EnergyAustralia Yallourn Pty Ltd

Declared Mine Rehabilitation Plan

(June 2025)

Mining Licences
MIN 5003, MIN 5216, MIN 5304

EnergyAustralia
LIGHT THE WAY

Document Control

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Version:	Details:	Reviewed and Approved:	Date:
Draft	For Public Consultation	Lance Wallace	[16/06/2025]
Mine Licence Nos.	MIN 5003, MIN 5216, MIN 5304		
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Acknowledgement

EnergyAustralia would like to acknowledge the contributions of many parties in developing this plan. This includes employees, contractors, suppliers, consultants, government, and community stakeholders. Successful rehabilitation requires input and positive contributions from all these key parties and EnergyAustralia would like to thank these parties for time and commitment to the process of developing this Declared Mine Rehabilitation Plan

Executive Summary

Yallourn has helped power the lives of Australians for over 100 years. EnergyAustralia Yallourn (EAY) is committed to honouring this proud history as it works towards closing the power station and coal mine in June 2028.

This marks a turning point—a chance to reimagine the land as a place of renewal, where nature, people, and culture can come together, providing ongoing economic opportunities for the Latrobe Valley.

The public exhibition of the draft Yallourn Declared Mine Rehabilitation Plan (DMRP) is a step towards achieving this. The draft DMRP is EAY's plan to make the mine site safe, stable and sustainable, filling the mine voids with water with a view to creating a lake that locals and visitors can enjoy, and wildlife can call home.

The rehabilitation strategy has been (and will continue to be) shaped through ongoing conversations with local communities, Traditional Owners, government, and other stakeholders. Their inputs are central to ensuring the land's future reflects shared values, heritage, and community aspirations.

To support this DMRP, detailed geological investigations and modelling have been conducted to understand the site's geological structure and understand how this needs to be considered during rehabilitation planning. The geological models cover the entire license area, focusing on subsurface structures, subsurface slopes and hydrogeological units.

Following detailed risks assessment of the rehabilitation activities, extensive studies have been completed to understand the land, water, and environment. These help to guide how the site will be safely reshaped and cared for. The goal is to create a landscape that is not only beautiful but also safe, stable and sustainable into the future. This means improving and protecting existing conservation areas, placing material in certain areas for geotechnical stability, protecting the Morwell and Latrobe Rivers by managing water levels, and protecting against erosion and other risks.

At the heart of the plan is the creation of a large lake where the mine once was. This lake will be constructed and managed with a view to achieving lake water quality consistent with EAY's aspiration for a lake that is suitable for recreational use by the community.

The importance of creating a healthy and sustainable surrounding environment is also recognised.

Native vegetation will be planted to rehabilitate the landscape. This will help prevent erosion, support local wildlife, and create a green, welcoming place capable of supporting recreational use by the community.

The management of the site is unlikely to cease when the lake is full. EAY understands that ongoing maintenance and monitoring will be required, and this will be planned for and implemented along with community updates. The plan also recognises that resources will need to be in place to support the land well into the future.

This is more than just a rehabilitation project—it's a chance to create something meaningful and lasting. The DMRP is about rehabilitating the land, honouring its history, and building a future that provides ongoing prosperity and amenity for all.

Abbreviations and Glossary

Abbreviations

Acronym	Description
AEP	Annual Exceedance Probability
AGMG	Australian Groundwater Modelling Guidelines
AHD	Australian Height Datum
ALARP	As Low as Reasonably Practicable
AMRD	Alternative Morwell River Diversion
ANCOLD	Australian National Committee on Large Dams
ARI	Average Recurrence Interval
AWBM	Australian Water Balance Model
BCM	Brown Coal Mine
BOM or BoM	Bureau of Meteorology
CEP	Community Engagement Plan
CFL Act	Conservation Forests & Lands Act 1987 (Vic)
CHMP	Cultural Heritage Management Plan
CLP	China Light and Power
CLR Act	Crown Land (Reserves) Act 1978 (Vic)
CMP	Conservation Management Plan
CMS	Consultation Management System
CoV	Coefficient of Variation
CSEP	Community and Stakeholder Engagement Plan
CSM	Conceptual site model
CTAP	Climate Transition Action Plan (EnergyAustralia)
DAS	Deep Aquifer System
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DEECA	Department of Energy, Environment and Climate Action
DELWP	Department of Environment, Land, Water and Planning
DEM	Digital Elevation Model
DMRP	Declared Mine Rehabilitation Plan
DNRE	Department of Natural Resources and Environment
DPI	Department of Primary Industries
EA	EnergyAustralia
EAY	EnergyAustralia Yallourn
EE Act	Environment Effects Act 1978 (Vic)
EES	Environmental Effects Statement
EMP	Environmental Management Plan
EOL	End of Life
EOM	End of Mining
EP Act	Environment Protection Act 2017 (Vic)
EPA Vic	Environment Protection Authority Victoria
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
ERC	Environment Review Committee

Acronym	Description
ERR	Earth Resources Regulations
ESMS	Electrical Safety Management System
EVC	Ecological vegetation classes
FCMP	Fire Control Management Plan
FFG Act	Flora and Fauna Guarantee Act 1988 (Vic)
FoS	Factor of Safety
FSP	Fire Services Pond
GCM	Global climate models
GCMP	Ground Control Management Plan
GDE	Groundwater Dependent Ecosystems
GDMS	Geotechnical Database Management System
GLaWAC	Gunaikurnai Land and Waters Aboriginal Corporation
GMCMC	Great Morwell Coal Mining Company
GWNM	Groundwater Numerical Model
HA	Hydrogeological Assessment
HFC	High flow channel
HHF	Haunted Hills Formation
HHFA	Haunted Hills Formation Aquifer
HMFI	Hazelwood Mine Fire Inquiry
HSSE	Health, Safety, Security and Environment
HSU	Hydrostratigraphic Units
ICMM	International Council on Mining and Metals
IESC	Independent Expert Scientific Committee on Unconventional Gas Development and Large Coal Mining Development
LCC	Latrobe City Council
LFC	Low flow channel
LoA	Life of Asset
LoM	Life of Mine
LVCBD	Latrobe Valley Coal Bore Database
LVRGM	Latrobe Valley Regional Groundwater Model
LVRRS	Latrobe Valley Regional Rehabilitation Strategy
Mact	Morton's Actual Evapotranspiration
MFAS	Morwell formation aquifer system
MLRA	Mine Land Rehabilitation Authority
MNES	Matters of National Environmental Significance
MOD	Midfield Overburden Dump
MRD	Morwell River Diversion
MRSDA	Mineral Resources (Sustainable Development) Act 1990 (Vic)
MRSDMIR	Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019 (Vic)
MVF	Maryvale Field
MWDD	Morwell West Drain Diversion
NATA	National Association of Testing Authorities
NPV	Net Present Value
PET	Potential evapotranspiration
PGA	Peak ground acceleration

Acronym	Description
PMLU	Post mining land use
PoF	Probability of Failure
PRMS	Precipitation Runoff Modelling System
PSHA	Probabilistic seismic hazard assessment
QA/QC	Quality assurance / Quality Control
RAMP	Risk Assessment and Management Plan
RCP	Rehabilitation and Closure Plan
RCP	Representative Concentration Pathway
RL	Reduced Level (equivalent to mAHD for Yallourn site)
RMP	Rehabilitation Master Plan
RORB	Runoff Routing Model
RTL	Roche Thiess Linfox
RUSLE	Revised Universal Soil Loss Equation
RVAC	Resources Victoria Approvals Coordination
SAS	Shallow aquifer system
SECV	State Electricity Commission of Victoria
SILO	Scientific Information for Landowners
SMF	Synthetic Mineral Fibre
SQL	Structured Query Language
SSRS	SQL Server Reporting Services
SUZ1	Land Zoning type
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids
TFAS	Traralgon Formation Aquifer System
VROTS	Victorian Rare or Threatened Species
WB	Water Balance
WGCMA	West Gippsland Catchment Management Authority
WPV	Work Plan Variation
WQ	Water Quality
YEF	Yallourn East Field
YEFX	Yallourn East Field Extension
YMA	Yallourn Mine Alliance
YMCMP	Yallourn Mine Conservation Management Plan
YNEOC	Yallourn North Extension Open Cut
YNOC	Yallourn North Open Cut mine
YOC	Yallourn Open Cut mine
YPS	Yallourn Power Station
YTF	Yallourn Township Field

Units

Units	Description
Mt's	Million Tonnes
°C/h	degrees Celsius per hour
µg/L	microgram per litre
cumecs	cubic meters per second (m3/s)
GL	gigalitres
HHa	Habitat Hectares
kN/m3	kilonewtons per cubic metre
m/s	meters per second
mbgl	meters below ground level
mg/L	milligrams per litre
ML	megalitres
ML/d	megalitres per day
MW	Mega Watts
N/m^2	Newtons/Square Meter
kPa	kilopascals
Ha	Hectares
t/ha/y	tonnes per hectares per year

Glossary

Term	Description
Acid and metalliferous drainage (AMD)	AMD from mine wastes resulting from the oxidation of sulphides such as pyrite and from contact with water. Often associated with metal leaching generating elevated concentrations of metals in the drainage. Metal leaching may also occur without acid conditions. Also known as acid mine drainage.
As Low as Reasonably Practicable	To put in proportionate controls to eliminate or minimise risks of harm. Proportionate means the greater the risk of potential harm, the greater the expectation for you to manage it
Care and maintenance	see *Temporary closure*
Care and maintenance/ temporary mine closure	Phase following a temporary cessation of operations, when infrastructure, plant and equipment remain intact and are maintained in anticipation of production recommencing. Such a site may be referred to as 'inactive'
Closure	Period when a mine or mine feature is closed and during which the mine rehabilitation plan is executed
Closure activity	Activity that is undertaken during the mine closure phase, or that applies to the mine closure strategy or mine closure treatment
Closure criteria	Criteria developed during mine closure planning against which mine closure if evaluated.
Closure principles	Common precepts that form the basis of and guide selected closure activities, such as physical and chemical stability.
Community	A group of people who live in the same geographical area or have a shared background, interest, affiliation or membership
Declared mine	A mine or quarry in Victoria declared by the Minister to have geotechnical or hydrogeological factors within that pose a significant risk to public safety, the environment or infrastructure
Decommissioning and demolition	Disconnection, dismantling, decontamination, demolishing and disposal of plant and equipment.
Domain	Areas comprising site features that have similar requirements. An asset can be divided into a number of physically or socially distinct domains.
end land use	see *post mining land use*

Term	Description
End of mining / operations	The point in time that mine ceases to operate
Environment Effects Statement (EES)	The Environment Effects Act 1978 in Victoria requires an assessment of the potential environmental impacts of a proposed development.
Environment Review Committee (ERC)	The Yallourn Environment Review Committee (ERC) has membership from key stakeholders to review Yallourn's environmental performance and enhance communication between industry, government agencies and the community.
Factor of Safety (FoS)	Slope stability is controlled by two factors: driving and the resisting forces. The driving forces tend to destabilise a slope, leading to landslide phenomena, and are typically associated with the triggering causes of the landslides (the weight of the ground and the additional loads). Resisting forces depend on the shear strength of the soil/rock materials, as well as any additional forces to increase stability of the slope (e.g., buttressing). The Factor of Safety (FoS) is defined as the ratio between the aforementioned two components. The FoS is used as design criteria for batter stability, final landforms and other ground engineering designs.
General environmental duty	A person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.
Inherent risk	The level of risk of a particular event or threat, in the absence of controls.
Knowledge base	The collection of site-specific information that will inform the closure plan, including physical, environmental, social and regulatory information. Initiated with baseline data and updated with additional information as it is collected.
Lake filling	The time during which the mined voids are filled with water to form a lake
Life of Asset (LoA)	The length of time an asset (including but not limited to mine, processing facilities, refineries, smelters, rail, port, utilities, towns and associated infrastructure) is owned, operated and closed by the mining company up until divestment or relinquishment. This LoA period includes exploration, development, operations, closure and post-closure
Life of mine (LoM)	The length of time a mine is, or is planned to be, in production. Based on a mine plan developed in consideration of the available capital and the ore reserves or a reasonable and justifiable extension of the reserve estimate.
mAHD	Elevation in metres with respect to the Australian Height Datum
Mine Land Rehabilitation Authority (MLRA)	The Mine Land Rehabilitation Authority (MLRA) are an independent authority working with community, industry and government. They facilitate the rehabilitation of declared mine sites to ensure they are safe, stable and sustainable for the beneficial use of future generations.
Mine void	Excavation made for the purpose of exploiting ore
Monitoring and maintenance	The period of time when the site is monitored and periodically maintained, however active management is no longer required. Pit Lake filling may continue through this phase. Moderated alternative land use such as grazing could occur during this phase.
Morwell River Diversion	The engineered structure that holds the Morwell River
non-polluting	Having no adverse impacts upon the receiving environment
Operations	Active mining and power generation
Overburden	Surficial materials, excluding *topsoil* and subsoils, lying above the ore body that are removed for the mining process
Pit lake	Body of water formed within the mine pit at cessation of mining activities by either ground, surface or marine water inflow
Pit void	see *residual void, mine void*
post mining land use (PMLU)	Management of land following mine closure for the purpose of habitation, production, recreation or conservation.
post mining landform	Constructed topographic feature for which reclamation has been completed to support long term stability and post mining land use. It can incorporate one or more mine features or domains.
Post relinquishment	The period of time when land management responsibility has been relinquished to the future land manager and alternative fund are used to monitor and maintain the landform
Progressive rehabilitation	Earthworks and revegetation activities that are undertaken concurrently during the operations phase and in accordance with the rehabilitation plan

Term	Description
Reduced Level	The surveyed level of a location relative to a datum. For the Yallourn mine the RL is consistent with mAHD references.
Rehabilitation	Returning land disturbed by mining to a safe, stable, productive and self-sustaining condition that enables beneficial uses of the site and surrounding land. Rehabilitation is considered as complete once closure criteria have been achieved and the mine license is surrendered.
relinquishment	Closed mine or mine feature for which management and monitoring has been completed and tenure has been surrendered, with responsibility transferred to the next landowner, relevant regulating authority or third party.
residual risk	Potential impact to successful mine closure from the mine material, mine feature or mine closure activity following application of a mine closure treatment.
residual void	Structure left after mining, also referred to as pit void, or void
revegetation	Establishment of vegetation upon a post mining landform or other disturbed area
Safe	The rehabilitated mine land does not pose a greater risk of harm to humans and the environment than comparable non-mining land uses
Social transition	The planning, considerations and activities undertaken throughout the life of the asset to develop and implement the transition of a community, including its workforce, towards closure of an operation
Stable	To rehabilitate the mine land such that final landforms are enduring in the long-term, with the potential for land movement minimised ensuring the viability of its proposed post-mining land uses.
Stakeholder	Person, group, or organization with the potential to affect, or be affected by, the process or outcome of mine closure
Sudden closure	Mine goes into final closure ahead of the previously planned timeline
Surcharging	A vertical load acting on the ground surface. A surcharge load placed adjacent to a slope can also apply a lateral load, depending on the slope design and ground surface conditions.
Sustainable	The rehabilitated mine land will remain in a condition that requires no or minimal intervention consistent with the post mining land uses, creates a positive legacy, enhances environmental values and provides a timely benefit to current and future generations.
Temporary closure	Phase following a temporary cessation of operations, when infrastructure, plant and equipment remain intact and are maintained in anticipation of production recommencing. Such as site may be referred to as "inactive".
Topsoil	Organic enriched native soil layer (horizon) that can be removed, stored and returned to post mining landforms and other disturbed areas to facilitate revegetation. Topsoil is distinct from the lower soil layers (subsoils) which contain less organic enrichment but still can be used to facilitate revegetation
Zone of influence	Represents the geographic area within which firstly, direct socioeconomic impacts can be attributable to a mining operation, inclusive of its activities (and those of its contractors), facilities, labour-sending areas and procurement of goods and services; and secondly, indirect impacts, including those on ecosystem services or where secondary or knock-on economic impacts are experienced.

Limitations

This draft Declared Mine Rehabilitation Plan (**DMRP**) is being prepared by EnergyAustralia Yallourn Pty Ltd (**EAY**) in satisfaction of its obligations under the *Mineral Resources (Sustainable Development) Act 1990* (Vic) (the **MRSDA**) and the *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019* (Vic) (**MRSDMIR**). The DMRP relates to the rehabilitation of the land in and surrounding the Yallourn Mine following the closure of the Yallourn Power Station and reflects relevant information available to, and the intentions of, EAY as at the date of this document. Following a statutory consultation period, the DMRP will be submitted for approval in accordance with the MRSDA and MRSDMIR. The DMRP is an iterative document that will be subject to review and refinement over time to reflect the latest evidence base and status of other regulatory processes.

Statements of fact in this DMRP are made as at June 2025 and are subject to change or updating from time to time. These statements are made on, and are applicable as at, June 2025 and no representation is made as to their accuracy, completeness or reliability after this date.

Other than as required by applicable regulations or law, EAY does not undertake any obligation to publicly update, release or review any revisions of this DMRP (including as a result of new information or future events), after this date.

To the extent that this DMRP contains any forward-looking statements, these are based on the expectations, best estimates, assumptions and intentions of EAY as at the date of preparation of the DMRP. However, these may be affected by a range of factors which could cause actual results to differ materially. These include but are not limited to: environmental conditions; regulatory and policy changes; technological development; changes in regulatory requirements; and the availability of water to EAY for rehabilitation purposes, which may be influenced by environmental and financial factors (noting that access to water to deliver the DMRP has yet to be resolved).

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Chapter 1 Purpose

1.1 Background

For nearly a century, Yallourn has played a vital role in powering Victoria and supporting the Latrobe Valley community. Recognising this deep connection, EnergyAustralia gave seven years' notice of the planned closure of the Yallourn Power Station and Mine. This early notice reflects our commitment to a responsible and respectful transition for the region.

EnergyAustralia Yallourn (**EAY**) Pty Ltd operates the Yallourn Power Station and Mine in Victoria's Latrobe Valley. The site is located approximately 150 km south-east of Melbourne on the traditional lands of the Brayakaulung people of the Gunaikurnai nation. The mine (also referred to as the **site**) is located within the Latrobe City Council in Victoria and is situated between the townships of Newborough, Morwell and Yallourn North. The mine is situated within the flood plains of the Morwell and Latrobe Rivers.

EAY is an indirectly wholly owned subsidiary of EnergyAustralia Holdings Limited, which is the Australian parent company for the EnergyAustralia group of companies (together **EnergyAustralia**).

In March 2021 EnergyAustralia announced that the Yallourn Power Station was to cease operation in mid-2028, at which point the Yallourn Mine would also cease production (EnergyAustralia 2021).

The Yallourn Mine is one of three mines in Victoria that are "declared mines" for the purposes of the *Mineral Resources Sustainable Development Act 1990* (**MRSDA**). Under the MRSDA, EAY is required to prepare and submit a Declared Mine Rehabilitation Plan (**DMRP**) for the Yallourn Mine to the Minister for Resources on or before September 30, 2025 (subject to any extension to that timeframe in accordance with the MRSDA). Among other things, the DMRP is required to address the safe, stable, and sustainable rehabilitation of the Yallourn Mine.

This DMRP satisfies the requirements of the MRSDA, providing detail on prescribed matters including:

- Post-mining land use – proposed outcomes for land use, for after mining and rehabilitation
- Knowledge base – repository of information, data and reports used to inform, monitor and evaluate rehabilitation planning activities. The DMRP outlines the ongoing research that will be undertaken to grow the knowledge base, to target and resolve any data gaps
- Closure objectives –the goals for what rehabilitation aims to achieve
- Closure criteria – metrics to measure the success of rehabilitation
- Closure and rehabilitation milestones – the milestones the licensee nominate to demonstrate that rehabilitation works are progressing and 'on-track' to achieving the outlined closure objectives / criteria. This includes milestones relating to ongoing engagement, obtaining legal approvals, and other rehabilitation activities.
- Post-closure plan –the monitoring and maintenance to be carried out following rehabilitation and license relinquishment
- Stakeholder engagement plan – identifying who has been, and will be, consulted in relation to the DMRP, and the strategies and milestones for that engagement.
- Risk assessment – identifies and assesses rehabilitation related risks, and an associated risk management plan that specifies the actions that will be taken to mitigate these risks
- An overview of roles and responsibilities of licensees' employees

EA is committed to honouring Yallourn's legacy and want the site to be part of the region's transition to new economic opportunities while providing beneficial future land uses beyond mining.

1.2 General Overview

1.2.1 EnergyAustralia Overview

EnergyAustralia supplies electricity, gas and renewable energy products and services to around 1.6 million customers in Australia. The EnergyAustralia purpose is *to lead and accelerate the clean energy transformation for all*, which includes reaching net-zero greenhouse gas emissions across Scopes 1 and 2 by 2050.

EnergyAustralia is wholly owned by CLP Holdings Limited which is listed on the Stock Exchange of Hong Kong. EnergyAustralia has ownership rights, or contractual arrangement, in relation to operational assets in Victoria, New South Wales and South Australia as per Figure 1-1 (the Yallourn Site shown as item 9).

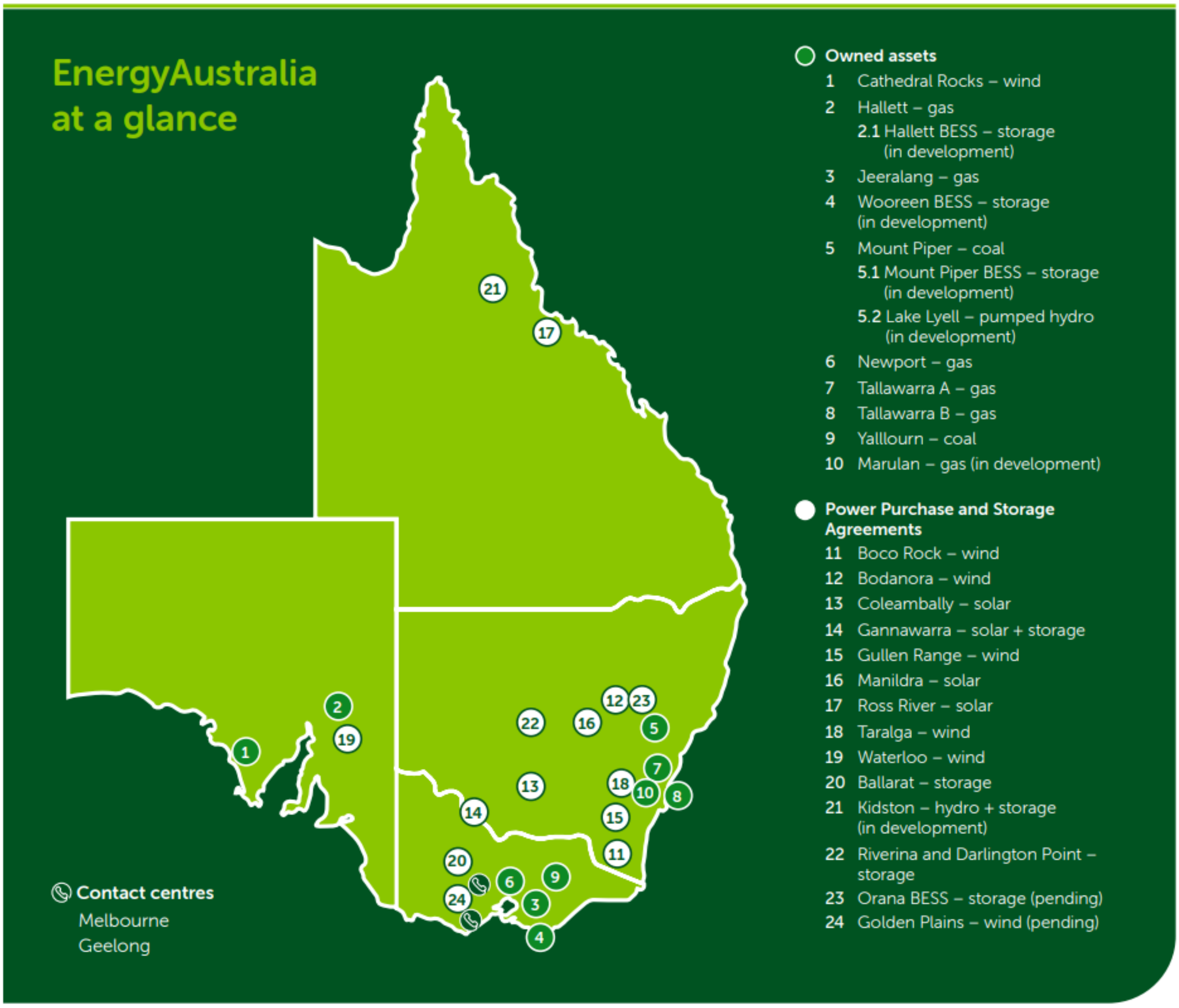


Figure 1-1: EnergyAustralia Owned Operational Assets and Power Purchase and Storage Agreements.

1.2.2 Yallourn Mine Overview

EAY is the private owner of the Yallourn Mine which became a declared mine in 2010 in accordance with the MRSDA. The Yallourn Mine is comprised of mining licenses MIN5003 (5,173 ha); MIN5216 (152 ha); and MIN5304 (83 ha).

The Yallourn Mine and Power Station site has a long history with brown coal mining beginning in the Yallourn North Open Cut area in 1888. Mining and power generation have occurred at the Site since the establishment of the State Electricity Commission Victoria (**SECV**) in the 1920s. Whilst Yallourn was originally part of the SECV, it was privatised in 1996. Post privatisation, the owners of the Site have continued developing the Yallourn Mine and producing electricity.

The main features of the Yallourn Mine licence areas are shown in Figure 1-2, and comprise:

- Township Field (comprises the previously mined areas of Yallourn Open Cut, South Field, and Township Field)
- East Field (comprises previously mined areas of East Field and East Field Extension, along with the current operational area of the Maryvale Field)
- the Morwell River Diversion (**MRD**) which is the man-made river channel that carries the Morwell River through the centre of the Site, dividing the Yallourn Mine into two main open cut pits, with Township Field to the west and East Field to the east.
- the Latrobe River which runs along the northern boundary of the Yallourn Mine and
- the Yallourn North Open Cut (**YNOC**) which now includes the EPA licenced landfills to the north of the Latrobe River.

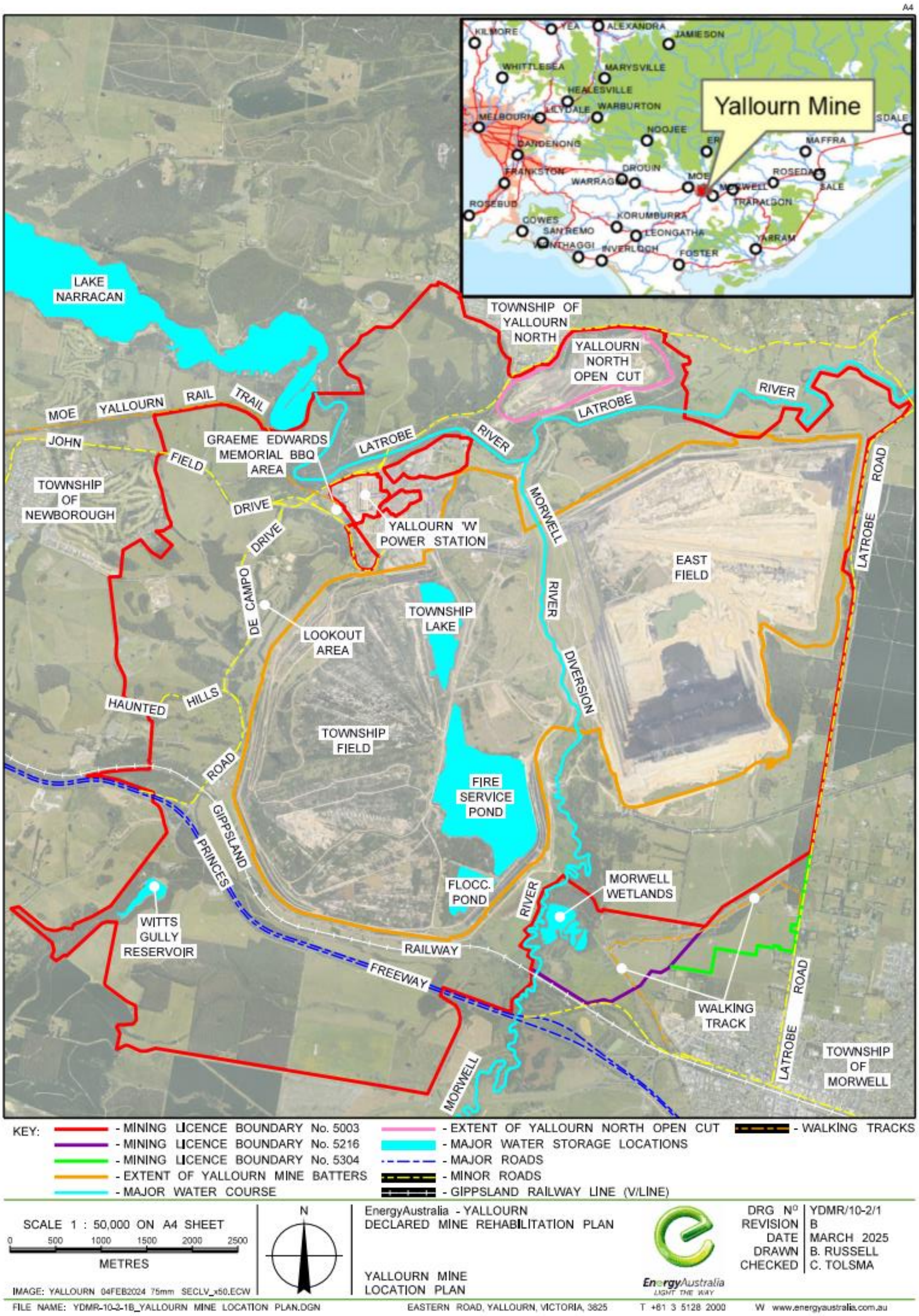


Figure 1-2: Location Plan including Mining Licence Boundaries

1.3 EnergyAustralia Values and Policies

1.3.1 EnergyAustralia HSSE Policy

EnergyAustralia (**EA**) maintains a *Health, Safety, Security and Environment Policy* (EnergyAustralia 2024b), the principles of which have been and will continue to be incorporated into rehabilitation works to date and planning. In accordance with the policy, EnergyAustralia is committed to providing a safe, healthy and secure work environment for all people at our workplaces, for those affected by our operations, and to meet all environmental obligations.

EnergyAustralia is also committed to the principles of sustainable development and environmental stewardship – the value of balancing our responsibility to meet the needs of our customers with the environmental, social and economic needs of our people, communities and other stakeholders. This has been incorporated into the definition of 'safe, stable and sustainable' in relation to the rehabilitation of the Yallourn Mine (see Chapter 6).

1.3.2 Climate Transition Action Plan

In August 2023, EnergyAustralia released its *Climate Transition Action Plan* (**CTAP**), which outlined EA's plan to achieve Net Zero by 2050. The plan was updated in 2024 (EnergyAustralia 2024a) with the following targets:

- commitment to achieving Net Zero greenhouse gas emissions across Scope 1 and 2 by 2050
- ambition to achieve Net Zero emissions for Scope 3 by 2050
- expanding our renewable portfolio by up to 3GW by 2030 and
- planned retirement of coal generation with Yallourn closing in mid-2028 and Mount Piper by 2040

1.3.3 Reconciliation Action Plan

As outlined in EA's *2023-2025 Innovate Reconciliation Action Plan* (EnergyAustralia 2023a), EnergyAustralia's vision for reconciliation is that we are a unified nation that acknowledges and celebrates First Nations peoples, their resilience, and their living cultures so that we can work collaboratively to lead and accelerate a clean energy future for all Australians. EnergyAustralia aims to bring this vision to life by:

- increasing the understanding of First Nations peoples, histories, and cultures across our organisation through nation-specific engagement strategies and localised cultural learning for our employees, contractors and partners
- revising and improving our approach to supplier and employment participation to ensure greater supplier diversity and creating employment pathways for Aboriginal and Torres Strait Islander peoples into our business
- establishing new partnerships and other collaborative opportunities to engage First Nations communities in the clean energy transition and
- voicing our support for reconciliation, and the Uluru Statement from the Heart and encourage our people to participate in reconciliation activities.

The rehabilitation of the Yallourn Mine offers a unique opportunity to build on existing relationships with Traditional Owners to achieve positive outcomes that benefit the Indigenous community. Mining activities at the site have changed the land and waters and it is important that EAY engage with, and listen to, the Traditional Owners and respect their future vision for the site. Details of stakeholder and community engagement can be found in Chapter 10.

1.3.4 Leading Transition

EnergyAustralia is committed to delivering a leading employment transition experience for its workforce and enabling prosperity and amenity to be derived from the Yallourn Site and its surrounds for generations to come. Our commitment to an orderly transition has been demonstrated with seven years advance notice of closure for the Yallourn Power Station; a $10 million support package for training and support services for the workforce (including reskilling and job opportunities in mine rehabilitation); and reinvestment in the region with the 350MW/4hr Wooreen battery storage system (EnergyAustralia 2023c).

Launched in November 2022, the $10 million *Yallourn Transition Program* provides the opportunity for employees to retrain and be job ready ahead of Yallourn's closure. The program casts a wide net, supporting workers that call Yallourn home, with access to services to plan, prepare and upskill for the future, whether that be finding a new job, retirement or self-employment.

Specifically, the program provides Yallourn workers with support to:

- develop personalised career plans
- access to all reasonable training
- individual career coaching
- financial advice and planning
- small business seed funding
- secondment opportunities
- recognition of prior learning
- job application assistance
- links to employment opportunities, and
- adult apprenticeships.

In addition, EnergyAustralia is actively working to understand where the new sources of employment will be in the region and create links for the Yallourn workforce. Identifying new industries is also important for Yallourn's supply chain to have the opportunity to pivot to potential new customers before Yallourn closes. EnergyAustralia will also utilise its existing generation assets and projects to provide employment opportunities for workers impacted by the transition.

1.4 Key Legislation and Administration

The MRSDA is the ley legislative instrument that governs mining in Victoria. In 2019, amendments to the Act were inserted, including provisions relating to the rehabilitation of declared mine land, with additional regulatory requirements for rehabilitation, stakeholder engagement, post closure management and financial security. The *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019* (Vic) (**MRSDMIR**) were subsequently amended in 2022 to include amended regulations for declared mines. The amended regulations commenced on 30 September 2022.

