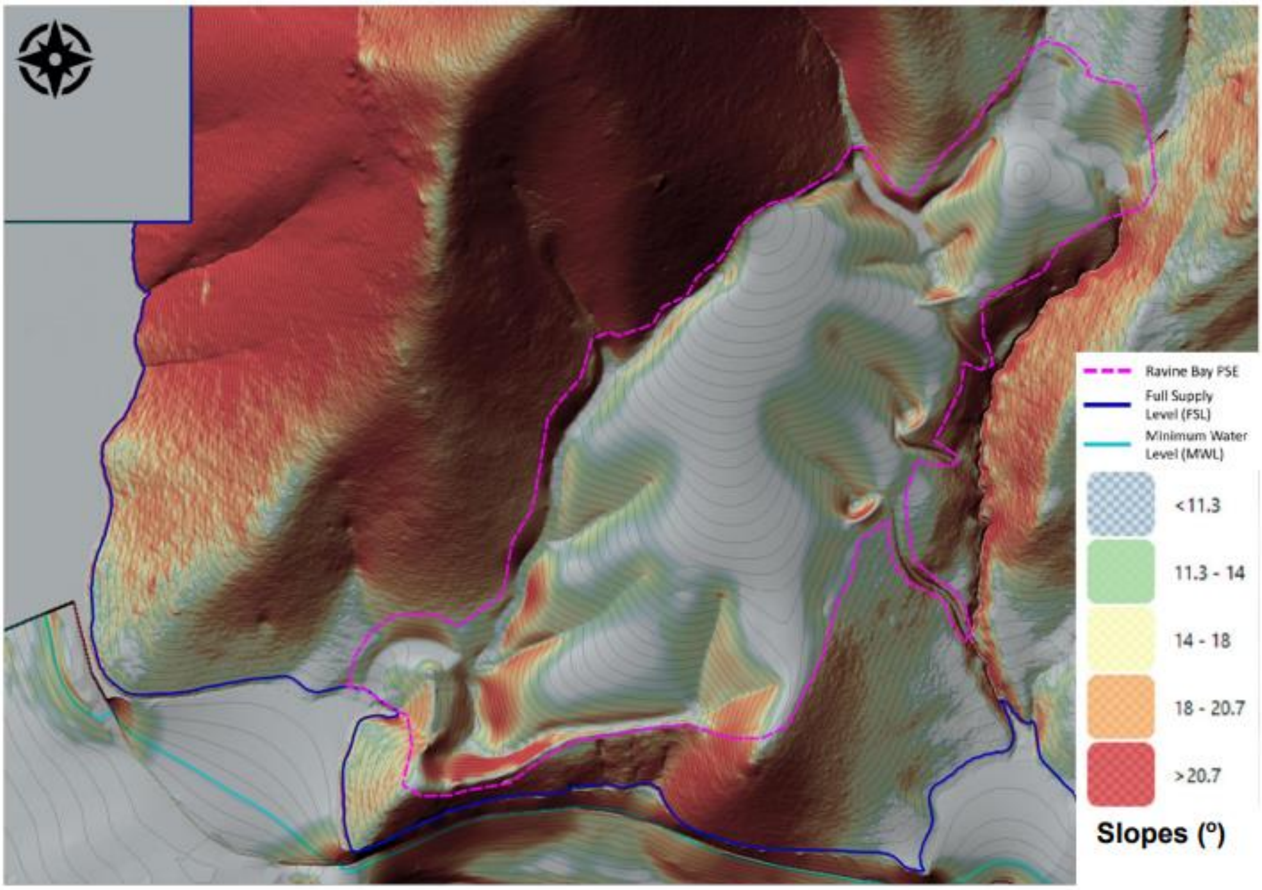
2.1.1. Slopes

A key design element involved targeting 1V:4H slopes (14°) for ease of topsoil placement and revegetation, and to limit the extent of slopes steeper than 1V:2.75H (20.7°) as far as is practical. While 1V:2.75H for some of the slopes at Ravine Bay PSE is steeper than the other PSEs, this is to ensure material is placed on land. However, majority of the landforms are mostly flatter than 1V:4H.

The following figure and Table 2-1 outline the slopes for Ravine Bay PSE. It should also be noted that a high proportion (just under half of the total) of the slopes steeper than 1V:2.75H are associated with the expected hard rock excavation for Sediment Dam #4. There is also a high proportion that tie into the surrounding natural slopes which are also steep.

Table 2-1: Ravine Bay PSE design slopes

Slope Ranges (°)	Slope	Area Measured on Slope (ha)	Area (%)	Cumulative Area (%)
11.3	1V:5H	57.0	30.3	30.3
14	1V:4H	42.5	22.3	52.6
18	1V:3H	44.3	23	75.6
20.7	1:2.75H	21.2	10.8	86.4
>20.7	>1:2.75H	28	13.6	100



Note: The spoil area is well above the FSL level - the toe of Dam 1, which is a pollution control dam, extends close to the FSL.

Figure 2-1: Ravine Bay PSE slopes

2.1.2. Erosion and Rock Armouring

An erosion risk assessment was carried out based on the Einstein-Brown equation computer in GIS. Based on the risk assessment, erosion risks are most confined to drainage lines. This information was used to inform the hydraulic modelling in computer software Lisflood, from which peak flows and flow widths can be determined. Rock sizing is then based on computing the flows per unit width in the hydraulic analysis together with the flow depth, from which the rock size can be computed.

It is expected that the typical rock size required in the rock drains will be a D50 of 300mm with a target maximum rock size of 400mm. A small portion of larger rock will be used at the stilling pond, but provisionally with a D50 of 450mm and a maximum size of 600mm. These sizes will be confirmed once the geotechnical investigation at Ravine Bay is completed. In addition, overspill from sediment dams #1 to #3 (Figure 3-1) occurs over a natural ridge which could potentially result in scour on the existing natural surface. Competent rock at the surface is however likely and will be assessed by the geotechnical investigation.

Geotextiles are proposed to be used on the drainage lines to minimise the erosion risk immediately post construction. In the longer term the use of correctly graded rocky material will be key to give long term stable surfaces.

The PSE is currently designed to be all on land hence there is no risk of scour from rising and falling water levels. This management plan will be reviewed and updated accordingly if the eventuality of in water placement arises.

2.1.3. Visual

The locality and visibility of the PSE from surrounding viewpoints is an important consideration in the landform design process. The geomorphic landform surface is shown in Figure 2-2 and Figure 2-3 together with the surrounding landform and natural topography post construction of the Ravine Bay PSE.

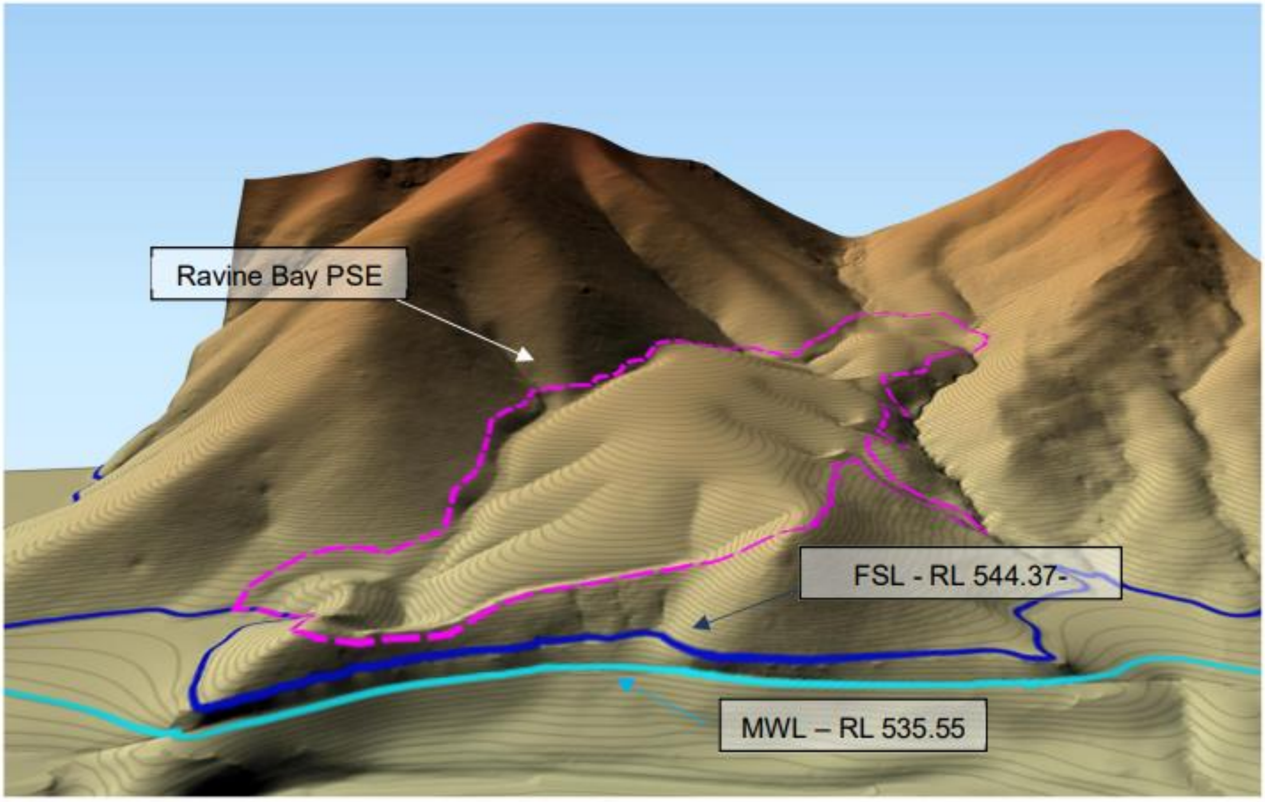


Figure 2-2: Ravine Bay PSE view from the south

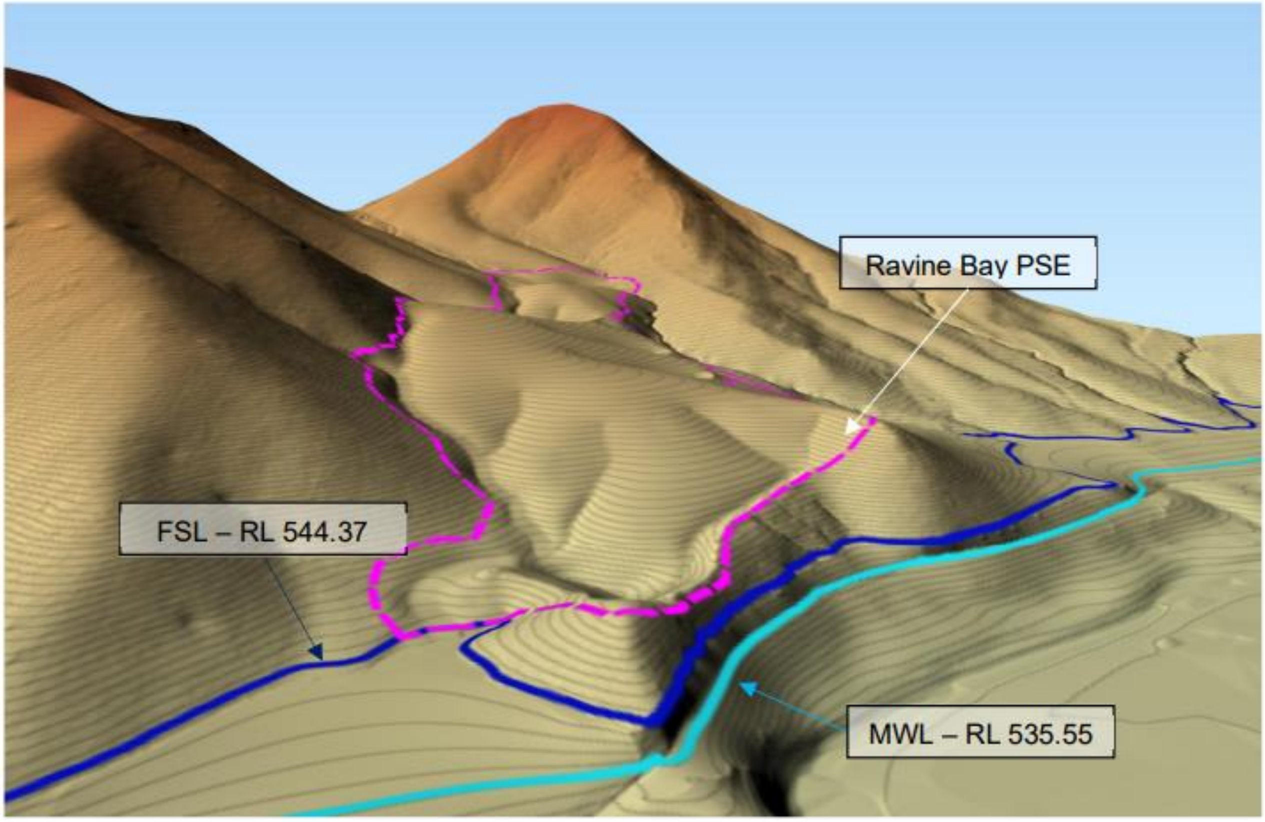


Figure 2-3: Ravine Bay PSE view from south-west

2.1.4. Drainage

Rock lined surface drainage channels, an impermeable membrane and subsurface drainage are the primary drainage features for Ravine Bay PSE.

Clean water

- Upstream catchments are to be diverted into the drainage line on the eastern side of landform. Creek diversions, clean water drains, a drainage blanket and subsurface drains will divert existing clean catchment flows to natural creek lines. Drainage on the western edge of the PSE will be redirected across constructed landform to reconnect with the existing eastern creek. This will mimic natural flow regimes.
- Prior to the emplacement being finalised and rehabilitation occurring, NSW EPA and NPWS will be consulted regarding the capping layer of the landform, of which may be required to limit clean water seepage through the final landform.

Sediment laden water

- The liner has been shown in 2D steady state and transient analysis to be effective in limiting the ingress of affected water to the clean water system potentially to below detection levels. This initial modelling was based on a clay permeability of around 7 x 10^{-7}m/s, and while this is based on estimated values for the material, it is also well known that the permeability of materials can vary significantly due to variations associated with construction and variations in the natural materials. It is almost certain that some seepage through the liner is likely to occur, in accordance with the project EPL, the liner must be suitably engineered to achieve a safe, stable and non-polluting landform.

- Four basins (initial sediment and re-classified leachate once placement commences are proposed to be constructed to manage water quality and limit sediment ingress. The basins have been sized above the blue book capacity of 95th percentile and 5-day rainfall (46.8mm) with a runoff of around 0.79 with a further 50% capacity provided for sediment accumulation.

The following table outlines the basin capacities of the four basins. Basin locations are depicted in Figure 3-1.

Table 2-2: Sediment dam capacities

Name	Designed capacity (m^3)	Blue book settling capacity (95th percentile 5-day event) (m^3)	Blue book sediment capacity (m^3)
Sediment basin #1	10,016	4,537	2,287
Sediment basin #2	1,010	355	117
Sediment basin #3	1,397	584	584
Sediment basin #4	27,079	6,302	6,302

2.2. Adopted Landform Design Criteria

The interpretation of the existing completion criteria into specific design criteria has been provided in Table 2-3: Landform design criteria. 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. Where design changes occur, agencies will be consulted in line with Section 2.3 below.

Table 2-3: 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 D_{50} 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.	From the initial design work and assessment of erosion risk, the current design has a drainage density of 81m/ha. 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 18deg (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. • Factor of safety overall including the underlying founding conditions and possible groundwater water levels >1.5 under long-term static loading. • Factor of safety ≥1.1 after a 1:10,000 annual exceedance probability (AEP) seismic event.	Design includes 1V:4H slopes (14°) for ease of topsoil placement and revegetation, and to limit the extent of slopes steeper than 1V:2.75H (20.7°) as far as is practical. While 1V:2.75H for some of the slopes at Ravine Bay PSE is steeper than the other PSEs, this is to ensure material is placed on land. However, majority of the landforms are mostly flatter than 1V:4H. Golder has completed geotechnical investigations (Report 20355010-012-TM-Rev0_Ravine Bay geotechnical desk top study and Report S2-CIV-AI-RBS-0002) confirming geotechnical stability for the landform using material properties provided.

Objective	Design Criteria Proposed	Notes
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 18deg (1V:3H).	Landforms to be rehabilitated with natural vegetation communities as described in the Rehabilitation Management Plan. This detailed rehabilitation plan for this area will include detail on the tracks that are required during the rehabilitation stage of the project. All tracks will be rehabilitated as per RMP unless NPWS requests a track(s) remain. See Section 3.4 for ongoing NPWS access consultation requirements.
Landform to be suitable and safe for access	• Tracks accessible for 4WD vehicle to access landform during rehabilitation of the landform.	Requirements of Rehabilitation Management Plan to be applied where relevant to the landform. As noted above, the temporary access tracks may be retained for use later if NPWS requests. Otherwise, the tracks will be rehabilitated. See Section 3.4 for ongoing NPWS consultation requirements.
Landform to limit impacts on water quality	• Provide containment on the toe of the PSE. • Sediment controls to be formed upstream of sensitive receptors. All of the landform drains to Talbingo sediment dams are located upstream of sensitive receptors.	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. This is detailed further in the progressive erosion and sediment control plans (temporary) and in the design (permanent).
Landform revegetation	Not detailed here – the surface will be revegetated with appropriate natural plant community types (to minimise erosion) within a reasonably short period of time, typically prior to anticipated late Winter rains.	These issues to be addressed in the Main Works 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). The capacity should be maximised where practical to limit the risk of spilling.	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.

2.3. 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 and Environment (DPE).

During onsite inspections or at 12-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. This plan will also be reviewed and updated to include information on the proposed in-reservoir spoil trail.

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 addition, prior to the emplacement being finalised and rehabilitation occurring, NSW EPA will be consulted regarding a potential capping layer of the landform.

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 m measured on the slope. NPWS will be consulted on access routes for rehabilitation, weed control, and fire fighting, and, if required approval will be sought where the 200 m requirement cannot be provided, prior to finalisation of design.

Once the Rehabilitation and Recreation Management Plans are approved, 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. Once internal review processes have been met, documentation will be provided following completion.

3. 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.

As stated above, this plan will be staged to reflect design and construction progress, and any potential changes. Currently, the design and management measures, reflect spoil emplacement occurring on land. This plan will be updated, and consultation carried out, for any design changes that involve spoil placement in-reservoir.

It is estimated that the Ravine Bay PSE will accommodate approximately 1.61 million m^3 total (1m D&B and 0.61m TBM material). All material, at this stage, will be placed above FSL. The Ravine Bay PSE will broadly be developed as follows (dates are indicative only and are provided to describe sequencing):

- Fourth Quarter 2023:
  - Pre-construction works including identifying weed control and environmental avoidance areas and marking them within the approved disturbance footprint.
- 2024 to 2025:
  - A cut-off drain on the western toe of the PSE collecting affected runoff and directing it to a sediment dam will be established, and appropriate sedimentation controls set in place, including silt curtains as a precautionary water quality control measure.
  - Installation of groundwater monitoring bores.
  - The mulch, topsoil, and subsoils will be stripped in staged approach, and stockpiled temporarily in accordance with Appendix B and C of the Spoil Management Plan.
  - Installation of liner in stages as clearing and spoil placement progresses. If the liner is not ready in time for spoil placement, SHL will place the spoil temporarily at the GF01 spoil site as it is already prepared with necessary environmental controls. The temporary placement of spoil at this site has been assessed under an internal consistency assessment.
  - On-land placement preparation
    - D&B material will be utilised to construction the sediment basin, provided the material is suitable for use as per the characterisation procedure in Attachment A.
    - D&B material will be 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 (net acid-generation) suite / ANC (acid neutralising capacity) measurements results are obtained and treatment carried out, if required
    - Material will be compacted with rollers until reaching the toe of the design boundary
  - On-land emplacement
    - On-land emplacement will involve a D&B layer being placed and compacted to act as the PAF / NAF barrier layer prior to emplacement of TBM spoil following a conventional bottom-up method.
    - 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 and treatment carried out, if required.
- 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 dispersion of the material, a layer of D&B material will be placed as a protection layer.

- 2025 to 2026:
  - The material generated from Tunnel Boring Machines (TBM) increases rapidly during this period, it is anticipated that all spoil will be TBM spoil.
- 2026 to 2027:
  - Demobilisation of temporary topsoil stockpiles and infrastructure such as haul roads no longer required.

The landform will be progressively rehabilitated as sections are completed. This process involves potential incorporation of a capping layer (to be determined through consultation with the NSW EPA prior to this stage) and then final shaping and stabilisation of the landform, followed by major rehabilitation works as per Rehabilitation Management Plan.

3.1. Environmental controls

3.1.1. Clearing and grubbing

The PSE will be cleared in progressive stages.

In accordance with the Biodiversity Management Plan (S2-FGJV-ENV-PLN-0028), pre-construction surveys and pre-clearing activities will be completed for land to identify key habitat features, facilitate the egress of fauna, collect seed, and eradicate weeds. 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.

3.1.2. Drainage

As noted in section 2.1.1 and section 2.1.4, prior to emplacement subsurface drains and a lining will be placed to separate natural groundwater flows from PSE drainage and runoff.

The current design has a liner placed over a clean water collection system, the intent being to ensure that seepage will flow on top of the liner, and clean water currently seeping into the base of the valley will be collected separately and directed off site Refer to section 2.1.4 for details on drainage design. The overall drainage design is shown in Figure 3-1 below and includes rock lined drainage channels, one key basin and three stage basins above FSL to limit sediment ingress into the reservoir. A clean water network on the eastern side will be installed directing any surface water run-off away from the construction area. A temporary clean water diversion will also be required during construction to manage the runoff and flows from the existing creek line on the western extent. bearing flows from earth worked areas will be directed to basins.

Basins will be classified as sediment basins during clearing and installation of environmental controls. Once the water draining into the basins has been in contact with spoil, the basins will be reclassified as leachate 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 basins on the toe of the landform 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-0062) will be implemented which identifies the analytes, frequency and location of monitoring until this has been proven to not exceed any background criteria for an agreed period with the respective government stakeholder departments (i.e. EPA and NPWS).

To assist with effective management of sediment controls, the basins have been sized above the blue book capacity of 95th percentile and 5-day rainfall (46.8 mm) with a runoff of around 0.79 with a further 50% capacity provided for sediment accumulation. Capacities of each sediment basin are outlined above in Table 2-2.

Sediment control will require active management, including the emptying of sediment basins between rainfall events in accordance with the Surface Water Management Plan (SWMP) (S2-FGJV-ENV-PLN-0011). A comprehensive surface water inspection and monitoring program will be implemented, in accordance with the SWMP and the Project EPL. This program will be more frequent to begin with and include monitoring after key rainfall or snowmelt events or following deviations to any of the WQO's during in-situ monitoring, to ensure that placement activities are not causing impact to the receiving environment.

The management of basins, including the treatment, reuse or disposal of basin water will be included in the relevant Ravine Bay spoil emplacement site procedures.

Sensitive Area Plans (SAPs) and Erosion and Sediment Control Plans (ESCPs) will be prepared and implemented, consistent with the SWMP to manage specific environmental aspects at each of the construction sites. Controls required for works on waterfront land will be managed in line with management approaches in Table 3-1.

Basins will remain in place until the site is rehabilitated such that the sediment loading, and suspended solids are suitable for discharge to the reservoir. Concrete lining will be removed from basins, and disposed of at a location certified to accept it and the basins will be left to naturally fill with sediment. If the basin's water quality doesn't meet the WQO criteria, SHL manage the water in accordance with relevant water licences or in consultation with the EPA.

To manage potential leachate seepage from the PSE, the Leachate Detection Procedure will be implemented and followed (S2-FGJV-ENV-PRO-0062). Seepage and runoff will be collected in Leachate Basins downstream of the emplacement area. Collected water will be tested for potential contamination which will be guided by the Project EPL. PAF validation audits will be also be undertaken regularly (further detail provided in section 3.6). 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. This includes the consideration of a capping layer on the landform.

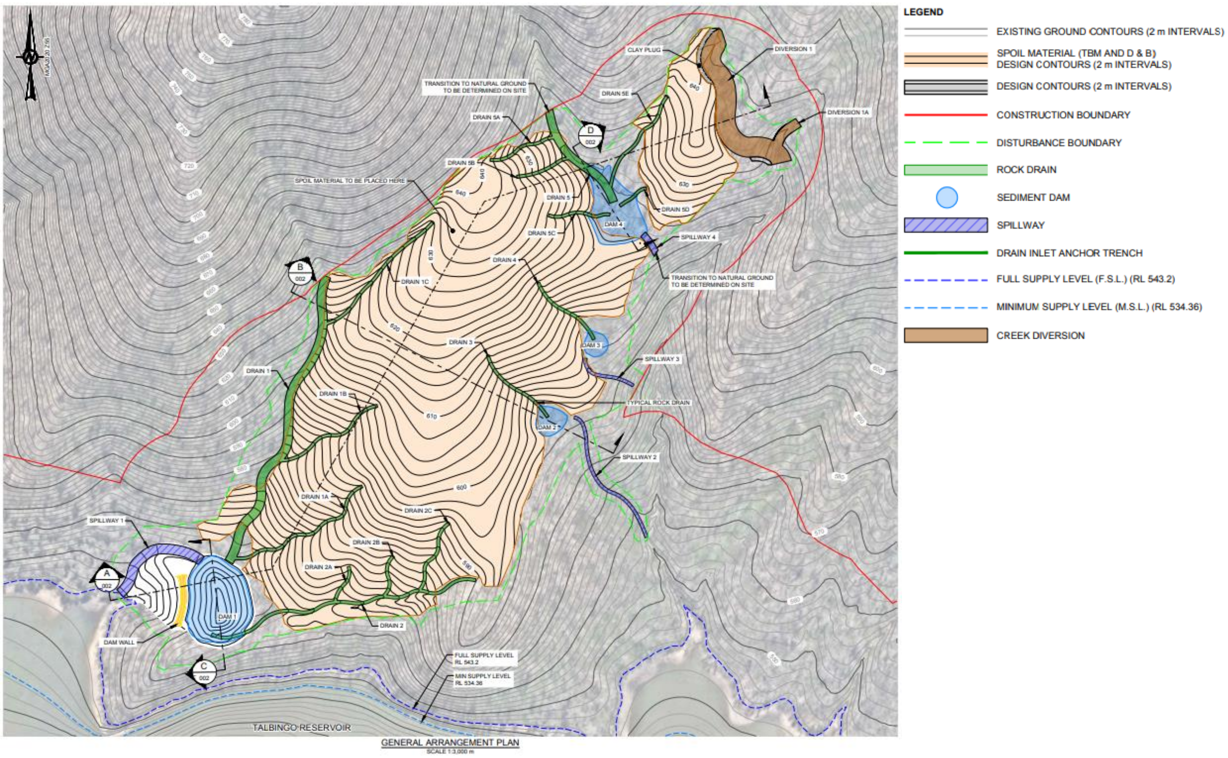


Figure 3-1 Indicative Ravine Bay PSE Layout

3.2. Works on waterfront land and instream works

The *Water Management Act 2000* defines waterfront land as the bed of any river, lake or estuary and any land within 40 m of a riverbank, lake shore or estuary mean high water mark. Instream works refer to modifications or enhancements to a watercourse. All instream works or development within 40 m of any watercourse will be undertaken generally in accordance with the requirements in the *Guidelines for Controlled Activities on Waterfront Land.*

Table 3-1 below outlines types of work expected at Ravine Bay PSE and how the management approaches outline in the SWMP are addressed.

Table 3-1. Management approaches for works on waterfront land and instream works at PSE.

Type	Description	Management approach	Where addressed
Permanent watercourse diversions	Any watercourse that traverses the project disturbance area may be permanently diverted.	Any watercourse that will be permanently diverted around permanent infrastructure will: • be a piped and/or surface drainage system; • be designed and constructed to have non-erosive hydraulic capacity and be structurally sound for the1% AEP event; and • have adequate scour protection at the system inlets and outlets. During detailed design a risk assessment will be undertaken to identify risks associated with by-pass flows that may occur because of system blockage or an event greater than the design event. Watercourses will be rehabilitated in accordance with Rehabilitation Management Plan.	Design, including rock armouring, accounts for the 1% AEP as per Table 2-3.
Temporary watercourse diversions	Any watercourse that traverses the project disturbance area may be temporarily diverted.	Where practical, any watercourse that will be temporarily diverted will; • be a piped and/or surface drainage system; • be designed and constructed to have non-erosive hydraulic capacity and be structurally sound for a design event (that will be established by a rick assessment); and • have adequate scour protection at the system inlets and outlets. A risk assessment will be undertaken to identify risks associated with by-pass flows that may occur as a result of system blockage or an event greater than the design event. Watercourses will be rehabilitated in accordance with Rehabilitation Management Plan.	Any temporary watercourse diversions will be documented in ESCPs in line with the management approach.
Works within 40m of a watercourse	Disturbance may occur on any land within the project disturbance area that is within 40 m of a watercourse or reservoir.	ESCPs are to dictate the specific controls to be used on waterfront land. Typical measures include: • monitoring weather forecasts and taking appropriate action prior; • minimising the extent of work and the amount of time disturbance where possible; • isolating work areas from natural flows where possible; • stockpiles to be located outside of the waterfront area; • use of temporary ground covers in areas of concentrated flow to minimise erosion of exposed soils during rainfall; • Stabilisation of exposed batters within 40m of a natural watercourse prior to forecasted 80% chance of 10mm rain.	Specific controls will be documented in ESCPs as per Section 3.1

		• completing and stabilising works as quickly as possible after works are complete	

3.3. 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 3-2: 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

3.4. 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:

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

While the Ravine Bay PSE will not receive spoil from the ECVT and MAT portals, 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 3-3: 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

3.5. 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), have been 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 were run for 12 months on each of the seven lithologies of interest that have been identified in previous works.

Samples 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. Key findings are summarised as follows:

- All HCT leachates were characterised by a circum-neutral pH over the course of the 53-week program. No HCT for any of the tested lithologies produced acidic leachates by the end of the column testing period.
- EC values decrease as a function of time, indicating the leaching of readily soluble salts. The main analytes controlling EC were sulfate, bicarbonate, sodium and calcium.
- Most of the metal(loid)s were released during the initial flush, with concentration then dropping below the selected threshold values. Exception to this were the concentrations of Al in all HCTs, and a few peak concentrations of As, Co, V and Zn measured in the Ravine Beds East (RBE) and Ravine Beds West (RBW) HCTs.
- The comparison of the geochemical characteristics of the samples pre- and post-kinetics did not indicate that significant changes to the materials had occurred during the test. This exemplifies the unreactive nature of these materials at the target total sulfur (TS) contents.

3.6. Potential acid forming (PAF) validation audits

SHL will conduct regular Potential acid forming (PAF) validation audits to assess the effectiveness of the PAF management strategy. An independent audit will be initiated within the first 6 months of placement of spoil, with the results of this audit to be provided to DPE. The frequency of subsequent audits will be determined in consultation with DPE. These audits will involve:

- Testing and analysis of leachate (pH, electrical conductivity (EC), oxidation reduction potential (ORP) and Temperature) from active emplacement areas;
- Sampling and analysis of geochemical properties of selected stockpiles (Total S, Acid Neutralising capacity (ANC), net-acid generation (NAG) suite parameters, pH and EC) to ensure that all PAF is being identified; and
- Visual assessment of stockpiles to confirm volume, chemical analysis, blending calculations and mixing method of PAF materials with non-acid forming (NF) materials is in line with that proposed as part of the PAF management strategy.

4. FINAL PLACEMENT AND REHABILITATION

4.1. Transport

- The Ravine Bay PSE area will receive spoil from the Talbingo Intake, Talbingo Haul Roads, Talbingo Spoil Road and Tailrace Tunnel. Ravine Bay 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 Ravine Bay spoil. Transport routes from the Talbingo Work Areas (A) to the Ravine Bay PSE (B) are summarised in Figure 4-1: PSE spoil transport routes

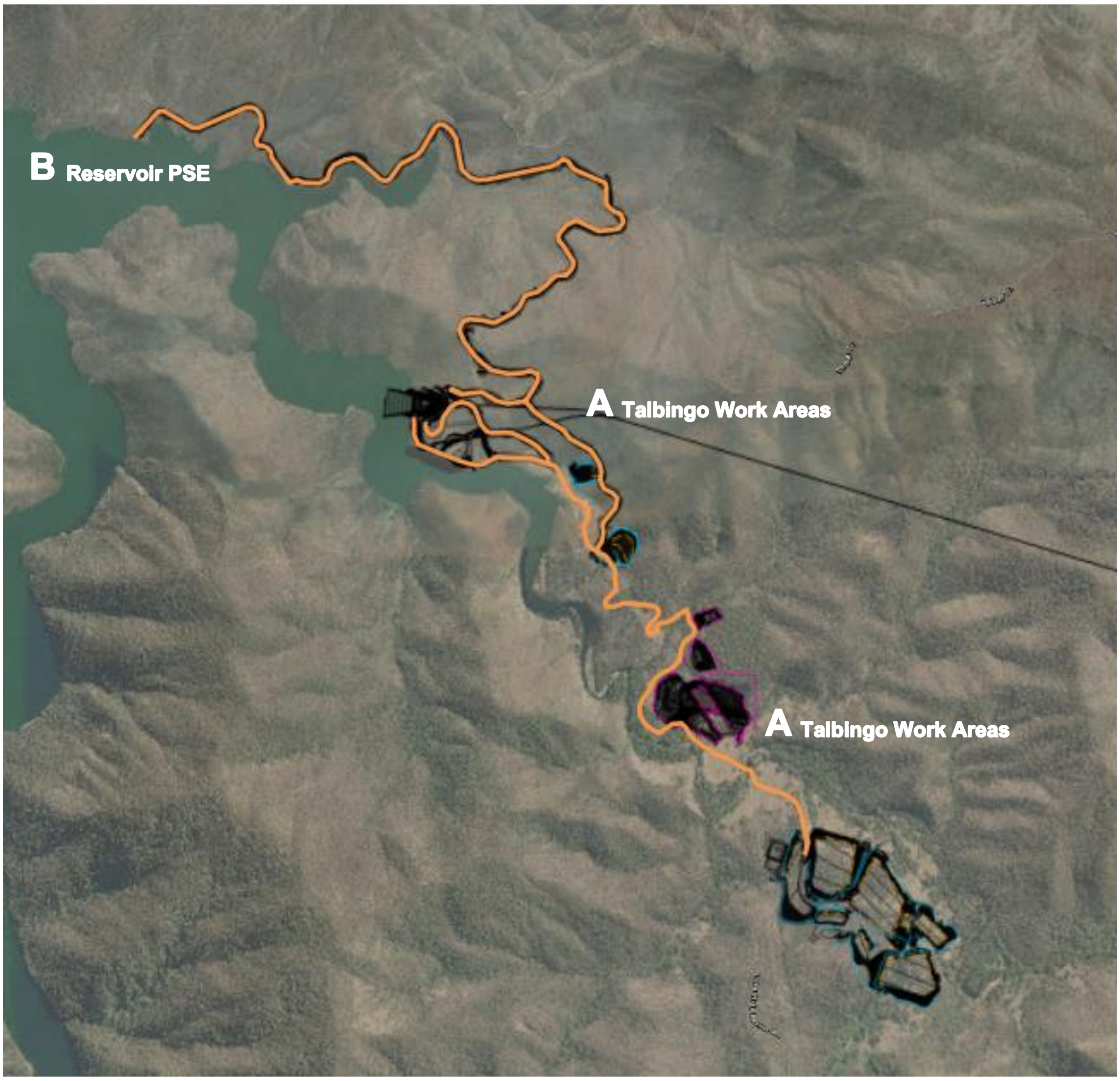


Figure 4-1: PSE spoil transport routes

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 Ravine Bay PSE will not require water-based placement methods (barge etc.). All spoil will be placed above FSL.

Where marine support is required (e.g. access or installation of the silt curtain), 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.

The project will use communication tools 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

Ravine Bay PSE is to be constructed with all material to be placed above FSL (RL544.37). In line with the Main Works RTS, material testing of Lobs Hole D&B material shows that only 2% of material is less than 63 µm (closest test faction is 0.075 mm or 75 µm) and 4% of material is less than 2.36 mm.