A declared mine is defined in the MRSDA, as a mine or quarry in Victoria declared by the Minister to have geotechnical, hydrogeological, water quality or hydrological factors within the mine or quarry that pose a significant risk to public safety, the environment or infrastructure. The Yallourn Mine, along with the Hazelwood and Loy Yang mine are currently the only declared mines in Victoria. The MRSDA requires a declared mine rehabilitation plan in relation to each declared mine to be submitted by 30 September 2025 meeting the requirements specified in the MRSDA and MRSDMIR. The DMRP for the Yallourn Mine will supersede the existing mine rehabilitation plans.

Chapter 2 Scope

2.1 Introduction

The purpose of this chapter is to outline the boundaries and intentions of the DMRP in relation to the requirements of the Act and Regulations. Key exclusions will also be detailed to provide clarity.

2.2 Mining Licences

The DMRP scope includes all land within the Yallourn Mining Licences (MIN5003, 5216 and 5304), which excludes the Yallourn Power Station. EAY owns the majority of the land within the licence area, with portions of the site leased for grazing and use by other third-parties (such as electricity transmission networks, business, recreational bodies). Crown Land and other private ownership are also situated within the Mining Licence as shown in Figure 2-1.

2.2.1 Licence MIN5003

Mining Licence MIN5003 is the major Yallourn Mining Licence. The licence covers 5,173 hectares (Ha) of land and the entire mining disturbance area. The majority of land within the licence area is owned by EAY, however rivers and floodplains, roads, railway, and some other titles, are owned by third parties. These third-party areas are addressed by the DMRP, with a priority placed on protecting their current use.

2.2.2 Licence MIN5216

MIN5216 is a small 152-hectare area situated on the southeastern portion of the site towards Morwell. The land is used for conservation and agricultural purposes with no coal mining taking place. No changes to land use are proposed for this area. Some recreational access is currently allowed through the public walking track which connects Latrobe Rd to Toners Lane through the Morwell West Drain Revegetation Project.

2.2.3 Licence MIN5304

MIN5304 is a small 83-hectare area situated alongside MIN5216. The land is also used for conservation and agricultural purposes with no coal mining taking place. Part of the public walking track also passes through this licence.

2.3 Timeframes

This DMRP accounts for the remaining period of mining operations and progressive rehabilitation, final rehabilitation implementation, monitoring, maintenance, and management until relinquishment of the rehabilitated land. At relinquishment, the responsibility of post closure management will fall to another party. An indicative timeline from operations through to relinquishment for this DMRP is shown in Chapter 14.

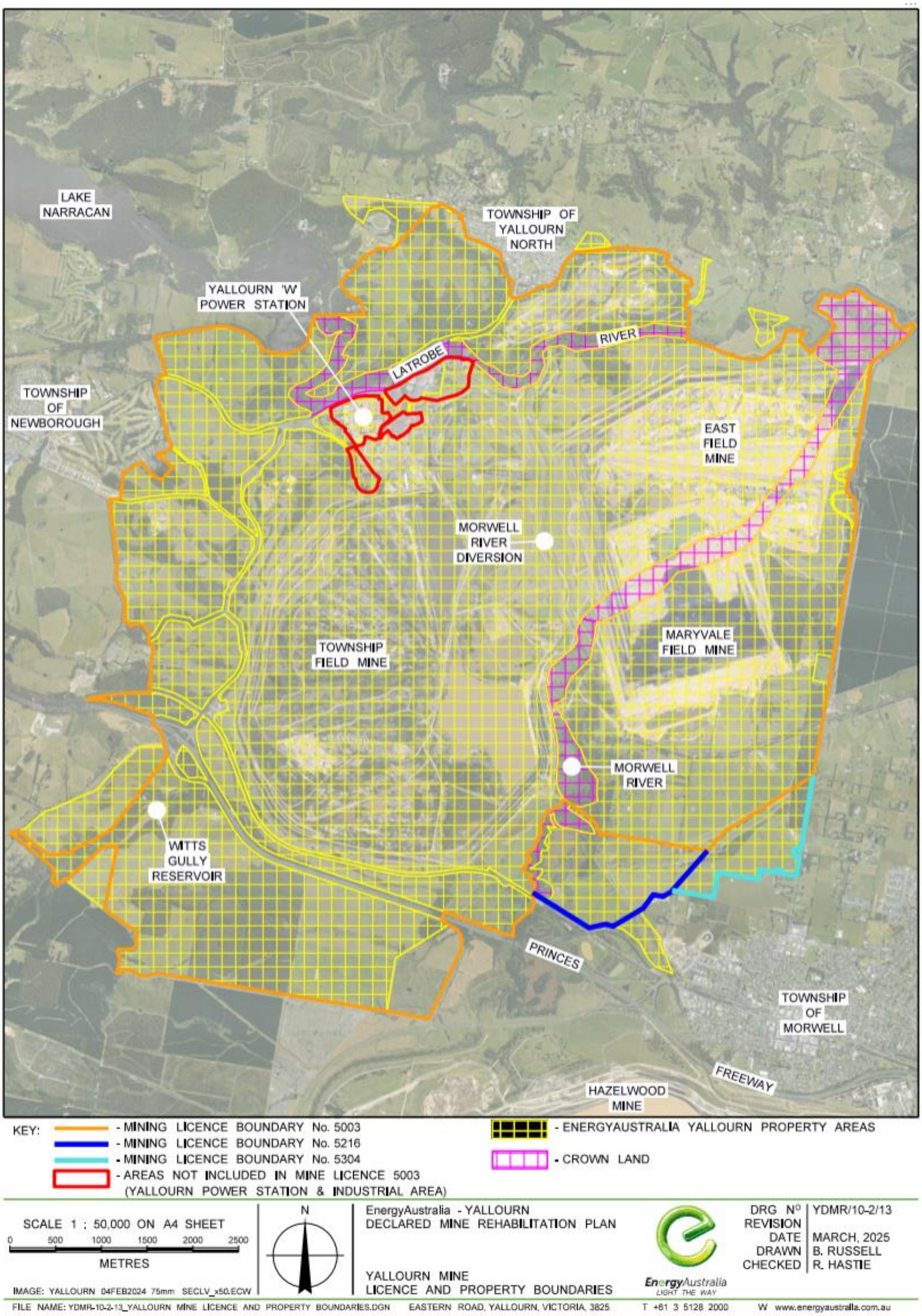


Figure 2-1: Mining Licence Land Ownership Status

2.4 Exclusions

2.4.1 Yallourn Power Station

The Yallourn Power Station area is not within any of the mining licence areas and so is not required to be addressed in the DMRP. A separate project and planning process for the decommissioning, demolition, and rehabilitation of the Power Station and associated infrastructure is being developed.

Chapter 3 Project Overview and History

3.1 Introduction

This chapter outlines the site setting including the operational history, rehabilitation plan history, the rehabilitation concept, and legacy decisions which have contributed towards a pit lake final rehabilitation plan.

3.2 History of Mining

Mining at Yallourn started north of the Latrobe River in 1888 within the Yallourn North Open Cut. Coal was discovered at ground surface near the Latrobe River and tunnels were constructed at first development. The site soon transitioned to an open cut operation although it did not experience continuous operation throughout its early phase. These early coal workings were performed by the private Great Morwell Coal Company before the beginning of the SECV. The SECV took control of this site after its formation and began developing the Yallourn Mine in 1921 with first coal and electricity production in 1924 at Yallourn A Station (DELWP 2019).

The Yallourn Mine developed in a southerly direction from its initial Latrobe River location, before pivoting in a westerly direction during the 1960s and 1970s. After moving west through the South Field, operations moved to a northerly direction in the late 1970s which necessitated in the removal of the Yallourn Township. This area of the operating mine was named the Township Field, which has since become the name of the entire western section of the Yallourn Mine. The Township Field finished coal operations in 1997 and now contains key water management infrastructure, some coal conveyors, and has been the subject of significant progressive rehabilitation. The Township Field name carries strong cultural context, especially for those that lived in the town and carry a connection to it.

With the Township Field coal resources becoming exhausted, the East Field development began in 1991 to provide continued supply to the Yallourn Power Station. East Field was mined in an easterly direction through the former Morwell River floodplain and then further east into the East Field Extension Development where mining was completed in 2015.

Coal and overburden operations are currently situated in the Maryvale Field where production began in 2011. Mining is currently in a southeasterly direction towards the Morwell Township. As of 2025, with closure expedited to 2028, only minimal further land will be disturbed due to mining, so the current extent of excavation almost represents the final footprint of the mine.

Coal and overburden mining at Yallourn from the 1920s to mid-2000s was typically performed through bucket wheel or ladder chain excavators (also known as dredgers). Dredgers are large mining machines which are capable of mining large quantities of material continuously. Importantly, these dredgers are able to leave very steep operating slopes which is efficient for mine production, although it does add complexity and possible constraints to the rehabilitation task. Dredgers load their material (coal and overburden) onto conveyors which transport the material to its end location. For coal, the end location is the power station and electricity production. For overburden, the material is transported by conveyor to a stacker, being a large mining structure which places the overburden back inside the mine void. This process is designed to aid geotechnical stability by adding weight and resistance forces within the void, with the aim of minimising ground movements.

In the mid-2000s, EAY introduced dozer and feeder breaker mining methods at the Site for coal mining. This method uses large bulldozers to push coal into a feeder breaker. The feeder breaker then processes and loads this coal onto conveyors where it is transported to the Raw Coal Bunker and then delivered to Yallourn Power Station. The change to dozer mining has allowed less steep mine walls to be developed in coal areas which assists in future rehabilitation.

In addition to overburden mining by dredger, areas of thick overburden are mined through mobile plant, also known as a ‘truck and shovel’ method, whereby excavators remove the overburden and place it into dump trucks, which instead of using conveyors, transport it to the required overburden backfill (dump) area. These thick overburden deposits are named overheight due to the height of material being above the practical height reach of a dredger. Truck and shovel operations provide flexibility for overburden placement which EAY has utilised to stabilise the batters and floor of the mine against geotechnical instability.

Table 3-1: Summary of Mining Operations at Yallourn

Field	Years of Operation
Yallourn North Open Cut	Intermittent from 1889 to 1963
Yallourn North Extension	1956 to 1989
Yallourn Open Cut	1921 to 1959
South East Field	1960 to 1969
South West Field	1969 to 1980
Township Field	1980 to 1998
East Field	1991 to 2009
East Field Extension	2009 to 2015
Maryvale Field	From 2011

3.3 History of Power Generation

Yallourn has a long and proud history of power generation which helped grow Victoria's economy and standard of living. The table below shows the operating dates from each of Yallourn's Power Station dating back to the first electricity sent to Melbourne in 1924. Prior to 1924, an electricity demonstration plant was also constructed at the Yallourn site, using coal from the Yallourn North Open Cut area.

Table 3-2: Yallourn Power Station History of Operations

Yallourn Power Station Name	Start of Operations	Decommissioned
Yallourn A Station	1924	1969
Yallourn B Station	1932	1970
Yallourn C Station	1954	1985
Yallourn D Station	1957	1986
Yallourn E Station	1961	1989
Yallourn W Station (now known as Yallourn Power Station)	1974	In operation

3.4 EAY as Owner

EAY is the private owner of the Yallourn Mine and adjacent Yallourn Power Station. Prior to EAY ownership, the SECV owned and operated the Yallourn Site from 1919 to the mid-1990s. In the 1990s, the Victorian State Government determined that it would privatise some of its energy generation assets, including the Yallourn Mine and associated power station. To enable sale, the Government created an unlisted public company, Yallourn Energy Ltd. Yallourn Energy Ltd was owned by the State of Victoria and prior to privatisation all of the shares in the company were held by the State-owned corporation named State Trustees Limited.

In April 1996, State Trustees Limited transferred ownership of all shares in Yallourn Energy Ltd to AusPower Pty Ltd, which was owned by a consortium led by Powergen UK Plc. Following a series of changes in shareholders, AusPower Pty Ltd became a member of what is now the EnergyAustralia Group.

Since 1996, Yallourn Energy Ltd has undergone name changes as follows:

- in 1996 it changed its name to Yallourn Energy Pty Ltd,
- in 2005 it changed its name to TRUenergy Yallourn Pty Ltd, and
- in 2012 it changed its name to EnergyAustralia Yallourn Pty Ltd

To simplify this DMRP and the ownership history since privatisation, EAY is used interchangeably as the site owner from April 1996 to present.

3.5 Rehabilitation Concept and Approvals History

The full pit lake concept has been developed and refined through a large body of work the SECV and EAY have completed since the 1990s. By the time of privatisation, the SECV already had a clear vision to transform the Yallourn Mine into a flooded lake.

3.5.1 SECV Mine Rehabilitation Plans

Prior to privatisation of the Yallourn Mine and Power Station, the SECV had produced plans to rehabilitate the Yallourn Mine to a full pit lake. A preliminary hydrological study by SECV/Geo-eng (1992) covering the developed mine areas (excluding Maryvale Field) found that natural filling by rainfall only would result in a period of some 65 years to fill the lake (Yallourn Energy Pty Ltd 2001). This was considered an unacceptably long period to complete a rehabilitation program following mine closure, so an evaluation was made of the time to fill assuming diversion of both or either of the Morwell and Latrobe Rivers. Assuming that desirable environmental flows were retained in the rivers, the lake filling time was estimated at below ten years.

The SECV then commissioned a report (Geo-Eng 1993) to investigate the open cut stability under different flooding options. The report concluded that mine batters would be stable in the short and long term when flooded.

In 1995, Yallourn Energy Ltd which was still owed by the SECV, submitted a Mining Licence Work Plan shown in Figure 3-1 (Yallourn Energy Pty Ltd 1995) which was approved. Included in the plan were:

- a high-water level of RL 38m for the lake proposed by the Rehabilitation Plan
- plans to prepare areas above RL 38m to function as stable landscaped batters and banks and
- interim management of area below RL 38m and progressive rehabilitation preparation for inundation

In 1996, ownership of the site and responsibility for delivering these rehabilitation commitments was transferred with the change in ownership to EAY.

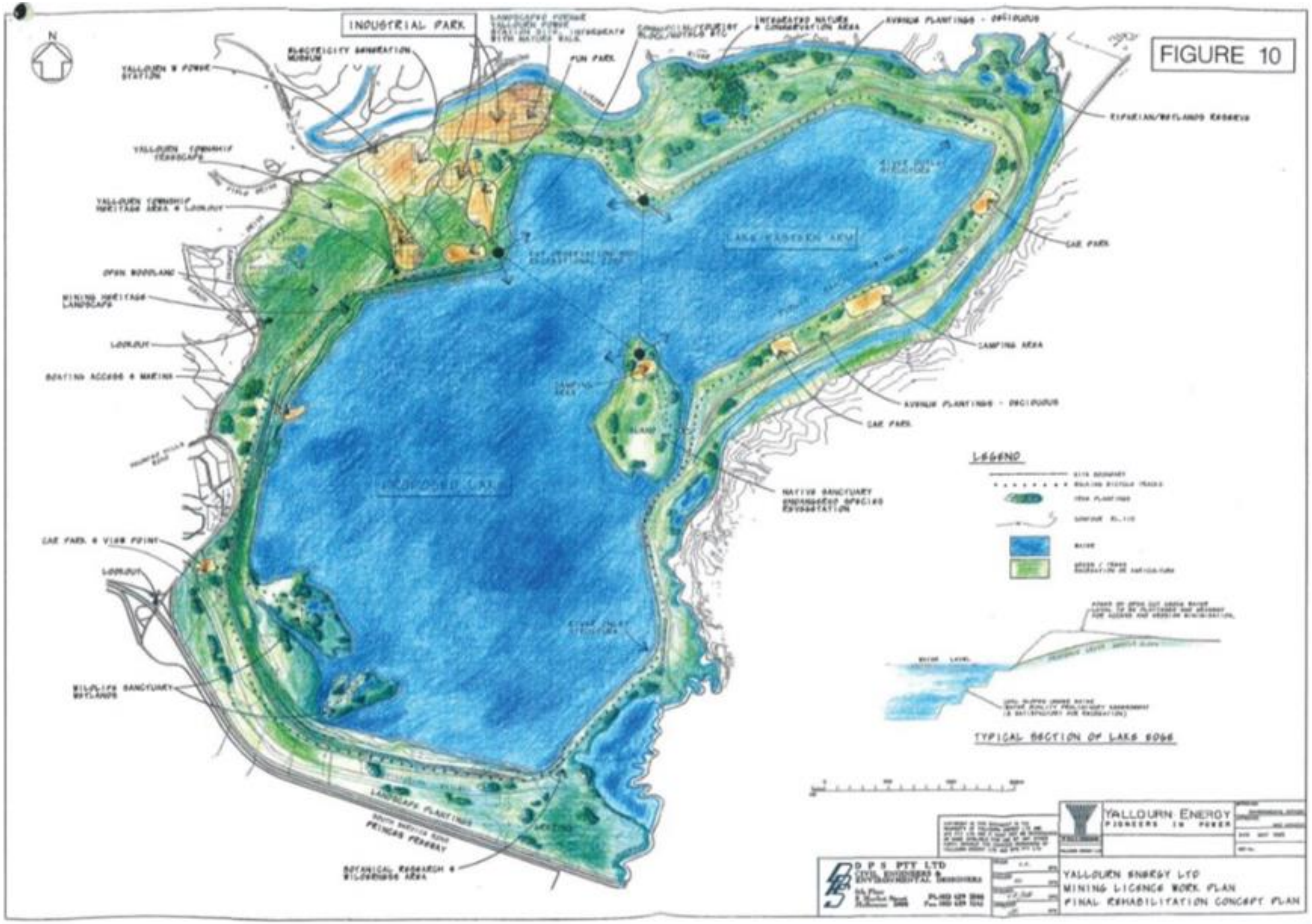


Figure 3-1: Mine Rehabilitation Plan for Work Plan (1995)

3.5.2 EAY Mine Rehabilitation Plans

3.5.2.1 Environmental Effects Statement 1999

On the 30th of March 1998 the Minister for Planning and Local Government advised EAY that it should prepare an Environmental Effects Statement for the proposed Maryvale Coalfield Project due to the large scale of the project and its relatively close proximity to the major town of Morwell. This project presented plans to divert the Morwell River to the east of the Maryvale Field, with conventional dredger mining techniques to transition from East Field into Maryvale Field. These plans would allow the Mine to supply brown coal to the Yallourn W Power Station from 2005 to at least 2027.

By January 1999 the EES for the Maryvale Coal Field Development had been completed and submitted (AGC Woodward-Clyde Pty Ltd 1999). The EES presented a full pit lake rehabilitation plan with the lake to be filled to the surrounding river level height. This plan provided incorporation of various features such as:

- Public recreational amenity.
- Conservation and Wildlife values.
- Wetlands.
- Grazing/forestry capability in perimeter area.
- Industrial/commercial park capability in perimeter area; and
- Heritage themes associated with past use.

The Minister for Planning released the findings on the EES in November 1999 stating that:

"*It is my assessment that, prior to the commencement of mining at the Maryvale field, the Department of Natural Resources and Environment (DNRE) establish the process, principles and timeframe for preparation of a final rehabilitation plan, in consultation with Yallourn Energy, the West Gippsland Catchment Management Authority and the Department of Infrastructure (DOI). Principles for the rehabilitation plan should give priority to the water management regime and landform concept design. It will be appropriate to review both the plan and progress of rehabilitation at least at five-year intervals, as the development of the mine proceeds and catchment management priorities evolve" (Minister for Planning 2002).*

Figure 3-2: Mine Rehabilitation Plan Presented in EES 1999

3.5.2.2 Supplementary Environmental Effects Statement 2001

In November 2000, advice from the Minister for Planning was sought for changes to the Maryvale Coal Field Development. These changes included an alternative alignment for the MRD (AMRD) which would change the alignment from being along the east of Maryvale Field as per the EES, to being on the western boundary of East Field (the current location). The Minister provided advice in December 2000 that a supplementary EES should be prepared.

In 2001, a supplementary EES was prepared, with the full pit lake again determined to be the preferred final rehabilitation landform (Maunsell McIntyre 2001). However, the lakes were now split by the MRD running through the centre of the mine site (Figure 3-3).

The Minister for Planning released findings on the supplementary EES in November 2001 stating that:

"I am satisfied on the basis of the Supplementary Report and its subsequent review by relevant Government authorities, that the Yallourn Coal Field Development can occur without significant adverse impacts on residents in the area, water quality or flows in the Morwell River, while also having a substantially reduced effect on indigenous flora and fauna. It is therefore my assessment that the diversion of the Morwell River and development of the Maryvale Coal Field be approved generally as proposed in the Supplementary Report and in accordance with other specific aspects of this Assessment" (Minister for Planning 2002).

Specifically for rehabilitation the following was stated:

"I note that the need to use a considerable amount of the overburden material for the construction of the AMRD embankment has redirected this material away from rehabilitation purposes and resulted in the need for the Rehabilitation Plan to be revised. This was an issue raised by Advance Morwell in their submission and has been addressed to their satisfaction by Yallourn Energy.

It is my assessment that those changes to the rehabilitation plan agreed to by Yallourn Energy and Advance Morwell should now form part of the revised rehabilitation plan, which incorporates anticipated rehabilitation levels at various year stages. This agreement includes monitoring and review of implementation, by the Environment Review Committee and an annual public reporting of progress by Yallourn Energy.

Further, the proposal for the ultimate rehabilitation of the mine area with interconnected lakes either side of the AMRD requires further research work and studies to be undertaken to advance development of the lake concept and consider potential connection of the river to the lake system under normal flows. I look to the Environmental Review Committee to oversee these matters."

3.5.2.3 Rehabilitation Master Plan 2001

EAY submitted the Rehabilitation Master Plan (RMP) (Yallourn Energy Pty Ltd 2001) per the conditions of the Supplementary EES for a '*revised rehabilitation plan'*. The RMP showed the full pit lake surrounded by open woodland, closed woodland, wetland, conservation, and agricultural areas whilst also showing a flood spillway from the Morwell River into the lake and an outlet spillway from the lake to the Latrobe River. The RMP explains that the full pit lake option provided the optimum balance of sustainability, public amenity, safety and cost, hence why it was selected and approved as the preferred landform.

The RMP was approved in January 2002 as part of the Work Plan Variation approval (DNRE 2002).

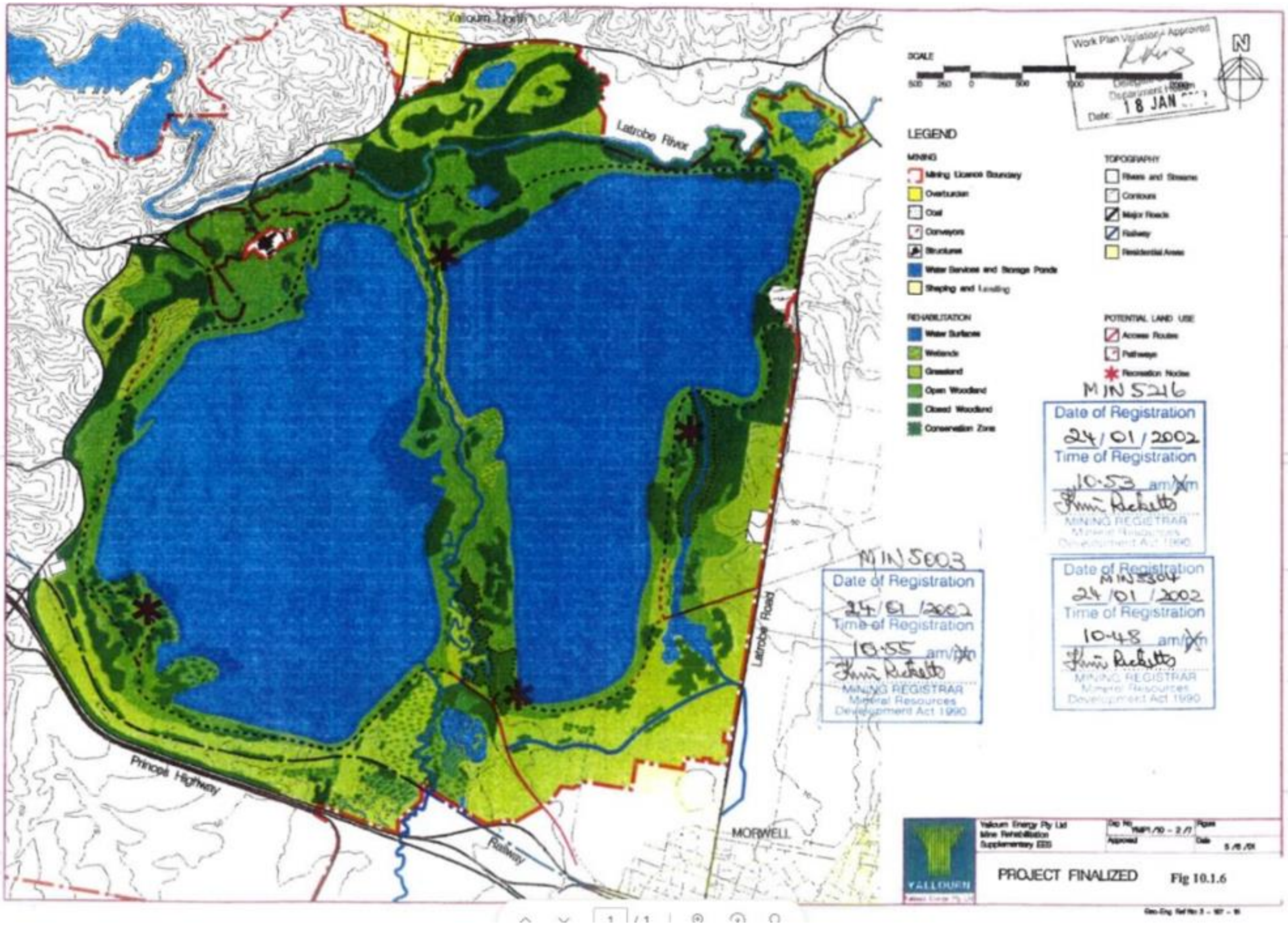


Figure 3-3: Mine Rehabilitation Plan Presented in Rehabilitation Master Plan 2002

3.5.2.4 Environment Report 2010

In 2009, EAY required planning approval to change the alignment of the Maryvale Field. This change in alignment would keep the Maryvale Field further away from the Morwell River and the Morwell Township. The Minister for Planning assessed that an EES was not required under the condition that an environment report was prepared.

The Environment Report (AECOM 2009) was prepared with the Minister for Planning providing their assessment in June 2010. The assessment concluded that "the project should be implemented in accordance with the measures recommended in this Assessment". Commentary was also provided for rehabilitation:

"*The final rehabilitation plan for the mine will not differ in its basic form from that endorsed for the approved Yallourn Coal Field Development Project. The Work Plan drawings approved on 18 January 2002 following the Supplementary Environment Report and then Minister for Planning's Assessment allow for permanent side batters of 1:1. This would not change under the proposed mine re-alignment. The Rehabilitation Master Plan for the project adopts the final concept of flooding the mine to form a large lake with interconnection to the local river systems. The depth of the lake will depend upon water availability at the end of the project."* (Minister for Planning 2010)

3.5.2.5 Work Plan Variation 2011

In 2011, a Work Plan Variation was submitted to the then Department of Primary Industries (DPI) which again showed the final rehabilitation plan as a full lake consistent with the RMP (TRUenergy 2011). DPI approved this plan with a condition that required a review of the full lake rehabilitation option (DPI 2011). This condition (Condition Seven) of the approval required a review of the Rehabilitation Master Plan which considered:

- the feasibility of the flooded mine scenario versus other alternatives.
- long term water balance studies.
- how to form safe and stable rehabilitated batters, including for the non-flooded mine scenario.
- how to minimise mine floor heave, including for the non-flooded mine scenario.
- strategic use of overburden in flooded and non-flooded mine scenarios; and
- the advantages and disadvantages of the flooded and non-flooded mine scenarios regarding progressive rehabilitation opportunities.

A technical review was completed, including technical studies, workshops, and design work to demonstrate compliance with this condition. This body of work again reached the conclusion the approved full pit lake option "*provides all stakeholders with the most achievable, sustainable, economical and responsible solution*."

EAY submitted the Condition Seven response to DPI in 2012 (TRUenergy 2012) and summarised the findings in the 2019 Work Plan Variation submission (EnergyAustralia 2019) as discussed below.

3.5.2.6 Rehabilitation and Closure Plan 2019

In 2019, EAY submitted a Work Plan Variation and a Rehabilitation and Closure Plan (RCP) to the Earth Resources Regulator (**ERR**) for consideration (EnergyAustralia 2019). A core purpose of this RCP was to present the then current understanding and future planning to be undertaken prior to closure of the Mine (EnergyAustralia 2019). This incorporated the requirements of the Department's '*Draft Rehabilitation and Closure Plan Guideline for the Mining Industry, v05b, January 2017'*. The rehabilitation concept presented in the RCP included a short list of refinements that were different from the 2002 approval of the RMP (Section 3.5.2.3). These included:

- a reduction in the pit lake water level from RL +38m to RL +37m to better facilitate integration of the Morwell River with the pit lake and discharge into the Latrobe River.
- reflecting the approved 2032 business plan mine shape; and
- landscaping the MRD in two sections to allow the Morwell River to flow into the mine void.

When these plans were produced the planned closure of the Yallourn Mine was still scheduled for 2032, with the pit shape design reflected in those plans. The RCP was intended to remain as a live document and would be updated and refined as new information became available, including: new knowledge, technological shifts, government approvals and policy reforms, the findings coming out of the Latrobe Valley Regional Rehabilitation Strategy (**LVRRS)** and new research.

The WPV was approved with Conditions 5 & 6 relating to the RCP needing to be reviewed following publication of the LVRRS. However, the LVRRS did not contain prescriptive requirements that warranted a review of the RCP. ERR provided confirmation in October 2020 that EAY was not required to meet Conditions 5 & 6 of the 2019 WPV (DJPR 2020).

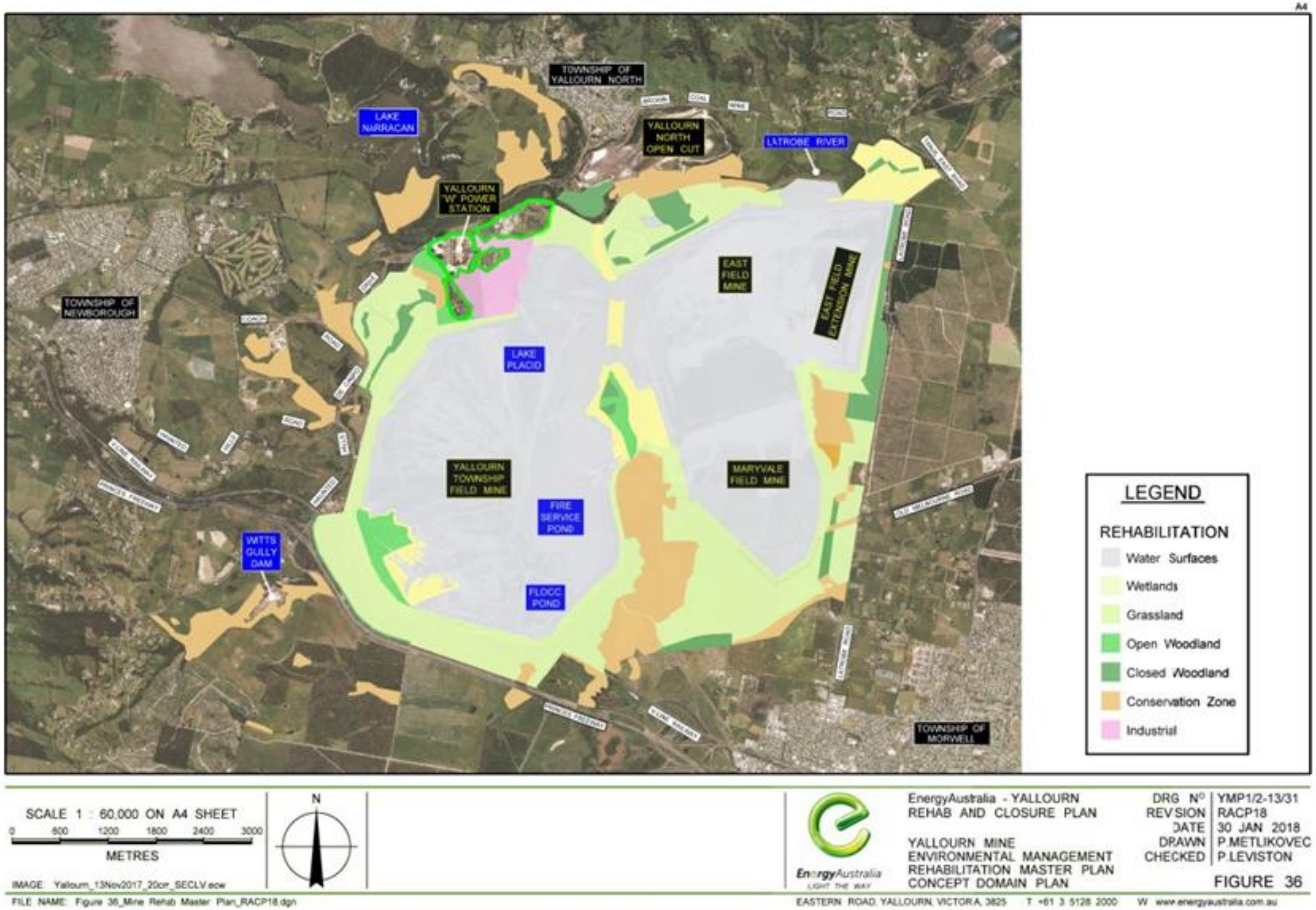


Figure 3-4: Mine Rehabilitation Plan Presented in 2019 Rehabilitation and Closure Plan

3.6 Government Policy and Decisions

Government policy and decisions during Yallourn's operation have influenced rehabilitation planning. A summary of key government decisions and policies is highlighted below.

3.6.1 DPI Mine Rehabilitation Options Assessment 2009

This government led study aimed to review the existing rehabilitation plans for the Latrobe Valley Mines and recommend a framework for rehabilitation design and approval (GHD 2009). Key findings from the study included:

- Mining should progress towards the final landform so worked out areas can be progressively rehabilitated. Changing the final landform part way through the life of mine is likely to be a difficult and costly exercise.
- Key elements to consider in rehabilitation design include: stability of the base of the mine, batter stability, fire risk of exposed coal, flooding and associated erosion, coal utilisation, surface and groundwater resources, costs.
- There are broadly two options for final rehabilitation, being a flooded lake option and a lowered landscape option

3.6.2 Hazelwood Mine Fire Inquiry 2015 - 16

In 2015, the Hazelwood Mine Fire Inquiry (HMFI) (Teague and Catford 2016) investigated mine rehabilitation within its Terms of Reference. After four days of public inquiry, extensive community consultation and public workshops, technical workshops, technical studies, interviews and tours of the Yallourn Mine, the HMFI concluded that pit lakes offered the best outcomes to Latrobe Valley Coal Mine Rehabilitation, but that further studies and consideration of water resourcing was required.