The management of runoff at Ravine Bay PSE is simplified by the absence of run-on from the natural catchment by having the eastern drain separating clean and dirty water. Water quality will be controlled on the edges of the PSE as describes in section 3.1.

Vehicles shall traverse an access road and utilize a turnaround bay to dump spoil.

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

Most of the landform will be placed in benches, and once the outer benches are at line and level, these can be dozed down to form the final surface. 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 done perpendicular to the benches to form the geomorphic landform.

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.

Progressive rehabilitation will be confined to the areas on land where the landform can be shaped as construction progresses. Portions that are completed during construction can be rehabilitated.

In general terms the construction of the embankments is a bottom-up approach undertaken with conventional earthmoving techniques. The process will be as follows:

- Stage 1: Weed removal and 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, likely at least 1 m depending on the value of the material. 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-0062) prior to the placement of confirmed PAF. Silt curtains will be installed around the emplacement area as a precautionary measure.

- Stage 2: Spoil emplacement
  - Prior to emplacement subsurface drains and a lining will be placed to separate natural groundwater flows from PSE drainage and runoff.
  - Spoil will be encapsulated in horizontal layers. PAF material is expected to be placed into the Ravine Bay PSE, so it is important to limit air ingress. Ideally this will involve compaction of the outer layers. 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.
  - PAF material will be placed away from the outer edges of the surface with an initial layer of NAF on the natural ground level and spread across the site to not have concentrated areas of PAF.
  - 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:
    - A D&B layer will be placed and compacted to act as the PAF / NAF barrier layer prior to emplacement of spoil,provided the material is suitable for use as per the characterisation procedure in Attachment A. 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 Talbingo PSE, both at the current time, and as updated through ongoing geochemical testing. From the initial design work and assessment of erosion risk, the current design has a drainage density of 81m/ha.
    - 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 Talbingo 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 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: 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, subsoil, and D&B material or some other material. This would be placed in a layer on the outer surface.
  - Prior to revegetation, deep ripping to a depth of around 0.5 m 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 will then be vegetated.

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). 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

It is not anticipated that NOA will be intercepted at the source locations for the Ravine Bay PSE. NOA screening will only be carried out in areas of confirmed or potential NOA. Where NOA is intercepted methods for transport and emplacement detailed in the NOA Management Plan (SMP) and on-site procedures will be adhered to.

4.3. Rehabilitation

The permanent structure will be rehabilitated consistent with project approval requirements (Schedule 3, Condition 9 and 10) and the Rehabilitation Management Plan and Recreation Management Plan undertaking a staged approach, rehabilitating the landform progressively where possible. 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 and Recreation Management Plan.

Suitable access for vehicles and/or all-terrain vehicles for rehabilitation, weed control and firefighting will be provided at around 200 m measured on the slope, or as approved by NPWS, in accordance with Schedule 3, Condition 6. Provision in the design for the access tracks is yet to be finalised and will be addressed at a later stage.

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.

Progressive rehabilitation will be confined to the areas on land where the landform can be shaped as construction progresses. Portions that are completed during construction will be rehabilitated.

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

Topsoils and subsoils will be stripped and stockpiled to be retained for future use and rehabilitation. Topsoil and subsoils will be screened or sorted to remove stumps, roots, clay lumps or stones and stockpiled no higher than 2.5m where possible to minimise the risk of compaction and to maintain the viability of the spoil seed bank. Soil 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. Soil 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. Soil will not be compacted so as to minimise soil structural decline.

Prior to reuse, 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 soil 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.

4.5. Key risks for the successful completion and contingency measures

The key risks and contingency measures relevant to the transition of the Ravine Bay PSE as a designated PSE area are provided in Table 4-1 below.

Table 4-1: Key risks and contingency measures for successful completion of the Ravine Bay PSE

Risk	Contingency
Clearing and grubbing outside approved area.	Disturbance boundaries are set out on site with no-go areas clearly 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.	There is flexibility around landform volumes which can be increased or decreased by changing the slopes and adjusting the footprint. However, the area on land is constrained by the adjacent drainage line.
Material placed into the Ravine Bay PSE contains contamination (other than the PAF and NOA material).	The proposed design involves placement of all material above FSL. Respond to incidents as per the Unexpected Finds Protocol and Section 6.6 of the Spoil Management Plan. The current planning is to utilise the liner and clean water collection system to limit the footprint of the PSE that is in contact with the environment.
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.
The Ravine Bay PSE design is modified and this results in changes to the landform’s future intended use, or approved form.	Check any changes to the Ravine Bay PSE design against the 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 and subsoils 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. Procedures to prevent the import of pathogens and weeds in any imported topsoil will be included in the Rehabilitation Management Plan.
Material placed has a higher risk of erosion than expected.	Although an outer topsoil layer is expected to 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.

Risk	Contingency
PAF presence to be managed	To be treated and placed in accordance with Appendices A and E of the SMP and 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. PAF validation audits will also be undertaken to assess the effectiveness of PAF management.
NOA presence to be managed	It is not anticipated that NOA will be intercepted at the source locations for the Ravine Bay PSE. Where pre-placement screening identifies the presence of NOA, methods for transport and emplacement detailed in the NOA Management Plan (SMP) and on-site procedures will be adhered to.
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. TARP to address deficiencies.
Soil and water impact(s) during removal of controls	Sediment dams 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	The landforms current staging is fully on land, no dozing will into 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.
The varying water level causes scour through wave action	The design has been revised to ensure, at this stage, all spoil is placed on-land. Risks from varying water levels and subsequent scouring are therefore avoided.
Risk of scour in relation to pump operation	The design has been revised to ensure, at this stage, all spoil is placed on-land. Risks from varying water levels and subsequent scouring are therefore avoided.
Water rising (flooding) the area due to high rainfall	Sediment basins and surface water will be monitored regularly during routine site inspections, particularly prior to rainfall and any shutdowns.
Public risks associated with the reservoir	Ensure appropriate exclusion zones and notifications to the community have been undertaken appropriately.
Risk of differential settlement during construction	Stability to be monitored at regular intervals during placement, separate stockpiles to differentiate material placement.
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, EC, and nutrient screening and validation testing by a NATA accredited laboratory (Appendix A of the SMP) to ensure material is neutralised prior to placement. Basins will be constructed on site and tested for potential contamination prior to reuse on the stockpile. Site specific controls including compaction rates, water quality controls, erosion and sediment controls and a potential capping layer will be developed and workshopped with the NSW EPA to ensure effective site management and will be monitored under the Project EPL.

Risk	Contingency
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.
Nitrates in spoil entering environment	Whilst there is not expected to be an issue at Ravine Bay with no placement of materials with concentrated levels of nitrates, Snowy Hydro has worked with the NSW EPA on a precautionary liner option to prevent seepage of water into the groundwater table, with details covered in the Project EPL. Additional controls include: • The basins will be impermeable. • The spoil testing and water monitoring programs will be increased following learnings from GF01. • A Nitrogen Management Plan is under development in consultation with the NSW EPA which will detail measures to be minimise the impacts of nitrogen and associated contaminants derived from spoil. If materials with high nitrate levels are encountered, these are currently proposed to be treated prior to placement or alternatively taken off site. Snowy Hydro is also exploring the potential to encapsulate untreated materials at the Ravine Bay PSE however this will require additional consultation with NPWS and the NSW EPA, and changes to the Project EPL prior to work being undertaken.

It is also noted that the Ravine Bay PSE could be subject to scour within the Talbingo Reservoir through the generation of high velocities during pumping or power generation if spoil is placed in water. Review of this will be included in the in-reservoir emplacement trial. This plan will be updated, and consultation carried out, for any design changes that involve spoil placement in-reservoir prior to placement as per section 1.3.

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

Using the design approach described in Section 3 of this plan, FGJV has developed designs for the Ravine Bay 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 2-3 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

Objective	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 D_{50} 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	• Confirmation of final landform using a combination of drone imagery and manual survey. • Long sections and cross sections show smooth integration with adjacent natural surface. • Max rock size to be appropriate to the channel width.
Landforms are stable from erosion	• 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. • Minimise valley infill (to limit run on). • 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 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 through 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 standard practice involves 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. It is proposed 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. • All material will be placed above FSL and subsequently not at risk of wave action

Objective	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 in accordance with the Design. • 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. • Landforms that are not constructed in accordance with the design will be deemed a non-conformance by Snowy Hydro and be managed through this process.	• Most of the landforms are inherently stable if the founding conditions are adequate because the slopes are typically flatter than 1V:4H. • In accordance with the Earthworks specification (including ITP compliance and inspection records) regular geotechnical inspections of the Ravine Bay PSE will be undertaken. Relevant ITPs include: ○ Surface Excavation, Protection and Support - S2-FGJV-QUA-ITP-0002. ○ General Fill Placement - S2-FGJV-QUA-ITP-0008. ○ Handling and Characterisation Spoil Management – S2-FGJV-QUA-ITP-0048. • The long-term geotechnical monitoring of the landforms will include regular aerial surveys, quarterly site inspections and annual monitoring as per Rehabilitation Management Plan.
	• 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 in accordance with the Design. • 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 • Management of potential stability risks at the edge of the reservoir where there is thick fill and potentially unconsolidated alluvial sediments will be investigated and verified by intrusive investigations once site access is available.
Landforms are appropriate for intended land use	• Landform to be safe for access where required. • 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 have not yet been indicated – these will be added during construction using the as-built surfaces. Where practical, 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. • "Heat maps" to confirm the constructed surfaces and slopes are within the required tolerances of the design surfaces

Objective	Objective	Performance Indicators	Measurement Tools
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, 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 sediment basins immediately downstream of the landform. • Design report to flag construction issues and management. 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.

Objective	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. • erosion and sediment control. • access. • initial shaping of the natural ground. • shapes and benching. • progressive rehabilitation. • safety around water.	• Landform design to include areas for temporary 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. • 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).

ATTACHMENT A – RAVINE BAY MATERIAL CHARACTERISATION AND HANDLING STRATEGY

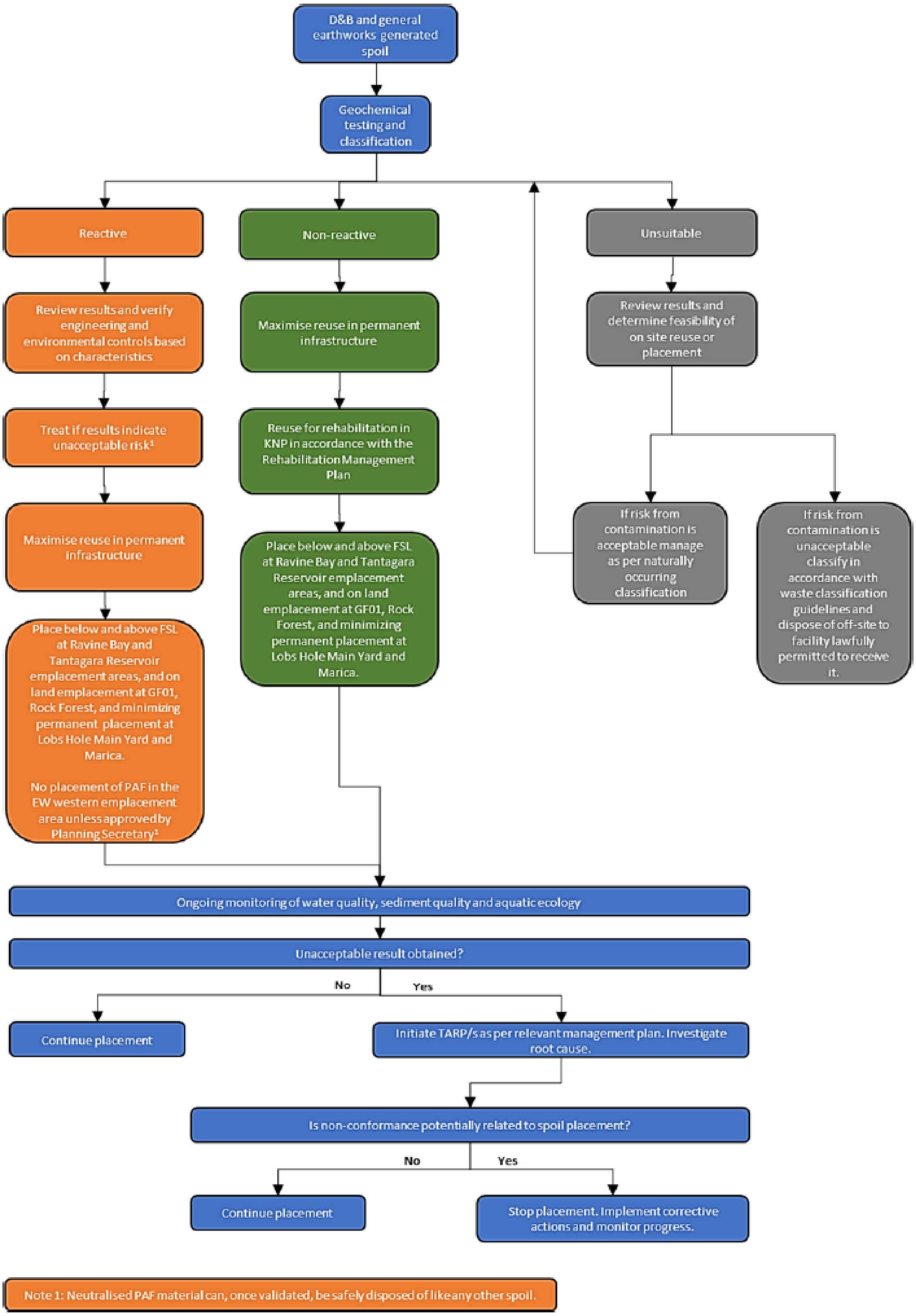


Figure A1 – D&B and earthworks generated material flow chart

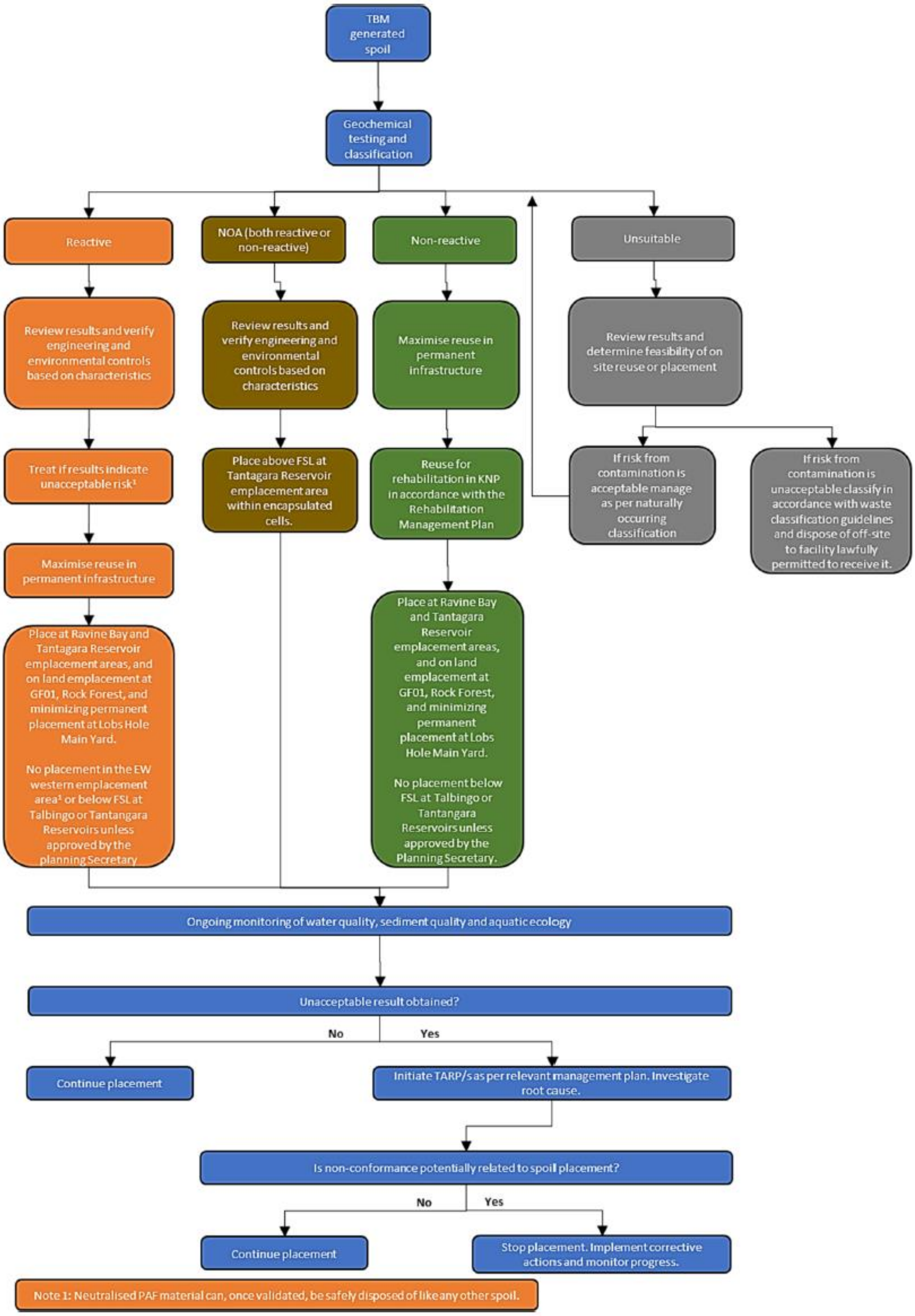


Figure A2 – TBM generated material flow chart

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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A ccountable:	Name: Ellen Porter Job Title: Environmental Manager Signed: Date: 07.09.2022
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: 06/09/2022

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.
C	**Consulted** Those who must be consulted before the document is published.
I	**Informed** Those who must be informed after the document is published.
E	**Endorsed** Those who must approve the document before publication.

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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. 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) 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.