The HMFI Report on mine rehabilitation states that rehabilitating coal mines is essential in providing long-term safe, stable, and sustainable conditions. To achieve this, the board concluded that:

- pit lakes are the most viable option for each Latrobe Valley mine.
- this closely aligns with current rehabilitation plan for the Yallourn Mine and
- concerns about mine stability, sourcing water, and water quality require further research

The Yallourn Mine has undertaken extensive studies to address concerns about mine stability, sourcing water, and water quality. These are discussed in Chapter 8.

3.6.3 Latrobe Valley Regional Rehabilitation Strategy

The LVRRS (DJPR and DELWP 2000), was undertaken to meet the requirement of further research recommended in the HMFI, and deliver the legislative requirement for the Minster for Resources to develop a document that sets out the strategy in relation to:

- the safety, stability and sustainability of coal mine land and any adjacent land.
- the planning for the Latrobe Valley region in relation to the rehabilitation of coal mine land and any adjacent land, and the relationship between each mine void.
- the development of a plan for the monitoring and evaluation of coal mine land after rehabilitation of that land is complete.

The LVRRS does not prescribe a preferred landform but acknowledges that safe and stable conditions are best met by a pit lake. It also highlights rehabilitation challenges and other environmental aspects including:

- if dry conditions continue, there is a risk of impacts if surface water is supplied without conditions that protect other users and the environment
- it would take 15 to 30 years to fill each mine using existing water sources.
- there are currently no alternative water sources considered more feasible than the existing water sources.
- water quality risks are not significant and are manageable
- failure to deliver minimum flow requirements in the Latrobe River would likely result in unacceptable impacts and
- existing groundwater monitoring activities appear to be adequate considering the known risks

3.6.4 Latrobe Valley Regional Rehabilitation Strategy 2023 Amendment

The 2023 update to the LVRRS (DEECA 2023a) recognises Yallourn's unique site setting, especially the MRD, Latrobe River, and historical stability challenges. The strategy states the fully flooded voids provide the highest likelihood of long-term stability, they better eliminate fire risk and require least maintenance. Also included are potential conditions for accessing water for lake filling without having detrimental impacts on the environment. These conditions are utilised in the various technical studies referenced within this report. The conditions are also set the terms for a Bulk Water Entitlement (**BWE**) application to provide access to water for flooding the Yallourn Mine following the closure of the Yallourn Power Station.

3.7 Yallourn Mine Rehabilitation Overview

Rehabilitation of the Yallourn Mine aims to satisfy the vision:

To transform the Yallourn site into a landscape that enables ongoing prosperity and amenity for all. One that is an example of what can be achieved when business, government, communities, and custodians of the land work together.

To achieve this, a technical focus on meeting safe, stable, and sustainable criteria for the rehabilitation outcome is required. The concept which best addresses these criteria is a full pit lake operating at RL 37m. The main aspects of the rehabilitation project include:

- decommissioning and removing redundant operational infrastructure
- filling the voids to RL 37m with approximately 665 gigalitres (**GL**) of water
- reshaping and revegetating areas above the pit lake level
- maintaining the MRD in its current location with improvement works to enhance long term stability
- works to allow the current conveyor tunnels under the MRD to be used as tunnels to transfer water and provide equilibrium between the lakes
- employing geomorphic principles in the design of the final landform and reshaping of batters to meet that design.
- removal of constructed operational surface water diversion features that have been installed to keep water out of the mine during operations
- construction of spillways to take Morwell River and Latrobe River flood flows out of the MRD and into the pit to protect the integrity of the MRD

- construction of a spillway in the northeast corner of the East Field to direct lake overflow to the Latrobe River
- manage mining and rehabilitation risks throughout the project
- provide ongoing protection of conservation areas
- revegetating areas above lake level to agricultural, environmental, and recreational beneficial land uses
- providing opportunities for commercial and industrial beneficial land uses

3.7.1 Rehabilitation Planning and Review

Closure and rehabilitation of the site has been integrated into the Life of Mine (LoM) planning. The envisaged final landform of a lake has underpinned decision making during operations such as the planning for progressive rehabilitation or how coal will be mined to leave suitable batter angles for future land use.

The *Integrated Mine Closure: Good Practice Guide* (ICMM 2025) has been used as a guide for mine closure planning with relevant sections of the guide discussed in this DMRP. As per the guide, mine closure planning is an iterative process that takes into account environmental, social and economic considerations. This iterative nature of planning will result in updates to the DMRP (Section 14.7) to include the latest evidence base and status of other regulatory processes.

Additional guidance documents used for planning closure and rehabilitation are discussed in Section 4.1.

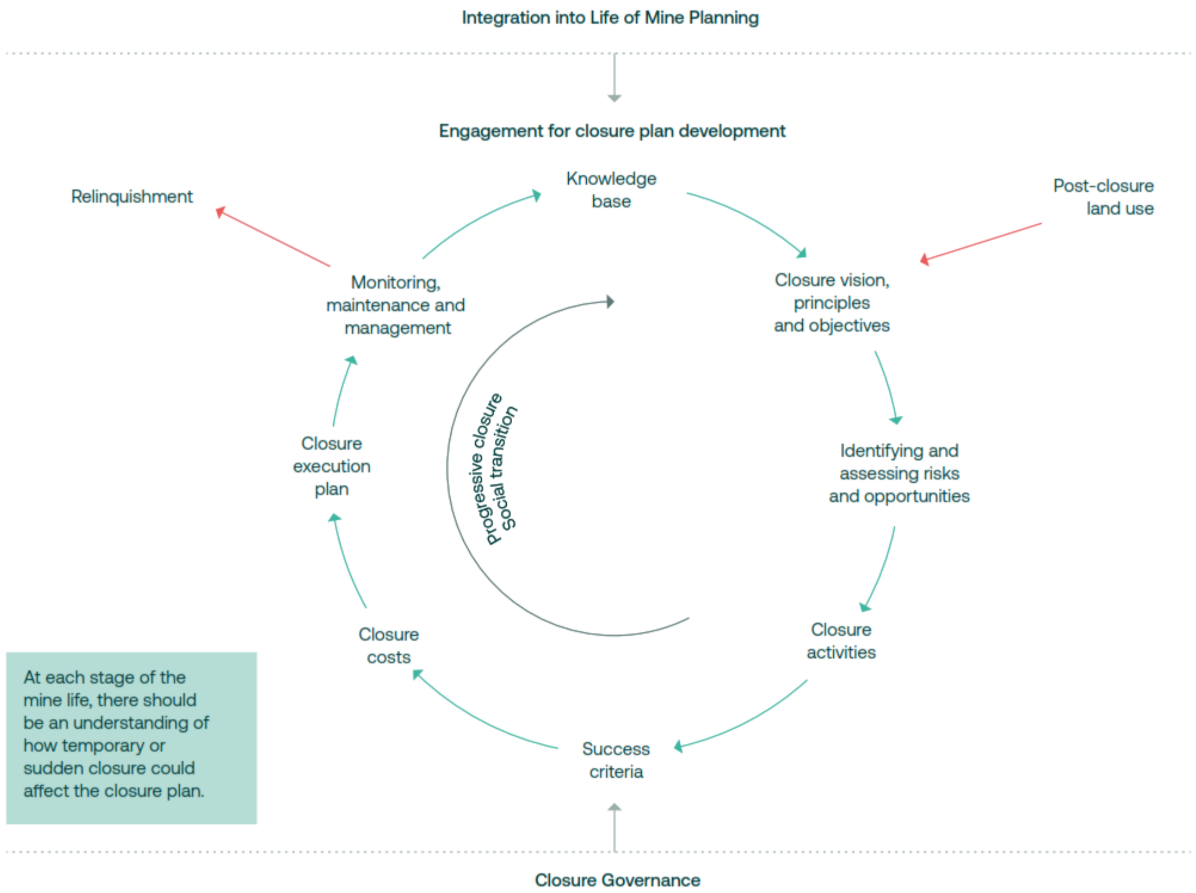


Figure 3-5: Integrated Mine Closure Planning (ICMM 2025)

3.7.2 Rehabilitation Design Intent Period

3.7.2.1 Industry Guidance

The Yallourn Mine Rehabilitation design defines three key planning milestones: End of Mining (EOM) set for 2028, Lake Filling, and Post-Relinquishment. The "**Design Intent Period"** refers to the period over which the design and performance of the rehabilitated landform, including any associated water bodies or infrastructure, is expected to remain effective and consistent with the post-mining land use, without the need for significant intervention or reconstruction. This period begins upon completion of rehabilitation works and reaching the post-relinquishment milestone - when the rehabilitated landform has reached the condition where it can be expected to perform as designed, with only minor maintenance or management interventions.

Design standards typically refer to a 'design service life', being the period a structure is expected to perform its intended function. For general infrastructure effective service lives vary. The *Australian Rainfall and Runoff: A Guide to Flood Estimation* (Ball et al. 2019) summarises typical effective services lives for some example infrastructure types: roads (35–110 years), stormwater pipes (80–100 years), open stormwater channels (10-100 years) and dams (50–500 years). Tailings dams, due to their significant environmental risks, may have design lives up to 1,000 years. Some problems with the general guidance from published standards and other sources are that much of it:

- Refers to concrete structures.
- Is focussed heavily on civil structures constructed within urban type environments.
- Forms part of civic infrastructure systems with well-established permanent management and maintenance regimes, for example bridges, buildings, roads and civil water supply infrastructure.
- Is focussed on water storage bodies with significant downstream safety implications under dam breach.
- Is for structures with potential for severe environmental contamination (e.g. tailings dams).

Consequently, it is difficult to readily fit the Yallourn Mine rehabilitation into the available guidance.

The Western Australia "*Guideline for Preparing Mine Closure Plans"* (DEMIRS 2025) does not provide specific guidance on closure design life, but references that "*The identified completion criteria and associated performance indicators must be able to demonstrate that rehabilitation is progressing as anticipated, particularly where numerical modelling is utilised to predict long-term (usually in the order of 300 years or longer) environmental performance for such structures as waste rock landforms."*. Tailings dams can often be associated with severe environmental and/or safety implications and hence the very long Design Intent Periods for these structures are not considered applicable at Yallourn. It is also important to note that for the MRD and the Yallourn Mine lakes, downstream safety under a breach scenario does not apply, therefore the available guidance on dams is not considered directly applicable at Yallourn. The remaining data indicates that a Design Intent Period of ≤ 100 years is appropriate for Yallourn.

In the context of mines, Anderson and Butler (2016) provides design life period recommendations for engineered mine waste structures, mainly mine waste dumps and tailings dams in Australia, with recommended periods ranging between 25 and 75 years depending on the consequence of failure, Figure 3-6. This assessment is heavily focussed on the longer term and two structures with high potential for generating adverse environmental pollution. Again, the focus for this guidance is around risk of significant environmental pollution.

LEVEL OF POTENTIAL RESIDUAL IMPACT	LOW	SIGNIFICANT	HIGH
OUTCOME	No change in environmental values of receiving environment	Environmental values diminished in receiving environment	Environmental values diminished in receiving environment
POTENTIAL RESIDUAL IMPACT DEFINITION#	Releases of mine-affected water cause no more than short-term (potential for a residual impact but this is short-term and manageable) impacts in the receiving environment (analogous to *Low Consequence* in DEHP, 2016)	Releases of mine-affected water cause medium-term impacts in the receiving environment (analogous to *Significant Consequence* in DEHP, 2016)	Releases of mine-affected water cause long-term or permanent impacts in the receiving environment (analogous to *High Consequence* in DEHP, 2016)
DESIGN LIFE PERIOD	25 years	50 years	75 years

Residual impact is evaluated against three criteria – harm to humans, general environmental harm, general economic loss or property damage. For illustrative purposes, the assessment is presented with reference to aquatic ecosystems.

Figure 3-6: Engineered Mine Waste Structure Design Life (Anderson and Butler 2016)

Some recent studies described in Anderson and Butler (2016) provide good guidance on the actual design service life experienced in practice with engineered earth structures and some mine waste structures, essentially with soil and rock materials used for the rehabilitation. This guidance is supported by a number of Australian based research projects into the success rate of mine rehabilitation outcomes (Anderson and Butler 2016). However, once again these studies are focussed on mine facilities with high environmental risk, such as tailings dams and waste rock dumps with acid mine drainage potential. The studies are also focussed on the earth capping used to limit surface water infiltration, which is a key factor in the control of adverse environmental effects long-term. It is important to note that this experience is with very important engineering structures where it would be reasonable to assume that at least some had detailed and careful engineering design and construction.

As discussed above, whilst much of the industry experience is considered to have only limited direct relevance to the Yallourn rehabilitation project, the experience with reference to the longer-term behaviour of engineered earth structures is directly relevant to the MRD. The other aspects set out in Anderson and Butler (2016) in relation to the Design Intent Period are the addition of the concepts of the complexity of the structure under consideration, it's durability and the assumed maintenance. Durability also relates in part to the design complexity of the structure, and it is logically inferred that a less complex structure would have an increased durability. Thus, durability also relates directly to the level of maintenance required such that the structure can perform in accordance with the design objectives. Therefore, the design strategy adopted for Yallourn Mine rehabilitation has design simplicity and durability as key elements.

3.7.2.2 Summary

Typically, geotechnical engineered earth structures have a design life of 50 to 70 years (Fourie et al. 2021). This does not mean the structure ceases to perform as intended after that period, rather that all engineered structures require some post-construction monitoring and maintenance. The design of earth structures needs to consider the design complexity and the durability as part of the considerations for the Design Intent Period.

Some regulators, published guidelines and ANCOLD (Australian National Committee on Large Dams), reference Design Intent Periods for earth structures of 100 years, 1000 years and "in perpetuity". However, these extended periods carry low certainty as no engineered structure functions in perpetuity (PSM 2025b).

Climate change introduces another layer of complexity, with significant uncertainties in long-term predictions. Current guidelines recommend an adaptive design approach, allowing for future modifications as climate projections evolve. Given that climate predictions for the Latrobe Valley extend only to 2065–2099, setting a Design Intent Period beyond 100 years would be speculative.

Therefore, a 100-year Design Intent Period has been adopted for the Yallourn Mine Rehabilitation Design, as this balances durability, maintenance and adaptability to climate uncertainties.

3.7.3 Lake Yallourn

The key feature of the rehabilitated landform is the 665 GL Lake Yallourn. The lake will operate at 37m above sea level baseline with slight fluctuations based on local climate and flood conditions. This level matches the nearby Morwell and Latrobe Rivers ensuring minimal hydraulic gradient between the lake and the rivers. This provides the best hydrogeological stability for the rehabilitated landform.

3.7.4 Water to Fill Lake Yallourn

To fill the lake, water is planned to be sourced from the Latrobe System via the Bulk Water Entitlement (BWE). This entitlement will provide up to 27 GL of water per year with strict conditions that restrict use in dry periods. These conditions are set out by the LVRRS amendment (DEECA 2023a) and include:

- restricting diversion for use to the wettest months of the year (June to November)
- a threshold to prevent winter-spring baseflow in the Latrobe River from being diverted
- a limit on annual releases from Blue Rock Reservoir
- a maximum period of water access for mine rehabilitation purposes of up to 30 years from the initial supply date at each mine or until 2065, whichever is earlier.

To access this water, EAY will apply for a new BWE from the System Waterway, which is defined as the Tanjil River between Blue Rock Reservoir and the Latrobe River, and the Latrobe River downstream of its confluence with the Tanjil River to Lake Wellington, including the pools formed by, and immediately upstream of, the Blue Rock and Narracan Dams, and Yallourn Weir. The water used for rehabilitation will contribute to the safe, stable and sustainable rehabilitation of the Yallourn Mine, as required by the MRSD Act.

The BWE Application is to be made under section 36(1) of the Water Act. It will specifically address the Section 40 Matters that the Minister for Water must consider in responding to the BWE Application.

The proposed annual extraction volume for the New BWE is 27,000 ML from the System Waterway, using a combination of Lake Narracan, Blue Rock and run of river proportions. The following specific conditions on the New BWE are proposed:

Yallourn shares			
Storage Source	**Storage Capacity Share**		**Inflow share**
Lake Narracan	29.94%	2,165 ML	22.41%
Blue Rock Reservoir	15.72%	31,168 ML	15.72%
Conditions			
Yallourn annual extraction limit			27,000 ML
Yallourn daily extraction limit			148 ML
Annual period of Extraction			01 June to 30 November inclusive
Limit on the releases from Blue Rock Reservoir			Releases from Blue Rock shares capped at 17.9 GL per year, which is the 25th percentile based on historical release.
A threshold to prevent winter/spring baseflow being diverted from the Latrobe River			No access to run of river water during extraction period when the Latrobe River at Willow Grove is below 447 ML/d.
Term of Bulk Water Entitlement			Date of termination of the Existing BWE until the first to occur of: • 30 November 2065. • the 30th anniversary of the commencement of extraction for mine rehabilitation under the New BWE; or • the date on which EAY provides written notice to the Minister that EAY considers the New BWE is no longer required for the purposes of the rehabilitation of the Yallourn mine.

The application for the BWE is captured in *Section 4.6 Future Legal* Approvals. The utilisation of this water fill source is an assumption adopted for the rehabilitation design and have formed a key input to all technical studies presented in Chapter 8.

3.7.5 Water to Maintain Lake Level

Whilst the lake can maintain a full level under some climate projections, it is possible that dry periods could cause a drop in lake water level below the desired operating range. If this occurred, additional 'top up' water would be needed to stabilise water levels until rainfall runoff returned the system to balance. The source and approval of this water is acknowledged as a gap in Chapter 17.

3.7.6 Morwell River Diversion

Once rehabilitation is executed, the MRD will be in a structurally sound condition to support hydrological processes (environmental flows and design flood flows) with water levels balanced throughout the structure. Prior to that, an MRD works program including: floodplain and internal embankment treatment and regrading, spillway construction, and levee reshaping, will improve integrity of the MRD during the filling phase and provide enhanced protection into the post relinquishment period. The MRD works program will maintain connection of the Morwell and Latrobe Rivers whilst keeping the mine disconnected. Only flood events will cause surface water interconnection between the river system and mine at the MRD. Licences to construct and operate these spillways are not yet approved. These are identified in Section 4.6.

3.7.7 Yallourn North Open Cut

The Yallourn North Open Cut (YNOC) area now contains three EPA Licenced Landfills which will be capped and rehabilitated in accordance with EPA approved plans as per the Operating Licence (EPA 2023). Areas of the YNOC outside of the landfills are subject to the same technical requirements and end land uses as the rest of the Mining Licence area.

3.7.8 Post Mining Land Use

The post mining land uses for the site include: beneficial uses of the lake, agriculture and grazing, environment and recreation, conservation, and industrial and commercial. Value-add land uses above these nominated are possible. However, this will require further government involvement, additional stakeholders, and supporting business cases. Further detail is shared in Section 9.3.

3.7.9 Timeline Summary

Implementation of the rehabilitation concept has been occurring at Yallourn since the 1990s, largely through the progressive rehabilitation program. Once coal mining operations stop in mid-2028, the priority shifts to decommissioning and removing infrastructure under lake level and providing geotechnical buttressing at the base of the mine slopes. This prepares the site for lake filling.

The lake filling period is expected to take approximately 24 years, over which time the remaining landform reshaping, drainage, revegetation, repurposing, and demolition activities will be completed.

Table 3-3: Summary of Conceptual Rehabilitation Aspects and Timelines

Aspect	Indicative Start	Indicative Completion
Operations	1888	2028
Progressive Rehabilitation	1990s	2028
Final Decommissioning	2028	2029
Buttressing and Stabilisation	2028	2031
Lake Filling	2029	2053
Perimeter Relinquishment	2035	2054
Mine Area Relinquishment	2054	2055
Post Closure Management	2035	n/a

The rehabilitation plan proposed is underpinned by historical water costs. Any material change to these costs has the potential to change the timings proposed, with an extended implementation period the likely outcome. This outcome is defined as a slow fill option. Whilst not meeting the LVRRS policy or being EAYs preferred timeline, the slow fill option can result in safe, stable, and sustainable outcomes, albeit without the realisation of timely rehabilitation benefits. Whilst a feasible rehabilitation solution, the slow fill option is not considered for this DMRP

3.7.10 Rehabilitation Domains and Aspects

To assist in rehabilitation planning, the site is broken into domains and aspects. Domains are spatial areas with common features, generally determined by their features related to geotechnical, surface water and environmental management. Environmental aspects are more typically used for environmental management where the impact from an event can impact a feature such as air, land, surface water, or groundwater. In these cases, it is considered more appropriate to use aspects for environmental management rather than a spatial area to analyse the problem and offer appropriate solutions.

There are two classification of domains presented for rehabilitation planning, design and future management of the land at Yallourn Mine. These include:

1. Geotechnical Domains, Figure 3-7 – these domain boundaries are relevant to stability management of the site and are a resultant of the geology, geotechnical characteristics, hydrogeology and surface water management, internal infrastructure such as the MRD, external receptors such as the railway, and future mining.
2. Peripheral Catchment Surface Water Domains, Figure 3-8 – these domain boundaries have been derived in consideration of the mapped catchments that report to the abovementioned geotechnical domains. These do not show the surface runoff areas that may run along the outside of the geotechnical domains (external to the mine) and remain outside of the mine void, e.g. flows reporting directly to Morwell River and Wetlands from the south-west of the mine.

The abovementioned domain classifications currently do not include the in-pit areas. The in-pit areas include the internal overburden dumps, mine floor and sumps. These have been utilised to determine the in-pit catchments for the Pit Water Balance & Quality assessment, discussed in Section 8.8. As part of the future stages of rehabilitation detailed design works the domains discussed are expected to be further refined linked to the future detailed site management plans. The planned monitoring and maintenance plans for the current rehabilitation design is discussed in Chapter 15.

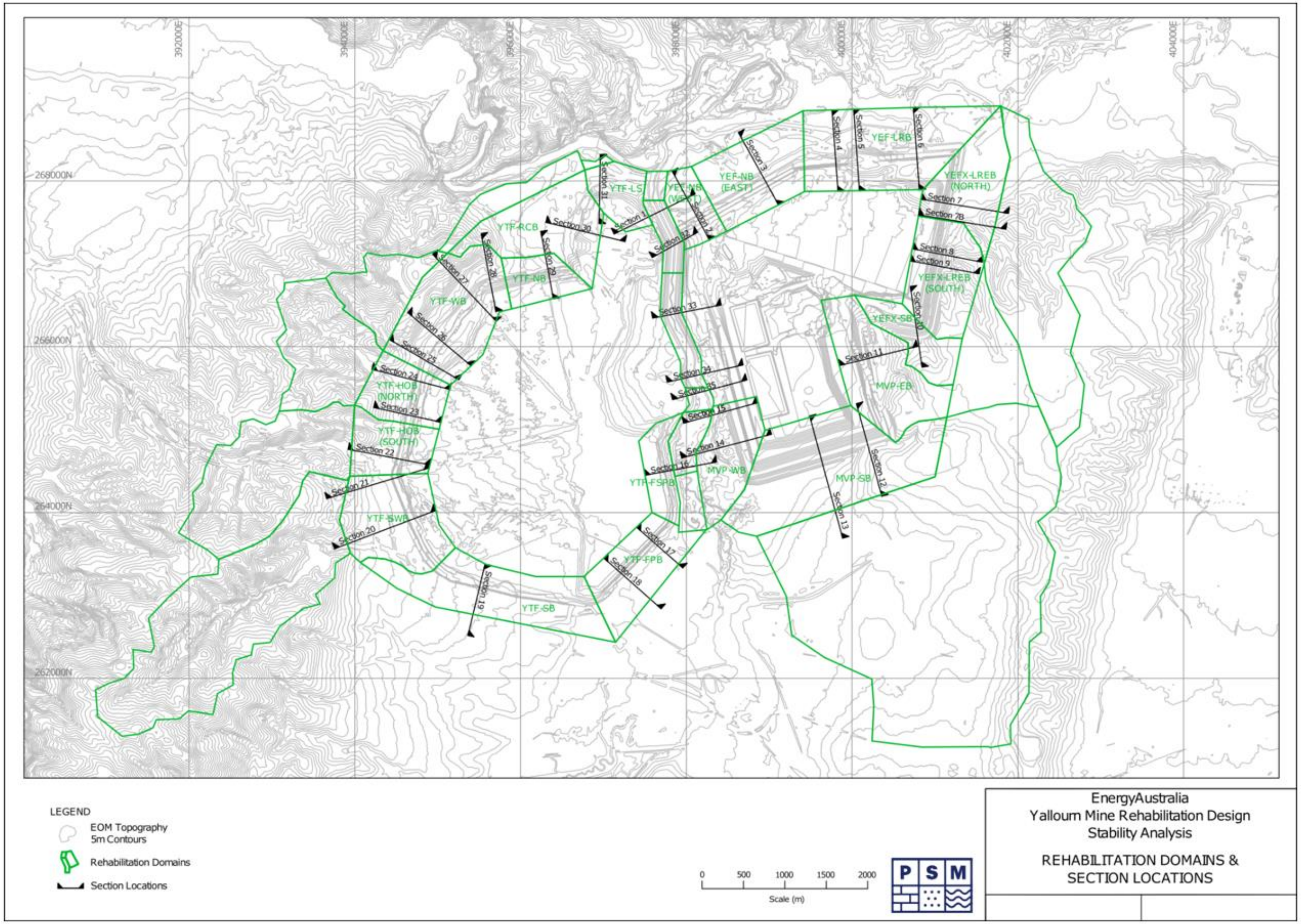


Figure 3-7: Yallourn Mine Geotechnical Rehabilitation Domains and Geotechnical Section Plan (PSM 2025b)

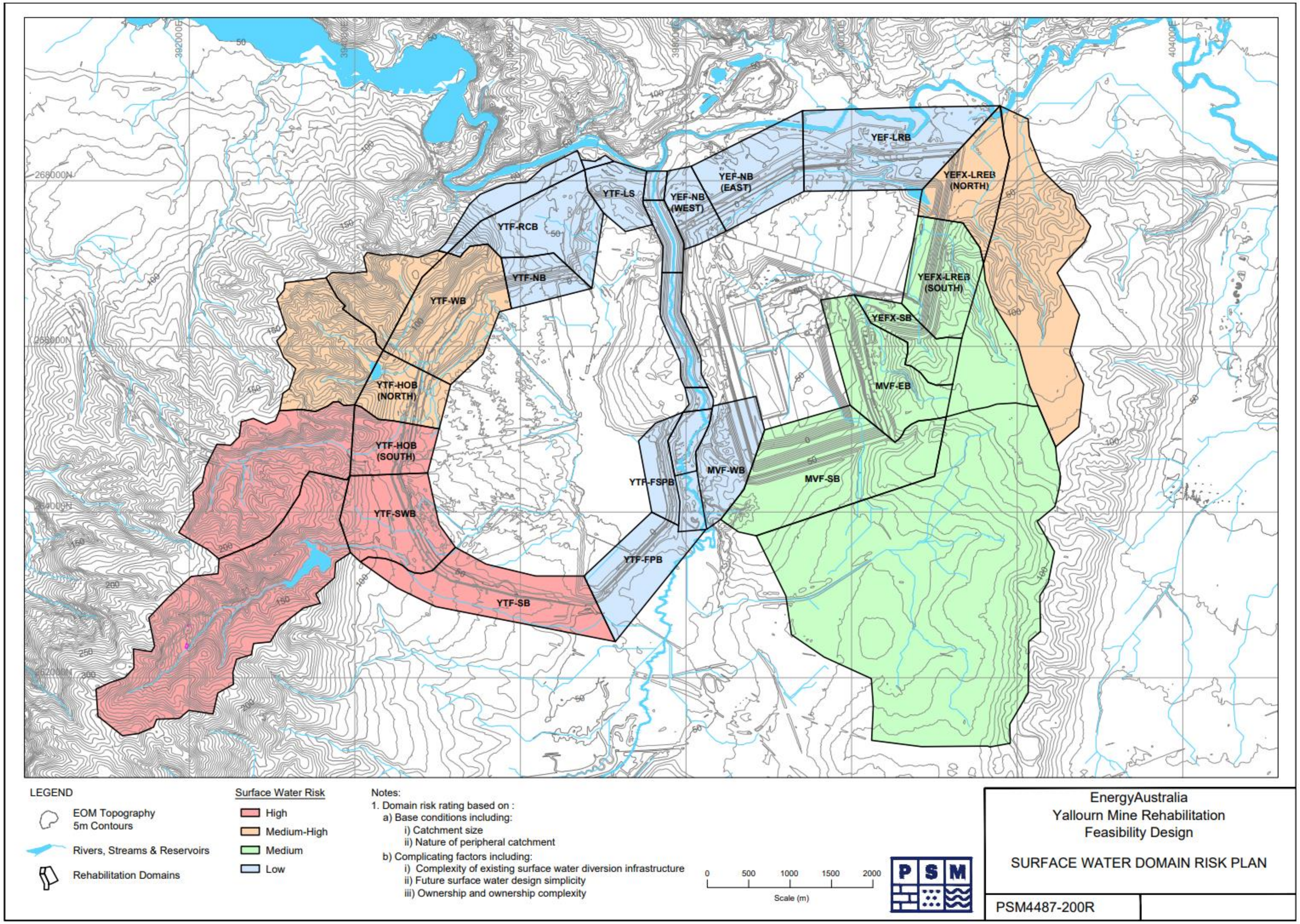


Figure 3-8: Peripheral Catchment Surface Water Domains for Mine Rehabilitation (PSM 2025b)

Chapter 4 Regulatory Context

This chapter provides an overview of the government policy and legal framework that applies to and informs the proposed rehabilitation of the Yallourn Mine. This chapter also sets out the current and future legal approvals and permissions required to support the activities and outcomes identified and proposed in this DMRP.

At this stage of the development of the DMRP, there is some uncertainty as to the entire set of legal approvals and permissions that will be required to implement the DMRP over the rehabilitation period. It is on this basis that EAY has identified the key legal approvals needed to commence the rehabilitation works as proposed in this DMRP. However, it is recognised that the development of the DMRP is an iterative process, with the document itself intended to be updated as needed to reflect and respond to changes in the policy, legal and technical state of knowledge, and stakeholder expectations as communicated during the formal exhibition period and beyond.

4.1 Guidelines, policy and standards

As mentioned, EAY has prepared this DMRP consistent with specific requirements for Declared Mines under the MRSDA and MRSDMIR. However, the regulatory context for the rehabilitation of declared mines is broader than these instruments. As such, the following have been drawn upon in developing this initial DMRP:

- *Latrobe Valley Regional Rehabilitation Strategy* (LVRRS) (2020 and amended 2023)
- *Integrated Mine Closure: Good Practice Guide* (2019, updated 2025)
- International Standards
- *Ministerial Guidelines for preparation of Declared Mine Rehabilitation Plans* (draft Nov 2024)

Each of these is discussed below.

4.1.1 Latrobe Valley Regional Rehabilitation Strategy

As discussed in Sections 3.6.3 and 3.6.4 of this DMRP, the LVRRS (Jacobs 2020a, DEECA 2023a) outlines policy and provides guidance to progress mine rehabilitation planning. The vision for the LVRRS is "that the Latrobe Valley coal mines and adjacent land are transformed to safe, stable and sustainable landforms which support the next land use". Underpinning the vision are the regional outcomes of:

- People, land, environment and infrastructure are protected.
- Land is returned to a safe, stable and sustainable landform.
- Aboriginal values are protected
- Community are engaged, and their aspirations inform the transformation.
- Long term benefits and future opportunities to the community are optimised.
- An integrated approach to rehabilitation and regional resource management is adopted.

To support the realisation of the vision and outcomes, the LVRRS sets out principles to guide planning for the rehabilitation of Latrobe Valley coal mines. The implementation principles of the LVRRS are shown in Table 4-1 and have been considered during the rehabilitation planning.

Table 4-1: LVRRS Principles

LVRRS Principle	Yallourn Mine Rehabilitation approach	DMRP Reference
The fire risk of the rehabilitated land should be no greater than that of the surrounding environment.	Exposed coal above lake level to be capped Fire control management plans Fire suppression infrastructure Lake provides water source for firefighting Self-heating technical studies	Chapter 8 Technical Studies Chapter 11 Risk Identification and Management
Ground instability and ground movement risks and impacts during rehabilitation and in the long-term, and requirements for ongoing management to sustain a safe and stable landform, should be minimised as far as practicable.	Significant technical studies have been conducted to design a landform that is stable.	Chapter 8 Technical Studies Chapter 11 Risk Identification and Management
Mine rehabilitation should plan for a drying climate. Rehabilitation activities and final landforms should be climate resilient.	Climate projections have been incorporated into relevant technical studies.	Chapter 8 Technical Studies
Any water used for mine rehabilitation should not negatively impact on traditional owners' values, environmental values in the Latrobe River system, or the rights of other existing water users.	The LVRRS Amendment provides guidance on potential water sources and access arrangements. The bulk water entitlement application for rehabilitation will be based on LVRRS Amendment (DEECA 2023a) and supporting technical study (Alluvium and HARC 2023).	Chapter 8 Technical Studies
Traditional owners should be involved in rehabilitation planning, assessment and decision-making.	EAY has engaged with GLaWAC during the rehabilitation planning. Consultation with Traditional Owners is a requirement of the MRSDA and MRSDMIR.	Chapter 10 Community and Stakeholder Consultation
The community should be consulted on rehabilitation proposals, the potential impacts, and have the opportunity to express their views.	EAY has engaged with the community during the rehabilitation planning, including via the Environment Review Committee (ERC). Further engagement will occur during the 60-day public exhibition period for this DMRP.	Chapter 10 Community and Stakeholder Consultation

4.1.2 Integrated Mine Closure: Good Practice Guide

The *Integrated Mine Closure: Good Practice Guide* (ICMM 2025) promotes a disciplined approach to integrated closure planning that considers environmental, social and economic factors throughout the life of the mine.

The guide provides a framework for closure planning that has been incorporated into this DMRP, particularly with the development of the vision, principles, objectives and closure criteria. Elements of the guide were also incorporated into the risk assessment process (refer to Chapter 11) such as the control identification decision tree.