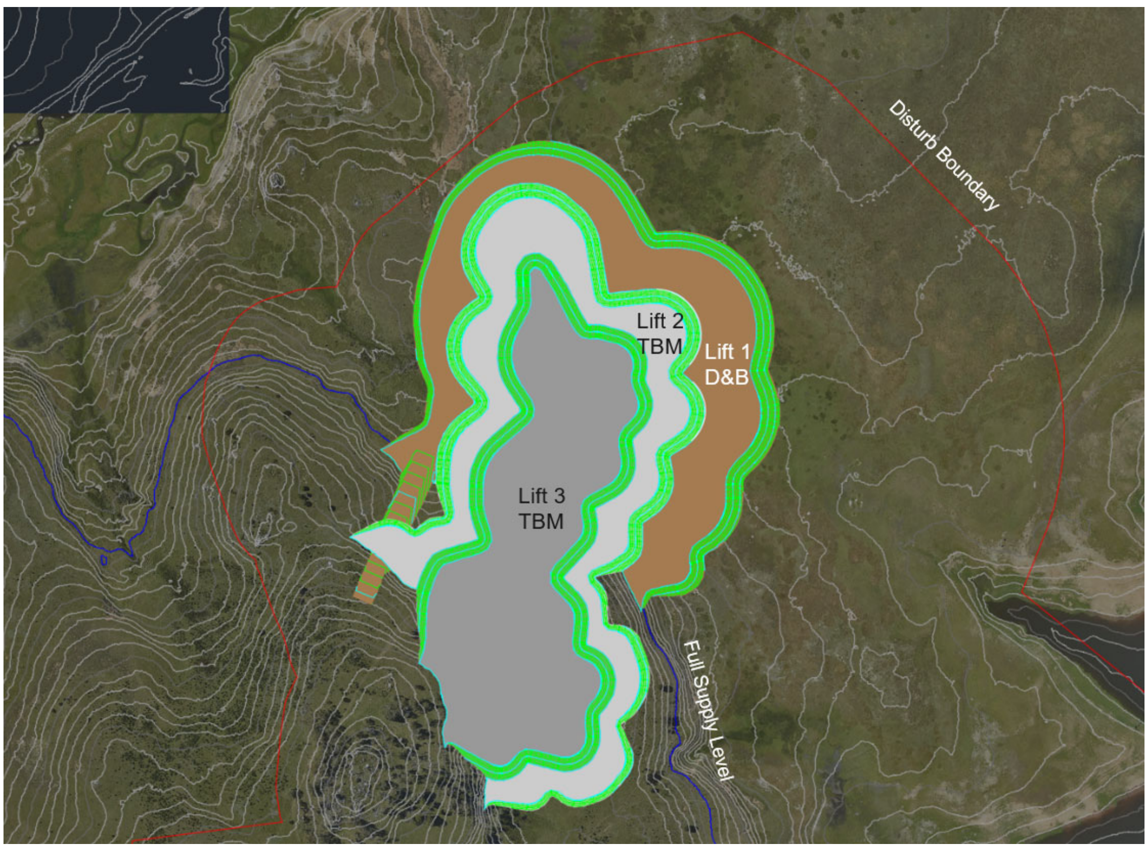


Figure 1-1 Tantangara PSE area location (Golder, 2021)

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.

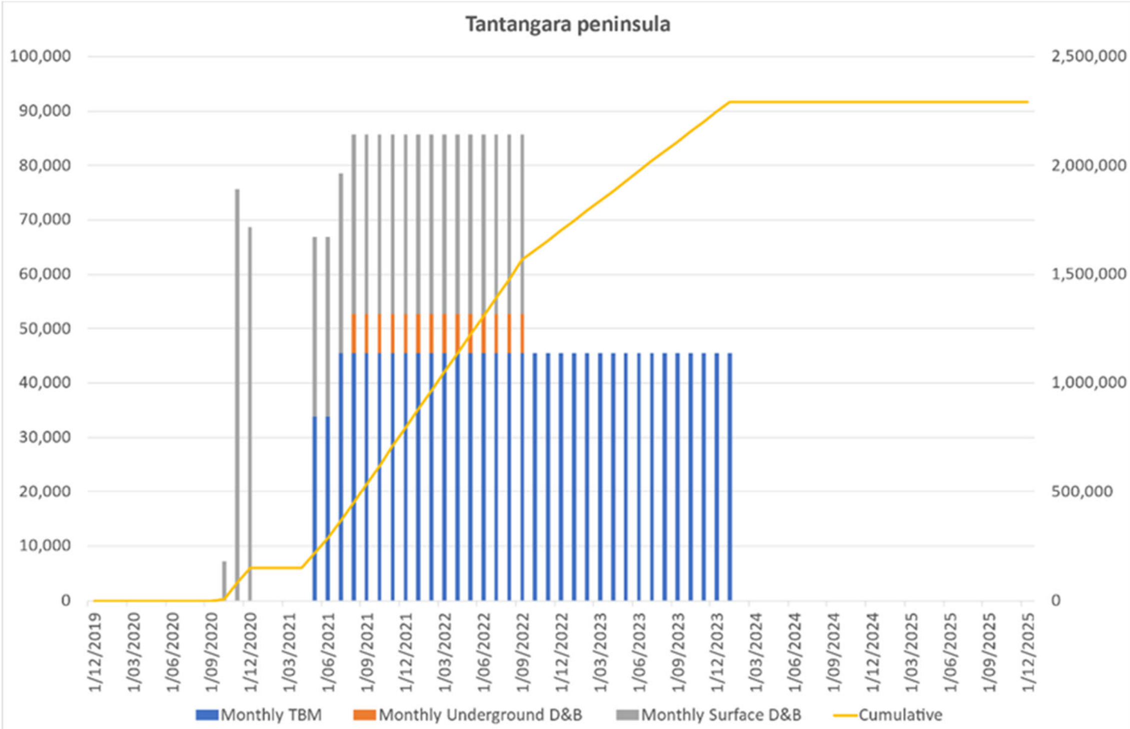


Figure 2-1 Planned monthly and cumulative placement of spoil at Tantangara PSE

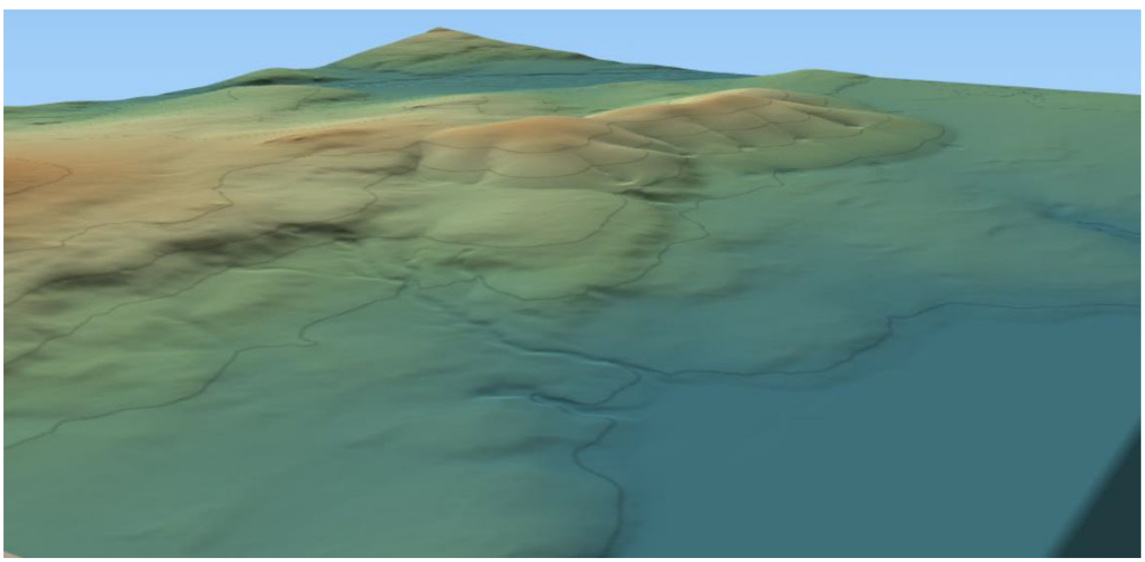


Figure 2-2 Indicative view from southeast of Tantangara PSE

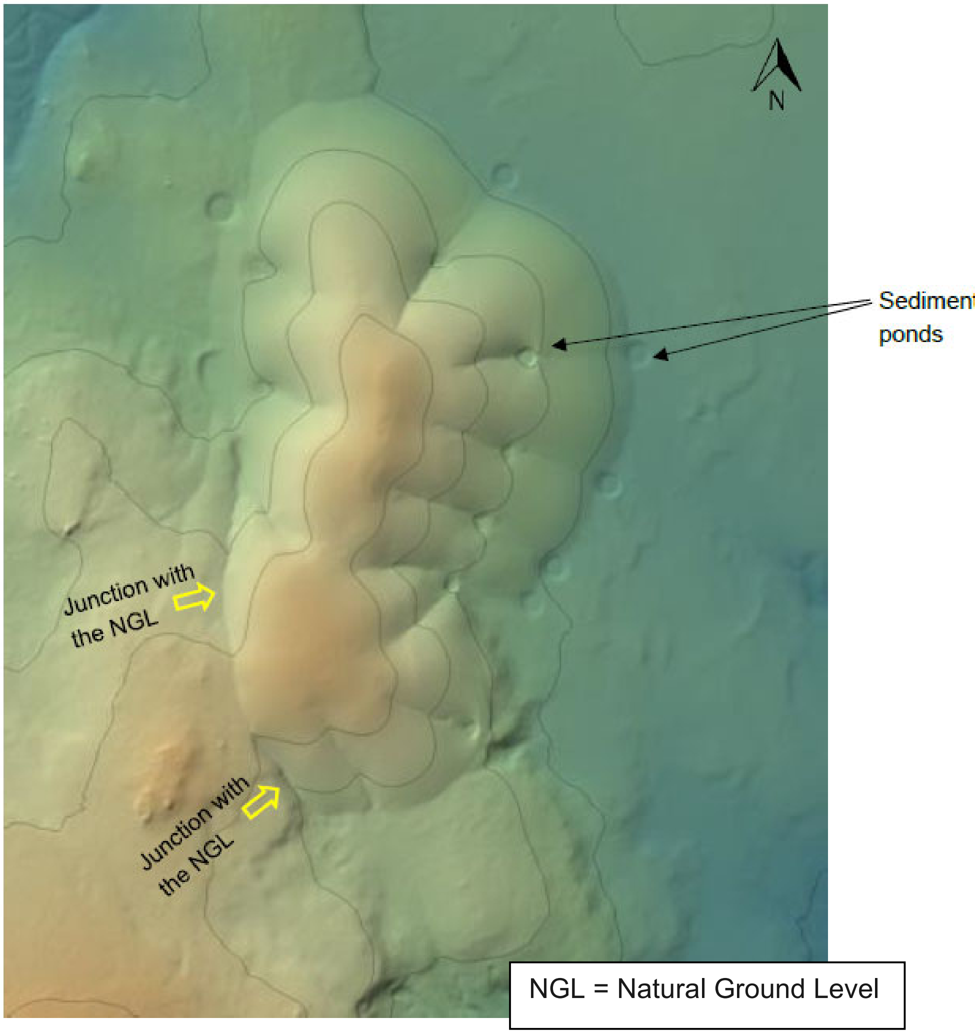


Figure 2-3 Indicative Tantangara PSE Layout

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 18^{o} (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.

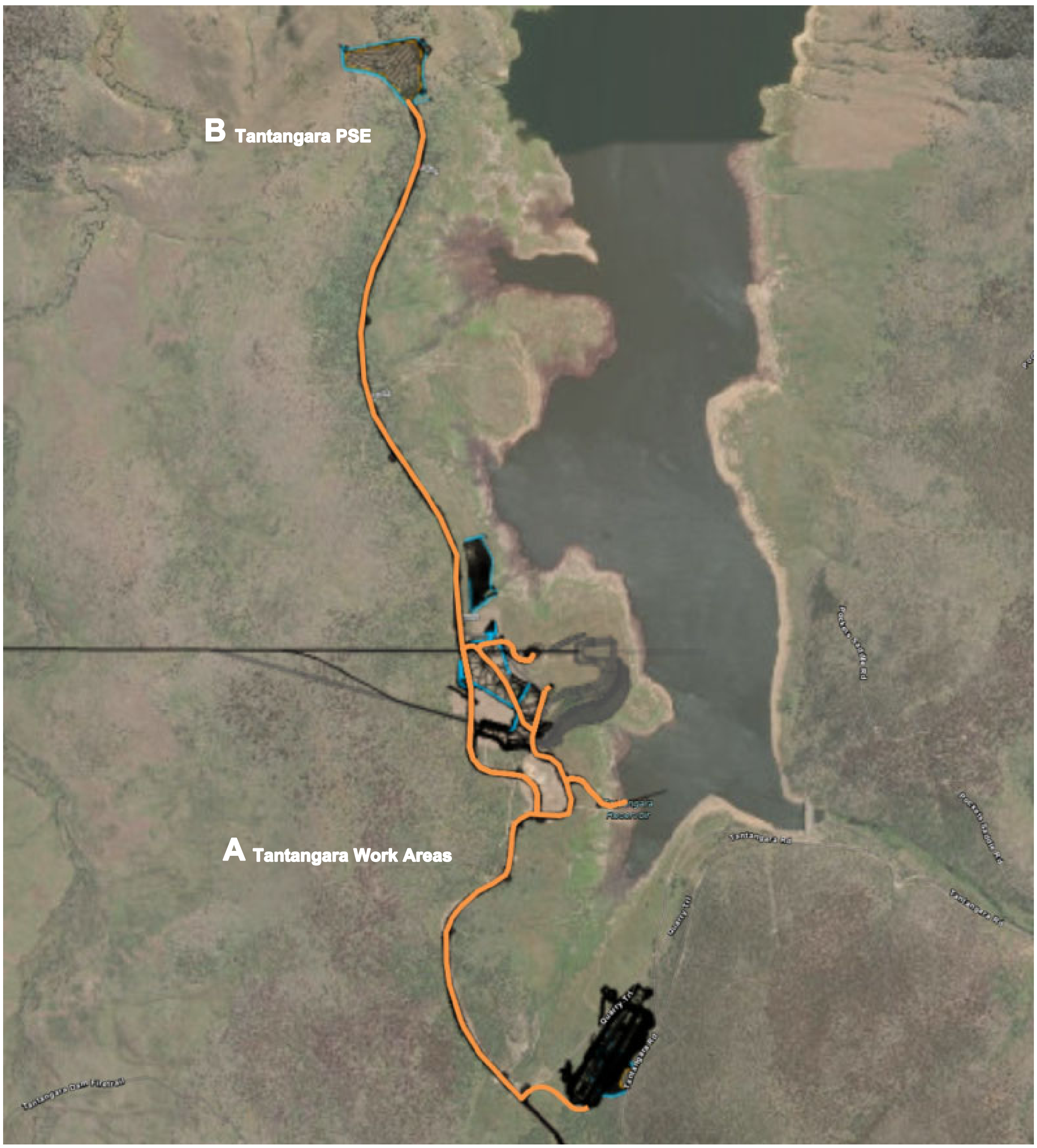


Figure 4-1 Tantangara PSE spoil transport routes

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.

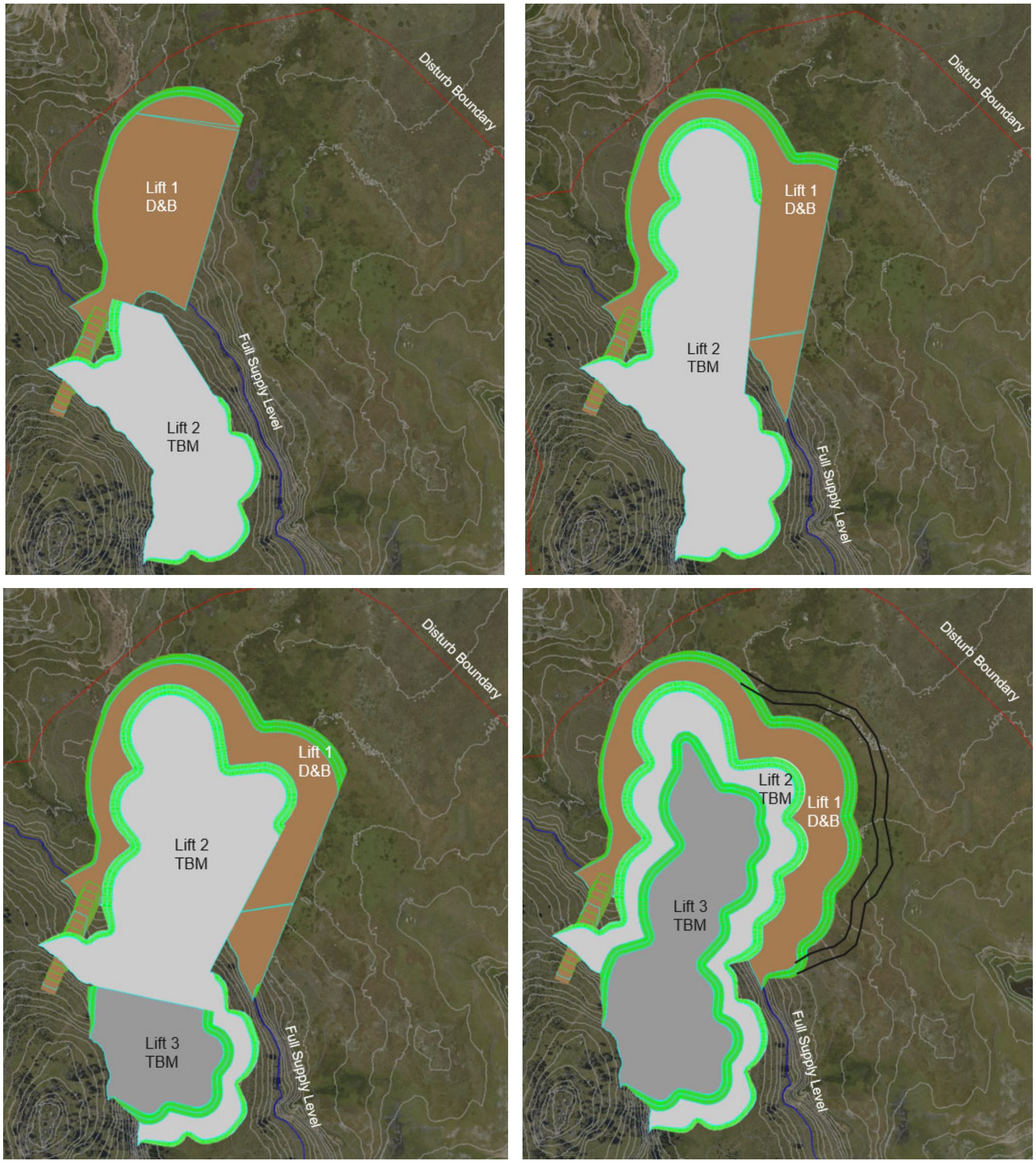


Figure 4-2 Indicative construction sequence, Tantangara PSE

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.