4.1.3 International Standards

International Standards related to mine rehabilitation planning include:

- *Mine closure and reclamation planning – Part 1: Requirements (ISO 21795-1:2021)*
- *Mine closure and reclamation planning – Part 2: Guidance (ISO 21795-2:2021)*
- *Mine closure and reclamation – Vocabulary (AS ISO 20305:2021)*

Mine closure and reclamation planning – Part 1 and *Part 2* (ISO 2021a, ISO 2021b) contain the requirements and recommendations for mine closure and reclamation planning. The main objective of these standards is to promote consistency and quality in planning for mine closure and reclamation. The objectives of the mine closure framework have been incorporated into the rehabilitation planning process, with the elements of the framework being: responsibility, integration, design, risk and opportunity assessment and management, evaluation and improvement, and knowledge.

The *Mine closure and reclamation – Vocabulary* (Australian Standards 2021) document forms the basis of the glossary in this DMRP, with some adjustments made based on the *MLRA Vocabulary* (MLRA 2024b) publication, which provides terms relevant to declared mine rehabilitation in Victoria.

The site maintains certification to:

- *Environmental management systems—Requirements with guidance for use (ISO 14001:2015)* (ISO 2015a),
- *Occupational health and safety management systems—Requirements with guidance for use (ISO 45001:2018)* (ISO 2018a), and
- *Quality management systems—Requirements (ISO 9001:2015)* (ISO 2015b).

EAY intends maintaining these certifications during rehabilitation to provide strong systems, governance and quality control throughout the project.

Additionally, ISO standards relevant to risk management were considered during the risk assessment process (Chapter 11).

4.1.4 Draft Ministerial Guidelines

Section 120A of the MRSDA enables the Minister to make guidelines relating to any of the objectives or purposes of the MRSDA or the MRSDMIR, which are given statutory effect once published in the Government Gazette.

In November 2024, DEECA provided its draft *Ministerial Guidelines for preparation of Declared Mine Rehabilitation Plans* for consultation with declared mine licensees (DEECA 2024b) (Draft Ministerial Guidelines). The Draft Ministerial Guidelines aim to clarify the expectations to assist declared mine licensees to prepare a DMRP to meet the statutory requirements. EAY has considered and referred to the Draft Ministerial Guidelines in preparing this DMRP.

EAY notes that at the time of exhibition of this DMRP, the Draft Ministerial Guidelines were not yet finalised or publicly available.

4.2 Legislative Framework for the Preparation of a DMRP

The MRSDA and MRSDMIR include requirements governing the rehabilitation of Declared Mines, and specifically for the preparation of a DMRP. Sections 84AZU(3) and 84AZU(4) of the MRSDA set out the mandatory content to be included in a DMRP which includes addressing closure criteria, a post-closure plan, assessment of risks posed by geotechnical, hydrogeological, water quality or hydrological factors within the declared mine land, and consultation with prescribed persons. Further form and content requirements for DMRP are prescribed by the MRSDMIR.

As part of preparing for the submission of the DMRP to the Department Head for consideration and approval, the proposed DMRP must be publicly exhibited for at least 60 days. The preparation of the DMRP must also include consultation with the prescribed persons or classes of persons listed under regulation 64G of the MRSDMIR. Matters raised during the exhibition period and through consultation will be considered by EAY, and the draft DMRP updated in light of this consideration before its submission to the Department Head for approval. This process is discussed in more detail in Chapter 10.

On receiving the DMRP, the Department Head must consult the Mine Land Rehabilitation Authority (MLRA), and other relevant Ministers as listed in section 84AZV(1) of the MRSDA (refer to comments in Table 4-3) before approving, denying or requiring changes to the plan.

The DMRP is an iterative document that will continue to be reviewed and updated over time to ensure that it reflects the latest evidence base and status of other regulatory processes. Section 84AZW of the MRSDA sets out the process for applying to the Department Head for variation of DMRP. The Department Head may also, on its own motion, direct a declared mine licensee to apply for a variation (section 84AZW of the MRDSA).

The licence relinquishment process commences with the licensee applying to the Minister for a "*determination that the closure criteria for the declared mine land covered by the licence of the licensee have been met*" (section 84AZY of the MRSDA). The Minister must then request advice from the MLRA and consult with other relevant Ministers as listed in section 84AZZ(1)(b) of the MRSDA, before determining whether the closure criteria have been met. Relinquishment can occur when the Minister has confirmed that the Closure Criteria have been achieved, and any relevant payment has been made to the "Declared Mine Fund" established under the MRSDA.

4.3 Legislation Relevant to Rehabilitation of Yallourn Mine

Further to the requirements of the MRSDA and MRSDMIR, other Acts and Regulations are also relevant to the rehabilitation of Yallourn Mine. These are summarised in Table 4-2 and Table 4-3.

Table 4-2: Summary of Relevant Commonwealth Legislation

Commonwealth Legislation	Summary of legislation	Relevance to rehabilitation
Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act)	The EPBC Act aims to promote ecologically sustainable development through the conservation and sustainable use of natural resources, conserve biodiversity, and protect heritage values. The EPBC Act establishes a framework for the protection of the environment, particularly those aspects that are matters of national environmental significance (MNES), whereby environmental impact assessments and approvals are required to ensure that activities likely to have significant environmental impacts are properly evaluated. Under the EPBC Act, a "controlled action" is an action that requires approval from the Commonwealth Minister for the Environment because it is likely to have a significant impact on MNES. The Act also includes provisions for bilateral agreements with states to reduce duplication in environmental assessments. The EPBC Act is administered by Department of Climate Change, Energy, the Environment and Water (DCCEEW). For EPBC Act assessments related to coal mining developments, the Independent Expert Scientific Committee on Unconventional Gas Development and Large Coal Mining Developments (IESC) is the statutory committee that provides independent advice on the impacts that large coal developments may have on water resources (IESC 2024).	The proposed works under this DMRP may be subject to assessments, advice and decisions under the EPBC Act. To address this, EAY will assess whether the proposed rehabilitation triggers the requirement for approval under EPBC Act approval. Particular consideration will be given to whether the proposed rehabilitation is likely to have a significant impact on water resources due to coal seam gas development or large coal mining development (i.e., the "water trigger"). If the rehabilitation work proposed under this DMRP is determined to be a controlled action under the EPBC Act and also requires an environmental assessment under the EE Act, the assessment process for such actions may be accredited to align with the Victorian environmental assessment process, ensuring that a single assessment satisfies both the Commonwealth and state requirements. However, final approval authority under the EPBC Act remains with the Commonwealth Minister.

Commonwealth Legislation	Summary of legislation	Relevance to rehabilitation
Native Title Act 1993 (Cth)	Traditional Owners have specific rights related to Crown land which are reflected in the *Native Title Act 1993* (Cth). This Act provides a legal framework for the recognition and protection native title rights, provides a process for claiming native title, and sets rules for future dealings with land that might affect these rights.	Yallourn Mine has a Native Title Agreement with the Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC).

Table 4-3: Summary of Relevant Victorian Legislation

State Legislation	Summary of legislation	Relevance to rehabilitation
Aboriginal Heritage Act 2006 (Vic) (AH Act)	Provides for the protection of Aboriginal cultural heritage in Victoria and recognises traditional owners as protectors of their cultural heritage on behalf of Aboriginal people and all other peoples through establishing a framework for Registered Aboriginal Parties.	The proposed works under this DMRP may be subject to assessment and approval under the AH Act. EAY will give particular consideration to whether any proposed works or actions trigger a requirement for a Cultural Heritage Management Plan (CHMP), or any other permits or agreements under the AH Act.
Conservation Forests & Lands Act 1987 (Vic) (CFL Act)	Establishes a framework that enables the Minister to act as an effective conserver of the State's lands, water, flora and fauna, and promotes the conservation of Victoria's native flora and fauna.	The proposed works under this DMRP may trigger requirements under this Act for new or amended co-operative land management agreements between itself and the State.
Crown Land (Reserves) Act 1978 (Vic)	Establishes a legislative framework for the reservation, management, and use of Crown land for specific public purposes, such as public recreation, conservation, education, health, tourism, and other community benefits. The Act allows for land to be reserved either temporarily or permanently, with the reservation process requiring publication in the Government Gazette and, in some cases, consultation with relevant authorities or public notice.	The proposed works under this DMRP may trigger the need for any new or amended licences under this Act for conservation protection purposes. EAY must consult on its proposed DMRP with the Minister administering this Act (section 84AZU(4), MRSDA and regulation 64G, MRSDMIR). The Department Head must also consult with the Minister administering this Act in respect of the closure criteria proposed in the DMRP (section 84AZV(1)(b), MRSDA).
Environment Protection Act 2017 (Vic) (EP Act)	The Act provides a legislative framework for protecting human health and the environment from pollution and waste and introduces a general environmental duty to	In relation to current operations, the EP Act governs various aspects of Yallourn Mine that interact with rehabilitation such as contaminated land management, dust

State Legislation	Summary of legislation	Relevance to rehabilitation
	minimise risks of harm from these sources. Additionally, the Act and associated Regulations establish a permissions scheme for issuing various licences and permits and provides a framework for waste management. The EP Act also establishes the Environment Protection Authority (EPA). The EPA is responsible for administering the EP Act. The EPA provides guidance to the mining industry via the *Mining and quarrying - Guide to preventing harm to the people and the environment* (EPA 2023) publication which includes information on complying with the environmental duties listed in the EP Act. ERR and EPA work closely together under a have a memorandum of understanding to identify and manage potential overlaps in work areas (ERR and EPA 2021).	management, noise management, surface water discharges, waste management, landfill management, and general environmental hazards. Additionally, both the current activities and the proposed works under in this DMRP will continue to attract the various positive duties under the EP Act. Particular consideration will be given to whether the proposed rehabilitation is likely to trigger the requirement for new or amended permissions, noting that EAY has an Operating Licence on foot under the EP Act in respect of its landfill, power generation, mining and reportable priority waste management activities. EAY must consult on its proposed DMRP with the Minister administering this Act on its proposed DMRP (section 84AZU(4), MRSDA and regulation 64G, MRSDMIR). The Department Head must consult with Minister administering the EP Act and the Environment Protection Authority in considering whether or not to approve the DMRP (sections 84AZU and 84AZV, MRSDA and regulation 64L, MRSDMIR).
Environmental Effects Act 1978 (Vic) (EE Act)	The EE Act aims to ensure that environmental considerations are taken into account in the decision-making process for significant projects and thereby establishes a framework for obtaining information and advice on the likely environmental effects of projects.	The proposed rehabilitation works under this DMRP may potentially be subject to assessments, advice and decision by the Minister for Planning under the EE Act. The LVRRS Amendment indicated that:

State Legislation	Summary of legislation	Relevance to rehabilitation
	The EES process is initiated by the referral of a proposed project for assessment by the Minister for Planning. The Minister will determine whether the project is likely to have a significant effect on the environment, with the possible outcomes being that: • no EES required. • no EES required, provided conditions are satisfied; or • EES required. Where an EES is required, the proponent is required to prepare a formal document as to the environmental effects of the proposed project or works that are capable of having a significant impact on the environment. The EES process involves public consultation, and the Minister may require supplementary statements or additional information as necessary. The final assessment by the Minister is provided to relevant decision-makers, who must consider it before making any statutory decisions or allowing works to proceed. The EES process is a statutory mechanism to ensure that environmental considerations are integrated into decision-making processes, rather than being a statutory approval in and of itself. The Department of Transport and Planning (DTP) administers the EE Act and EES process, as guided by the	*"The requirement for referrals under the EE Act and EPBC Act at Hazelwood has created a presumption that referrals are likely to be required for the remaining mines to inform submission of DMRPs by their due date of October 2025. Decisions on water access do not predetermine the outcome of a potential EES process or which rehabilitation works will be approved in a DMRP." (DEECA 2023a)* EAY has commenced engagement with the Minister for Planning in respect of the potential application of the EES process in relation to the rehabilitation of the Yallourn Mine as contemplated by this DMRP. If an EES is required, other approvals processes and applications will be put on hold until the EES process is completed. In relation to its proposed DMRP, EAY must consult with the Minister responsible for administering the EE Act (regulation 64G, MRSDMI). In the case of a DMRP that is subject to an EES, the Department Head must consult with Minister administering the EE Act in considering whether or not to approve the DMRP (section 84AZV, MRSDA and regulation 64L, MRSDMIR).

State Legislation	Summary of legislation	Relevance to rehabilitation
	Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978 (DTP 2023).	
Flora and Fauna Guarantee Act 1988 (Vic) (**FFG Act**)	The FFG Act aims to protect and enhance Victoria's biodiversity and mitigate the impacts of potentially threatening processes through a range of conservation and management measures.	The proposed rehabilitation works under this DMRP may potentially trigger requirements for FFG Act approvals and other compliance matters.
Forests Act 1958 (Vic)	The Act provides the framework for the control and management of State forests, including the establishment, maintenance, improvement, and renewal of forests and plantations in Victoria.	The proposed rehabilitation works under this DMRP may potentially trigger requirements for approvals and other compliance matters under this Act. The Department Head must consult with Minister administering this Act in respect of the closure criteria proposed in the DMRP (section 84AZV(1)(b), MRSDA).
Heritage Act 2017 (Vic)	Provides for the protection and conservation of the cultural heritage of the State of Victoria, including the establishment of a Victorian Heritage Register for the registration of places and objects of cultural heritage significance, and a Heritage Inventory for recording archaeological sites and approved sites of archaeological value.	The proposed rehabilitation works under this DMRP may potentially trigger requirements for approvals and other compliance matters under this Act.
Land Act 1957 (Vic)	Governs the management and disposition of Crown land in Victoria. It covers various aspects, including the sale, lease, and licensing of Crown land, as well as the reservation and use of such land for public purposes.	The proposed rehabilitation works under this DMRP may potentially trigger requirements for approvals and other compliance matters under this Act. The Department Head must consult with Minister administering this Act in respect of the closure criteria proposed in the DMRP (section 84AZV(1)(b), MRSDA).

State Legislation	Summary of legislation	Relevance to rehabilitation
Mineral Resources (Sustainable Development) Act 1990 (Vic) (MRSDA) *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019* (Vic) (MRSDMIR)	The purpose of the MRSDA is to "…*encourage mineral exploration and economically viable mining and extractive industries which make the best use of, and extract the value from, resources in a way that is compatible with the economic, social and environmental objectives of the State"* (section 1 of MRSDA). The MRSDA also establishes a legal framework to ensure that mined lands are rehabilitated. The supporting MRSDMIR were updated in 2022 is include amended regulations for declared mines. This included prescribing certain matters concerning DMRPs and registration of declared mine. DEECA administers the MRSDA, with ERR being the primary regulator for the mining industry. DEECA and ERR work closely with other regulators and agencies to provide a whole-of-government approach. Key overlaps are discussed below to provide some context for the current and potential future approvals for mine rehabilitation.	The MRSDA and MRSDMIR set out the specific requirements for the preparation of, and process for considering and approving, DMRPs.
National Parks Act 1975 (Vic)	Governs the management and use of National and State parks in Victoria.	The proposed rehabilitation works under this DMRP may potentially trigger requirements for approvals and other compliance matters under this Act. The Department Head must consult with Minister administering this Act in respect of the closure criteria proposed in the DMRP (section 84AZV(1)(b), MRSDA).

State Legislation	Summary of legislation	Relevance to rehabilitation
Planning and Environment Act 1987 (Vic) (PE Act)	Establishes the framework for regulating land use in Victoria by setting out the objectives, structure, and application of planning schemes. The PE Act aims to ensure the fair, orderly, economic, and sustainable use and development of land while balancing the present and future interests of all Victorians. It also seeks to integrate land use and development planning with environmental, social, and economic policies at state, regional, and municipal levels. Planning schemes are the primary instruments for regulating land use and development in Victoria. These schemes include the Victoria Planning Provisions, a statewide reference document that ensures consistency across all planning schemes. Each planning scheme incorporates both the State Planning Policy Framework, which addresses issues of state importance, and the Local Planning Policy Framework, which includes local and regional strategic policies relevant to specific municipalities.	At this stage, it is considered unlikely that planning approval will be required for activities associated with the rehabilitation works as proposed under this DMRP, given the underlying land zoning (Special Use Zone Schedule 1 of Latrobe Planning Scheme). However, there may be requirements for approvals and other compliance matters under the PE Act, particularly if there are any changes to the applicable planning scheme and its incorporated policies. This will be monitored by EAY. Particularly relevant to rehabilitation will be whether any need to remove native vegetation is identified as part of the proposed rehabilitation under this DMRP, and to confirm whether such vegetation is located on Crown Land needing permit under the PE Act or EAY land. The Department Head must consult with Minister administering this Act in respect of the closure criteria proposed in the DMRP (section 84AZV(1)(b), MRSDA). The Department Head must also consult the relevant responsible authority in considering whether or not to approve the DMRP (regulation 64L, MRSDMIR).

State Legislation	Summary of legislation	Relevance to rehabilitation
Traditional Owner Settlement Act 2010 (Vic)	Traditional Owners may have specific rights related to Crown land under the *Traditional Owner Settlement Act 2010* (Vic). This Act creates an alternative framework to the *Native Title Act 1993* (Cth) for negotiating land use agreements with the Victorian Government.	The proposed works under this DMRP may trigger the land use agreement processes under this Act. GLaWAC is the registered entity for Yallourn and the majority of Gippsland. EAY will consult GLaWAC and all other relevant traditional owner groups and entities within the meaning of this Act in accordance with sections 84AZU(4) of the MRDSA and regulation 64G(2) of the MRSDMIR.
Water Act 1989 (Vic) (Water Act)	The Water Act aims to ensure the efficient and equitable use of water resources, protect environmental qualities, and involve the community in water management decisions, while providing water authorities with the necessary powers to fulfil these objectives. DEECA administers the Water Act.	The proposed works under this DMRP will trigger the need to apply for various water entitlements under the Water Act. Particularly relevant to the proposed mine rehabilitation works are bulk water entitlements, take and use licenses, works on waterways licenses, groundwater extraction licences and operating works licences. The Department Head must consult with Minister administering this Act in respect of the closure criteria proposed in the DMRP (section 84AZV(1)(b), MRSDA).
Wildlife Act 1975 (Vic)	The Act is a key piece of legislation in Victoria that governs the protection and management of wildlife. It includes various provisions related to offences, permits, and the regulation of human activities that may impact wildlife.	The proposed works under this DMRP may trigger the need for approvals under this Act. The Department Head must consult with Minister administering this Act in respect of the closure criteria proposed in the DMRP (section 84AZV(1)(b), MRSDA).

4.4 Summary of associated documents

In planning for the delivery of a safe, stable and sustainable landform for the Yallourn Mine, EAY will also draw from a wide range of other good practice guidance about mine rehabilitation as summarised in Section 4.1. This is not an exhaustive list of relevant guidance documents as other documents may also be referred to and utilised as required (e.g. for regulatory purposes). The inclusion of a document in Table 4-4 does not translate to EAY formally complying with every aspect of the document, rather the information has been used to guide effective rehabilitation planning and implementation.

Table 4-4: Summary of Guidance Documents for Yallourn Rehabilitation

Policy and Plans	**Summary**
Department of Environment, Land, Water and Planning. (2017). *Protecting Victoria's environment – Biodiversity 2037*. State of Victoria	Sets long-term goals for biodiversity conservation, guiding mining operations to align with state biodiversity objectives. Provides guidance on future biodiversity and habitat land uses.
Guidelines	**Summary**
Department of Energy, Environment and Climate Action. (2021). *Community Engagement Guidelines for Mining and Mineral Exploration in Victoria.*	Provides practical advice on community engagement needed for Yallourn Mine and this DMRP, ensuring miners consult with the community throughout the mining lifecycle.
Department of Environment, Land, Water and Planning. (2017). *Guidelines for the removal, destruction or lopping of native vegetation* (Publication No. 669.1).	Outlines how native vegetation removal is assessed and offset, ensuring minimal impact on biodiversity.
Department of Environment, Land, Water and Planning. (2017). *Native vegetation gain scoring manual* (Publication No. 669.2).	Details how to calculate biodiversity gains from vegetation management, especially used for offsetting previous Yallourn Mine activities.
Environmental Protection Authority Victoria. (2019). *Agriculture - Guide to Preventing Harm to People and the Environment* (Publication No. 1819.1).	Offers guidelines to manage agricultural risks, relevant for managing for agricultural land on the Mining Licences.
Environmental Protection Authority Victoria. (2007). *Protocol for Environmental Management: Mining and Extractive Industries* (Publication No. 1191).	Sets requirements for managing air emissions from mining activities, especially dust.
Environmental Protection Authority Victoria. (2017). *Assessing and Controlling Risk: A Guide for Business* (Publication No. 1695.1).	Provides a risk management framework to prevent harm to health and the environment. Provides a pathway to General Environmental Duty (GED) compliance.

Environmental Protection Authority Victoria. (2019). *Construction - Guide to Preventing Harm to People and the Environment* (Publication No. 1820.1).	Outlines risk management for construction activities, applicable to mine infrastructure projects.
Environmental Protection Authority Victoria. (2021). *Noise Control Guidelines* (Publication No. 1254.2).	Assists in managing noise pollution from mining operations.
Environmental Protection Authority Victoria. (2020). *Working Within or Adjacent to Waterways* (Publication No. 1896).	Provides guidelines for activities near waterways such as the Morwell and Latrobe Rivers around Yallourn Mine.
Environmental Protection Authority Victoria. (2021) *Mining and quarrying - Guide to preventing harm to the people and the environment* (Publication 1823.1)	Provides guidance on legal obligations including the general environmental duty and highlights parts of the EP Act that might apply to activities.
Environmental Protection Authority Victoria. (2021). Guideline for Environmental Management (GEM) - *Rapid Bioassessment Methodology for Rivers and Streams* (Publication No. 604.2).	Offers methods for assessing river and stream health, important for monitoring impacts of mining on local waterways.
Environmental Protection Authority Victoria. (2022). *Hydrogeological Assessment (Groundwater Quality) Guidelines* (Publication No. 668.1).	Guides groundwater quality assessments utilised for this DMRP.
Environmental Protection Authority Victoria. (2023). *Civil Construction, Building and Demolition Guide* (Publication No. 1834.1).	Provides guidelines for construction and demolition activities, relevant for mine rehabilitation.
Environmental Protection Authority Victoria. (2012). *Noise* (Publication No. 1467).	Guidelines for managing noise pollution.
Environmental Protection Authority Victoria. (2021). *Contaminated Land Policy* (Publication No. 1915).	Outlines management of contaminated land necessary for mine rehabilitation, especially relinquishment.
Environmental Protection Authority Victoria. (2021). *Guide to Classifying Industrial Waste* (Publication No. 1968.1).	Helps to classify and manage industrial waste from mining operations.
Environmental Protection Authority Victoria. (2021). *Managing Industrial Waste: Your Duties as a Waste Producer* (Publication No. 1990.1).	Details responsibilities for managing industrial waste.
Environment Protection Authority Victoria. (2022). *Groundwater sampling guidelines* (Publication No. 669.1).	Offers guidelines for groundwater sampling which are utilised in the groundwater monitoring program.

Environmental Protection Authority Victoria. (2020). *Guide to the Environment Protection Regulations* (Publication No. 1753.2).	Explains environmental protection regulations, ensuring compliance in mining operations.
Environmental Protection Authority Victoria. (2022). *Guide to the Duty to Manage* (Publication No. 1977.1).	Details the duty to manage environmental risks, applicable to mining activities.
Environmental Protection Authority Victoria. (2019). *Industry Guidance - Supporting You to Comply with the General Environmental Duty* (Publication No. 1741.1).	Provides guidance on complying with environmental duties.
Environmental Protection Authority Victoria. (2018). *Liquid Storage and Handling Guidelines* (Publication No. 1698).	Outlines best practices for storing and handling liquids such as diesel and other products used at Yallourn Mine.
Environmental Protection Authority Victoria. (2021). *Potentially Contaminated Land: A Guide for Business* (Publication No. 2010).	Offers guidance on managing potentially contaminated land.
Environmental Protection Authority Victoria. (2020). *Reasonably Practicable* (Publication No. 1856).	Explains the concept of taking reasonably practicable steps to manage risks and maintain GED compliance.
Environment Protection Authority Victoria. (2015). *Siting, design, operation and rehabilitation of landfills* (Publication No. 788.3).	Offers guidelines for landfill management, relevant for mine waste disposal into the EPA Licensed Landfills.
Environment Protection Authority Victoria. (2009). *Sampling and analysis of waters, wastewaters, soils and wastes* (Publication No. IWRG701).	Provides methods for sampling and analysis used to collect data for this DMRP.
Standards, Good Practice Guides	**Summary**
International Association for Public Participation (2015) *Quality Assurance Standard for Community and Stakeholder Engagement.*	The document outlines what each stage of a community and stakeholder engagement process should entail.
International Council on Mining and Metals (ICMM). (2019). *Integrated Mine Closure: Good Practice Guide (2nd edition)*	Provides best practices for mine closure, ensuring sustainable post-mining land use. Referenced frequently within this DMRP.
Standards Reference Group SERA (2021) National Standards for the Practice of Ecological Restoration in Australia. Edition 2.2. Society for Ecological Restoration Australasia.	Provides standards for ecological restoration which are proposed in the DMRP.

International Organization for Standardization (ISO)	Summary
International Organization for Standardization. (2021). *Mine closure and reclamation planning – Part 1: Requirements* (ISO Standard No. 21795-2:2021)	Provides requirements and recommendations for mine closure and reclamation planning. Objective is to promote consistency and quality in planning for mine closure and reclamation.
International Organization for Standardization. (2021). *Mine closure and reclamation planning – Part 2: Guidance* (ISO Standard No. 21795-1:2021)	Provides guidance on how to implement *Mine closure and reclamation planning – Part 1*.
International Organization for Standardization. (2015). *Environmental management systems—Requirements with guidance for use* (ISO Standard No. 14001:2015)	Sets standards for environmental management systems, ensuring systematic environmental management and good governance.
International Organization for Standardization. (2015). *Quality management systems—Requirements* (ISO Standard No. 9001:2015)	Provides standards for quality management systems, ensuring consistent quality in mining operations and good governance.
International Organization for Standardization. (2018). *Occupational health and safety management systems—Requirements with guidance for use* (ISO Standard No. 45001:2018).	Sets standards for occupational health and safety management, ensuring worker safety and flowing into public safety benefits.
Standards Australia Committee (2021). *Mine closure and reclamation – Vocabulary* (AS ISO No 20305:2021)	Establishes a vocabulary for mine closure and reclamation management

4.5 Existing Legal Approvals

Set out in Table 4-5 below are the current licenses, permits, agreements and other approvals (together, the "**legal approvals**") held by EAY. Most legal approvals were granted or obtained to facilitate and support current coal mining and power generation activities. However, as noted in the table, some existing legal approvals are identified as necessary and relevant to the rehabilitation works as proposed under this DMRP.

Table 4-5: Existing Legal Approvals for Yallourn Mine (and relevance to rehabilitation)

Work Stream	Legislation	Issued	Valid to	Comments
Landowner Agreements BBA-2778, BBA-2779 and BBA-2780	*Conservation Forests & Lands Act 1987* (Vic)	November 2015	No end date	In compliance with EPBC Act Approval 2008/4454, EAY has established three legally binding conservation covenants over various offset areas on EAY title in the form of Landowner Agreements for conservation protection purposes. The agreements are expressed to be binding on the landowners successors in title.
Crown land Licence No. 2022279	*Crown Land (Reserves) Act 1978* (Vic)	8 May 2014	10-year term ends 17 November 2025	EAY holds a section 17B Crown land licence which specifies that certain land has been "[t]emporarily reserved for Preservation of species of native plants" and authorises EAY to use the licensed area on a non-exclusive basis for the purpose of "conservation". Engagement commenced in late 2024 regarding a licence extension.

Work Stream	Legislation	Issued	Valid to	Comments
EPA Operating Licence OL000010961	*Environment Protection Act 2017* (Vic)	19 June 1996 Last amended 2023	NA	EAY holds an Operating Licence which governs certain aspects of its operations, namely its landfilling, power generation, reportable priority waste management and extractive industry and mining activities. Condition OL_L22.01 provides that EAY must prepare and implement a landfill and ash-pond rehabilitation plan that accords with the requirements of Section 8 of *Best Practice Environmental Management, Siting, Design, Operation and Rehabilitation of Landfills* (EPA Publication 788) and with the mining rehabilitation plan approved under the MRSDA. This plan was submitted to EPA in December 2021, and in accordance with the licence, will be revised and submitted at least every 5 years or after a major variation to the rehabilitation plan.
EPBC Act Approval 2008/4454	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)	15 February 2011, as varied in September 2021 and February 2024	30 November 2035	EA holds an EPBC Act Approval in relation to the realignment of the Yallourn Coal Field Development Project. The approval is subject to conditions (as varied) relating to the clearing and protection of Strzelecki Gums (a MNES) and addressing various procedural matters. EAY will continue to monitor and assess compliance with this EPBC Act Approval as the DMRP progresses.

Work Stream	Legislation	Issued	Valid to	Comments
Mining Licence MIN5003	*Mineral Resources (Sustainable Development) Act 1990* (Vic)	1996	Approved to 2051	The term of MIN5003 covers the expected rehabilitation period as proposed under this DMRP.
Mining Licence MIN5216	*Mineral Resources (Sustainable Development) Act 1990* (Vic)	1999	Expired 8 October 2019	An application to renew the licence was submitted to ERR prior to the expiry date, with a decision still pending. No coal mining has taken place under this licence (section 2.2.2).
Mining Licence MIN5304	*Mineral Resources (Sustainable Development) Act 1990* (Vic)	2000	Expired 12 July 2020	An application to renew the licence was submitted to ERR prior to the expiry date and is still pending. No coal mining has taken place under this licence (section 2.2.3).

Work Stream	Legislation	Issued	Valid to	Comments
Work Plan Variations (WPV)	*Mineral Resources (Sustainable Development) Act 1990* (Vic)	1996 and last varied in 2023	NA	Work Plan Variations are discussed at section 3.5.2, noting that the most recently approved WPV (2019) covered rehabilitation and closure planning. This preceded the release of the LVRRS (and its amended version) and the requirements for a DMRP under the MRSDA and MRSDMIR. While the 2019 WPV already covers rehabilitation, a DMRP is specifically required for declared mine land and is a standalone requirement under Part 7C of the MRSDA. It is not apparent that the DMRP will replace the need for a WPV. Instead, the two processes appear to operate in parallel, with the DMRP addressing the unique requirements of declared mine land and the WPV addressing broader changes to work plans, including rehabilitation, for other mining activities (KG18 in Table 17-1). Both must be approved by the Department Head. EAY will work with ERR to clarify and confirm specific arrangements in respect of the currently approved WPV going forward.
Native Title Agreement	*Native Title Act 1993* (Cth)	2000	NA	A Native Title Agreement is in place with GLaWAC. EAY will continue, through the rehabilitation planning and implementation stages, to adopt a co-operative approach to environmental management with GLaWAC.
Bulk Water Entitlement Conversion Order 1996 (consolidated to 2016)	*Water Act 1989* (Vic)	1996 Amended 14 April 2016	NA	The existing BWE allows EAY to take water up to an annual total of 36,500 ML from the Latrobe River System to supply electricity generation works.

Work Stream	Legislation	Issued	Valid to	Comments
Groundwater Licence No. 2007403	*Water Act 1989* (Vic)	25 March 1996 (but valid from 1 September 1995)	31 August 2025	Under the groundwater licence, EAY is entitled to extract groundwater to facilitate mining for coal and electricity generation. Some groundwater pumping from Yallourn Mine will be required to cover the operational period of the mine and the transition to the rehabilitation period. As such, EAY intends to apply to extend the term of the groundwater licence before the licence expires.
Licence to operate works Witts Gully (WLE048339)	*Water Act 1989 (*Vic)	2010 with various updates	30 June 2027	EAY holds this section 67 licence to operate a dam for industrial or commercial uses (as well as domestic and stock use). Witts Gully Dam will be required throughout the rehabilitation phase for firefighting purposes. As such, EAY will apply to extend the term of the licence before its expiry on 30 June 2027.
Licence to operate works Twin Ash Ponds (WLE048336)	*Water Act 1989* (Vic)	2010 with various updates	30 June 2027	EAY holds this section 67 licence to operate a dam for industrial or commercial uses (as well as domestic and stock use). A short extension of this licence will be needed to cover to end of operations in mid-2028. As such, EAY will apply to extend the term of the licence before its expiry on 30 June 2027.

4.6 Future Legal Approvals

Section 84AZU(3)(f) of the MRSDA and regulation 64F(1)(d) of the MRSDMIR require the DMRP to include "all the legal approvals and permissions required for the activities or outcomes in the declared mine rehabilitation plan". However, the Draft Ministerial Guidelines note that the regulatory framework is premised on the basis that all the necessary legal approvals and permissions required to implement the DMRP may not be in place for the preparation of the initial DMRP (DEECA 2024b). That is certainly the case in respect of this DMRP, but one that EAY would expect to have made significant progress on over the course of 2025 and 2026, well prior to planned closure of Yallourn Mine.

Set out in Table 4-6 below are the key future legal approvals identified as necessary and relevant to the rehabilitation works as proposed under this DMRP.

The future legal approvals set out below are in addition to the existing legal approvals in Table 4- above that have been identified as continuing to be needed to support the rehabilitation of Yallourn Mine as proposed in this DMRP.

Table 4-6: Key future legal approvals necessary to outcomes proposed in this DMRP

Application or Instrument	Legislation	Description	Planned timing for approvals
Bulk Water Entitlement (BWE)	*Water Act 1989* (Vic)	Passive filling of the mine void through rainfall and groundwater infill alone is estimated to take up to 80-100 years. That timeframe is potentially unacceptable from a geotechnical and public safety risk management perspective. As such, EAY intends to apply to the Minister for Water for a new BWE to support its proposed pit filling as set out in this DMRP. The current estimated time to fill if this BWE is granted is 24 years.	EAY plans to apply to the Minister for Water a new BWE by end 2026.
Take and Use Licence	*Water Act 1989* (Vic)	EAY acknowledges that any "take" of water from a waterway requires a water entitlement under the Water Act, such as a section 51 take and use licence. Some rainwater or other water may flow (otherwise than in a waterway or bore) on EAY land and enter the pit, such as during flooding events. The entering of such water that flows over EAY land into the pit is unlikely to be considered a "take" of the water, such that water can be retained in the pit (depending on the lake level) without the need for an entitlement under the Water Act (i.e., per section 8(4)(c) of the Water Act).	The need for other forms of water entitlements such as a take and use licence turn on whether EAY can obtain a BWE on acceptable terms for the pit filling purposes. As such, EAY expects to be in a position to identify and confirm the needs for other water entitlements around the end 2026.
Licence to construct works (etc.) on waterways	*Water Act 1989* (Vic)	There are several aspects of the rehabilitation solution that may trigger the requirement for a licence to construct works on waterways: southern coffer dam decommissioning, MRD works (spillway construction, reshaping, tunnel preparation), and connection of the pit overflow in NE corner to Latrobe River.	EAY will further investigate and assess its licence to construct works requirements by end 2026.