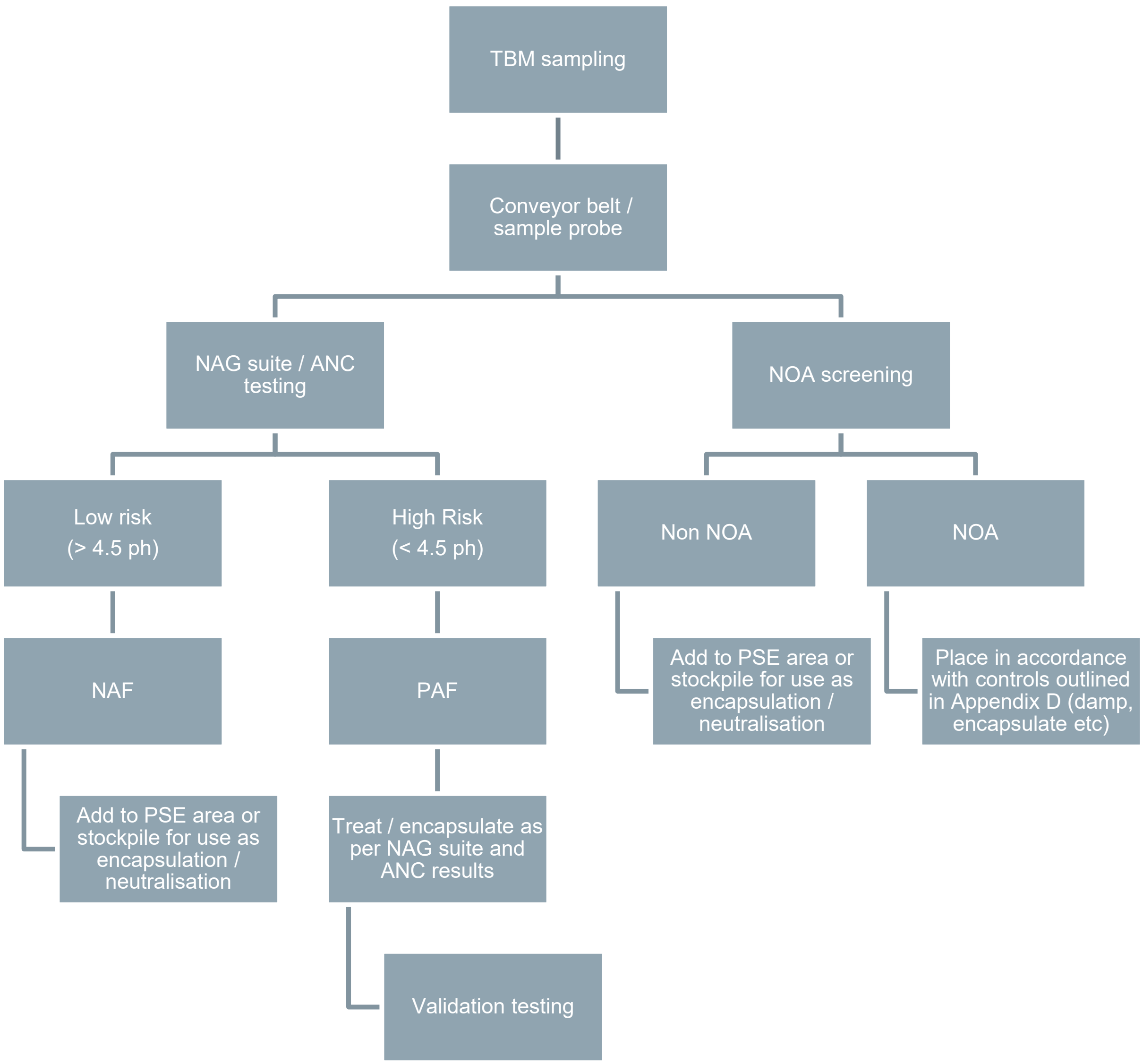
Aspect	Objective	Performance Indicators	Measurement Tools
Landforms are geotechnically stable	• Ensure placed material for the landform is stable geotechnically by ensuring slopes within the final surface are appropriate to the materials being used (excludes material underlying the PSE).	• Slopes to 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

Department of Planning, Housing & Infrastructure

Our ref: SSI-9687-PA-231

Ms Nicola Fraser
Post Approvals
Snowy 2.0 Project
By email

23 January 2025

Subject: Spoil Management Plan – Rock Forest Emplacement Area

Dear Ms Fraser

I refer to the Spoil Management Plan – Rock Forest Emplacement Area (Revision G dated 13 January 2025) submitted in accordance with 7(e), Schedule 3 of the approval for the Snowy 2.0 Main Works (SSI-9687). I also acknowledge your response to the Department's review comments and request for additional information.

I note the Spoil Management Plan – Rock Forest Emplacement Area:

- has been prepared in consultation with parties required to be consulted with;
- has been reviewed by the proponent and no issues have been raised with the Department; and
- contains the information required by the conditions of approval.

The Department has carefully reviewed the document and is satisfied that it meets the requirements of the relevant conditions in approval SSI-9687.

You are reminded that if there are any inconsistencies between the plan and the conditions of approval, the conditions prevail.

Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact David Way at David.Way@planning.nsw.gov.au.

Yours sincerely

Anthony Ko
A/Director
Energy Assessments
As nominee of the Planning Secretary

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN – APPENDIX J – ROCK FOREST EMPLACEMENT AREA

S2-FGJV-ENV-PLN-0019

JANUARY 2025

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 Rock Forest PSE. area

Revision Record

Rev.	Date	Reason for Issue	Responsible	Accountable	Endorsed
G	13/1/2025	Address to Adress DPHI comments	Steven McKenney	Ellen Porter	Massimo Franceschi

Document Verification

RACIE Record

R esponsible:	Name: Steven McKenney Job Title: Environmental Approvals Coordinator Signed: Date: 13.01.2025
A ccountable:	Name: Ellen Porter Job Title: Environment Manager Signed: E Porter Date: 13.01.2025
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:

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.
C	**Consulted** Those who must be consulted before the document is published.
I	**Informed** Those who must be informed after the document is published.
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Revision Tracking

Rev.	Date	Description of Revision
A	30.09.2021	Initial draft for Snowy Hydro review
B	13.01.2022	Issued to EPA, NPWS, NRAR, Water Group, DPIE Fisheries, TfNSW
C	25.02.2022	Updated to reflect NPWS, TfNSW and EPA comments
D	16.09.2024	Updated to reflect new PSE design
E	07.10.2024	Updated to address SHL comments
F	11.11.2024	Updated to address SHL and EPA comments
G	13.01.2025	Updated to address comments in DPHI Request for Information

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1. INTRODUCTION

1.1. Background

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 Schedule 3, Condition 7(e) for the Rock Forest (PSE), including adherence to Schedule 3, Condition 4 and the design objectives in Table 2.

The general location of the Rock Forest PSE is shown in Figure 1-1.

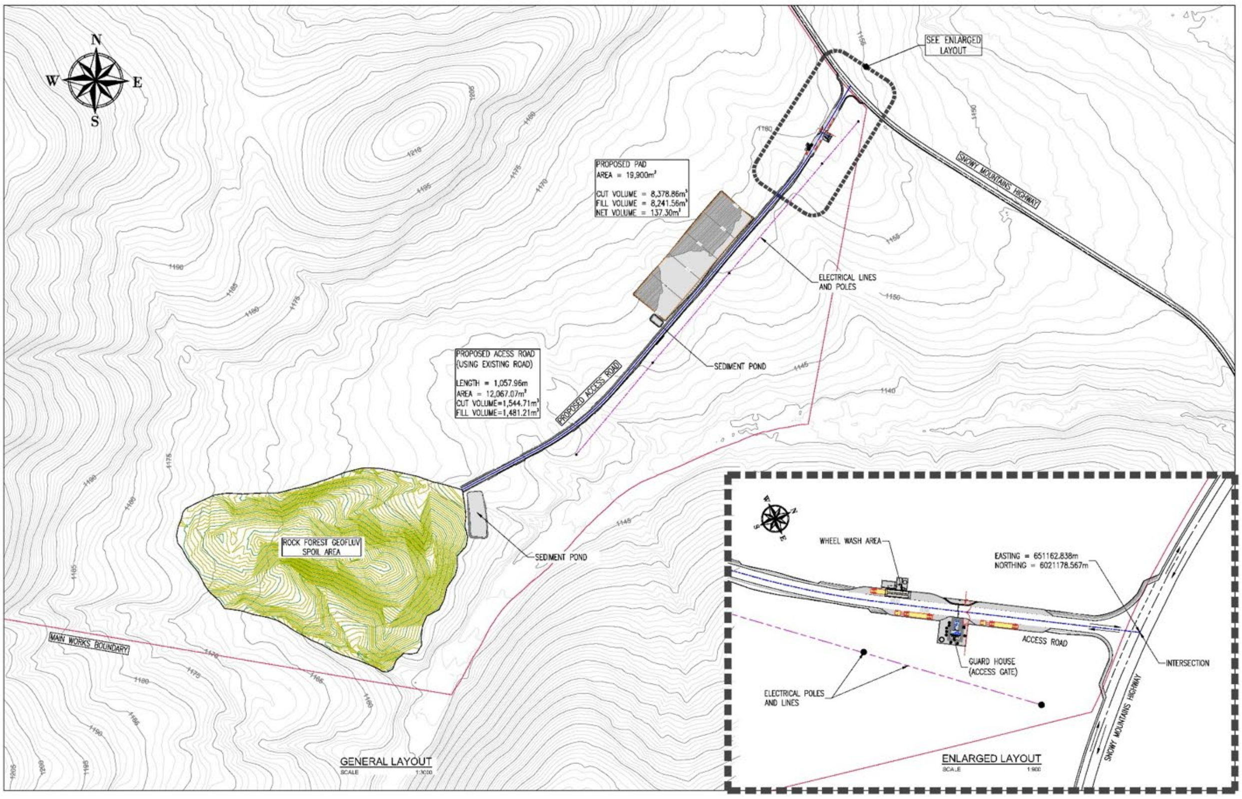


Figure 1-1 Rock Forest PSE Area Location (EMM, 2020)

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		
(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	Installation of Geosynthetic liner or equivalent for leachate management
	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 to the Rock Forest PSE, 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. Access for NPWS is not applicable for the Rock Forest PSE.

Aspect	Objective	Notes
Water management	Integrate the drainage of the emplacement area with the surrounding drainage network, including any upstream flows and residual run-on water	There is a small upstream catchment that flows around the Rock Forest PSE.
	Minimise downstream water flows and velocities with any changes to be quantified and addressed though suitable design	Flow downstream catchment largely unimpacted.
	Minimise valley infill	The Rock Forest PSE is not a valley infill but is located on a higher lying area adjacent to the natural drainage.
	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	Sediment generation and dispersion will be managed in accordance with Appendix A, Annexure A of the Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107-F), and 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)	All slopes are flatter than 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	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 the Rock Forest PSE 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	The landform design has typically gentle slopes that are suitable for easy access, but no specific recreational use is envisaged at this stage for the Rock Forest site This plan will be reviewed for consistency with the Rehabilitation 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 is not applicable to the Rock Forest PSE unless the adjacent creeks are in flood.

2. DEVELOPMENT

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

The Rock Forest site has been designed to accommodate 700,000 m^3 in line with the design capacity as outlined in the EIS. The Rock Forest PSE will broadly be developed as follows (dates are indicative only and are provided to describe sequencing):

- Last Quarter 2024:
  - Pre-construction works including identifying environmental avoidance areas and marking them within the approved disturbance footprint.
  - Establishment of a clean water cut-off drain and appropriate sedimentation controls.
  - Establishment of access track into PSE
- First quarter 2025:
  - The topsoil will be stripped and temporarily stockpiled in accordance with Appendices B and C of the Spoil Management Plan.
  - Consultation with the EPA regarding technical specifications and performance criteria for proposed liner of the PSE
- 2025 to 2026:
  - Installation of GCL or approved equivalent following approval of technical specification
  - Permanent placement of excess spoil begins .
  - Spoil will be placed in benches that will be tipped and levelled.
  - Progressive stabilisation throughout to minimise extent of exposed / unconsolidated materials. Depending on the erodibility and dispersity of the material, a layer of D&B material may be placed as a protection layer. Topsoil will then be placed and treated with hydroseed or jute mat protection to stabilise the soil.
  - An upstream clean water cut-off drain will be implemented throughout different stages of placement.
- 2026 to 2028:
  - 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.

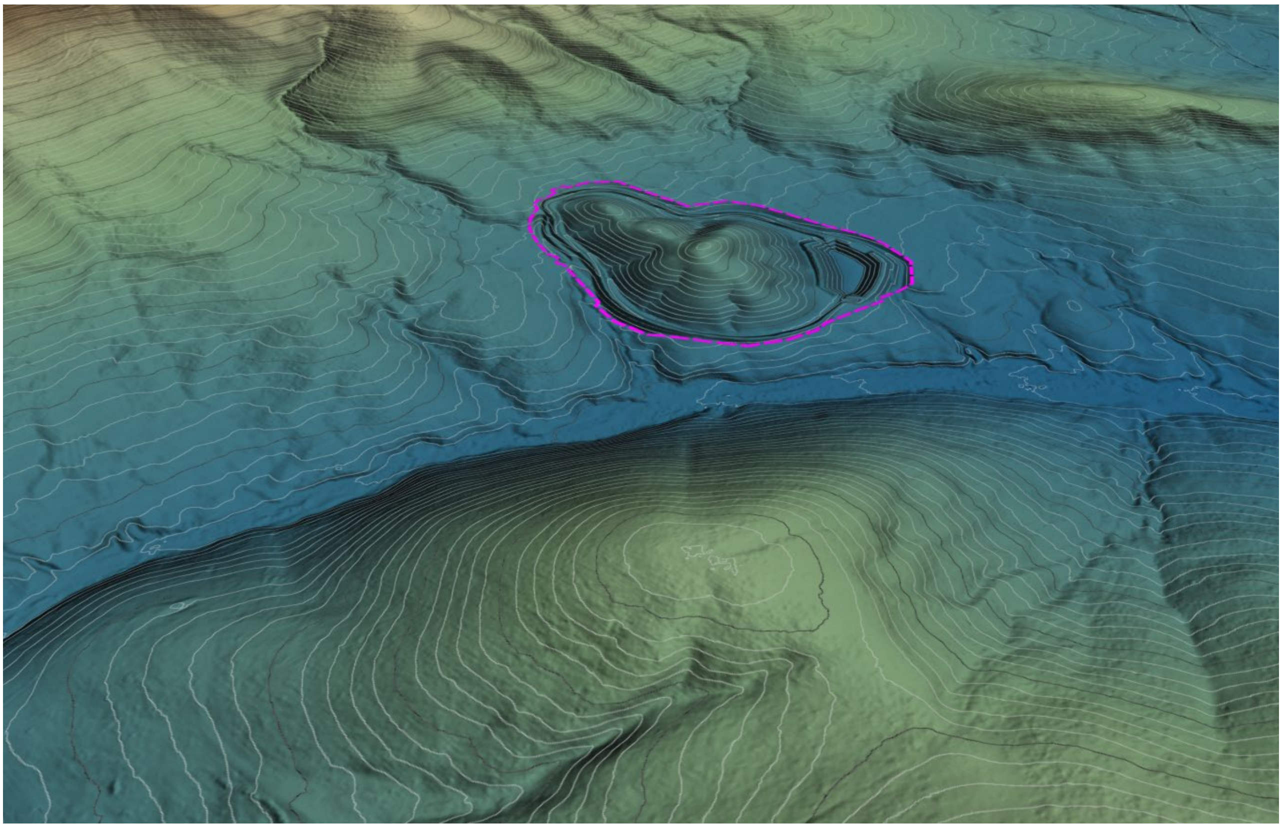


Figure 2-1 Indicative view from the South

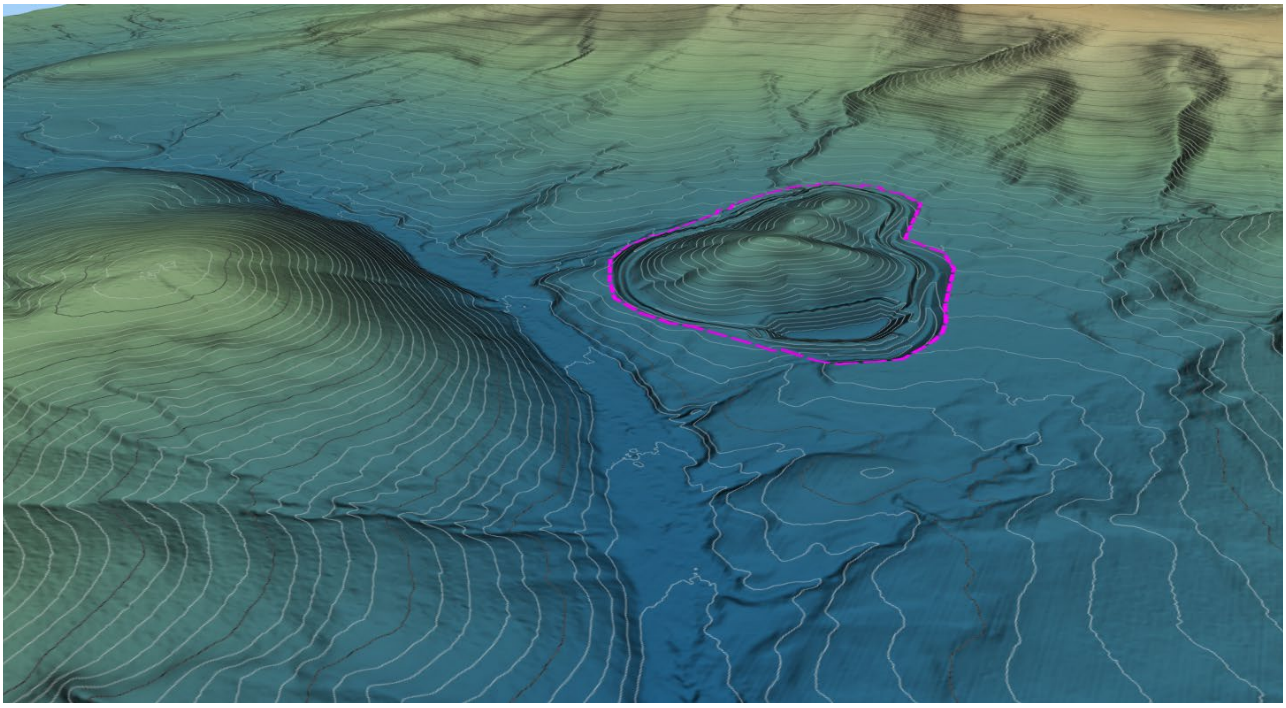


Figure 2-2 Indicative view from the North-East

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 sediment basin which will be managed as a leachate basin at the commencement of spoil placement.

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 sediment ponds at the point 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 sediment ponds on the toe of the landform or contained by temporary sediment ponds within the disturbance footprint.

All measures and controls implemented throughout construction including the sediment basin which, 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) in the form of a leachate detection program. The Leachate Detection Program for Rock Forest (S2-FGJV-ENV-PRO-0061) which identifies the analytes, frequency and location of monitoring will be implemented, is currently being implemented to assess background site conditions.

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.

In accordance with the SWMP, the basin 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. The management of the basin, including the treatment, reuse or disposal of basin water will be included in the relevant Rock Forest PSE site procedures.

The basin will remain in place until the site is rehabilitated at which time the basin can then be removed or left to naturally fill with sediment.

To manage potential leachate seepage from the Rock Forest PSE, the Leachate Detection Procedure (LDP) will be implemented and followed (S2-FGJV-ENV-PRO-0061). The LDP will be prepared in consultation with EPA in line with other PSE areas. The PSE will be lined with a Geosynthetic liner or approved equivalent following acceptance by the EPA to manage potential leachate contaminates from leaving the PSE. 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 feed into management processes that seek 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 into 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) where water quality meets criteria as detailed in dewatering arrangement (S2-FGJV-TEC-PLN-0006) or, where the water quality is not suitable for reuse, treated. Should the water treatment be insufficient to treat the water to a suitable water quality to enable reuse, 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

The Rock Forest PSE is expected to receive spoil predominantly form the Marica site 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

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) including the section potentially excavated as part of MOD 3; and
- Surface excavation works, including road upgrades and construction areas at Plateau and Marica.

2.3. Testing

Surge Shaft excavation works commenced at Marica in 2021 and testing on the excavated material has been carried out in accordance with the overarching Spoil Management Plan consisting of the following:

- NAG pH suite, and
- Validation by a NATA accredited laboratory

While the Rock Forest PSE will not receive spoil from the MAT portal, the results of the testing carried out to date are outlined in the following table for comparison and are reflective of the Ravine Beds geological unit as presented in Table 2-2.

The results of testing undertaken for the Marica surge shaft since 2024 have been provided in

Table 2-3.

	Avg Chromium Reducible Sulfur (S%)	Avg Net Acid Production Potential (NAPP) as as kg H2SO4	Avg Acid Neutralising Capacity - as as kg H2SO4	Acid Production Potential – as kg H2SO4	Avg pH After oxidation
MAT	0.033	-13.01	14	1	8.5

Table 2-2 Validation testing MAT portal

Table 2-3 Validation Testing Marica

	NAF Count	PAF Count	Avg Chromium Reducible Sulfur	Avg Net Acid Production	Avg Acid	Acid Production	Avg pH After	NPR
Marica	183	0	0.038	-15.4	17	1.2	9.5	14

2.4. 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), have been 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 were run for 12 months on each of the seven lithologies of interest that have been identified in previous works.

Samples 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.

Key findings are summarised as follows:

- All HCT leachates were characterised by a circum-neutral pH over the course of the 53-week program. No HCT for any of the tested lithologies produced acidic leachates by the end of the column testing period.
- EC values decrease as a function of time, indicating the leaching of readily soluble salts. The main analytes controlling EC were sulfate, bicarbonate, sodium and calcium.
- Most of the metal(loid)s were released during the initial flush, with concentration then dropping below the selected threshold values. Exception to this were the concentrations of Al in all HCTs, and a few peak concentrations of As, Co, V and Zn measured in the Ravine Beds East (RBE) and Ravine Beds West (RBW) HCTs.

- The comparison of the geochemical characteristics of the samples pre- and post-kinetics did not indicate that significant changes to the materials had occurred during the test. This exemplifies the unreactive nature of these materials at the target total sulfur (TS) contents.

2.5. Noise

Given the location of Rock Forest and the proximity to sensitive receivers, noise assessments were undertaken to assess the change in impact to adjacent sensitive receivers. These are detailed in the Rock Forest Construction Noise Management Plan (S2-FGJV-ENV-PLN-0089).

Predicted impacts have resulted in the Project limiting Rock Forest spoil emplacement works to standard daytime construction hours, where spoil emplacement works include haulage, emplacement and land forming of spoil within the emplacement area.

Ongoing use of the logistics area will be undertaken 24 hours 7 days per week throughout the life of the Project.

The Rock Forest site will be subject to ongoing noise monitoring throughout the development of the PSE

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 Rock Forest 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 200m 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.

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 required to demonstrate long term sustainability.

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.

Key elements applicable to the Rock Forest PSE include the following:

- The design is for 700,000 m^3 total as predicted in the EIS
- The design currently has a liner as an approach to managing potential contaminants. The specifics of this potential liner (type, specification, extent, construction method and staging) is being refined to meet the objectives of this plan and the requirements of the NSW EPA. The Project EPL has been updated to include a requirement for SHL to choose and construct a liner in consultation with the NSW EPA. Placement will not occur without meeting this condition
- The site will not receive filter cake, wedge pit slurry, fish tank slurry, and balance tank slurry nor untreated water which are materials which have been found to have high levels of nitrates, unless results proved otherwise.

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 two key aspects are evaluated:

- The landform surface not exposed to concentrated flow: As discussed above, for landforms designed using a geomorphic approach, 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. 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 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 4-1 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 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.

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.

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.
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. • 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 18deg (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 ≥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 permanent access tracks at spacing 200 metres or as approved. • Minimise slopes over 18deg (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.
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.	Requirements of Rehabilitation Management Plan to be applied where relevant to the landform.

Objective	Design Criteria Proposed	Notes
Landform to limit impacts on water quality	• Sediment controls to be formed upstream of sensitive receptors. • Installation of liners in spoil emplacement areas to minimize potential leaching of spoil, so far as reasonably practicable, in accordance with EPA requirements.	Sediment dams are located on the toe of the PSE with sediment fencing and local channels used to ensure sediment control occurs upstream 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. Lining of the spoil area (if required) will be designed in consultation with the EPA.
Landform revegetation	Not detailed here – the surface will be revegetated with appropriate natural plant community types (to minimise erosion) within a reasonably short period of time, typically prior to anticipated late Winter rains.	These issues to be addressed in the Main Works Rehabilitation Management Plan.
Landform constructability	• Include areas 1V:4H or flatter 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 e.g. outer edges.

4. FINAL PLACEMENT AND REHABILITATION

4.1. Transport

The Rock Forest PSE area is expected to primarily receive spoil from the Marica work area, although is not limited to receiving spoil from Marica. Spoil will be transported approximately 35 kms from Marica to Rock Forest via the Snowy Mountains Highway.

As described in the Main Works Transport Management Plan (TMP) (S2-FGJV-LOG-PLN-0008) and Spoil Management Plan, Vehicle Management Plans (VMPs) will detail internal haulage routes, vehicle types and traffic controls to ensure the safe and efficient movement of vehicles across the project.

The TMP also includes the following appended documents:

- Drivers Code of Conduct
- Heavy Vehicle Salvage Plan
- Marine Transport Management Plan
- Snow and Ice Traffic Management Plan, and
- Transport Communications Strategy.

Details of external truck movements and management measures are included within the Main Works Transport Management Plan, including but not limited to:

- Upgrade of the Snowy Mountains Highway / Rock Forest intersection (complete)
- Speed reductions at key intersections
- Covered loads
- Reduction of mud/dirt tracking by rumble grid or road sealing
- Assessment of access points, and
- Scheduling of vehicle movements.

In accordance with the TMP and Section 138 of the *Roads Act 1993,* a Road Occupancy License (ROL) has been obtained from TfNSW for speed reductions and other construction activities likely to impact the operational efficiency of the road network.

Adequate scheduling and spacing of spoil trucks moving between Marica and Rock Forest will be implemented and enforced by site logistics and security personnel. Variable message boards at the exits from sites have provided a positive outcome on the Project reminding heavy vehicles to increase distances between trucks.

The transport route from Marica (A) to the Rock PSE (B) is summarised in Figure 4-1 below.

Figure 4-1 Rock Forest PSE spoil transport route

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 construction sequencing for the Rock Forest PSE is relatively straight forward, with material to be placed in benches prior to dozing down of the surfaces.

Once the outer benches are at line and level, these can be dozed down to form the final surface, the benches being 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 will be done perpendicular to the benches to form the geomorphic landform.

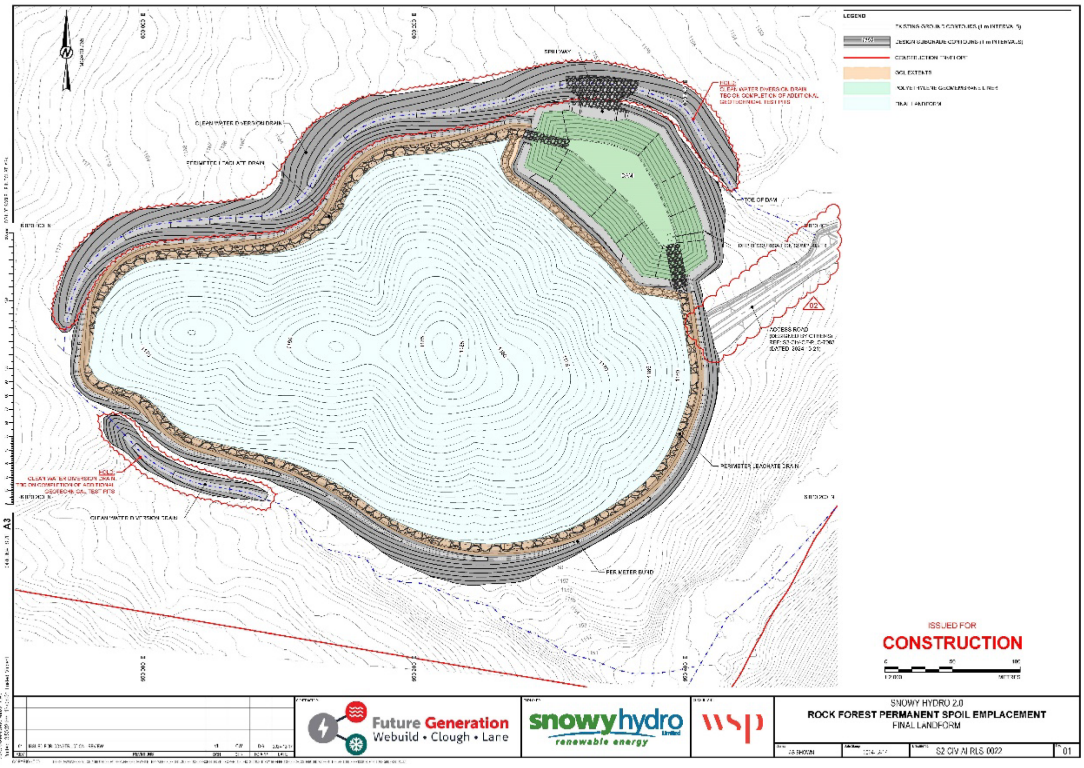


Figure 4-2 Rock Forest PSE Final Landform

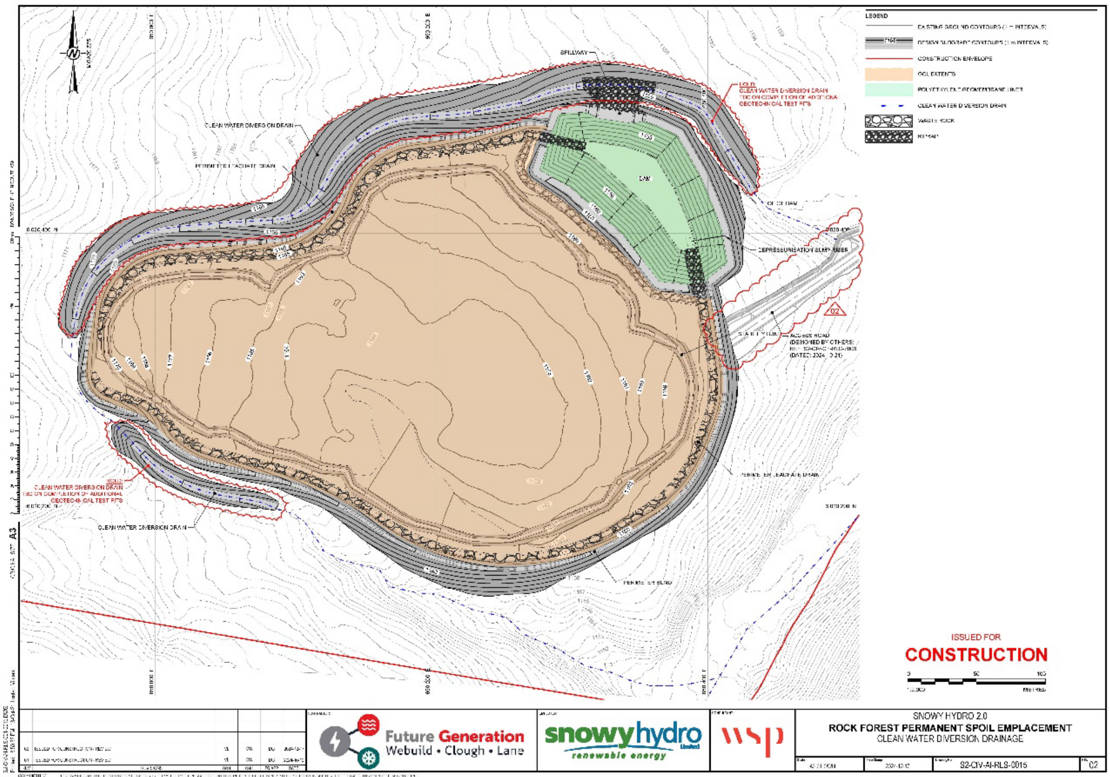


Figure 4-3 Rock Forest surface water drainage layout

Figure 4-2 represents the final of the Rock Forest PSE post construction, with Figure 4-3 detailing surface water drainage around the PSE. The Rock Forest PSE will be built-in stages as soon as the spoil becomes available from the working fronts.

The Rock Forest PSE has been designed to accommodate 700,000M m^3 in line with the approved volumes outlined in the project EIS

In general terms the construction of the PSE is a bottom-up approach undertaken with conventional earthmoving techniques. This will be staged as per below

- Stage 1:
  - Trimming and clearing of all vegetation
  - Topsoil, and subsoils will be stripped in staged approach, and stockpiled temporarily in accordance with Appendix B and C of the Spoil Management Plan.
  - Installation of clean water diversions around the emplacement area.
  - Establishment of relevant ERSED control measures
  - Construction and lining of leachate basin with HDPE
  - Establishment of PSE liner following approval of technical specification and performance criteria.
- Stage 2:
  - Spoil will be encapsulated in base-up horizontal layers. Material will be placed in benches which will then be dozed down.
  - Material will be placed in layers adequate to facilitate suitable compaction. PAF material is expected to be placed into Rock Forest from the Marica Surge Shaft, 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 with suitable ANC properties if and when required.
  - 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.
  - To limit the risk of poor-quality leachate, outer edges will require compaction to limit air ingress. However, 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. The proposed strategy is as follows:
    - The required density for the materials being excavated will be assessed in view of the geochemical data obtained for the Rock Forest PSE, 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 Rock Forest PSE and not on the outer edges where the air ingress will occur.

- The need for additional compaction 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 (still to be approved). At this stage works 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 a 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.

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). Further to characterisation and validation, PAF 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).

Requirements on PAF sampling including PAF validation sampling is included in Appendix E of the SMP. These requirements should be read in conjunction with this Plan.

4.2.2. NOA Material

It is not anticipated that NOA will be intercepted at the source locations for the Rock Forest PSE. NOA screening will only be carried out in areas of confirmed or potential NOA. Where NOA is intercepted methods for transport and emplacement detailed in the NOA Management Plan (SMP Appendix D) and on-site procedures will be adhered to.

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) 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. A Topsoil Strategy is presented in Appendix B of the Spoil Management Plan that outlines rehabilitation principles.

All areas will be left in a stable and safe condition, 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.

Progressive rehabilitation can be undertaken as areas are completed, either shaping the lower benches and rehabilitating or rehabilitating sections from crest to toe. When working from the lower benches upwards, water management on any benches above the rehabilitated areas will be undertaken to prevent water running uncontrolled on to a rehabilitated area. Four sediment ponds have been provided at the toe of the Rock Forest PSE; these are likely to be removed once no longer required.

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. A Topsoil Strategy is presented in Appendix B of the Spoil Management Plan. It outlines the measures to be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target PCTs in the long term.

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 the Rock Forest PSE as a designated permanent spoil emplacement area are provided in Table 4-1.