Application or Instrument	Legislation	Description	Planned timing for approvals
Environmental Effects Statement (EES)	*Environmental Effects Act 1978* (Vic) (EE Act)	An assessment and decision under the EE Act is not a "legal approval" but a legal mechanism by which the Minister for Planning gives advice to other decision-makers on whether the project is acceptable and any conditions that should apply to statutory approvals. As described above, the rehabilitation project is likely to involve a referral to the Minister to determine whether an EES is required.	Pre-referral engagement with the Minister has commenced and is expected to continue through the DMRP exhibition and assessment process.
EPBC Approval “water trigger”	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)	EAY to review if the rehabilitation project triggers the requirement for EPBC Act approval due to the water trigger or the potential for a significant impact of any other MNES.	EAY's review of EPBC triggers will coincide with ongoing development of DMRP. If a referral is needed, the timing is likely to align with any referral needed under the EE Act.

4.7 Other Possible Future Legal Approvals

Other possible future legal approvals may ultimately be required under Victorian legislation listed in Table 4-3 to support the rehabilitation works and outcomes proposed in this DMRP. EAY is not in a position to definitively and exhaustively list the other possible future legal approvals as there is considerable uncertainty as to the actual need. This is due in large part to dependency on identifying and being granted the key regulatory approvals needed under the DMRP, and associated mitigants, which must first be addressed in order to plan and schedule the work required to obtain other regulatory approvals and permits

Chapter 5 Environmental Setting

5.1 Introduction

This chapter outlines the Yallourn Mine environmental setting at a high level. Shown within are short sections and statistics on climate, topography, geology, hydrogeology, soils, hydrology, flora and fauna, fire, dust, and heritage. The information is used from existing datasets. Many of these aspects are then detailed further within this DMRP. Specifically, *Chapter 8 Technical Studies* introduces modelling and forecasting from this baseline data and *Chapter 12 Key Activities and Design Considerations* are directly informed by this chapter. Furthermore, *Chapter 13 Closure Criteria* is informed by the baseline data and analysis discussed in this Chapter.

5.2 Climate

An overview of the climate at Yallourn is provided below. Climate information is used to inform rehabilitation planning and is incorporated into relevant technical studies. Information in the technical studies may vary from the information presented below depending on the data set used (e.g. onsite data versus Bureau of Meteorology data, different time periods).

5.2.1 Rainfall

The Latrobe Valley climate is temperate and generally features cool to warm summers and mild to cool winters. Climate data has been sourced from SILO (Scientific Information for Landowners) datasets for the Bureau of Meteorology (**BOM**) Morwell (Latrobe Regional Airport) climate station (station number 085280). The BOM has maintained a rainfall record at Latrobe Regional Airport since 1984 and SILO has interpolated the data prior to this period based on the surrounding rainfall records.

The Yallourn Mine has hosted two former BOM stations as follows:

- Yallourn (station number 085098) operated between 1932 and 1949.
- Yallourn SECV (station number 085103) operated between 1950 to 1990.

The Yallourn Mine also currently operates five climate monitoring stations as follows:

- Fire service rain gauge – located at the fire services building in the main infrastructure area and manually operated since 1991.
- GPS weather station – located above the East Field Northern Batters and automatically operated since 2016.
- Fire service weather station – located at the south of Township Field and automatically operated since 2014.
- Yallourn North weather station – located at the YNOC and automatically operated since 2022.

The Yallourn Mine weather stations are located approximately 9-10 km west of Latrobe Regional Airport. A long-term rainfall comparison between Yallourn Mine and Latrobe Regional Airport shows more rainfall falling at the Yallourn Mine compared to the Latrobe Valley Airport BOM site. The average annual difference between Latrobe Regional Airport and the Yallourn Mine is 41mm or 5.5%.

Table 5-1: Summary of Rainfall at Yallourn Mine and Surrounds

Date range	Location	Average annual rainfall for the date range
1932 to 1949	Yallourn (085098)	886 mm
1950 to 1990	Yallourn SECV (085103)	876 mm
1984 to 2021	Latrobe Regional Airport (085280)	751 mm
1991 to 2021	Fire Service Rain Gauge	792 mm

For peak flow analysis, an understanding of peak rainfall intensity is needed. Shown below are the design rainfall charts for the Yallourn Mine ranging from a 63.2% annual exceedance probability (**AEP**) to a 1 in 2000-year AEP.

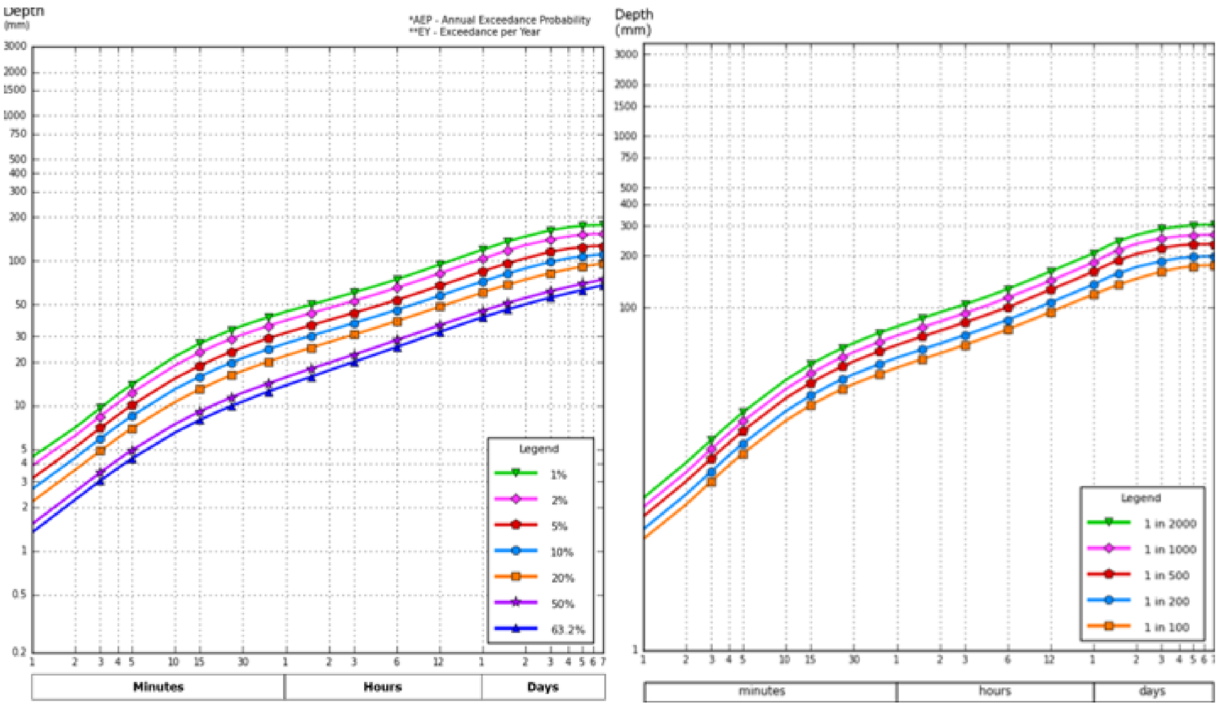


Figure 5-1: Intensity Frequency Duration Rainfall Design Values (BOM 2025b)

5.2.2 Evaporation

Long-term average annual pan evaporation is 1,233 mm with January experiencing the highest rate of evaporation and June experiencing the lowest rate of evaporation (GHD 2023). The mean monthly evaporation exceeds the mean annual rainfall during the warmer months (September to April). Rainfall exceeds the evaporation from May through to August (GHD 2023).

The mean number of cloudy days is also higher from May to August (15.6 days/month) than September to April (13.1 days/month), contributing to the lower evaporation rates (BOM 2025a).

The LVRRS (Jacobs 2020a) has adopted Morton's Shallow Lake Method as the preferred evaporation estimation technique for Latrobe Valley Mine Rehabilitation. This method gives an annual average evaporation of 1,068 mm for Yallourn which is 24% higher than the traditional pan evaporation method when multiplied by a factor of 0.7 to derive lake evaporation. Pan evaporators have been installed at site and will be used for future evaporation monitoring.

Two different sets of evaporation datasets have been adopted for this DMRP, these are:

- Morton's Shallow Lake Evaporation is used in the model to represent the evaporation loss from the lake surface. The shallow lake dataset is calculated using Morton's method which converts observed pan evaporation to the evaporation that would likely be observed on a larger body of water. This evaporation dataset will be used to simulate evaporation losses from the lake surface.
- Morton's Actual Evapotranspiration (Mact) represents the combined loss of water from a given catchment area, by evaporation from the soil surface and by transpiration from plants. The Mact dataset provided in the SILO data is calculated using Morton's method and is an input to the hydrological modelling (Australian Water Balance Model (AWBM)), to calculate surface runoff to the pit.

Table 5-2: Evaporation – Average Daily per Month (RGS 2025)

Month	Evaporation (Lake Surface, mm/day)	Evaporation (Catchment, mm/day)
January	5.5	4.3
February	4.8	3.5
March	3.4	2.3
April	2	1.2
May	1.1	0.7
June	0.7	0.6
July	0.8	0.6
August	1.4	1.1
September	2.4	2.1
October	3.5	3.2
November	4.5	4.0
December	5.3	4.4

5.2.3 Temperature

Yallourn is within a temperate climate setting with warm summers and cool winters (GHD 2023). The mean maximum temperature is highest in January (26.7 ºC) and lowest in July (13.8 ºC). The mean minimum temperature is also highest in January (13.0 ºC) and lowest in July (3.7 ºC) (BOM 2025a).

5.2.4 Wind Conditions

Wind roses summarise the occurrence of winds at a location, showing their strength, direction and frequency. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. The length of the bar represents the frequency of occurrence of winds from that direction, and the colour and width of the bar sections correspond to wind speed categories. Using wind rose plots, it is possible to visualise how often winds of a certain direction and strength occur at a particular location.

The wind rose from the EAY dust monitor in Yallourn North is provided in Figure 5-2. The annual wind rose for 2024 shows that westerly winds (blowing west to east) are most common at the Yallourn Mine.

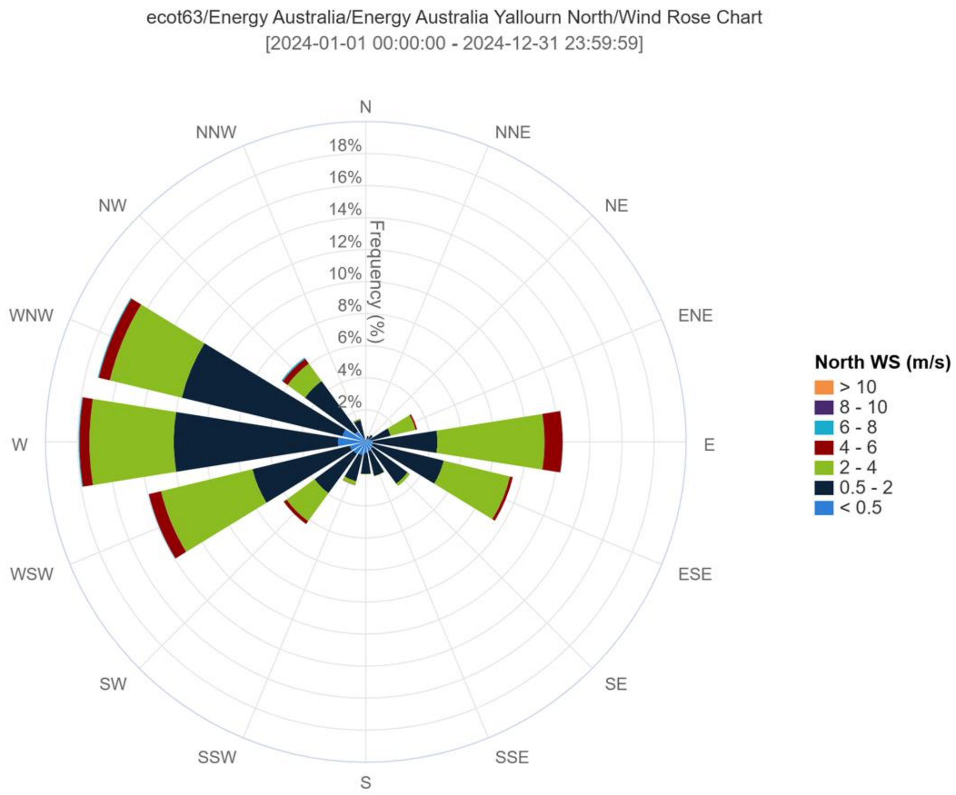


Figure 5-2: Annual Wind Rose Yallourn North

5.2.5 Climate Change

The *Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria* (DELWP 2020) documents revised estimates for rainfall, evaporation and runoff factors from 2040 to 2065. This document is referenced in the LVRRS and subsequent amendment as being the applicable guidelines (DJPR and DELWP 2000, DEECA 2023a). There are 42 global climate models (GCM) that were used to produce the low (wet), medium and high (dry) climate change projections under the Representative Concentration Pathway (RCP) 8.5 emissions scenario, and a slightly lower number of models for the RCP4.5 emissions scenario. The RCP8.5 emissions scenario incorporates high rates of greenhouse gas emissions and is recommended for water supply planning applications (DELWP 2020).

The 10th (low), 50th (medium) and 90th (high) percentile climate change projections provide a wide range of projections that are plausible. The high (dry) projection is sourced from the model that generates the 10th percentile driest projection (i.e., only 10 % of models produce results that are drier than this projection), whilst the low (wet) projection is sourced from the model that generates the 10th percentile wettest projection.

Victoria’s annual recorded rainfall has seen a downward trend from the early 1900s to date. This has seen reductions in annual streamflow and shifts in rainfall-runoff behaviour over recent decades.

Pan evaporation data now indicates a stable or increasing trend across southern Australia due to increasing vapour pressure deficits (i.e., decreasing humidity) since the mid-1990s, consistent with increases in temperature and decreases in rainfall over this period (DELWP 2020).

Table 5-3 presents the projected average annual temperature changes for the Latrobe Basin. Under the RCP8.5 emissions scenario, average annual temperature is projected to increase by 0.9-1.5 ºC by 2040 relative to 1995, with a medium projection of 1.2 ºC. Further temperature increases are projected between 1.7-2.8 ºC by 2065.

Table 5-3: Projected Change in Average Annual Temperature for the Latrobe Basin under Climate Change (DELWP 2020)

Temperature change relative to 1995 (ºC)							
River Basin	**Projection type**	**2020**		**2040**		**2065**	
Emissions scenario		RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
Latrobe	Low	0.5	0.4	0.9	0.7	1.7	1.0
	Medium	0.7	0.5	1.2	1.0	2.2	1.4
	High	0.8	0.7	1.5	1.2	2.8	1.8

Rainfall and evaporation projections for the Latrobe Basin are provided in DELWP (2020). Table 5-4 and Table 5-5 present the rainfall and evaporation projections for the Latrobe Basin using the RCP8.5 emissions trajectory. The projections show a declining rainfall trend and increased rates of evaporation across the Latrobe Basin between 2040 to 2065.

Table 5-4: Projected Change in Rainfall for the Latrobe Basin under Climate Change (DELWP 2020)

River Basin	Projection	Rainfall change relative to 1995 (%)		
		Year 2020	Year 2040	Year 2065
		RCP8.5	RCP8.5	RCP8.5
Latrobe	Low (Wet)	1.80%	3.30%	2.20%
	Medium	-2.20%	-4.00%	-4.50%
	High (Dry)	-6.30%	-11.40%	-16.70%

Table 5-5: Projected Change in Evapotranspiration for the Latrobe Basin under Climate Change (DELWP 2020)

River Basin	Projection	Evapotranspiration change relative to 1995 (%)		
		Year 2020	Year 2040	Year 2065
		RCP8.5	RCP8.5	RCP8.5
Latrobe	Low (Wet)	1.40%	2.50%	4.80%
	Medium	2.50%	4.50%	7.60%
	High (Dry)	3.20%	5.80%	11.30%

5.3 Topography

The Yallourn area has been significantly altered through historic and current mining activities. The natural terrain has a topographic high at the southwestern boundary of Reduced Level (RL) 200 m Australian Height Datum (AHD) and a topographic low of RL 30 m at Thoms Bridge on the Latrobe River. North of the Latrobe River, the topography of the YNOC ranges from an elevation of approximately RL 105 m in the western margin of the former YNOC down to RL 40 m at the Latrobe River.

The Yallourn Mine is bounded to the west by a topographical ridge of around RL 190 m and to the east of the mine, the elevation ranges from RL 30 m AH close to the Latrobe River to RL 100 m near Morwell. The area to the south towards Hazelwood Mine is generally flat between RL 40-70 m.

In-pit overburden placement within the northern and southern portion of Township Field has produced a downslope grade from the southwest (RL 35-40 m AHD) to the east (RL -15 to 30 m AHD) at the Fire Service Pond. A downslope grade from east to west towards Township Lake and the Fire Service Pond occurs from the Mid Field Dump (RL 40-50 m AHD). A downslope grade from north to south towards Township Lake also occurs (RL 5 to 15 m AHD). East Field and the operational Maryvale Field floor range from RL -30 to -50 m AHD with variations in elevation based on geology and the distribution of overburden across the pit floor.

5.4 Geology

5.4.1 Regional Geology

5.4.1.1 Gippsland Basin depositional settings

The Gippsland Basin was initiated most likely during the Jurassic period, with rift-related graben development and subsidence occurring during the Cretaceous–Cenozoic period (GHD 2023). Non-marine rift-fill sandstone of the Lower Cretaceous age Strzelecki Group underlies and outcrops extensively to the south of the study area in the Balook Block, and to the west in the Narracan Block. Episodic basin inversion commencing in the mid-Cretaceous period folded and uplifted the Strzelecki Group, forming the Strzelecki Ranges and causing changes in sedimentation patterns.

The structural zones within the Gippsland Basin are shown in Figure 5-3. Yallourn Mine is located to on the north western margin of the Latrobe Valley Depression which from the western end of the Gippsland Basin. The Latrobe Valley Depression is bounded to the north by the Southern Highlands and Lakes Entrance Platform and to the south by the Balook Block and Baragwanath Anticline. The Lake Wellington Depression is located to the east of the Latrobe Valley Depression, with the boundary coinciding with the western limit of the marine transgression and deposition of the Seaspray Group. The thickness and depth of the Gippsland Basin sediments increase to the east into the Lake Wellington Depression and offshore in the Central Deep (the principal depo-centre of the basin).

The Moe Swamp sub-basin is located in the north western extremity of the Gippsland Basin, bounded by the Darnum Fault to the west, Palaeozoic and Cretaceous basement to the north and south, and to the east by the regionally significant Yallourn Fault that separates it from the Latrobe Valley Depression.

The lignite seams of the Latrobe Valley Depression were deposited in swamps during renewed rifting in the late Eocene to Miocene epoch. The relatively shallow Latrobe Valley lignite fields lie in paleo-depressions between the Strzelecki Group (and Palaeozoic) blocks west of the marine Seaspray Group. The thickness and uniformity of the lignite seams over large areas of the valley is consistent with slow, steady rates of subsidence. To the north of the Latrobe River, the lignite seams are deeply buried and split into multiple thin sub-seams.

Basin inversion in the Late Miocene reactivated older basin faults, leading to the formation of reverse faults, monoclines and paleo-uplift in the poorly consolidated Latrobe Valley Group. The principal trend of most structures is parallel to the Latrobe Syncline. This fold plunges to the east and runs parallel to the Lower Cretaceous ranges to the south. Erosion of the uplifted Latrobe Valley deposits continued into the Late Pliocene, before deposition of sand, clay and silt of the Plio–Pleistocene Haunted Hill Formation (GHD 2023).

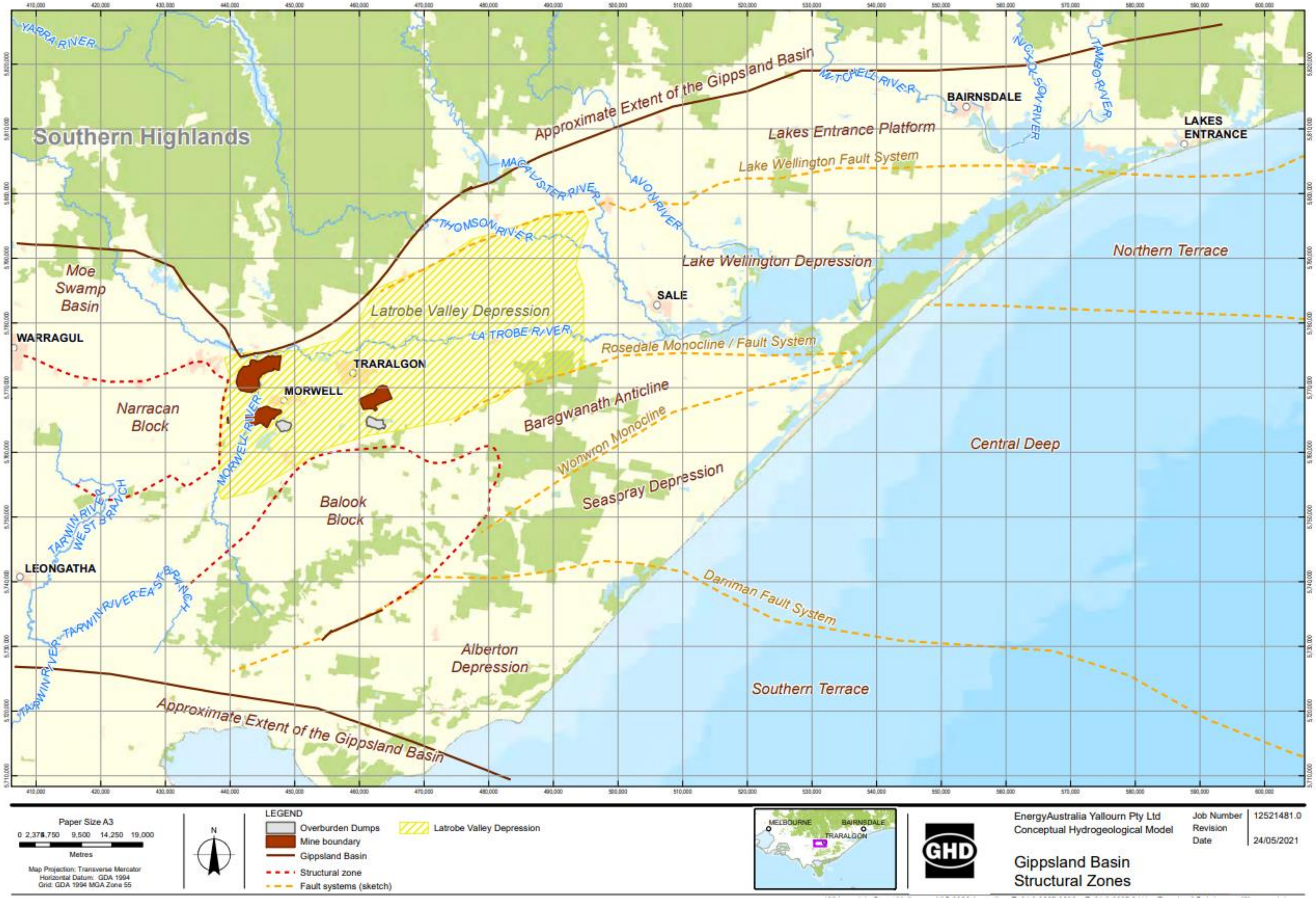


Figure 5-3: Gippsland Basin Structural Zones (GHD 2023)

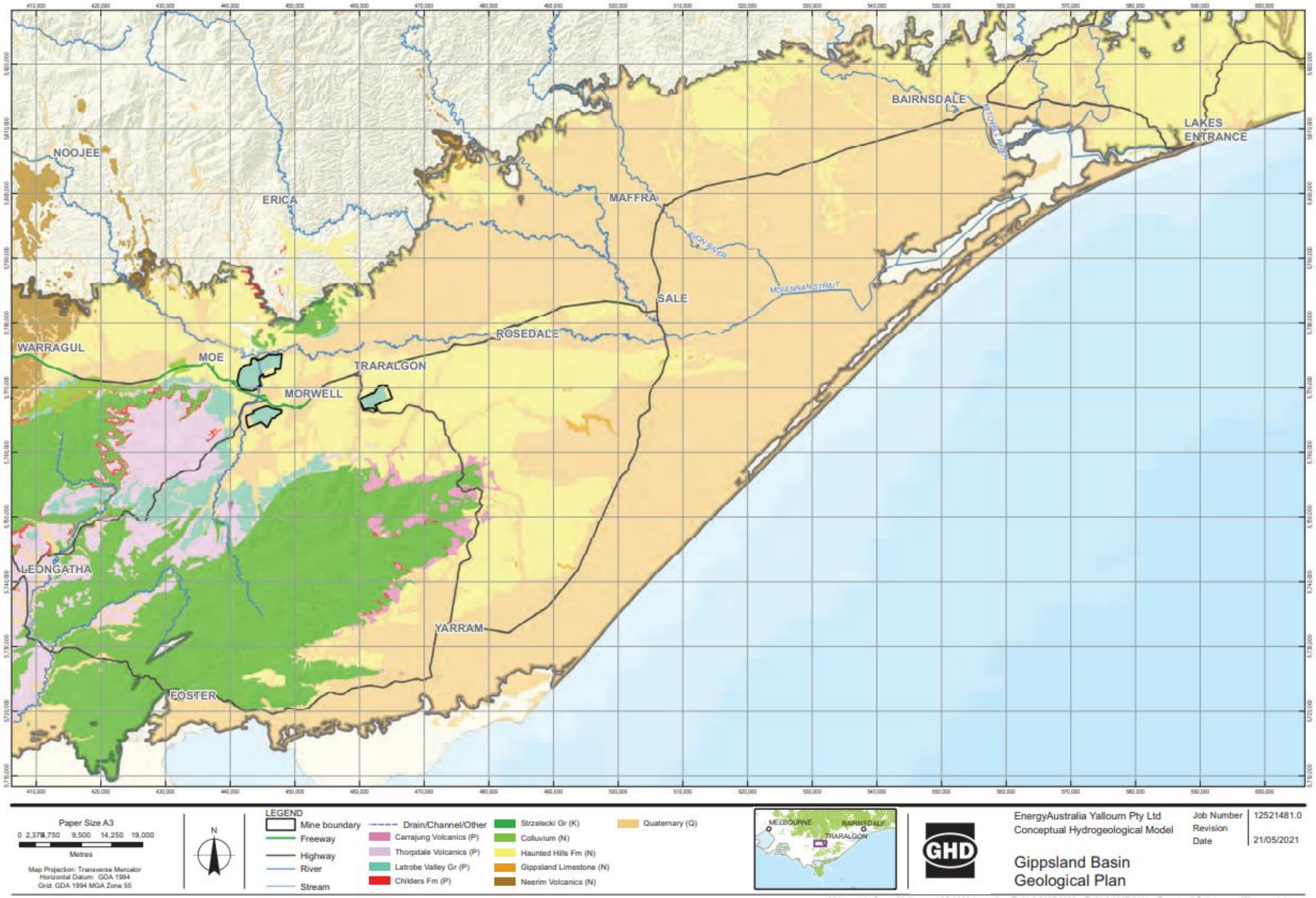


Figure 5-4: Gippsland Basin Geological Plan (GHD 2023)

5.4.1.2 Regional Stratigraphy

Three main lignite bearing sequences identified in the Latrobe Valley Depression are the Traralgon, Morwell and Yallourn Formations (Figure 5-6), belonging to the Latrobe Valley Group (previously referred to as the Latrobe Valley Coal Measures). Individual coal seams are identified by their formation and depth within the sequence, e.g. M1 is the shallowest Morwell Formation coal seam.

Non-coal materials between the seams are termed interseam and these are named according to the overlying coal seam, e.g. M1 interseam underlies the M1 coal seam. The interseams comprise sand, silt and clay and their lithology can change abruptly due to the mode of deposition. The interseams can contain local and regional scale aquifers depending on the extent and hydraulic properties of the sand units.

Volcanism within the basin resulted in the Thorpdale and Carrajung Volcanics. The Thorpdale Volcanics are interbedded with the Morwell Formation sediments particularly in the western sections of Latrobe Valley Depression. The Carrajung Volcanics are found interbedded with the deeper Traralgon Formation.

The Seaspray Group is a succession of marine limestones and marls that accumulated as a facies equivalent of the Latrobe Valley Group. It covers most of the onshore part of the Gippsland Basin near the coast and extends offshore. The Balook Formation is a barrier sand sequence that lies immediately inland of the Seaspray Group and was deposited in the transition zone between the mostly terrestrial lignites and interseams to the west and north and the marine carbonates to the east and south. The Balook Formation extends north-northeast across the Seaspray and Lake Wellington Depressions but is not present across the Baragwanath Anticline and associated structures (GHD 2023). The geological cross section (Figure 5-5) shows the distribution of the Tertiary stratigraphic units across the onshore section of the Gippsland Basin.

The Lower Cretaceous Strzelecki Group and Palaeozoic sediments form the basement to the younger Cenozoic sediments. The Strzelecki Group consists of volcaniclastic sediments and predominately upwards-fining sequence of massive, coarse to fine grained sandstones interbedded with siltstone. The Strzelecki Group outcrops to the south and west of the Latrobe Valley forming the Balook and Narracan Blocks as shown in Figure 5-7.

The Palaeozoic sediments comprise a range of geological formations and outcrop to the north of the Gippsland Basin, forming the Southern Highlands. The Devonian Walhalla Group and the Silurian Anderson Creek Formation are the main geological formations, comprising a marine sequence of turbiditic sandstones, siltstones and mudstones.

5.4.1.3 Latrobe Valley Major Geological Structures

The Latrobe Valley Depression forms a part of the larger Gippsland Basin and the structures within the depression are extensions of the larger structures associated with the basin. The fundamental basin architecture reflects the reaction to north-northeast to south-southwest directed crustal extension, represented by the Northern and Southern Platforms and Terraces, which are bounded by complex fault systems. The major folds are typically described as monoclines in which coal measure strata are draped over basement faults (GHD 2023). The monoclines are located both at the margins of and within the sedimentary basin as shown in Figure 5-7. Between monoclines, the stratigraphic sequences are gently folded within open synclines and anticlines.

Holdgate et al (2015) identified that structures traditionally thought to represent features of the shallower Cenozoic strata have deeper underlying structures (GHD 2023). In particular, the Yallourn and Morwell faults, which influence the depth and thickness of the coal strata, are interpreted as deep basement faults. These deep basement faults largely align with corresponding monoclines, as previously interpreted by the SECV and Geological Survey.

The main structural features of the Latrobe Valley Depression include:

- Yallourn Monocline that forms the northern boundary of the Latrobe Valley Depression.
- The Yallourn (also referred to as Haunted Hills) fault, as mapped by the Geological Survey, that separates the Latrobe Valley Depression from the Moe Swamp Basin in the west. Previous SECV work has shown this feature as a southerly trending extension of the Yallourn Monocline and hence both names have been used interchangeably in the literature to represent this structure.
- Traralgon – Latrobe Syncline, which forms the central axis through the Latrobe Valley Depression.
- Rosedale Monocline, which separates the Latrobe Valley Depression to the north and Baragwanath Anticline to the south. It is the largest anticline structure within the onshore part of the basin.

The approximate extent of the Yallourn and Morwell Formations and the western extent of the marine transgression represented by the Seaspray Group are shown in Figure 5-5. The uppermost Traralgon Formation (T1) coal extends westwards, between the Loy Yang and Hazelwood Mines and its westerly extent represents the point where the underlying units of the Traralgon Formation are in contact with the basal M2 units of the Morwell Formation.

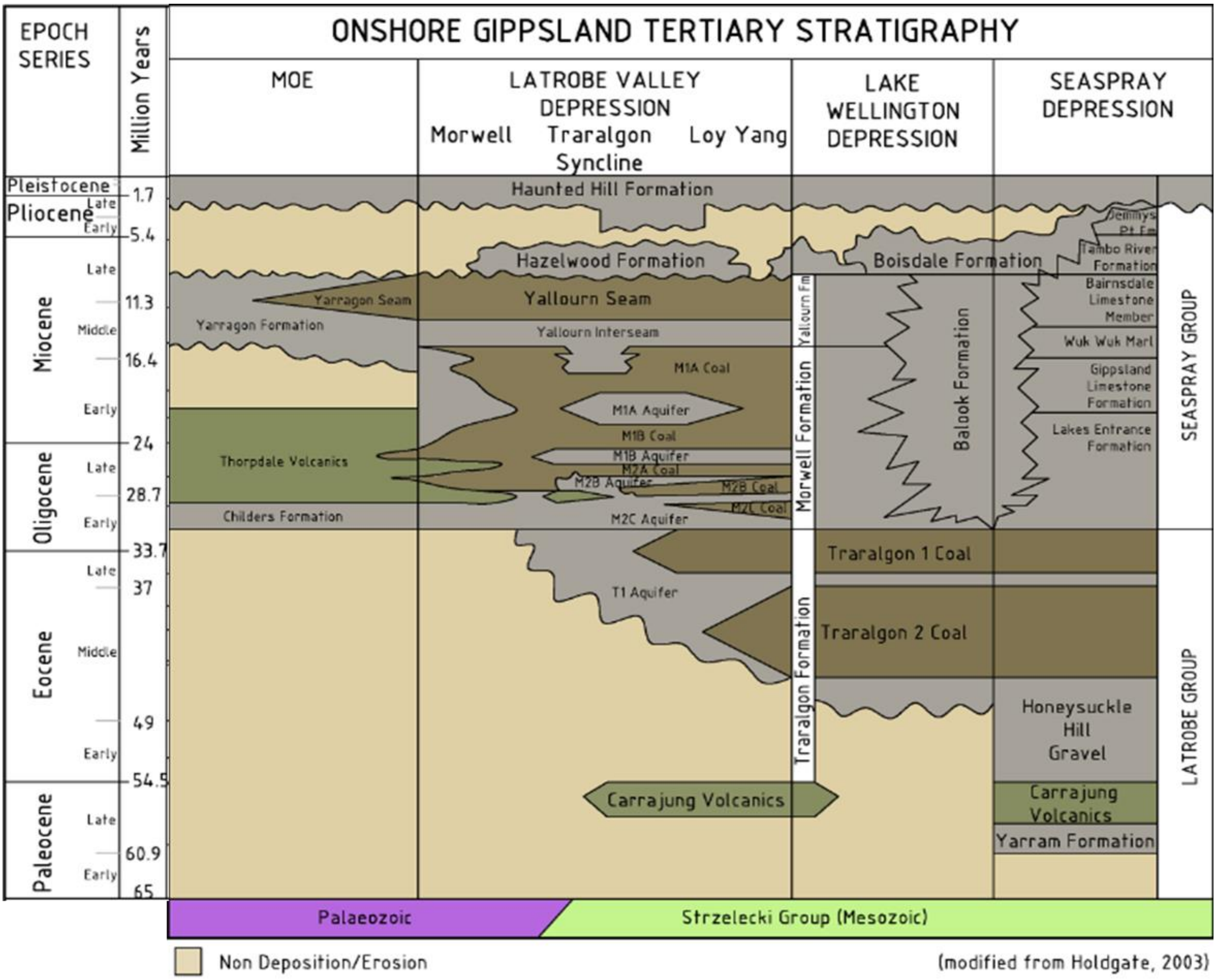


Figure 5-5: Gippsland Basin Cenozoic Stratigraphy (GHD 2023)

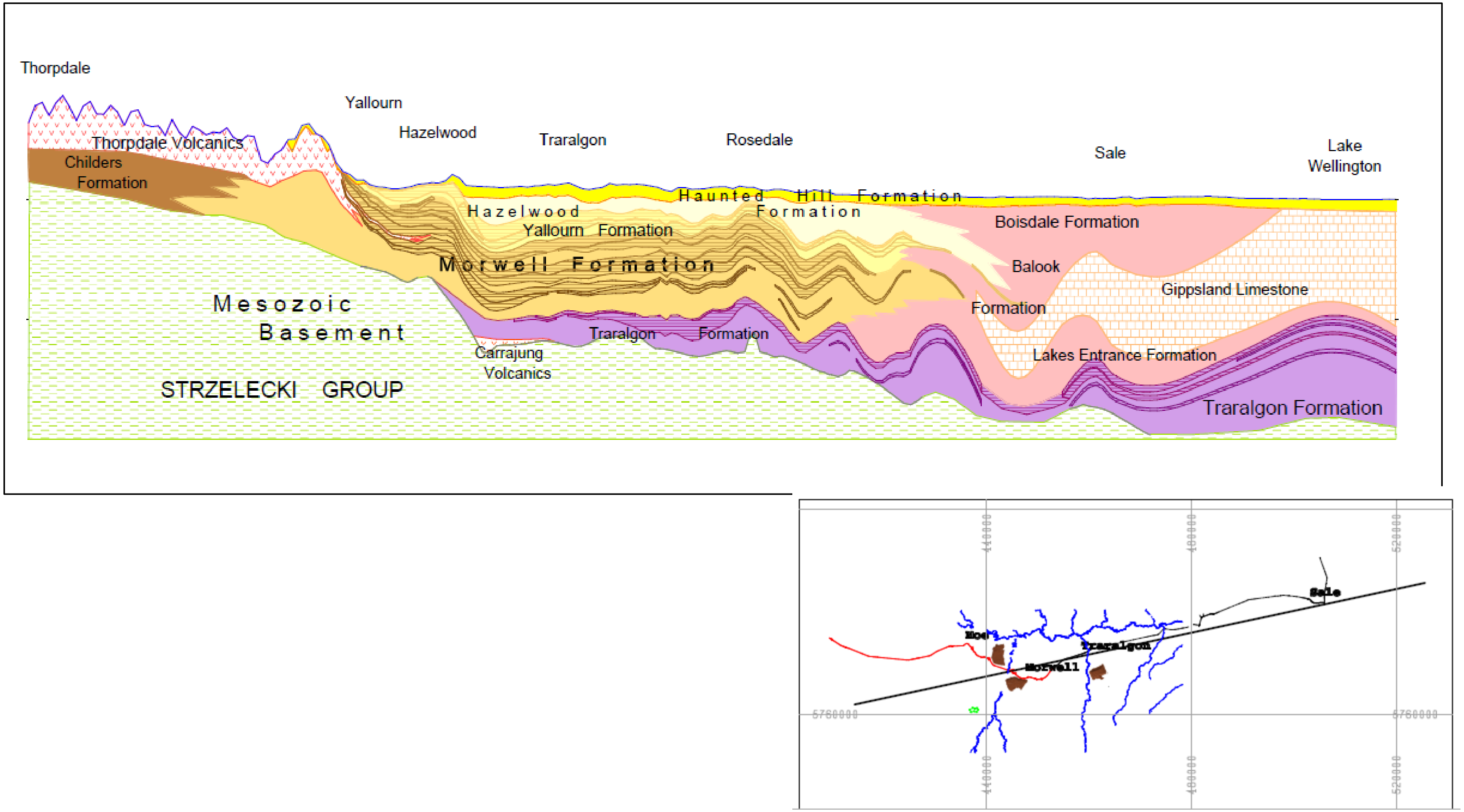


Figure 5-6: Onshore Gippsland Basin Regional Cross-Section (GHD 2023)

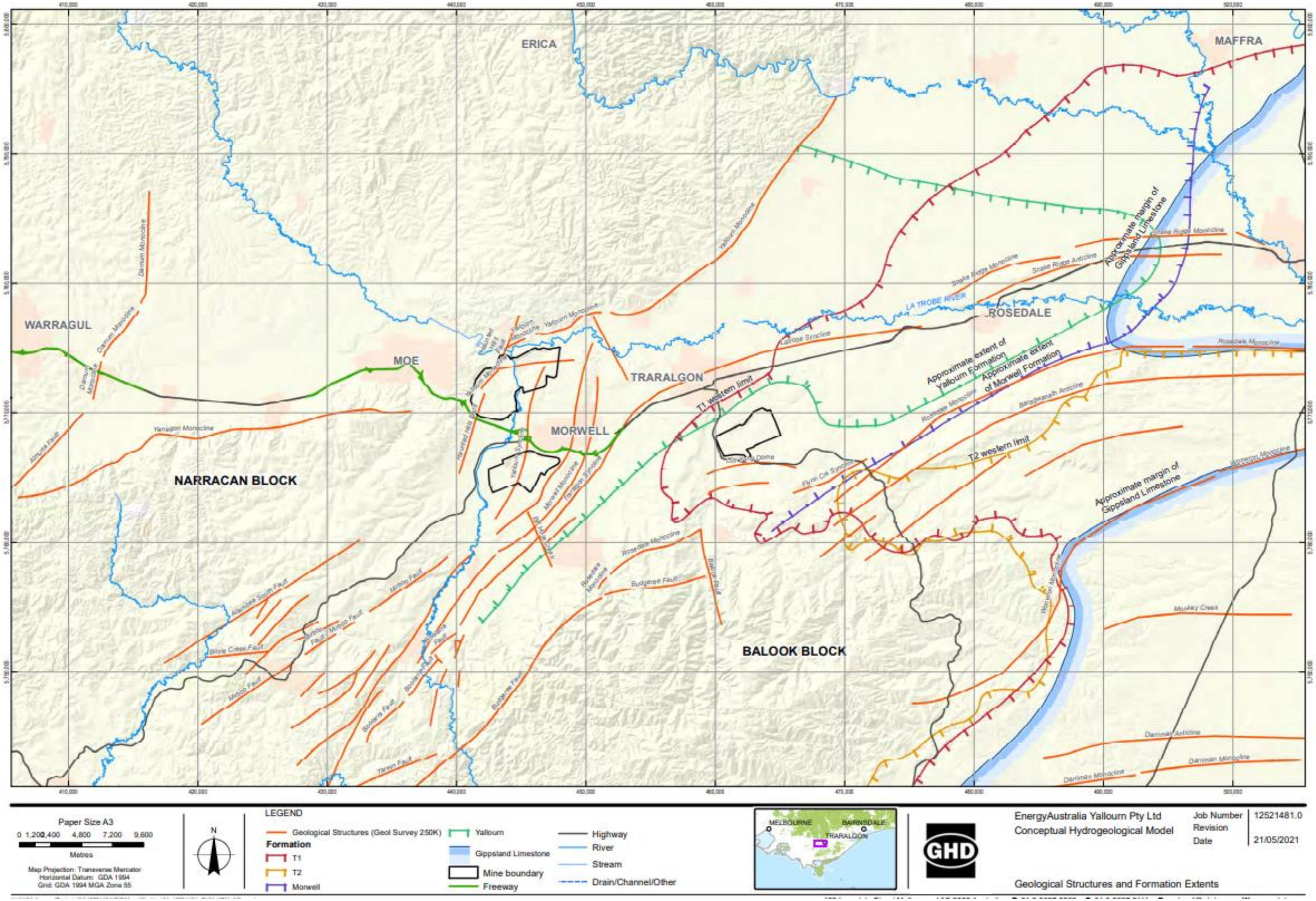


Figure 5-7: Geological Structures and Formation Extent (GHD 2023)

5.4.2 Local Geology

The Yallourn area is overlain by the Quaternary Haunted Hill Formation, comprising largely discrete lenses of sands, gravels, silts and clays, which is underlain by the Yallourn Coal Formation (Tertiary age). Below the Yallourn seam there are various small splits of the coal seam which are separated by clays, sands and sandy clays. These form part of the Yallourn interseam along with the thicker bands of clays, sands and gravels which are deposited below the Yallourn coal splits. The M1A formation is the next deeper sequence comprising of a coal seam followed by clays, sands and gravels known as the M1A interseam. The M1A interseam sands form the M1A Deep Aquifer System (DAS) with the M1A coal acting as the aquitard layer between the Yallourn and Morwell sequence. The major geological units at Yallourn Mine are in Table 5-6 below.

Table 5-6: 5Major Geological & Hydrogeological Units at Yallourn Mine

Unit Name	Min to Max Thickness (m)	Description of Typical Lithology
Haunted Hills Formation (HHF - Overburden)	5 to 45	Consists generally of sands and gravels and interbedded sequences of clay and sandy clay. Occasionally the sands and gravels display ferruginous cementation. Basal sand layer often present. HHF forms part of the unconfined Shallow Aquifer System (SAS). This aquifer is not actively depressurised (pumped) but is naturally drained along the pit crest due to mining excavations.
Yallourn Coal (Y_COL)	60 to 100	Vertically continuous unit in MVF and Yallourn East Field (YEF) and Yallourn East Field Extension (YEFX). Some splits are evident near the base.
Yallourn Interseam (YAL_INT)	30 to 50	Generally, clay, interbedded with thin (approximately 2 metres) coal seam and a clay repeat.
M1A Coal (M1A_COL)	5 to 35	Vertically continuous coal unit in MVF, splitting to the north with sand and clay facies equivalents in northern YEF. Top of unit generally first coal split observed below the YAL_INT unit and floor is generally last coal split above the M1A_INT (M1A Interseam) unit.
M1A Interseam (M1A_INT) & Aquifer	35 to 95	This unit has an average thickness of 70 metres and four discontinuous, but persistent sand layers (aquifers) have been identified in the M1A interseam in YEF, YEFX and MVF. These aquifer layers include the M1ASL, generally within the lower 10 m of M1A_INT, M1ASM found in the middle, M1AS1 in the upper 5 to 20 m of M1A_INT and M1AS0 in the upper 5 m below the base of the M1A coal. In between these modelled aquifer layers are interbedded layers of clays, silts, sands and gravels. The M1A Aquifer forms part of the confined Deep Aquifer System (DAS) and actively depressurised (pumped) for mine stability.

There are three geological structures in the immediate vicinity of the Yallourn Mine:

- Yallourn Monocline - reverse fault in basement on the western and northern edges of the Yallourn Mining Licence and immediately beneath the power station's Cooling Tower No.3
- Yallourn Syncline - wide broad syncline in the Yallourn seam that defines the deepest part of the mine
- Morwell Monocline - to the east of the Yallourn Mining Licence, where all seams dip sharply, and overburden cover increases sharply

5.4.3 Pre-mining Engineering Geomorphology

This section provides a brief summary of the pre-mining geomorphology for Yallourn Mine. Post-mining and rehabilitation geomorphology is discussed in the Landform Section, refer Chapter 12.

5.4.3.1 Geology and Landform Evolution

Before mining, the Latrobe Valley was a stable landform shaped over millions of years, forming part of the Southern Lowlands, an east-west belt of plains underlain by deep geological basins filled with Cretaceous and Cainozoic sediments (PSM 2025b). Yallourn Mine is in the Latrobe Valley, within the eastern lowlands of the Gippsland Plains. The valley is bordered by the Southern Uplands to the south and the Eastern Highlands to the north and underlain by Tertiary rocks, erosional, and alluvial plains. It sits above a deep trough, inundated by the sea during the mid-Tertiary, creating ideal conditions for coal swamp formation. These swamps are now preserved as thick coal seams, reaching up to 300 m in places.

After coal accumulation, the basin underwent tectonic uplift and folding in the mid-Miocene and early Pliocene due to blind thrust faulting in the basement (PSM 2025b). This caused exposure and erosion of coal, forming deep fire holes up to several hundred meters in diameter. The Pliocene to Pleistocene saw widespread gravel deposition (HHF) from fluvial erosion of the adjacent highlands, creating vast alluvial plains. These deposits consist mainly of clast-supported, sub-angular to sub-rounded quartz in a clay matrix, ranging from fine sand to cobbles, sourced from the Southern Highlands.

After gravel deposition, continued uplift caused streams to incise into the plains. Recent Quaternary fluvial erosion reworked HHF material, depositing it along rivers. The confluence of surface water drainage toward the Morwell River and river channel migration formed alluvial fans and raised terraces. This process is shown in Figure 5-8.

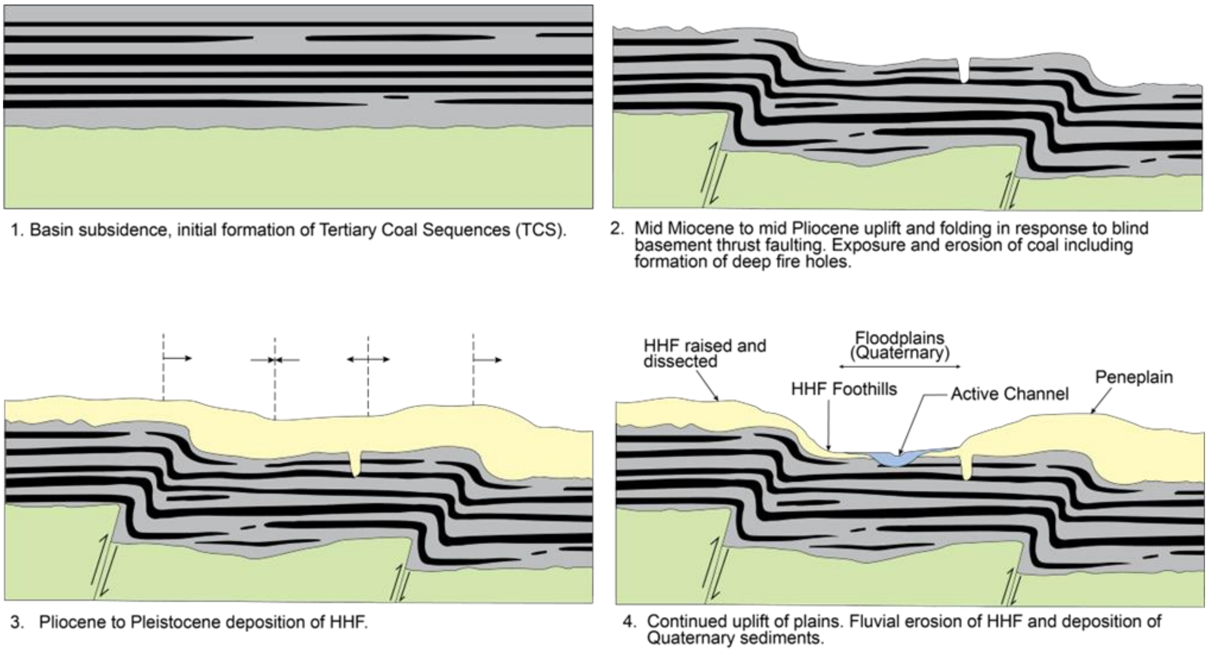


Figure 5-8: Example of Valley Landform Evolution around Yallourn Mine (PSM 2025b)

5.4.3.2 Pre-Mining Landform

There are three land systems identified around Yallourn, comprising two raised blocks of land separated by a wide valley: Western Hills, Eastern Rise and the Morwell River Floodplain.

The western hills are deeply incised into weakly cemented soils (HHF) with no internal structural fabric influencing the landform. These hills are influenced by a known fault and monocline on the eastern margin. Denudation in this area is primarily through localised fluvial erosion, where small drainage channels form and continuously regress. There is minor evidence of landsliding, which is considered a minor contributor to the overall erosion process.

The eastern rise is approximately 50 meters lower in elevation compared to the western hills and is characterised by a flat terrain with moderately incised margins into thick HHF over coal. Denudation here is slow and gradual, primarily due to fluvial action around the margins. Overall, erosion is less aggressive compared to the western hills, and mass wasting is a very minor contributor to denudation in this block.

The Morwell River Floodplain is a broad, curved valley that drains gently to the north and northeast, influenced by a regional syncline axis. The valley features a central floodplain with a meandering main channel, forming numerous oxbow lakes and abandoned channels. Raised terraces, which are less influenced by fluvial action from the main drainage channel, are more affected by the underlying geology, regional structures, and fluvial erosion from runoff from the raised and incised hills to the west.

Nine terrain facets have been identified to describe the different pre-mining landforms, refer Table 5-7 and Figure 5-9.

Table 5-7: Pre-mining Terrains

<table>
<tr><th>Land system</th><th colspan="2">Land facet</th></tr>
<tr><td>Broad flat valleys with meandering channels (Morwell River Floodplain)</td><td>1. Active channels and floodplain
2. Floodplain
3. Alluvium/colluvium</td><td></td></tr>
<tr><td>Raised and incised hills (Western Hills)</td><td>4. Landslide
5. Remnant peneplain
6. Denuded, deeply incised</td><td rowspan="2">7.Denuded and peneplain flank</td></tr>
<tr><td>Low flat hills with incised margins (Eastern Rise)</td><td>8. Peneplain with dissected margins
9. Peneplain</td></tr>
</table>

Active Channels and Floodplains: These are broad flat valleys with meandering channels. The Morwell River system's floodplains are up to 0.5 km wide, while the Latrobe's are up to 1 km wide. Both rivers have highly sinuous channels with numerous abandoned channels and oxbow lakes. The floodplains are subject to flooding, with the Latrobe experiencing more regular inundation.

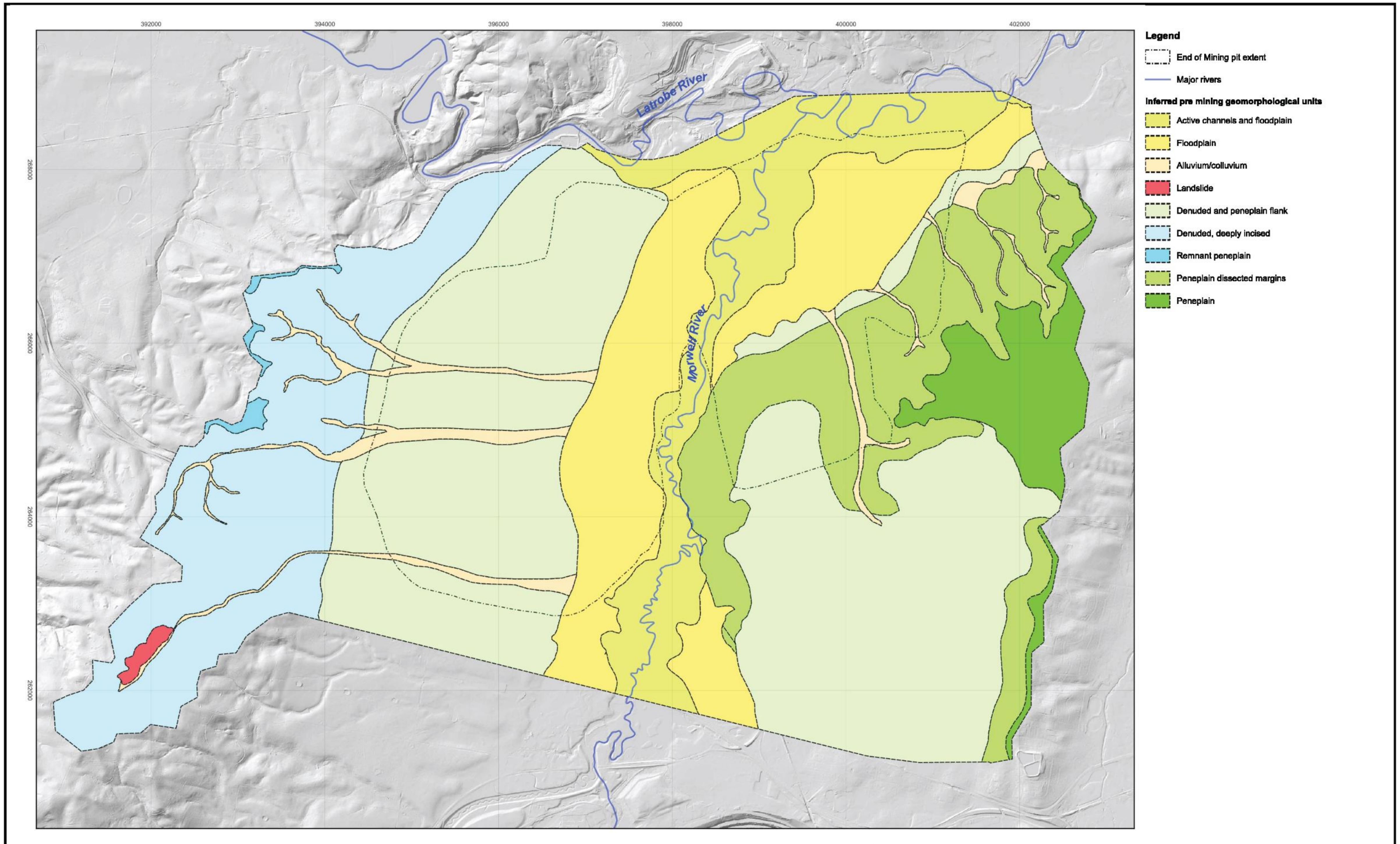
Alluvium and Colluvium: These deposits are not widespread beyond the main river floodplains. Minor deposits occur in the valley floors of both the eastern and western raised blocks, forming flat sections of the valley floor. These materials are of limited importance for rehabilitation at Yallourn.

Landslides: This terrain is confined to the catchment area of Witts Gully Dam within the denuded and deeply incised terrain. The extent of landsliding covers approximately 16 hectares, with defined head scarps and hummocky ground indicating past complex mass movement mechanisms. Significant landsliding is not observed in other terrains.

Denuded, Deeply Incised, and Remnant Peneplain: Found in the western hills, these terrains comprise moderately inclined rolling hills with slopes between 10 and 15°, underlain by HHF. Denudation is mostly via sheet erosion, producing subdued relief with simple ridge and valley morphology. There is minimal evidence of landsliding.

Peneplain and Dissected Margins: Located east of YEF, this elongated raised peneplain in HHF is elevated between 60 and 70 m above adjacent floodplains. Denudation is slower and more subtle, with sheet erosion causing uniform soil removal. This terrain is more stable, with no observed landsliding.

Peneplain and Denuded Flank: Found adjacent to both the western and eastern blocks, these terrains have very gently sloping ground. In the west, the terrain transitions into flat linear slopes influenced by the Yallourn Monocline and fault. In the east, the flanks are bowl-shaped, concentrating flow towards the Latrobe and Morwell watercourses. Both are subject to periodic localised flooding.



NOTES:
1. The dash-dot black line shows the approximate outline of the extent of mining of YTF, YEF, YEFX and MVF

N

Scale 1:40,000

400 0 400 800 1,200 1,600 m

Local Mine Grid: SECV

PSM

Created By: TRN	Revision: 2	EnergyAustralia Yallourn Mine Rehabilitation Design Geological, Geotechnical, Groundwater & Engineering Geomorphology Models	
		INFERRED PRE MINING GEOMORPHOLOGY	
Date: 03 May 2024	Paper Size: A3	PSM4487-125R	Figure 21

Figure 5-9: Pre-mining Land Facets at Yallourn (PSM 2025b)

5.5 Hydrogeology and Groundwater

5.5.1 Aquifers

The hydrogeology of the Latrobe Valley on a regional scale has been described with reference to aquifer systems. These are broadly consistent with the definition of shallow, intermediate and regional groundwater flow systems that form within a groundwater basin (Tóth (1963) referenced in (GHD 2023). The term system has been adopted in recognition of the complexity of the regional hydrogeology, characterised by interbedded sequences of sand, gravel and basalt aquifers that are rarely continuous throughout the region resulting in aquifers of variable thickness, lateral extent and interconnectivity.

The three regional aquifer systems of the Latrobe Valley include the following:

Shallow Aquifer System (SAS), consisting of unconfined and semi-confined aquifers in the upper part of the stratigraphic sequence that typically hosts the water table. The aquifers of the SAS include the surficial HHF Aquifer (HHFA), and alluvial sediments and sands encountered in the Hazelwood Formation and Yallourn Interseam. The SAS provides low yielding supply for domestic and agricultural purposes and has only required dewatering intermittently at the Yallourn Mine.

In the western part of the basin the Morwell Formation Aquifer System (MFAS) is generally a confined aquifer system comprised of the M1, M1A, M1B, M2A, M2B and M2C Aquifers. It consists of interbedded sands and clays, between coal seams and, minor fractured basalts within the Morwell Formation. The MFAS extends eastward as far as Kilmany where it meets the barrier sand sequence of the Balook Formation. At the Yallourn Mine, the MFAS is primarily represented by the sand lenses within the M1A Interseam. The confined aquifers of this system generally occur between 100 to 500 m beneath the present surface. The MFAS is analogous to the intermediate groundwater flow system of Tóth (1963).

The confined M2/Traralgon Formation Aquifer System (TFAS) aquifer system is of regional scale and extends across the entire Gippsland Basin. The onshore part consists of interbedded sands, clays, coals and basalts (M2, Traralgon Aquifers), and the offshore section consists of interbedded sandstones, mudstone, coals, and basalts (Latrobe Group Aquifers). Groundwater is extracted from this aquifer system as part of the mining operations at Loy Yang and Hazelwood Mines, for agricultural and industrial supplies in the southern Gippsland Basin, and for offshore oil and gas production. The confined aquifers of this system generally occur between 150 and 1,500 m beneath the ground surface. The M2/TFAS is analogous to the regional groundwater flow system of Tóth (1963).

The distribution of the three regional aquifer systems in the Latrobe Valley area is shown in Figure 5-10.

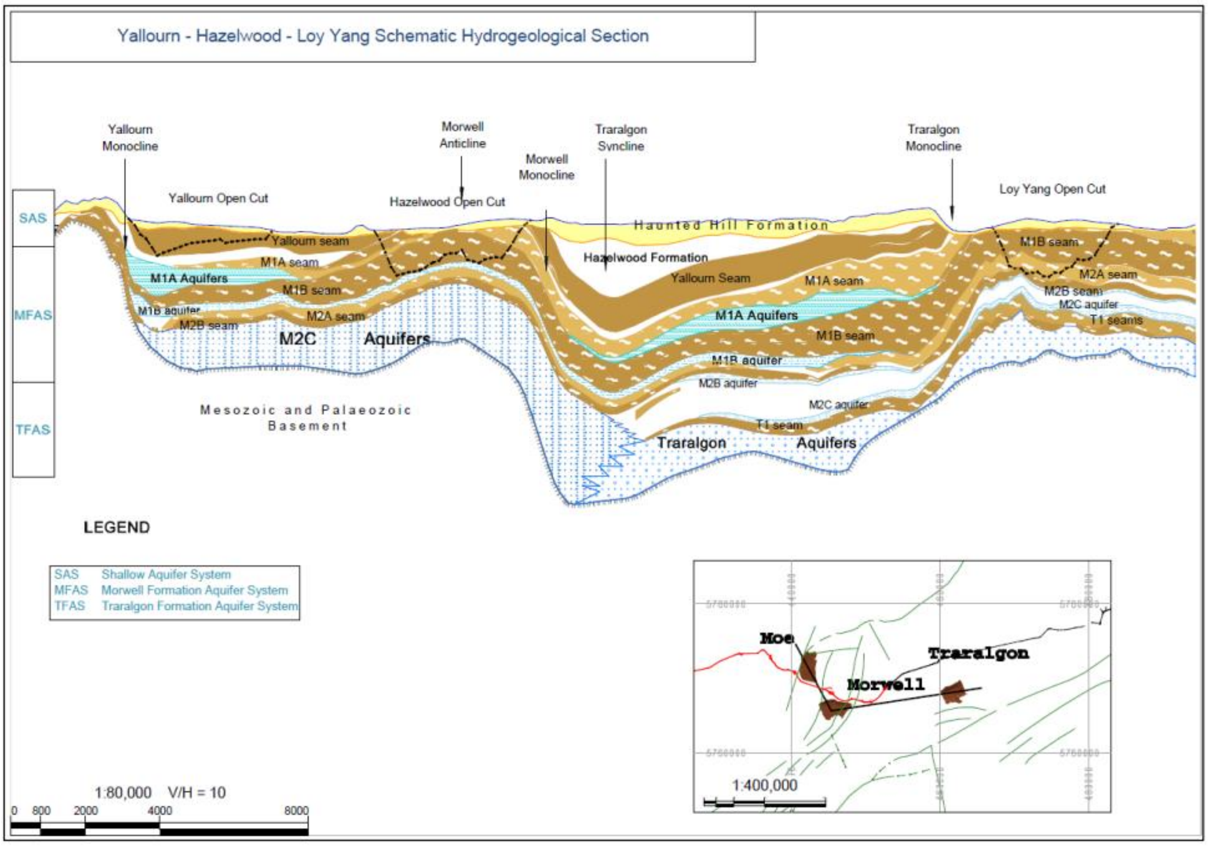


Figure 5-10: Hydrogeological cross-section for Yallourn-Hazelwood-Loy Yang Mines (GHD 2023)

5.5.2 Groundwater Flow Paths

Groundwater is derived from rainwater that percolates through cracks and pores in rocks and sediments. In low-lying areas, groundwater discharges at surface whereas in topographically elevated areas the water table rises to higher elevations. The differences in the elevation of hydraulic heads drives the flow of groundwater from topographically higher levels to lower levels. In the upper part of the groundwater system, a local flow system develops due to local undulations in topography and spatial variations in recharge and evapotranspiration. This results in the water table typically being a subdued reflection of the ground surface. Groundwater interacts with surface watercourses along drainage lines, where groundwater can provide baseflow or receive leakage. In the deeper part of the system, groundwater flows via longer flow paths driven by regional difference in hydraulic heads associated with regional differences in topography (GHD 2023).

Mines in the Latrobe Valley currently form low points in the regional groundwater system, influencing the groundwater levels and flow directions. Anthropogenic stresses, such as groundwater pumping at the mines have depressurised the aquifers and modified natural groundwater flow directions. The geology of the region also has an important control on groundwater flow, with variations in material properties and structures resulting in deflections of flow lines. In a regional context, the essential components of the hydrological cycle include the mines in the region, topography, hydrology, land use, climate and geology.

When hydrological stresses such as recharge and pumping are imposed on the hydrogeological system, changes in groundwater levels are observed. Temporal trends in groundwater levels reflect the combined influence of hydrological stresses and how they vary over time in response to climate and mining operations. The stress-response relationships observed in the monitoring data based on the analysis of hydrographs from representative bores/piezometers informs the groundwater trends.

The long-term climate induced trends are represented by the bore data (piezometric levels). Generally, these indicate that groundwater levels rise during wet periods due to cumulative effect of above average recharge replenishing the aquifer storage. During dry periods, there is a net declining trend as recharge is insufficient to maintain the water table.

The bore data (piezometric levels) for the M1A Interseam represent the pumping (groundwater extraction) induced trends. When these are plotted with the extraction rates, a relationship between pumping and groundwater levels can be established. Generally, the hydrographs show a net declining trend over time in response to pumping, with a steeper rate of decline during periods of higher pumping and temporary recovery/stabilisation during the period of low pumping between 2004 and 2008. The decrease in drawdown is observed with increase in distance from the pumping bore(s). The M1A Interseam over the mine shows a radial flow response to pumping typical of a laterally continuous confined aquifer, with spatial differences reflecting spatial variability in aquifer properties.

The piezometric responses in Yallourn Interseam also show declining trends that appear to be influenced by pumping occurring in the M1A Interseam, indicating a degree of hydraulic connection between these two Hydrostratigraphic Units (HSUs). In summary, pumping in the M1A Interseam is likely a contributing factor for the depressurisation in the Yallourn Interseam albeit to a varying degree depending on the depth of the Yallourn Interseam below the mine floor. The influence of other mining activities and the level of hydraulic connection that exists between the two HSUs is likely to be influenced by the thickness and properties of the intervening M1A Coal.

Other factors that influence the groundwater trends are pressure loading and dissipation. Temporary changes in piezometric heads have been observed due to pressure loading effects associated with the placement of overburden material. These are typically characterised by a sharp spike in the piezometric heads when the load is placed (Figure 8-37), followed by a gradual dissipation of pore pressure. The response to the pressure loading effect becomes more subdued deeper in the stratigraphic profile, characterised by a smaller spike that rises more gradually.

Pressure dissipation can be a factor of drawdown of hydraulic pressure in Yallourn coal due to dewatering via sub-horizontal bores drilled in coal and relaxing of the coal joints following mining stress relief.

5.5.3 Groundwater Extraction

There are no active pump bores within the SAS at Yallourn, Hazelwood or Loy Yang Mines (Table 3 in (GHD 2024a)). Regional monitoring of the SAS comprises two key bores (52883 and 80493) outside the three mine license boundaries (Table 8 in (GHD 2024a)). The SAS water level trend at key bore 52883 shows a slight decline since the early 1990s, while bore 80493 showed an increase from 2011 levels. This suggests the SAS is influenced by long-term seasonal trends, such as the millennium drought and higher rainfall periods.

There are three active pump bores (N5056, N6899 & M4203) operating in MFAS at Yallourn Mine. These extract water from the M1A formation, being the upper most formation in the Morwell Formation and is the most relevant for Yallourn Mine aquifer pressure management. The extraction volumes are administered under a Groundwater License No. 2007403, issued by Southern Rural Waters. The extraction volumes at Yallourn are an average of 1.1 Gigalitres/Year, making it the lowest among the three Latrobe Valley mines. For this reason, the regional impact of depressurisation at this site are minimal. The regional influence is assessed and reported in accordance with the license conditions.

5.5.4 Groundwater Quality

Groundwater quality across the deeper aquifer systems is consistent, generally within class A1 as defined by EPA in the *Environment Reference Standard* (EPA 2022). However, variability is noticeable within the mine where overburden geochemistry creates localised changes in groundwater quality.