Table 4-1: Key risks and contingency measures for successful completion of the Rock Forest 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 the Rock Forest PSE, and there is flexibility around landform volumes which can be increased or decreased significantly by changing the slopes and adjusting the footprint.
Material placed into the Rock Forest PSE 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.
Rock Forest PSE design is modified, and this results in changes to the landform’s future intended use, or approved form.	Check any changes to the Rock Forest PSE design against the 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 is expected to be placed over the excavated tunnel material, there is the risk that the D&B 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. 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. TARP to address deficiencies.
Long term stability not demonstrated	Undertake LEM to confirm long term stability and address any areas of higher erosion risk.
Construction encroaches on or impacts adjacent small drainage lines	The toe of the PSE will be close to the small drainage lines, but a bund and/or sediment fence will be placed between the construction and the drainage line.
Flood events occur during construction in the adjacent small drainage lines	The relatively small catchment for these drainage lines will limit the extent of flood risk, and the construction can prioritise completion of these areas during sunny weather days.
Residents impacted by noise, dust.	Operational controls will be implemented by FGJV to limit the impact on Residents in line with the environmental studies. Maintain open communication with local residence.
The new surface has a slightly different watershed resulting in changes to existing water catchments	The watershed changes are minor and affecting only a very flat existing floodplain where flow direction is uncertain, and only a short portion of creek, with all of the landform still reporting to the main river system immediately downstream of the landform.
Public risks associated with the highway	Ensure appropriate delineation and exclusion zones between members of the public and the construction site.
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 NAG suite analysis and validation testing by a NATA accredited laboratory (Appendix A of the SMP) to ensure material is neutralised prior to placement. Leachate basin will be constructed on site and tested for potential contamination prior to reuse on the stockpile. Appendix E of the SMP 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 presented in Section 2.4 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.

Risk	Contingency
Nitrates in Spoil entering environment	Snowy Hydro has worked with the NSW EPA on a precautionary liner option to prevent seepage of water into the groundwater table, with details covered in the Project EPL. Additional controls include: • The basins will be impermeable. • The spoil testing and water monitoring programs will be increased following learnings from GF01. • A Nitrogen Management Plan is under development in consultation with the NSW EPA which will detail measures to be minimise the impacts of nitrogen and associated contaminants derived from spoil. Snowy Hydro is also exploring the potential to encapsulate materials with a comparatively high contraction of nutrients at the Ravine Bay PSE however this will require additional consultation with NPWS and the NSW EPA, and changes to the Project EPL prior to work being undertaken.

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 the Rock Forest 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

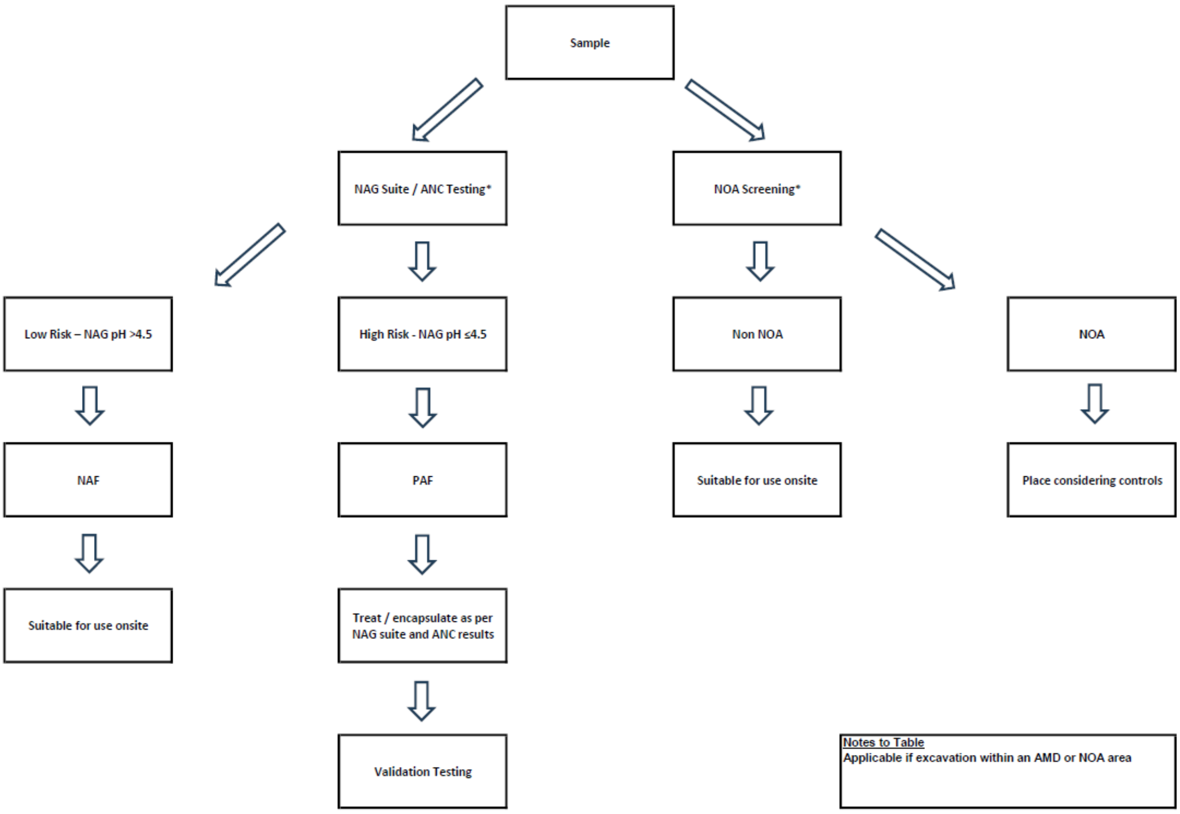
Aspect	Objective	Performance Indicators	Measurement Tools
Final landforms are compatible with the landscape	• As natural as possible, including minimising the use of linear or engineered structures. • Sympathetic with the landforms of the surrounding area, particularly from a visual, water management 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 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 through 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.

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. • Groundwater seepage and fluctuating water level management strategy if required and where appropriate.	• 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 where required. • Access tracks to be provided for rehabilitation, weed control and firefighting. • 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	• 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.

Aspect	Objective	Performance Indicators	Measurement Tools
Landform to limit impacts on water quality	• Outer surface to be geochemically benign to not impact on water quality. • 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. • 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, Annexure A of the Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107), Trigger Action Response Plans will be followed. • Monthly EPL monitoring downstream of emplacement area. If required, and in accordance with, Annexure C of the Groundwater Monitoring Program (S2-FGJV-ENV-PLN-0012), 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 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 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 – ROCK FOREST MATERIAL CHARACTERISATION AND HANDLING STRATEGY



Appendix K. MARICA TEMPORARY SPOIL EMPLACEMENT

MANAGEMENT PLAN

SNOWY 2.0 MAIN WORKS – SPOIL MANAGEMENT PLAN APPENDIX K – MARICA TEMPORARY SPOIL EMPLACEMENT AREAS

S2-FGJV-ENV-PLN-0296

REV G

AUGUST 2025

ABSTRACT

This plan has been prepared to review the requirements of Schedule 3, Condition 7(e) and Condition 4 of the Infrastructure Approval against the Marica Temporary Spoil Emplacement (TSE) areas.

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Revision Tracking

Rev.	Date	Description of Revision
A	08.07.2022	Initial draft for Snowy Hydro review
B	01.09.2022	Updated based on Snowy Hydro comments
C	31.10.2024	Update based on new design
D	10.11.2024	Updated based on SHL Comments
E	14.01.2025	Updated for Agency comments
F	01.02.2025	Updated based on SHL Comments
G	20.08.2025	Updated to reflect DPHI RFI and currency for Modification 3

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1. INTRODUCTION

1.1. Background

The Marica Temporary Spoil Emplacement (TSE) areas are expected to temporarily store spoil predominantly generated by Upstream Surge Shaft (USS) excavation activities as well as excavated material associated with Tunnel Boring Machine (TBM) 4 and associated structures.

The three (3) TSE areas within the Marica site are outlined below:

- USS TSE as per Figure 3-1;
- Pad 3 TSE as per Figure 3-2; and
- Pad 4 TSE as per Figure 3-3.

The Marica TSE's are expected to temporarily hold spoil for beneficial reuse in the backfill and rehabilitation works of the Marica site. Surplus spoil may be transported to the Rock Forest site for permanent emplacement.

The general location of the Marica spoil areas is shown in Figure 1-1 below

1.2. Objectives

While not a requirement, given the significance of spoil emplacement, temporary or permanent, on the Snowy 2.0 Project, this Marica Spoil Management Plan (MSMP) has been developed.

Where applicable, this MSMP will aim to address the following requirements:

- Schedule 3, Condition 7(e) of the Infrastructure Approval as per Table 1-2; and
- Schedule 3, Condition 4 of the Infrastructure Approval as per Table 1-3.

These requirements generally apply to Permanent Spoil Emplacement (PSE) areas only and have limited relevance to TSE areas like Marica. Despite this the Marica TSE areas will attempt as far as practicable to adopt these requirements.

1.3. Relevant Management Plans and Procedures

Relevant Management Plans are provided in Table 1-1.

Table 1-1 Relevant Management Plans and Procedures

Document Title	Document Number
Spoil Management Plan	S2-FGJV-ENV-PLN-0019
Water Management Plan	S2-FGJV-ENV-PLN-0010
Surface Water Management Plan	S2-FGJV-ENV-PLN-0011
Nitrogen Management Plan	S2-FGJV-ENV-PLN-0367
Biodiversity Management Plan	S2-FGJV-ENV-PLN-0028

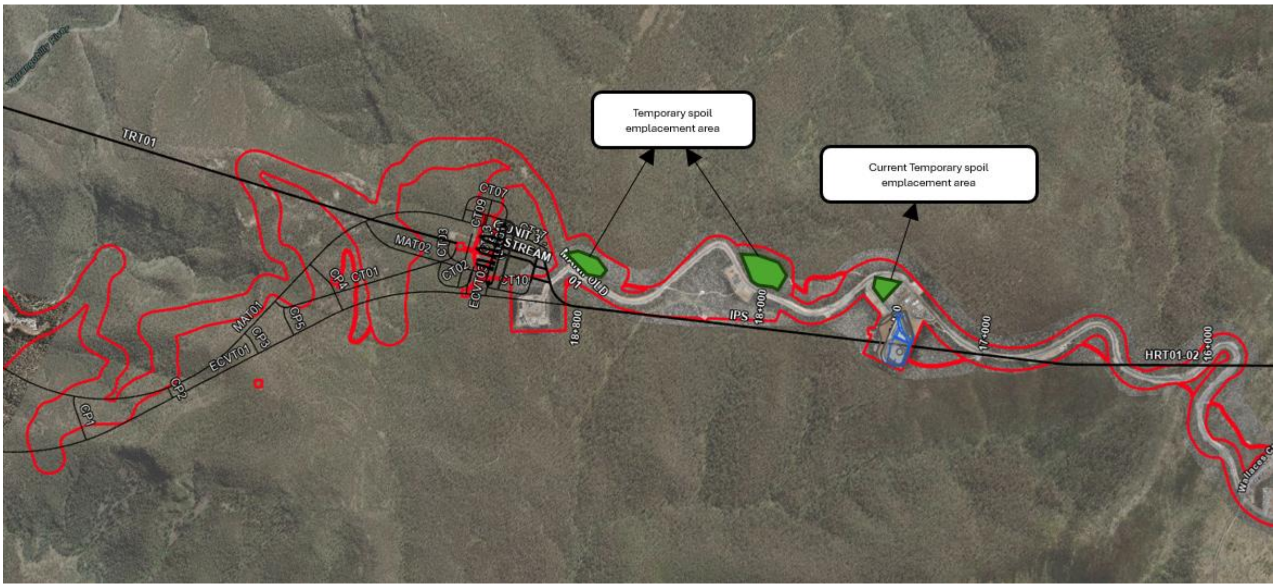

Figure 1-1 Marica Temporary Emplacement Area Locations

1.4. Requirements

Schedule 3, Condition 7(e) of the Infrastructure Approval requires detailed PSE plans using analogue and erosional methods. While not applicable to the Marica TSE, efforts to meet this requirement are outlined in Table 1-2.

Table 1-2 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 3 and Section 4
• describe the measures that would be implemented to comply with the spoil management requirements in Condition 4 and the design objectives in Condition 6 of the Infrastructure Approval;	Section 3
• 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 2.2.2 and Spoil Management Plan (S2-FGJV-ENV-PLN-0019)
• 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	Section 4.3
• include detailed completion criteria and performance indicators for each emplacement area, including criteria for triggering remedial action (if necessary).	Section 3 and Section 4

Schedule 3, Condition 6 of the Infrastructure Approval applies design objectives to the PSE areas. While not applicable to the Marica TSE, efforts to meet this requirement are outlined in Table 1-3. These requirements are addressed in Section 3.

Table 1-3 Design Objectives

Aspect	Objective
Landforms	As natural as possible, including minimising the use of linear or engineered structures

Aspect	Objective
	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 18^{o} 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
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

2.1. Expected Program

Development of the emplacement areas and storage of both mechanically excavated, drill and blast (D&B) and TBM material from the USS and headrace tunnel construction will occur over approximately a six-year period. There will be continual reference to, and assessment against, the design objectives described in Table 1-3, using the design methodologies and criteria described herein. Rehabilitation of the temporary emplacement area will commence once the spoil has been removed from the area.

Marica TSE 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 Spoil Management Plan (S2-FGJV-ENV-PLN-0019).
    - Pipeline from the leachate basin to the Construction Water Treatment Plant (CWTP) will be installed as a contingency measure for easier management.
    - A turkey nest will be established as a second contingency measure for water management at the temporary stockpile area.
- 2022 to 2026:
    - Excavation of the USS will commence second half of 2022. Prior to excavation, testing and spoil characterisation will likely be carried out via probe holes.
    - Spoil from the probe hole will be tested in accordance with the Spoil Management Plan (S2-FGJV-ENV-PLN-0019). The samples will be tested always in advance to determine suitable spoil management measures.
    - Where required, leachate barrier system installed to direct potential leachate to the leachate basin. Pads will be suitably lined to manage the risk of potential leachate coming from the spoil emplacement activity. The suitable material for reuse will be managed separately.
    - Spoil will be tracked as the material is excavated from the USS, based on the depth of the excavation.
    - D&B spoil from the USS will be placed at the temporary clay lined stockpile area and stockpiled in accordance with the spoil characterisation results.
    - 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.
    - Surplus spoil may be transported to Rock Forest (once approved) for treatment and suitable permanent emplacement.

- 2025:
    - Consultation with the EPA regarding technical specifications and performance criteria for Marica TSE's
    - Installation of TSE based on any requirements (if applicable) in EPL 21266
    - Establishment of the Pad 3 and Pad 4 TSE areas
- 2027 to 2028:
    - Suitable material will be reused as backfill and in the rehabilitation of the Marica site
    - Demobilisation of temporary stockpiles and infrastructure no longer required.
    - Rehabilitation of temporary emplacement area occurs.

The following measures will be implemented to mitigate and minimise impacts to the surrounding environment during the temporary placement of spoil at Marica.

2.2. Installation of Environmental Controls

Prior to commencement of works environmental controls will be implemented.

2.2.1. Clearing and Grubbing

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.

2.2.2. Topsoil Stockpiling

A Topsoil Strategy has been prepared in Appendix B of the Spoil Management Plan (S2-FGJV-ENV-PLN-0019) and will be implemented as part of Marica spoil management. It outlines the measures that would be implemented to ensure the surface of the emplacement areas will be suitable to sustain the target Plant Community Types (PCT) 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)

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

2.2.3. 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. 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 (ESCP) 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 the Spoil Management Plan (S2-FGJV-ENV-PLN-0019).

2.2.4. Water Controls

A clean water drainage network will be installed directing any surface water away from the TSE areas. Sediment bearing flows from earth worked areas will be directed to designated leachate basins.

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 comprehensive surface and ground water inspection and monitoring program will be implemented, in accordance with the SWMP and the Main Works Environment Protection Licence (EPL 21266).

Sensitive Area Plans and Erosion and Sediment Control Plans will be prepared and implemented, consistent with the SWMP to manage specific environmental aspects including:

- segregate clean and dirty water including clean water diversions;
- capture, contain, and treat or discharge to a suitable location leachate water;
- capture 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);

Water seepage from the emplacement area e.g. during rainfall will be minimised by compaction of materials. Potential seepage and runoff will be collected in the leachate basins downstream of the TSE area. The TSE areas will be visually monitored for potential seepage. 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 or the turkeys' nest be insufficient, the water will be classified and will be disposed of offsite at a facility licensed to accept the classification of water.

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

A site-specific leachate detection procedure has been developed to assess and monitor the risk of leachate production from the spoil for the duration of the temporary emplacement in accordance with the Project EPL 21266. Trigger Action Response Plans (TARPs) (Section 6 of the Surface Water Monitoring Program S2-FGJV-ENV-PLN-0107) 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.

2.3. Spoil Minimisation and Beneficial Reuse

2.3.1. Minimisation

Spoil generation at Marica has been reduced through design optimisation and where possible both temporary and permanent infrastructure has been designed to minimise excavation. The spoil volumes expected at the Marica TSE areas are as follows:

- USS – 140,000 m^3
- TBM 4 – 383,000 m^3
- Pads and Adit for TBM 4 – 400,000 m^3

It is anticipated that spoil that is surplus to the required volume for permanent infrastructure or rehabilitation works at Marica will be transported to the Rock Forest emplacement area.

2.3.2. Beneficial reuse

Beneficial reuse of spoil on site will be maximised in permanent infrastructure consistent with Schedule 3, Condition 4 (f) of the Infrastructure Approval to reduce the overall volume of material requiring placement. Prior to reuse all spoil will be subject to extensive characteristic testing in accordance with the Spoil Management Plan (S2-FGJV-ENV-PLN-0019) to ensure that all potential contaminates of concern are below acceptable levels prior to onsite placement. Spoil at the Marica site is anticipated to be able to be reused in:

- Fill at permanent operational pads and structures;
- TBM 4 Adit backfill;
- Selected fill and tunnel and shaft backfill and rock armour; and
- Permanent roads in the project area.

Temporary work areas 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.

2.4. Expected Geology

The Marica TSE areas are expected to receive spoil predominantly form the Marica site which is located west of the Long Plain Fault Zone. The following table is a summary of the geochemical acid base accounting characteristics relevant to the Marica site geological units.

The summary is based on the Geotechnical Baseline Report for Snowy Hydro 2.0 (2019), which indicates the low risk of Acid Mine Drainage (AMD).