Other observations include (GHD 2023):

- The salinity of Yallourn Coal ranges from 220 mg/L at the Western Batters- Hernes Oak, to up to 1,200 mg/L observed in the East Field, above the Latrobe River Batters.
- The HHF also shows a wide variability in groundwater salinity, ranging from less than 60 mg/L in areas close to topographic ridges and inferred rechange zones at Hernes Oak (near the bores recording long term climate induced trends), to up to 770 mg/L adjacent to the Floc Pond Batters. The salinity is higher and more variable in the East Field and Maryvale areas. Similarly, the salinity of bores in the Overburden ranges from 190 mg/L at Hernes Oak and 640 mg/L in East Field.
- The samples of M1A Interseam (aquifer) groundwater collected from pumping bores N6899 and N5056 indicate low salinity, with a Total Dissolved Solids (TDS) concentration of 300 mg/L and 210 mg/L respectively.
- The pH levels range from 5 to 6 pH units for the different HSUs, which is in line with the historical data.
- Analysis of major anions and cations indicates that the four HSUs identified showed a similar distribution, except for the Overburden which showed no dominant type and a wider spread of mixed water types (reflecting their heterogeneous nature).

5.5.5 Groundwater Dependent Ecosystems

Groundwater Dependant Ecosystems (GDE) are defined as ecosystems that require access to groundwater to meet all or some of their water requirements to maintain the communities of plants and animals, ecological processes they support, and ecosystem services they provide (ERM 2023a).

GDE can be classified by:

- **Subterranean:** Aquifer and cave ecosystems (Type 1) where groundwater-inhabiting ecosystems (e.g. stygofauna) reside, commonly in karst and fractured rock aquifer systems
- **Aquatic:** Ecosystems dependent on the surface expression of groundwater (Type 2), including wetlands, lakes, seeps, springs, and river baseflow systems where the water table extends above the land surface as a visible expression
- **Terrestrial:** Ecosystems dependent on subsurface presence of groundwater (Type 3), including terrestrial vegetation where the root zone lies within the capillary fringe of the water, either permanently or episodically

Relevant and potentially relevant aquatic and terrestrial GDE are show in Figure 5-11 and are located around the Latrobe River and Morwell River floodplains area. A summary of each sub-region is provided in Table 5-8.

Subterranean GDE were not identified from the search of publicly available information. Further assessment of stygofauna and subterranean ecosystems is not considered relevant for the Yallourn Mine.

Details of GDE identification is contained in Section 8.4.

Table 5-8: Summary of aquatic and terrestrial Groundwater Dependent Ecosystems (GDE) in sub-regions of Yallourn Mine.

Sub Region	GDE status
West of Mine	GDE identified in this area were unlikely to be relevant to the Yallourn Mine due to the elevated topography, presence of the Yallourn Monocline and large depth to groundwater.
Southwest of Mine	GDE identified in this area were unlikely to be relevant to the Yallourn Mine due to the large depth to groundwater (20 to 50 metres below ground level (mbgl).
North of Latrobe River	GDE identified in this area were unlikely to be relevant to the Yallourn Mine as the area has increase in elevation a short distance away from the river towards the north with depth to groundwater between 20 to 50 mbgl.
Southeast of Mine	GDE identified in this area were unlikely to be relevant to the Yallourn Mine due to the large depth to groundwater (20 to 50 mbgl).
Latrobe and Morwell River floodplains	GDE identified in this area are likely to be relevant to the Yallourn Mine due to the relatively flat topography and shallow inferred groundwater.

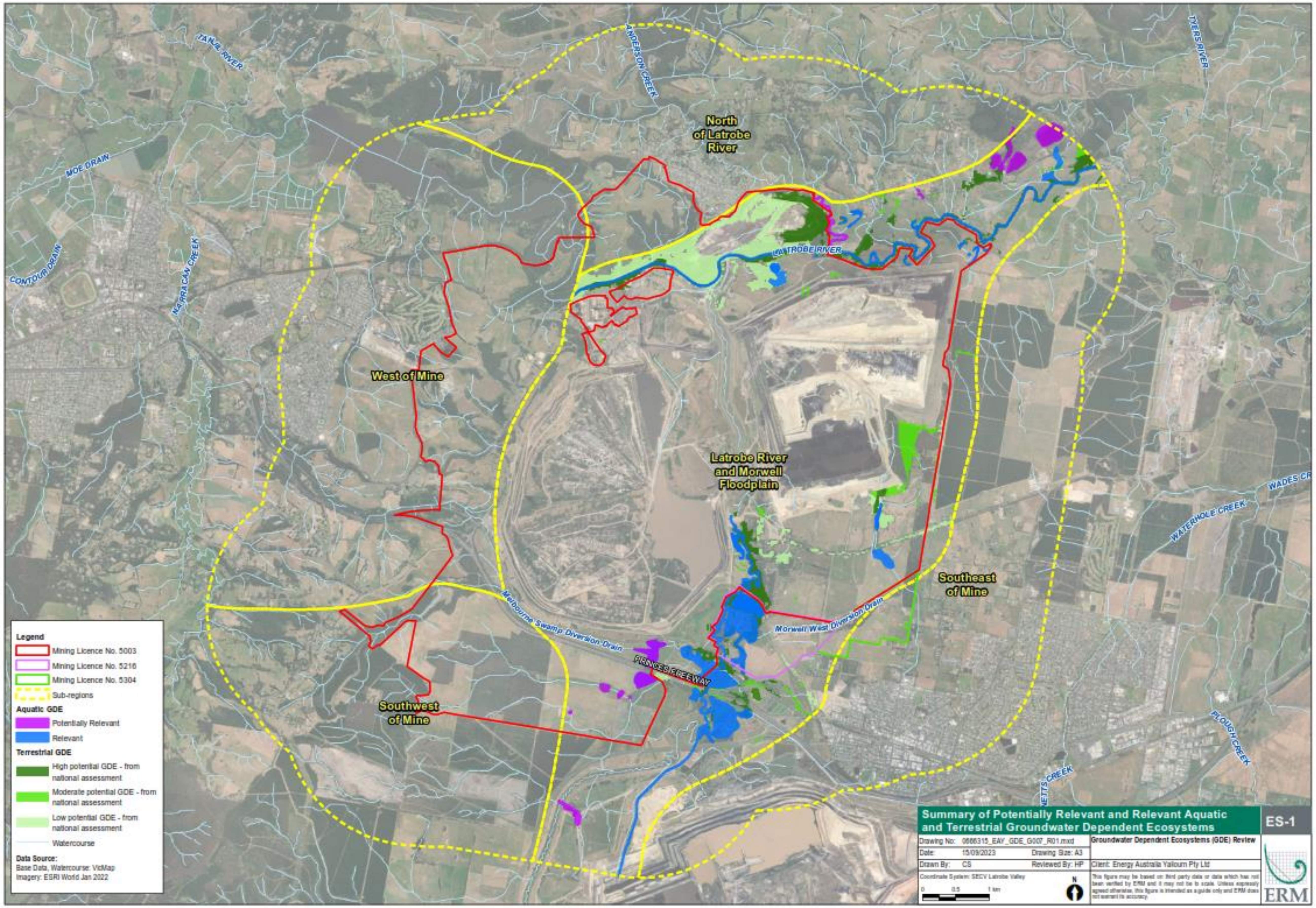


Figure 5-11: Summary of Potentially Relevant and Relevant Aquatic and Terrestrial Groundwater Dependent Ecosystems (ERM 2023a)

5.6 Soils

5.6.1 Topsoil

Topsoil texture shows variability and has can be described as brown clay through to loamy sand (Landloch 2022). Topsoil is generally acidic (pH 4-6) with low salinity and chloride (Landloch 2022). Chemical fertility of the topsoil (based on the presence of nitrogen, available phosphorus, and organic carbon) is moderate to high and suitable for the establishment of vegetation (Landloch 2022). Low levels of calcium, potassium and boron were reported for stockpiled topsoil. Topsoil is predominantly sodic (exchangeable sodium percentage (ESP) is >6 %) and has a low cation exchange capacity (CEC). Low salinity and high ESP can result in the dispersion of clays, reduced infiltration capacity and an elevated erosion risk if vegetation cannot be established.

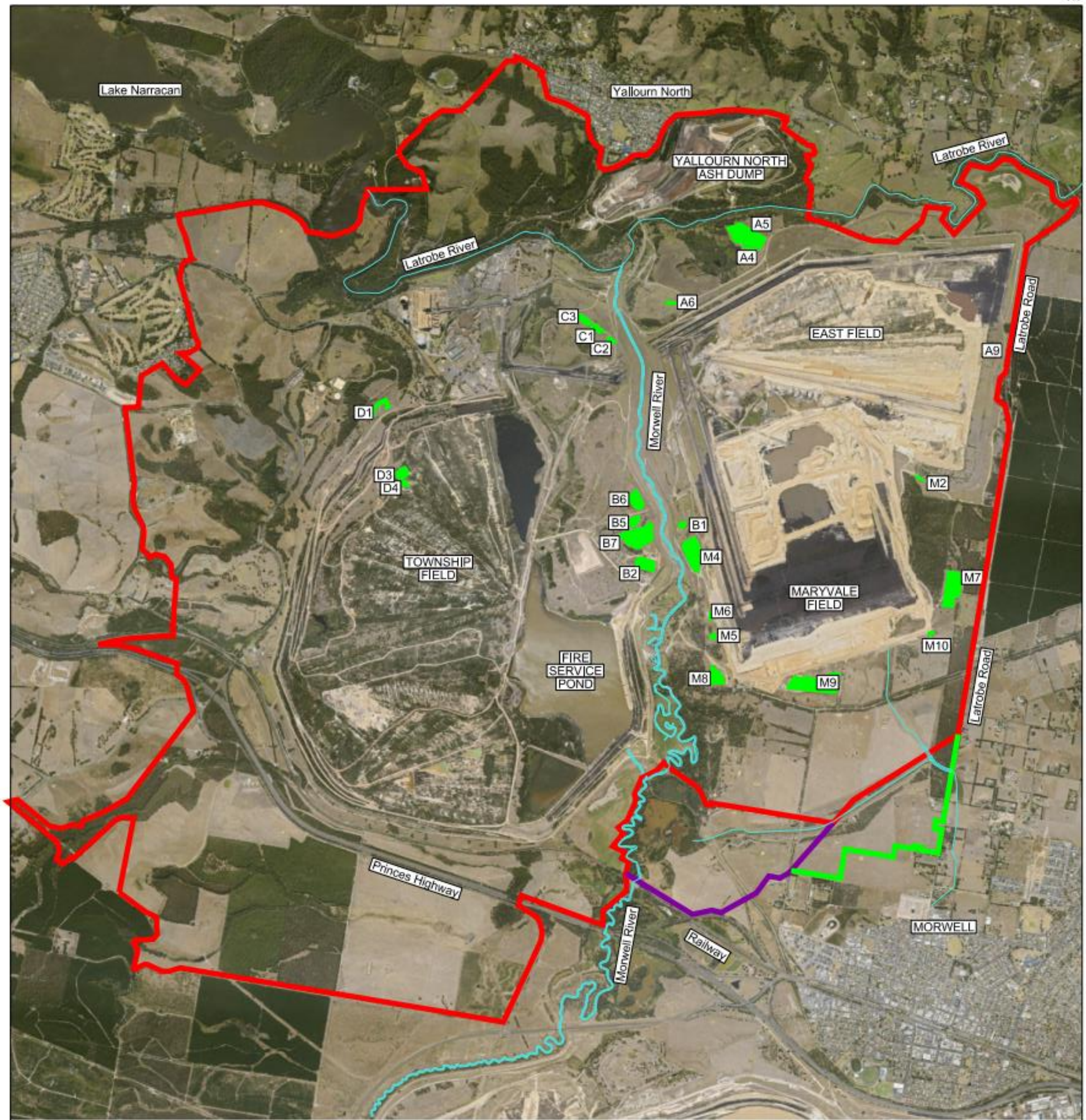
Yallourn Mine conserves all topsoil (stripped ahead of the active mining face) in stockpiles in strategic locations for future use in rehabilitation. Topsoil stockpiles are strategically located to minimise double handling and are shaped and seeded to promote grass cover and minimisation of erosion. The location of these topsoil stockpile areas and their quantities is presented as Figure 5-12.

5.6.2 Overburden

The overburden above Yallourn Coal is composed of the Haunted Hills Formation (HHF), which consists of sands and gravels with sequences of clays, silts and sandy clays. Alluvial soils are also present adjacent to the rivers.

Stockpiled overburden has low levels of nitrogen, potassium and organic carbon with moderate levels of available phosphorus and very low CEC (Landloch 2022). Sandy overburden in the East Field Overburden Dump also reported low levels of macronutrients, a very low CEC with rill erosion widespread across the dump batters (Landloch 2022). Washout erosion in the in-situ upper level of the HHF also occur due to the shallow groundwater table in the Maryvale overburden face.

Overburden has been largely placed inside the mine void with some overburden required to be dumped outside the mine pit void to ensure continuity of coal mining. Figure 5-13 shows the location of the overburden dump areas.



TOPSOIL SITES AND VOLUMES

ID	VOL (m3)	ID	VOL (m3)	ID	VOL (m3)	ID	VOL (m3)
A4	6,292	B5	18,210	D1	6,627	M6	2,436
A5	108,000	B6	28,300	D3	6,611	M7	134,502
A6	-	B7	171,426	D4	8,848	M8	46,255
A9	15,851	C1	23,200	M2	16,333	M9	16,336
B1	6,930	C2	13,811	M4	29,736	M10	-
B2	40,500	C3	27,585	M5	11,232		
	177,573		282,532		79,387		199,529
					GRAND TOTAL		938,550

YALLOURN MINE LICENCE BOUNDARY

- No. 5003
- No. 5216
- No. 5304

FILENAME:C:\DGN\Request\2025\250114 - pm - Rehab Final Plan\DMRP Top Soil Plan.dgn[250515 - DMRP - Top Soil Plan]DGN

SCALE 1 : 50,000 ON A4 SHEET 0 500 1000 1500 2000 2500 METRES IMAGE: 250301	N	EnergyAustralia - YALLOURN DECLARED MINE REHABILITATION PLAN YALLOURN MINE TOPSOIL STOCKPILE SITES AND VOLUMES GENERAL SITE PLAN	DRG Nº YDMR/10-2/17 REVISION DATE 16 MAY 2025 DRAWN G. BAKKER CHECKED S. LINEHAM

EASTERN ROAD, YALLOURN, VICTORIA, 3825 T +61 3 5128 2000 W www.energyaustralia.com.au

Figure 5-12: Topsoil Stockpile Locations and Quantities

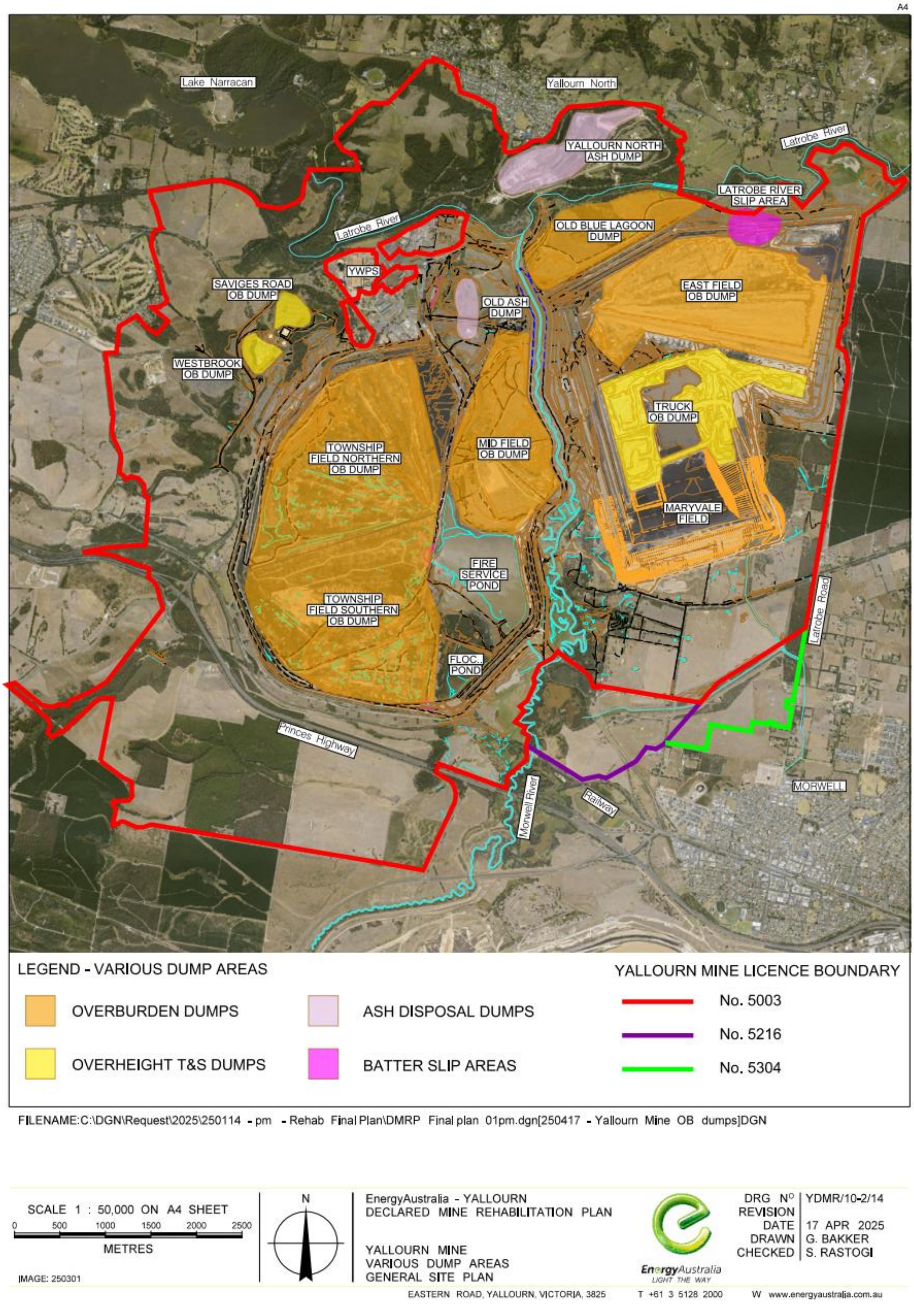


Figure 5-13: Overburden Dump, Ash Disposal, and Historical 2007 Slip Locations

5.7 Hydrology

This section presents an overview of the hydrology of Latrobe and Morwell River systems, and the regional hydrologic implications associated with mine rehabilitation at Yallourn Mine. Section 8.6 presents the details of flood studies considering the planning objectives of Yallourn Mine rehabilitation.

The Yallourn Mine is essentially a combination of the two pits that lie either side of the MRD. To the west of MRD is Yallourn Township Field and to the east is Yallourn Eastfield & Extension and Maryvale Fields Figure 1-2. The mine is located immediately upstream of its presently diverted confluence with the Latrobe River. The Morwell River's upstream drainage basin spans 612 km², while the Latrobe River's catchment extends to a size of up to 1,940 km² (Alluvium 2025). Approximately 3.5 km upstream from their confluence lies Lake Narracan on the Latrobe River. The important tributaries and the reaches of Latrobe River system are presented in Figure 5-14 below.

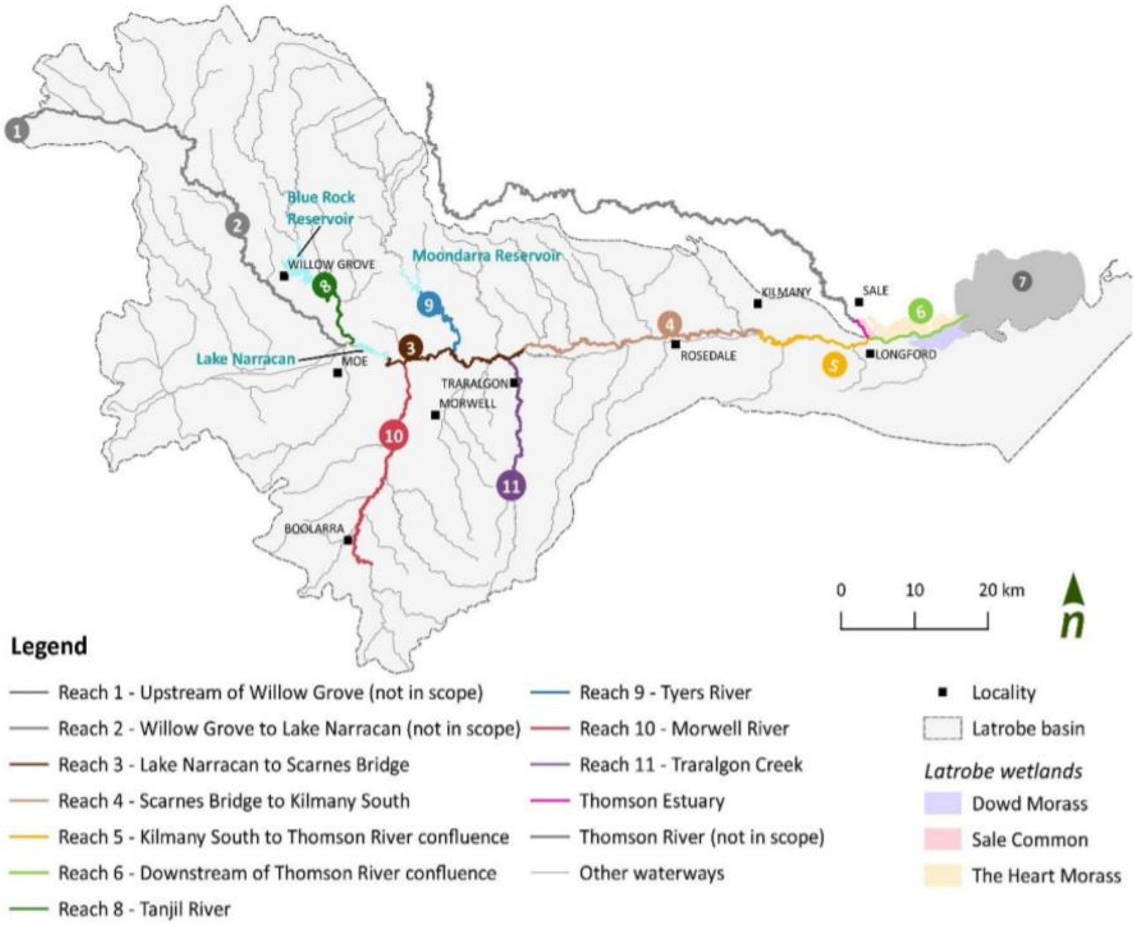


Figure 5-14: Reaches of Latrobe River System and Important Tributaries (Alluvium 2025)

The Latrobe River system, including its wetlands, floodplains and estuary, supports a wide range of social, environmental, economic and cultural values and assets. Environmental values include native fish populations, vegetation communities, and the internationally significant wetlands of the Gippsland Lakes that are listed under the Ramsar convention (including some of the lower Latrobe wetlands and all of Lake Wellington). The river system also supports a diversity of recreational (e.g., boating and angling), cultural and amenity values. Taken together, these values, and the opportunities they present, are becoming increasingly important to the Latrobe valley and its communities.

5.7.1 Latrobe River

The Latrobe basin is located between the Strzelecki and Baw Baw Ranges in West Gippsland, Victoria. With tributaries originating in the Baw Baw plateau and northern Strzelecki ranges, the Latrobe River flows through a mainly agricultural landscape before merging with the Thomson River and flowing into Lake Wellington (Figure 5-15).

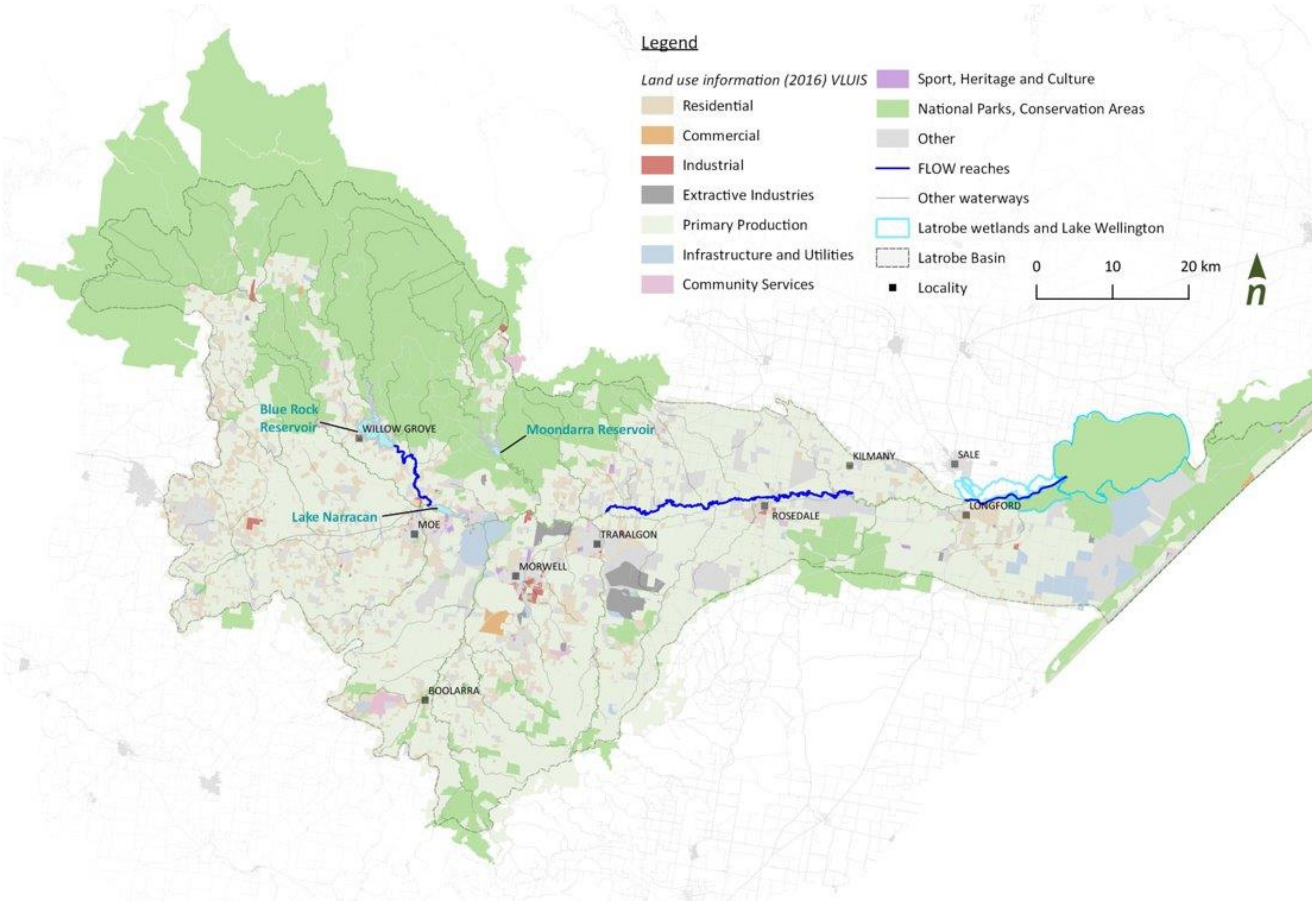


Figure 5-15: Land use Across the Latrobe River System (Alluvium 2025)

The existing state of the Latrobe River system has been influenced by several factors. Historically, agricultural development following European settlement has led to clearance of native vegetation and grazing of the riparian zones, floodplains and Latrobe wetlands (Alluvium 2025). Reductions in freshwater flows in the Latrobe River and the ongoing effects of the opening of a permanent entrance to the Gippsland Lakes has led to increasing salinity in the lower Latrobe wetlands. Parts of these wetlands are internationally recognised under the Ramsar Convention, but they have been degraded and altered from their original freshwater condition. Substantial de-snagging and meander cutoffs have occurred since European settlement, predominantly upstream of Yallourn site. Downstream of Lake Narracan, meander cutoffs were constructed between 1930's to 1970's to reduce occurrence of floodplain inundation and increase agricultural production.

5.7.2 Morwell River

The river rises in the central and southern Strzelecki Ranges with a catchment area of 612 km^2 (Alluvium 2025). Flowing in a general northerly direction, the Morwell River is joined by two minor tributaries before reaching its confluence with the Latrobe River. The lower reaches of the river have been diverted at the Hazelwood and Yallourn Mines by channels and other structures prior to flows reaching the Latrobe River (Jacobs 2020a).

The Morwell River provides ecological services to the catchment with Section 8.6.2.1 highlighting the risks and issues associated with a failure into the mine area. These risks are treated at the design stage in Chapter 12.

5.7.3 Morwell River Diversion (MRD)

The Morwell River channel has been diverted several times within the footprint of Yallourn Mine to support mining activities. The current diversion is directed through the middle of the open cut, via an engineered structure, known as the MRD. The MRD was commissioned in 2005. It consists of a Low Flow Channel (LFC) which services the environmental flows and some flood flows, which then report to the Latrobe River. When the flow capacity of the of LFC is exhausted, flood flows can spill onto the designed floodplain known as the High Flow Channel (HFC), up to the design flood levels. To either side of the HFC are earthen embankments which support the passage of design flood flows.

The design flood level for the original construction is no longer considered valid as the structure has deteriorated over the years. Two major events are noteworthy for the MRD.

- Failure of MRD in 2012, requiring large scale reconstruction of northern section of MRD.
- Instability incident of MRD in 2021, requiring reconstruction of a section of the LFC and repairs along the HFC limited to the southern section of MRD.

The aforementioned events, combined with the stress and strain imposed on the MRD by mining-related activities, have been key indicators to a progressively deteriorating structure. The current limitations and constraints of the MRD are further detailed in Section 8.12.

5.7.4 Flood Events

Historical floods provide context for the future flood events we may experience during rehabilitation and post closure. Significant flood events have been recorded in 1934, 1978, 1993, 1995, 2012, and 2021 with estimated peak flows at the Latrobe River at Thoms Bridge provided in Table 5-9. Aside from the December 1934 event, all recordings can be found on Victoria's Water Measurement Information System (DEECA 2024c). Median flows at this gauge site are 904 ML/d from 1962 to 2025.

Table 5-9: Historical Flood Dates and Peak Flows

Date	Estimated Peak Flow (ML/d)
December 1934	260,000
June 1978	71,000
September 1993	70,000
November 1995	71,000
June 2012	43,000
June 2021	84,000

See Section 8.6 for further analysis of Morwell and Latrobe River flooding and the potential impact on rehabilitation design.

5.7.5 Water Quality

5.7.5.1 River Water Quality

Latrobe River

The upstream Latrobe River generally maintains good water quality, although there are occasional exceedances in certain parameters. Key points include:

- Electrical Conductivity (EC): The EC levels are consistently higher than the default water quality guideline for the protection of aquatic ecosystems but remain well below the objective for irrigation.
- Heavy Metals: Ambient levels of aluminium, copper, iron, and zinc are above the relevant water quality objectives for the protection of aquatic ecosystems, human consumption of aquatic food, aquaculture, and water-based recreation.
- Turbidity: Turbidity levels are variable but typically below the relevant default water quality guideline.
- pH: The pH levels are within the range for all applicable default water quality guidelines.

Morwell River

The Morwell River also exhibits generally good water quality, with occasional exceedances in specific parameters. Key points include:

- Electrical Conductivity (EC): EC levels are elevated but within acceptable limits for irrigation.
- Heavy Metals: Concentrations of aluminium, copper, iron, and zinc are higher than the water quality objectives for aquatic ecosystems and aquaculture.
- Turbidity and Suspended Solids: Both parameters show increased levels at times but are generally within acceptable limits.
- pH: The pH levels are within the acceptable range for all applicable water quality guidelines.

Both the Latrobe and Morwell Rivers maintain good water quality overall, supporting their respective environmental values and uses. However, there are occasional exceedances in parameters such as salinity, heavy metals, and turbidity, primarily influenced by upstream sources and natural conditions. The rivers' natural flow and dilution capacity help manage these impacts, ensuring that the overall water quality remains within acceptable limits for most uses.

5.7.5.2 Mine Water Quality

Fire Service Pond (FSP) and Flocculation Pond

The water quality in the Fire Service Pond (FSP) and Flocculation Pond at the Yallourn Mine is generally good, with occasional exceedances in certain parameters. Key points include:

- pH: Typically, between 6.3 and 7.6, within the licence limits of 6.0 to 8.5.
- Electrical Conductivity (EC): Median value of 740 μS/cm, with a maximum of 770 μS/cm,
- Total Dissolved Solids (TDS): Median value of 485 mg/L, with a maximum of 550 mg/L.
- Total Suspended Solids (TSS): Median value of 30.5 mg/L, with a maximum of 40 mg/L.
- Turbidity: Median value of 70.5 NTU, with a maximum of 80 NTU, this is treated in the Flocculation Pond by dosing with cationic polymer before being sent to the licenced discharge point.
- Heavy Metals: Concentrations of aluminium, copper, iron, and zinc are monitored, with occasional exceedances but generally within acceptable limits.

Discharge to Morwell River

The treated wastewater from the Yallourn Power Station is discharged into the Morwell River. The discharge quality generally complies with the conditions of the EPA licence, although there are occasional exceedances in certain parameters. Key points include:

- Flow Rate: The average daily discharge volume is 31 ML/d, with a maximum of 50 ML/d, below the licenced mean volume of 80.5 ML/d.
- Colour: Median value of 30 pcu, with a maximum of 70 pcu, within the licence limits.
- Suspended Solids: Median value of 12 mg/L, with a maximum of 24 mg/L, within the licence limits.
- Total Dissolved Solids (TDS): Median value of 430 mg/L, with a maximum of 470 mg/L, within the licence limits.
- Turbidity: Median value of 13 NTU, with a maximum of 36 NTU, within the licence limits.
- pH: Typically, between 7.1 and 7.4, within the licence limits of 6.0 to 8.5.
- Heavy Metals: Concentrations of aluminium, copper, iron, and zinc are monitored, with occasional exceedances but generally within acceptable limits.

Overall, the mine water quality and discharge are well-managed, with effective treatment processes in place to ensure compliance with regulatory standards and minimal impact on the receiving waters.

5.8 Flora and Fauna

5.8.1 Conservation Zones

EAY has a long history of successful conservation protection and vegetation establishment.