Table 2-1 Count and Average Geochemical Material Characteristics

Geology	NAF count	PAF count	Avg %S	Avg ANC (kg H_2SO_4/t)	Avg MPA (kg H_2SO_4/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

2.5. Testing

Excavation works at Marica commenced in 2021 and testing on the excavated material has been carried out in accordance with the overarching Spoil Management Plan (S2-FGJV-ENV-PLN-0019).

3. DESIGN

3.1. Design Drawings

The Marica TSE areas will consist of three (3) distinct areas as presented in Figure 3-1, Figure 3-2 and Figure 3-3.

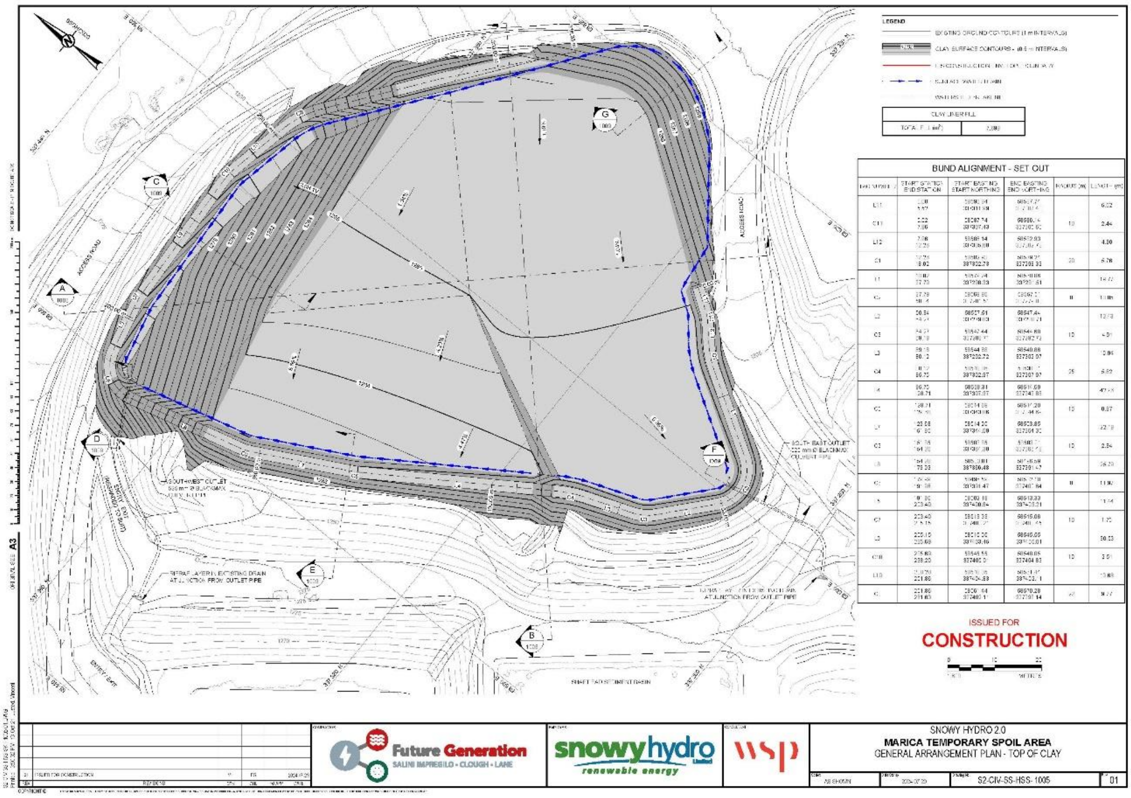

Figure 3-1 Marica TSE - USS

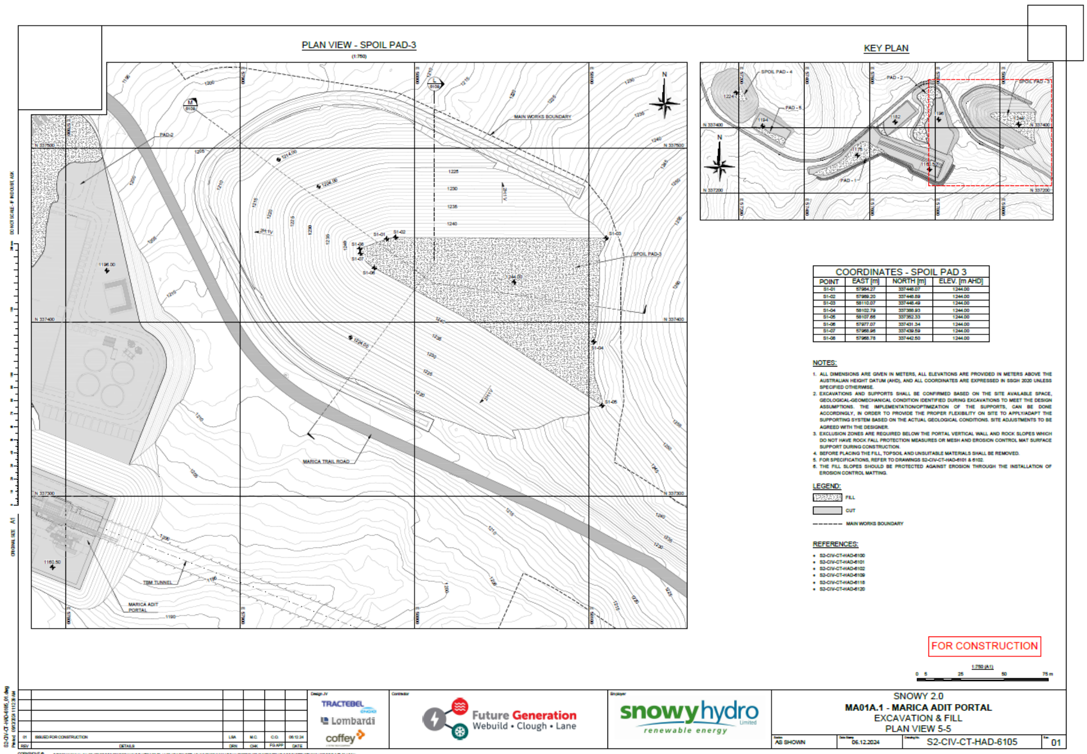

Figure 3-2 Marica TSE – Pad 3

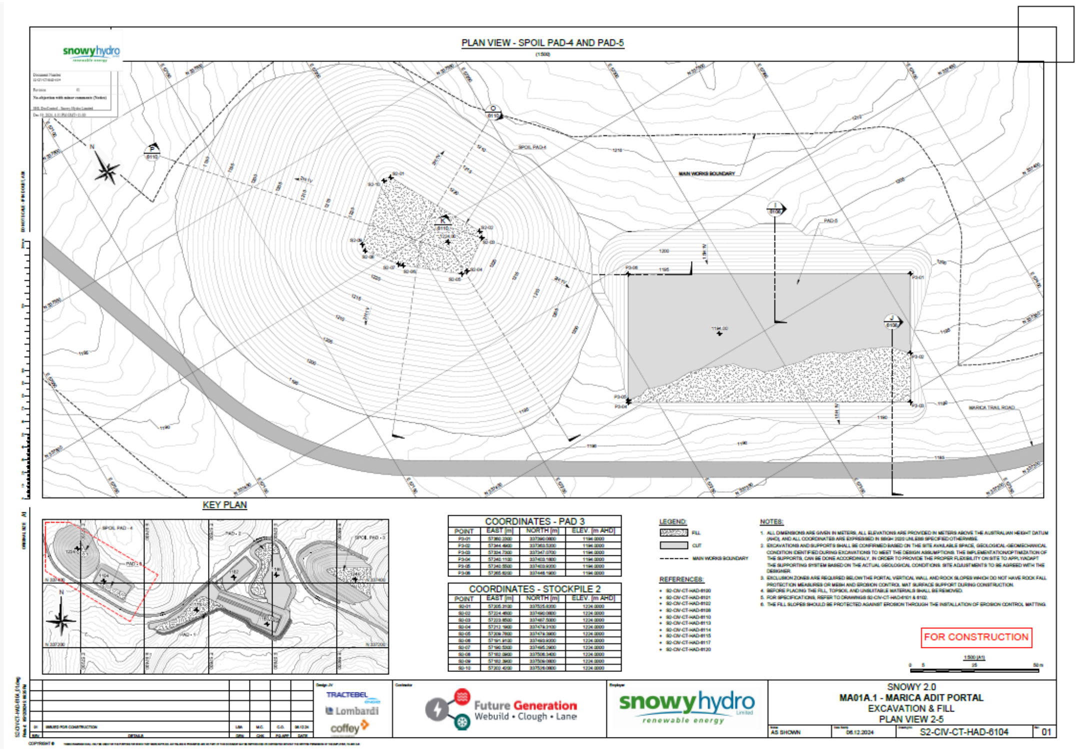

Figure 3-3 Marica TSE – Pad 4

3.2. Landform Design Criteria

The TSE areas that will likely be active for up to five (5) years, therefore the design criteria for the PSE areas required on the project, largely, does not apply. However, the interpretation of the existing completion criteria into specific design criteria has been provided in Table 3-1.

Table 3-1 Landform Design Criteria

Aspect	Objective	Notes
Landforms	As natural as possible, including minimising the use of linear or engineered structures	This was considered in the design assessment however given the temporary nature of the Marica TSE consideration also had to be given to minimising the footprint of the TSE areas.
	Sympathetic with the landforms in the surrounding area, particularly from a visual, water management and ecological perspective	This requirement is generally not applicable to the Marica TSE areas given they are temporary.
	Suitable drainage density	Drainage lines have been implemented as and where concentration of flow is likely due to the plan footprint and overall shape of the landform.
	Safe, long-term stable and non-polluting	Construction of the TSE's will be undertaken in accordance with EPL 21266 (where applicable) to minimise the risk of pollution incidents.
	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 the spoil emplacement at Marica as it is not located adjacent to 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	Due to the temporary nature of the TSE areas, access tracks are not expected to be required for the rehabilitation. A permanent track used to haul material will remain in place to allow for spoil removal following the cessation of excavation works.
Water management	Integrate the drainage of the emplacement area with the surrounding drainage network, including any upstream flows and residual run-on water	This has been considered in the Marica TSE areas design. Drainage flows directly into sediment or leachate basins. During construction drainage will be managed in accordance with an Erosion Sediment Control Plan (ESCP).
	Minimise downstream water flows and velocities with any changes to be quantified and addressed though suitable design	This has been considered in the temporary design. Water will be sent to the Water Treatment Plant (WTP) or irrigated over the temporary stockpile area. A leachate basin will be constructed in the spoil emplacement area pads to a minimum of the blue book conditions but will exceed these conditions where feasible to ensure sufficient capacity to capture and treat the potential leachate water accordingly.
	Minimise valley infill	The Marica TSE areas are not located in a valley and as such this requirement is largely non applicable.
	Create natural drainage lines that are long-term sustainable having regard to the selection of suitable underlying materials, including rock sizing and grading	Typically, an average D50 of 100mm is required for drainage lines – this might be typical of the rock to be placed into the TSE and additional armouring may not be required. During construction drainage will be managed under the ESCP.
	Minimise the use of large rocks in drainage lines	See response above.
	Minimise the concentration of water on landforms unless this is consistent with accepted drainage density and geomorphic design practices	Drainage lines have been implemented as and where concentration of flow is likely due to the plan footprint and overall shape of the landform.
	Minimise the generation and dispersion of sediment in the Talbingo Reservoir, Tantangara Reservoir, or other waterways	The Marica TSE areas are not located within the immediate vicinity of water bodies. Run off is directed to the leachate basins. Monthly water monitoring

Aspect	Objective	Notes
		downstream of emplacement area is currently undertaken in accordance with the project EPL and in accordance with Appendix A, Annexure A of the Surface Water Monitoring Program (S2-FGJV-ENV-PLN-0107), Trigger Action Response Plans will be followed. A site-specific Leachate Detection Procedure has also been developed.
Erosional stability	Minimise steep slopes, particularly slopes that will be difficult to access and maintain (such as slopes over 18° or 1V:3H)	Due to the temporary nature of the TSE and the limited space, slopes of up to 1V:2.0H (or 26.6°) have been proposed. The use of steep slopes has avoided the disturbance footprint for the works.
	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	Because of the temporary nature of the TSE areas, it is proposed to review the erodibility of the material being generated during placement and potentially hydroseed directly on to the landform if required to stabilise the TSE until it is removed. This would be carried out in consultation with a design specialist or CPESC.
	Maximise the revegetation of the final surface	The Marica TSE areas are temporary and as such the revegetation of the final surface is not applicable. Following the removal of the TSE's the revegetation of the area will be undertaken in accordance with the Rehabilitation Plan which is currently under development.
	Ensure areas subject to wave action are suitably protected or the slopes are flattened to limit wave action	The Marica TSE areas are not located next to the Talbingo or Tantangara Reservoir and as such this is not applicable.
Land Use	Native vegetation and habitat must be consistent with the approved Rehabilitation Management Plan	The temporary nature of the TSE areas indicate the need for short term stabilisation (if required depending on the erodibility of the material produced) and a short-term hydroseeding option is likely to be implemented if required.
	Recreational facilities and use must be consistent with the approved Recreation Management Plan	This is not applicable given the landforms are temporary.
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	In terms of constructability, due to the temporary nature of spoil stockpiling: • Unlikely to be topsoiled. • Sediment control has been incorporated together with erosion assessments. • The area is only accessible for tracked vehicles and in some areas, only by foot. • Natural ground requires only clearing prior to placement, and/or topsoil stripping if there is material worth saving. • Progressive rehabilitation is not planned – construction and subsequent removal will occur within a short period of less than two years. • Benches are temporary only; surface to be shaped post placement

3.3. Consultation and Revision

As this emplacement area is temporary this MSMP is not required to be prepared in consultation with the NPWS, EPA, Water Group, NRAR, NSW DPI and TfNSW, or approved by the Department of Planning Housing and Infrastructure (DPHI).

However, given the significance of spoil emplacement, temporary or permanent, on the Snowy 2.0 Project, this MSMP will be developed in consultation with the NPWS, EPA, Water Group, NSW DPI, TfNSW. and DPHI.

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.

The Rehabilitation and Recreation Management Plans management strategies will be implemented at the Marica TSE areas as they will across the site where rehabilitation is required.

4. PLACEMENT, REHABILITATION AND RISKS

4.1. Placement

In general terms the construction of the embankments is a base-up, thin lift approach undertaken with conventional earthmoving techniques. This will likely 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. Topsoil or other usable material will be stockpiled in accordance with applicable procedures. Installation of clean water diversions around the emplacement area.
- Stage 2: Spoil will be placed in horizontal layers typically between 300 – 500 mm thick and are compacted as required.
- Stage 3: Spoil will be beneficially reused as backfill materials around the site including the USS as well as the Marica Adit.
- Stage 4: Prior to revegetation, deep ripping to a depth of approximately 0.5 m is currently proposed. The site will then be handed over to the rehabilitation team for placement of ameliorants.

Spoil will be generated up to 24 hours per day, approximately every 5 days to enable probe hole drilling; it is anticipated that 24-hour emplacement operations will be utilised.

4.2. Rehabilitation

On completion of the construction works, the spoil will either be reused onsite or taken to Rock Forest. The final location is dependent on the remaining environmental approvals, including the Consistency Assessment for spoil reuse around the USS. The temporary emplacement area will be rehabilitated, for other areas which were only required temporarily for construction, the site will be decommissioned, appropriately land-formed and planted.

All areas will be left in a stable and safe condition, consistent with project approval requirements including Schedule 3, Condition 9 and 10 of the Infrastructure Approval and the Rehabilitation Management Plan is currently being prepared by SHL in consultation with NPWS.

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.

Following completion of the works the TSE areas 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 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 of the Infrastructure Approval.

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 (S2-FGJV-ENV-PLN-0019).

4.3. Key Risks for the Successful Completion and Contingency Measures

The key risks and contingency measures relevant to Marica as a temporary spoil emplacement area are provided in Table 4-1 below.

Table 4-1 Key Risks and Contingency Measures for Successful Completion of 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, SHL will be consulted.
Material placed into Marica contains contamination (other than PAF and NOA material).	Respond to incidents as per the Unexpected Finds Protocol and the Spoil Management Plan (S2-FGJV-ENV-PLN-0019).
Temporary foreign or unsuitable objects prevent effective filling and / or compaction	Ensure only spoil is placed in the Marica TSE 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.
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.
PAF presence	To be treated as per the Spoil Management Plan (S2-FGJV-ENV-PLN-0019) and the Material Characterisation Procedure outlined in Appendix A. Site specific controls including compaction rates, water quality controls and erosion and sediment controls will be developed to ensure effective site management and will be monitored.
Laboratory turnaround time does not meet rate of excavation and placement	Material will be stockpiled at the temporary spoil area until laboratory results are received
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.
Leachate from the spoil emplacements	Leachate basins to be constructed on site and tested for potential contamination prior to reuse on the stockpile. 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.
Neutral mine drainage	Kinetic testing has been carried out to understand the reactivity of the excavated rock. These tests were run for 12 months on each of the seven lithologies of interest that have been identified in previous works.

Risk	Contingency
	Samples 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. Key findings are summarised as follows: • All HCT leachates were characterised by a circum-neutral pH over the course of the 53-week program. No HCT for any of the tested lithologies produced acidic leachates by the end of the column testing period. • EC values decrease as a function of time, indicating the leaching of readily soluble salts. The main analytes controlling EC were sulfate, bicarbonate, sodium and calcium. • Most of the metal(loid)s were released during the initial flush, with concentration then dropping below the selected threshold values. Exception to this were the concentrations of Al in all HCTs, and a few peak concentrations of As, Co, V and Zn measured in the Ravine Beds East (RBE) and Ravine Beds West (RBW) HCTs. • The comparison of the geochemical characteristics of the samples pre- and post-kinetics did not indicate that significant changes to the materials had occurred during the test. This exemplifies the unreactive nature of these materials at the target total sulfur (TS) contents.
Nitrates in Spoil entering environment	SHL has worked with the NSW EPA to prevent potential groundwater contamination from D&B derived nitrates, with details covered in the Project EPL. A Nitrogen Management Plan (S2-FGJV-ENV-PLN-0367) has been developed in consultation with the NSW EPA which will detail measures to be minimise the impacts of nitrogen and associated contaminants derived from spoil.

APPENDIX A – MARICA MATERIAL CHARACTERISATION AND HANDLING STRATEGY