The original 2002 *Yallourn Mine Conservation Management Plan* (YMCMP) was developed as a response to the Ministerial Assessment for the Yallourn Coal Field Development EES for the clearance of 57 hectares of native vegetation that directed a CMP be prepared to protect significant vegetation in and around the mine development area. Native vegetation offsets were to be achieved through the management of 141.3 hectares of remnant native vegetation and revegetation of 27.6 hectares across 20 blocks.

The 2005 YMCMP revision included additional native vegetation removal as a result of the Morwell River Diversion (MRD) and changes to the mining boundary to include the Morwell Hill Climb complex. It reduced the use of revegetation as an offset method and increased the protection and enhancement of remnant native vegetation. An additional area of offsets included 18.59 habitat hectares (a vegetation quality metric) across 17 new blocks.

The 2011 YMCMP revision focused on the approved Work Plan Variation for the Maryvale Field Realignment (2011), which resulted in the additional loss of 10.37 Habitat Hectares (HHa) of remnant native vegetation, plus 179 large old trees and 136 scattered trees. This included the complete loss of four existing 2005 YMCMP blocks and the partial loss of five others. This YMCMP was the first to have offsets associated with the EPBC Act, with vegetation to be removed including 523 *Eucalyptus strzeleckii* (Strzelecki Gum) (IDEM 2023). Offsets required included the protection of 1480 remnant Strzelecki Gum and a 10:1 offset ratio for replacement, with a total of 5230 to be revegetated. Offsets were focused around the Morwell and Latrobe River corridors and the Morwell West Drain Diversion (MWDD).

By 2015, a large number of the 2005 YMCMP blocks reached their 10-year improvement milestone and were approved to move into their maintenance phase from the Victorian Department of Environment, Land, Water & Planning (DELWP).

In June 2021 a sudden and major high-flow event impacted the MRD, and significant cracking was discovered. Following geotechnical investigations, a temporary cofferdam upstream and connection of pipeline to divert water flows around this section of the MRD was approved. These works caused further changes to Commonwealth offset sites, changing some aspects of the plan, including:

- Planting of an additional 20 Strzelecki Gums.
- Removal of offsets contained within the construction or operational footprint of the MRD Onsite Diversion Project.
- Amendment to the Morwell West Drain Diversion (MWDD) revegetation planting requirements.
- Variations to the protection mechanisms already established during the period of the Original Offset Plan (2017) for the Morwell River Corridor.

The product of these major events is a conservation program spanning 626 hectares within the Mining Licence area.

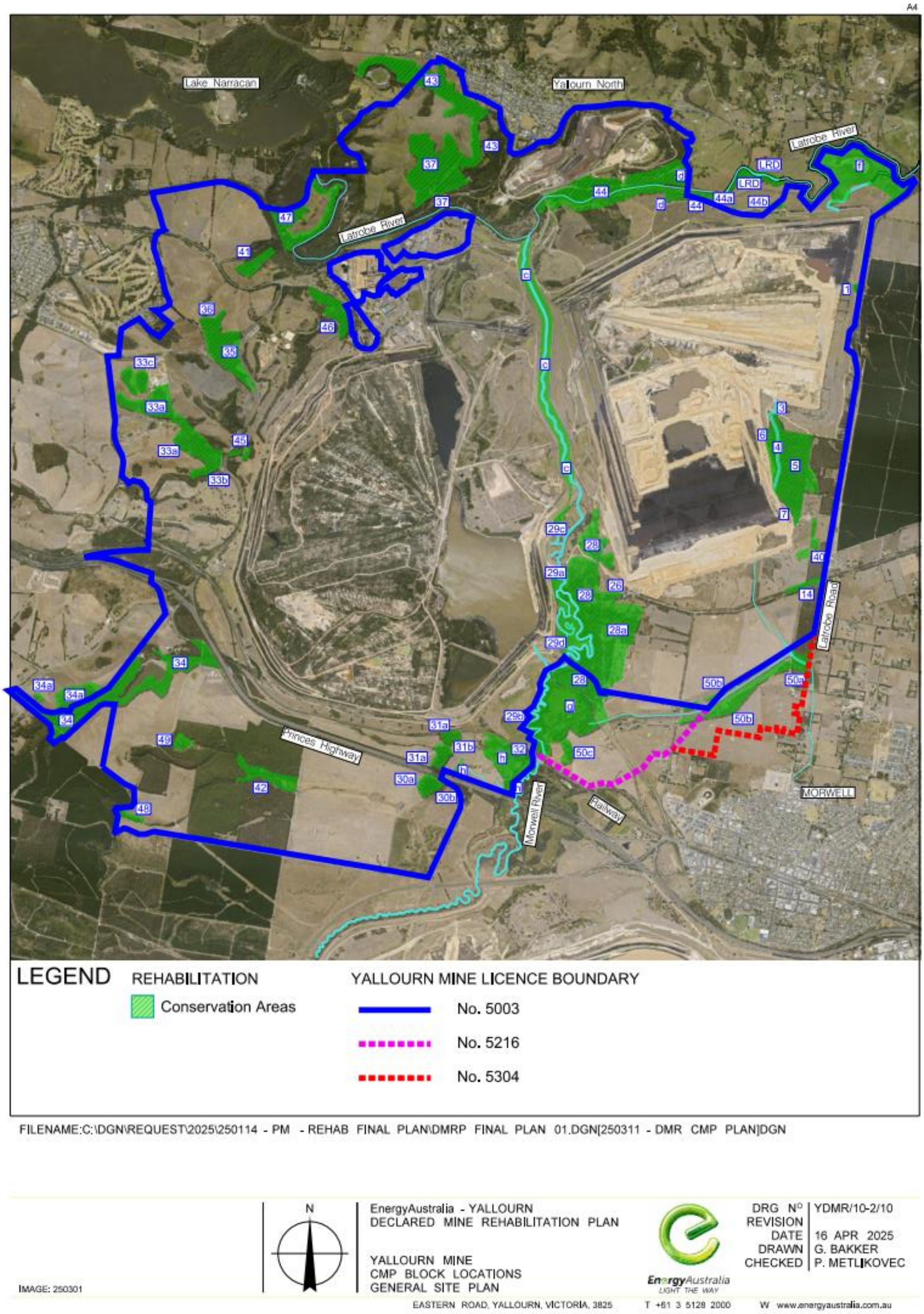


Figure 5-16: Existing Conservation Zones at Yallourn Mine

5.8.2 Flora

The Yallourn site sits within the Gippsland Plains (GipP) bioregion (DEECA 2024a). Within each of the Victorian states 28 bioregions, there are ecological vegetation classes (EVC). The EVC provide a standard unit for classifying vegetation types. Prior to European settlement, the site was covered by various EVC including:

- Lowland forest.
- Riparian forest.
- Damp forest.
- Swamp scrub.
- Plains grassy woodland.
- Swampy riparian complex; and
- Plains grassy forest

The site is home to a range of remnant patches, revegetation projects, farmland, and scattered trees, which host a variety of wattle, gum, native grass, aquatic, pea, lily, and invasive species. A comprehensive list of native and invasive vegetation found at the site was detailed in *Ecological Assessment: Yallourn Coal Field Development Maryvale Field Eastern Extension* (IDLM 2008) and is shown in Appendix B - Flora at Yallourn. Seed from these native species is collected and used for revegetation projects at the site which will include the rehabilitation period.

Rare and threatened flora species at site include the *Eucalyptus strzeleckii*, *Eucalyptus fulgens,* and *Cardamine tenuifolia.*

5.8.3 Fauna

Fauna survey records within the site identified 23 species of fauna that are considered rare, threatened or protected across the site perimeter (IDEM 2022). This includes four species protected under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), four species protected under international treaty and 20 species listed on the *Flora and Fauna Guarantee Act 1988* (FFG Act) Threatened List. Details are presented in Table 5-10 with site locations shown in Figure 5-16.

Table 5-10: Summary of rare and threatened species

Class	Common name	Scientific name	EPBC	FFG	Treaties	Site recorded
Bird	Australasian Bittern	Botaurus poiciloptilus	EN	cr		g
Bird	Australasian Shoveler	Anas rhynchotis		vu		G, VBA*
Bird	Blue-billed Duck	Oxyura australis		vu		G,VBA
Bird	Cattle Egret	Ardea ibis	Mr		CJ	g
Bird	Eastern Great Egret	Ardea modesta	Mr	vu	CJ	g,h
Bird	Freckled Duck	Stictonetta naevosa		en		g
Bird	Gang-gang Cockatoo	Callocephalon fimbriatum	EN			34,37,44,g,VBA
Bird	Grey Goshawk	Accipiter novaehollandiae		en		50b
Bird	Hardhead	Aythya australis		vu		G,VBA

Class	Common name	Scientific name	EPBC	FFG	Treaties	Site recorded
Bird	King Quail	Coturnix chinensis		en		44
Bird	Latham's Snipe	Gallinago hardwickii	Mr/Mg		CJ	28,YOC*
Bird	Lewin’s Rail	Lewinia pectoralis		vu		34,g,YOC,VBA
Bird	Little Bittern	Ixobrychus dubius		vu		g,VBA
Bird	Powerful Owl	Ninox strenua		vu		41
Bird	White-bellied Sea Eagle	Haliaeetus leucogaster	Mr	en	C	28, 30, 32, 47, 50c, g, h, YOC, VBA
Mammal	Grey-headed Flying Fox	Pteropus poliocephalus	VU	vu		34,VBA
Mammal	Platypus	Ornithorhynchus anatinus		vu		28,44
Mammal	Yellow-bellied Sheathtail Bat	Saccolaimus flaviventris		vu		5
Reptile	Glossy Grass Skink	Pseudemoia rawlinsoni		en		Yallourn Open Cut
Reptile	Lace Monitor	Varanus varius		en		37
Reptile	Swamp Skink	Lissolepis coventryi		en		h
Fish	Dwarf Galaxia	Galaxia pusilla	VU	en		28,h,YOC,VBA
Fish	Flinders Pygmy Perch	Nannoperca sp.1		vu		28,VBA

Key to Conservation Status

Flora and Fauna Guarantee (FFG) Act 1988	Environment Protection and Biodiversity Conservation (EPBC) Act 1999	International Treaty
Vu – Listed as Vulnerable in Victoria En – Listed as Endangered in Victoria Cr – Listed Critically Endangered in Victoria	VU – Listed as nationally Vulnerable EN – Listed as Nationally Endangered Mr – Listed Marine Mg – Listed Migratory	C – China-Australia Migratory Bird Agreement J – Japan-Australia Migratory Bird

Aquatic surveys in the Morwell River have also included environmental deoxyribonucleic acid (eDNA) sampling for Australian Grayling (*Prototroctes maraena*) which are listed as Vulnerable under the EPBC Act. This work was undertaken to inform EAY of the potential presence of the species in the Morwell River and to assist in guiding any in-river works that EAY may undertake currently or during rehabilitation. The results did not detect Australian Grayling in the Morwell River (Aquatica Environmental 2023).

5.9 Fire

The Yallourn Mine *Fire Control Management Plan* (EnergyAustralia 2023b) provides the following assessment of bushfire behaviour at the site:

"At a landscape scale, having consideration of vegetation, weather, and topography there is a real and significant threat of high intensity bushfires reaching the Yallourn Mine.

North to north-westerly influenced weather patterns are associated with the most adverse conditions possible in Gippsland. With adverse conditions the likely forms of bushfire attack in the area would include ember attack and spotting into the area. There is potential for spot fires to form ahead of the main fire front impacting on the area from various directions. Also, if the main fire front impacted on the area there is potential for other forms of bushfire attack including, radiant heat and direct flame contact.

Fires may emerge from the forest and could travel through existing vegetation, plantations and grasslands located around the township of Yallourn North and in locations such as Purvis Road and Latrobe River Road, regenerating fire intensity relevant to the vegetation.

This could result in direct flame contact and radiant heat impacts to the Yallourn Mine site and EnergyAustralia estate, particularly from the northern aspects.

Historically, bushfires have frequently occurred in these areas. The years 1997/1998, 1999, 2001, 2004 and 2006/2007 have all seen bushfires occur in the heavily forested land within the northerly aspects of the Yallourn Mine. South-easterly wind changes also associated with adverse conditions in Gippsland have the potential to influence bushfire behaviour impacting on Tyers. Fire may spread across farmland, hardwood and softwood plantations in locations to the south east of the Yallourn Mine with fire emerging and impacting on the mine and associated assets. Bushfires of this nature occurred in 2014.

In a more extreme fire event, there is a potential for a convection driven fire (convection column over the Boola Boola or Tanjil State Forests) to move in from the north and west. This type of fire would move through the landscape in a manner, unaffected by local conditions (including weather, topography). When fires of this nature reach areas of lower fuel (for example: small acreage property's in the areas north of the Yallourn Mine) generally the convection column would "collapse" showering embers across the landscape and generating excessive winds (for example: 75 k.p.h)".

Figure 5-17: Yallourn Mine Fires from 1929 (top left), 1933 (top right) and 2014 (bottom)

Exposed coal presents an extreme fire risk to the employees and the community which must be addressed and managed through the rehabilitation period. This forms an integral consideration for the rehabilitation design for the site.

5.10 Heritage

The Maryvale Coal Field Development Environmental Effects Statement (EES) (AGC Woodward-Clyde Pty Ltd 1999), and supplementary report to the EES (Maunsell McIntyre 2001), document cultural heritage investigations throughout the Maryvale Field and Morwell River Corridor. Investigations found eleven indigenous heritage sites within the study area and four non-indigenous heritage sites of significance (AGC Woodward-Clyde Pty Ltd 1999).

5.10.1 Indigenous Heritage

An indigenous heritage assessment at Yallourn Mine began in 1999 which determined the need for further engagement (Maunsell McIntyre 2001).

Based on this assessment, EAY entered into a Native Title Agreement with the Gunaikurnai People which is still active today.

In 2021, the Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) managed a cultural excavation, inspection, and collection project where various artefacts were recovered. No further impacts to indigenous heritage sites are expected during operations or rehabilitation as all areas requiring disturbance have already undergone assessment, however if circumstances change, engagement with GLaWAC and approval for disturbance will be required.

5.10.2 Non-Indigenous Heritage

Four non-indigenous heritage sites have been located within the Morwell Bridge / Morwell West area, adjacent to Old Melbourne Road (Maunsell McIntyre 2001). A summary of the non-indigenous heritage sites is below in Table 5-11.

The original Maryvale design impacted on all four sites, however re-alignment of the mine design in 2008/2009 prevented disturbance of the heritage sites. The four sites show evidence of early European settlement. Any unplanned disturbance of these heritage areas needs to be approved by Heritage Victoria with the necessary permits obtained.

Table 5-11: Non-indigenous heritage sites

Site Name and Number	Description	Removed	Easting	Northing
Morwell Bridge 1 H8121-0028	Farmhouse - rare occurrence of early European settlement	N	398365.9	264116.0
Morwell Bridge 2 H8121-0029	Farmhouse - rare occurrence of early European settlement	N	398268.5	264347.1
Morwell Bridge 3 H8121-0030	Non-indigenous artefacts in excavation	N	398145.7	264550.4
Smith's Hotel H8121-0032	Former site of the Smith's Hotel	N	398277.0	264236.9

Chapter 6 Rehabilitation Vision and Objectives

6.1 Introduction

Development of a project vision, underlying principles and objectives is part of the best practice approach to mine closure planning (ICMM 2025). The closure vision provides a high-level aspirational description of what a company and stakeholders want to achieve through implementation of the closure plan.

Rehabilitation project principles are high-level statements that cover general site wide conditions to be incorporated in rehabilitation activities.

Rehabilitation objectives set out the long-term goals for rehabilitation of the site, and therefore are focused, positive statements on key aspects of the site. They are specific to the Yallourn Mine and reflect the company's vision for the site, and incorporate legal requirements, alongside community and stakeholder considerations on potential post-mining land uses, whilst ensuring key technical risks are addressed. The development of the Yallourn Mine rehabilitation objectives considered all the aspects that may be or are impacted by the operation. Rehabilitation objectives are an essential component of the rehabilitation process, providing transparency for stakeholders as to what EAY commits to achieve at relinquishment.

To meet rehabilitation objectives, the relevant rehabilitation activities are planned and implemented. These activities have criteria attached (requirements and measurements) which once achieved indicate the success of the closure activities in meeting the rehabilitation objectives.

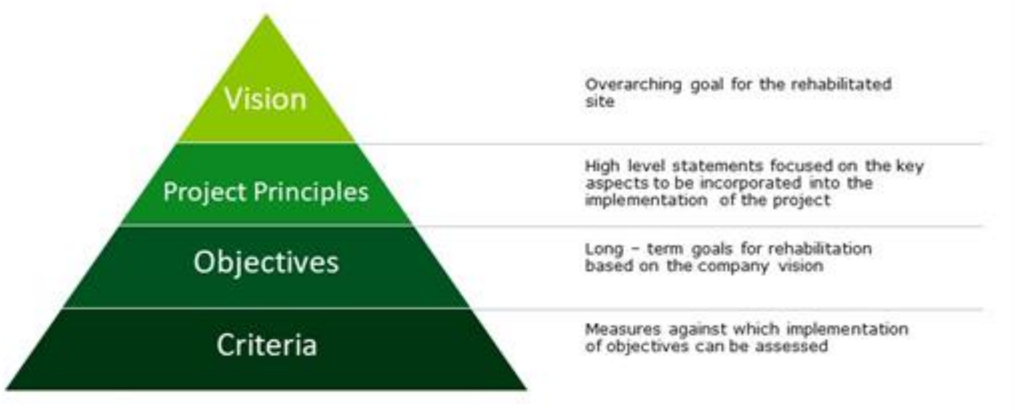


Figure 6-1: Development of Vision, Project Principles and Rehabilitation Objectives

Per regulatory requirements the post-mining landform must be "safe, stable and sustainable" to support the post mining land use. This requirement, alongside other legal requirements, technical knowledge, stakeholder engagement, and risk analysis, underpins the development of the vision, rehabilitation principles, objectives and the resulting criteria (refer to Chapter 13).

6.2 Vision Statement for Rehabilitation

EAY are committed to honouring Yallourn's legacy and want the site to be part of the regions transition to new economic opportunities, creating jobs, while providing beneficial future land uses beyond mining. As raised in previous chapters, the vision for the Yallourn Mine is:

To transform the Yallourn site into a landscape that enables ongoing prosperity and amenity for all. One that is an example of what can be achieved when business, government, communities, and custodians of the land work together.

This vision centres around the transformation of the current pit voids into a lake and EAY's aspiration that it will be capable of supporting recreational uses.

The vision statement was informed by visioning workshops held in late 2022 and 2023 (ERM 2023b, ERM 2023c). These workshops consulted a wide range of people who either worked at the site, or had a connection with Yallourn, to understand their views on "What does good rehabilitation and closure look like for Yallourn?". Attendees were asked to think about this question from the perspective of being a community member.

Over 360 ideas were captured, collated and reviewed from the internal workforce, site leadership team, corporate personnel, Jeeralang Power Station and the Environment Review Committee (ERC). The sentiment from these visioning workshops included:

- **Safety and sustainability:** Leave a safe, stable, and sustainable final landform.
- **Demonstrate best practice in rehabilitation:** Aspire to be seen as a leading example of successful closure and rehabilitation.
- **Focus on engagement:** Actively engage with the workforce, community and stakeholders throughout all stages of the rehabilitation.
- **Consider commercial viability:** Plan to rehabilitate in a way that is financially viable, both in terms of the rehabilitation work itself and future land uses.
- **Leave something we're proud of:** Leave a site for the community that makes people feel proud of what is left behind.
- **Have a clearly defined strategy:** Understand and communicate the steps required to close and rehabilitate the site.
- **Consider a broader view of the project:** Take into consideration other factors outside the site boundary such as the rehabilitation plans for the other coal mines.

Sentiments from these workshops, along with company values and regulatory expectations, were considered when developing the rehabilitation vision and objectives.

6.3 Key Rehabilitation Project Principles

Key rehabilitation project principles have been developed with a focus on the regulatory requirements for *safe, stable and sustainable*. Definitions of *safe, stable and sustainable* were developed with consideration of regulatory definitions, ICMM closure principles (ICMM 2025) and the *MLRA Vocabulary* document (MLRA 2024b). Drafting the definitions was achieved using a multi-disciplinary approach to ensure the definitions were suitable across all aspects of the projects.

These principles (Table 6-1) will guide the project planning and be reviewed and revised as the knowledge base for the project grows.

Table 6-1: Key Rehabilitation Principles

Project principle	Definition
Safe	The rehabilitated mine land does not pose a greater risk of harm to humans and the environment than comparable non-mining land uses
Stable	To rehabilitate the mine land such that final landforms are enduring in the long-term, with the potential for land movement minimised ensuring the viability of its proposed post-mining land uses
Sustainable	The rehabilitated mine land will remain in a condition that requires minimal intervention to support the nominated post mining land uses, create a positive legacy, enhance environmental values for both site and the broader Latrobe Catchment and provide a timely benefit to current and future generations. Execution of rehabilitation works will minimise emissions generated through optimising the use of materials required to develop the rehabilitated landform.

6.4 Rehabilitation Objectives

To develop site specific rehabilitation objectives a number of inputs were considered, including:

- Consequences of not achieving safe, stable and sustainable
- Regulatory obligations
- Vision statement
- Project principles
- Knowledge Base
- Post mining land use
- Risk management
- Stakeholder input

EAY has developed the following rehabilitation objectives based on these considerations as shown in Table 6-2.

Table 6-2: Key Rehabilitation Objectives

Overarching Closure Principle	Aspects	Objectives
Safe	Voids and excavations	All pit voids and other excavations are made safe through backfilling, grading slopes according to approved geotechnical design and ensuring controlled access as required.
	Pit lakes and other water bodies	Pit lakes and water bodies are formed with designated entry points which allow safe egress and ingress.
	Fire management	Exposed coal is managed appropriately to manage the risk of fire in the long term.
	Infrastructure	Remove or make safe all light and industrial infrastructure from the mine site with the associated footprint rehabilitated in accordance with the respective post mining land use.
Stable (Physical Stability)	Voids and excavations	All pit voids and excavations remain stable in the long term both in terms of significant land movements and in terms of erosional processes such as tunnelling and, gullying and rilling.
	Pit lakes and other water bodies	Artificial water bodies remain stable in the long term with consideration to climate change and varying hydrological regimes.
	Pit lakes and other water bodies	Embankments of pit lakes remain stable in the long term with consideration to erosion, both from stormwater drainage and from the effects of wave action.
	Artificial or modified water courses	Artificial or modified water courses and drainage lines are constructed to remain stable in the long term, with consideration to erosion protection, varying hydrological regimes and climate change.

Overarching Closure Principle	Aspects	Objectives
	Downstream hydrological regime	Downstream hydrological performance is improved during the closure and rehabilitation phase through to post closure compared to baseline.
	Constructed landforms	All constructed landforms remain stable in the long term with acceptable rates of erosion that allow the establishment of a self-sustaining vegetated cover in line with the respective post mining land use.
Stable (Chemical Stability)	Pit lake chemical stability	Pit lake water quality although may fluctuate does not become a source of water quality that has an unacceptable impact on downstream receptors.
	Overburden stockpiles	Overburden material will not become a source of problematic mine drainage in the future.
	Contaminated land	All potentially contaminated areas are investigated and managed in accordance with statutory guidelines and legislation to ensure that the land supports the respective post mining land use.
	Watercourses	Surface runoff or seepage from the rehabilitated mine site does not have an unacceptable impact on downstream receptors.
Sustainable (Socioeconomic)	Stakeholder and community engagement	Stakeholders and the community are engaged throughout the closure planning phase.
	Transparency	Stakeholders and the community are kept informed of the closure planning and implementation process.
	Socio-economic transition	The transition to mine closure is undertaken in a manner that proactively manages and mitigates the associated decline in economic activity as far as practicable.

Overarching Closure Principle	Aspects	Objectives
	Visual Amenity	Rehabilitated landforms are congruent with the surrounding landscape as far as practicable.
Sustainable (Ecological)	Aquatic ecosystems	The quality and diversity of downstream aquatic ecosystems is not compromised due to seepage, runoff or mixing processes from the rehabilitated mine site.
	Terrestrial ecosystems	Rehabilitated surfaces support a resilient and self-sustaining vegetated ecosystem that is compatible with the post mining land use.
Sustainable (Post Closure)	Post closure care and maintenance	Post closure care and maintenance requirements are minimised, with no ongoing earthmoving, water treatment or ecosystem management requirements beyond comparable land uses in the broader region.

6.5 Rehabilitation Closure Criteria Framework

The vision and objectives shown above guided the knowledge base enhancement, technical studies, risk management, and detailed design processes which ultimately lead to setting project closure criteria. Due to these inter-dependencies, closure criteria are shown in Chapter 13.

Chapter 7 Progressive Rehabilitation

7.1 Introduction

Progressive rehabilitation refers to the rehabilitation activities completed during the mine operations period (MLRA 2024b). Progressive rehabilitation is a requirement under the MRSDA, a requirement that EAY has taken great pride in completing over the last 20 years. Prior to EAY ownership, the SECV did little progressive rehabilitation with majority of the work completed associated with the 1980s Morwell River Diversion. These works have since been mined out and removed.

Through progressive rehabilitation works, EAY has used their existing knowledge base to trial, test, and improve rehabilitation methods to inform final rehabilitation execution. This has resulted in an increased knowledge base with improved confidence in the results produced, a more targeted technical study program, increased efficiency, and increased effectiveness, which are summarised within the following case studies. These learnings have contributed to improved risk reduction, design, implementation, and highlighted additional knowledge gaps to be addressed in the future.

Shown below are specific case studies on completed progressive rehabilitation works at Yallourn, highlighting the successes, failures, and risks. Implementing progressive rehabilitation is a best practice principle, improving environmental outcomes today and informing future final rehabilitation.

A plan showing the locations of these progressive rehabilitation case studies is shown in Figure 7-1.

7.2 East Field Extension Batter

EAY achieved a major progressive rehabilitation milestone in 2017 with the completion of the East Field Extension Latrobe Road and Southern Batter rehabilitation works. This project saw 492,000 cubic metres (m^3) of overburden shaped over the permanent coal batter, with the upper sections covered by topsoil and grass to provide surface stability against erosion. The overburden slope was reshaped to a three parts horizontal to one-part vertical grade (3:1 grade) and the coal slopes 2.5:1. Maximum slope lengths are greater than 90m.

Within the project works a detailed drainage plan was constructed to drain both surface rainfall runoff and groundwater from the series of horizontal bores drilled into the coal batter. This drainage construction prevents overtopping of the various benches, preventing significant erosion failure.

With eight years of monitoring information available from groundwater bores, movement pins, and landscape function analysis, plus visual inspections and an annual slashing program, there is confidence in the work completed and its ability in being a long term, high integrity, erosion resistant landform. A detailed erosion study in Section 8.13 provides further context.

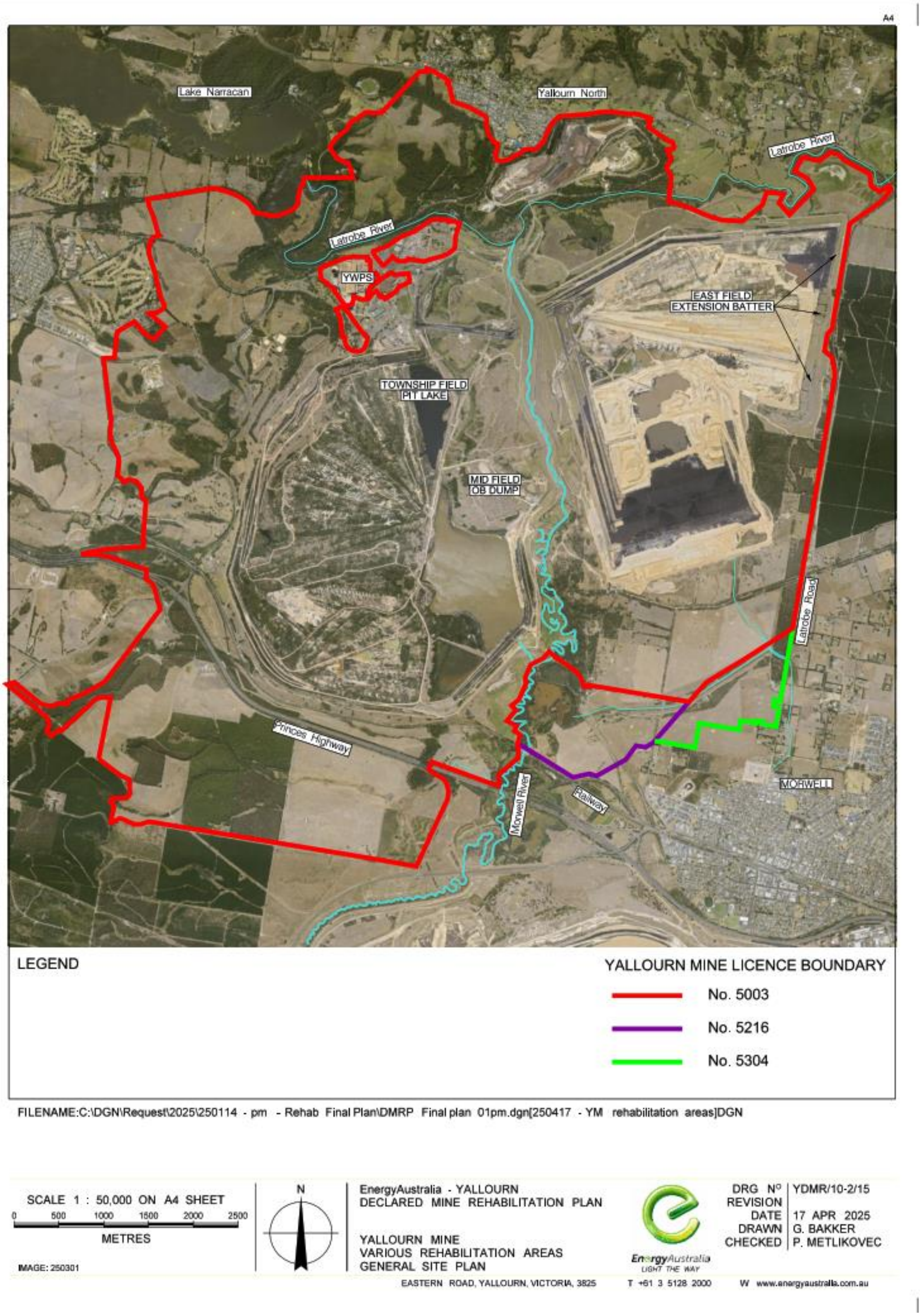


Figure 7-1: Location Plan of Progressive Rehabilitation Case Studies

Figure 7-2: East Field Extension During Active Mining (2013)

Figure 7-3: East Field Extension After Significant Coal Coverage and Progressive Rehabilitation (Oct 2017)

7.3 Township Field Pit Lake

After the cessation of overburden backfilling in Yallourn Township Field in October 2010, progressive rehabilitation works commenced. The aim of these works was to demonstrate that pit lake filling was achievable, whilst gaining knowledge about the key processes and risks. The progressive rehabilitation program included infrastructure removal, reshaping, drainage diversion and construction, native vegetation direct seeding, and ultimately filling the 3.6 GL Township Lake void with water.

Extensive infrastructure removal included the overburden stacker, conveyor frames and belt, pumps, pipework, conduits, cables, overhead lines, and civil structures to allow earthworks and Township Lake filling to progress. Reshaping activities included the overburden dump face which was laid back from angle of repose to a 4:1 grade including a flat shoreline 1 m below the final Township Lake level of RL-3.0 m.

Reshaping above the overburden dump face smoothed out the disturbance caused by mining activities, allowing tractor access for direct seeding to native woodland.

To speed up lake filling, the main northern overburden dump drain was diverted into the new Township Lake void with additional drainage paths also diverted afterwards. This work was completed on the 9th of April 2011 which marked the initial fill date for the lake. Lake filling continued throughout 2011 and 2012 with completion interrupted by the MRD failure of 2012.

Although the MRD failure caused the Township Lake to overflow the data captured until that point equated to a runoff coefficient of 0.56 with the lake 95% complete by volume. In total, 3.2 GL of lake filling had occurred against a full lake of 3.4 GL capacity. A digital terrain model of the lake and surrounds was constructed which allowed accurate water balance tracking through level measurements of the lake.

Initial water quality of the lake was poor with high acidity and total dissolved solids. During lake filling, improvements were seen in total dissolved solids concentrations whilst pH was treated with hydrated lime. Once cooling tower overflows were diverted into Township Lake, pH and TDS results rapidly improved and are now regularly within EPA Licence discharge limits. This cooling tower overflow is representative of a slightly concentrated Latrobe River inflow with natural acid buffering capacity.

EAY has achieved positive results with shoreline vegetation establishment with common reed, river club rush, and broadleaf cumbungi, all providing noticeable levels of erosion control on the sandy overburden material.

Whilst only a small volume and area by comparison, Township Lake rehabilitation demonstrates that meeting EPA Licence water quality criteria is achievable for pit lake filling, whilst also showcasing the surrounding earthworks, drainage diversions, landforms, and vegetation profiles consistent with long lasting final rehabilitation implementation.

Figure 7-4: Reed Club Rush Establishment on Township Lake Shoreline

Figure 7-5: Common Reed Establishment on Township Lake Shoreline

Figure 7-6: Township Lake Void in October 2010

Figure 7-7: Township Lake After Void Flooding and Surrounding Vegetation Establishment in 2019

7.4 Mid Field Overburden Dump

Due to the MRD failure event in 2012, excess flows from the Morwell River were diverted into the Township Field Mine. These flows travelled along the toe of the previously stabilised Mid Field Overburden Dump, causing erosion of the base which eventually caused a circular slip failure. This failure was left untreated until 2018 when progressive rehabilitation works were initiated to return the area to a stable grassland.

Figure 7-8: Mid Field Dump Disturbance from Morwell River Flow Toe Erosion and Circular Failure

The rehabilitation works to remediate the site included cut to fill dozer push reshaping of the disturbed area, topsoil imported by truck and shovel and spread to a depth of 100mm, before grass seeding was completed to stabilise the area. A sequence of rock weirs were installed within the drainage line at the new project toe, these drains dissipate energy by slowing water which minimises erosion and also allows aquatic vegetation to establish.

Figure 7-9: Mid Field Dump Progressive Rehabilitation Works Completed

This rehabilitation work highlights the importance of surface drainage which can easily erode fill landforms, especially where large flows are directed towards embankment toe areas.

7.5 Progressive Rehabilitation & Batter Stabilisation

As outlined in Section 3.5, the long-standing rehabilitation strategy for Yallourn Mine involves the creation of a lake upon completion of mining activities. To support this objective, the mine plan has progressively incorporated batter stabilisation requirements, which have been implemented over time as part of the ongoing mine development. Some of the examples of these measures are provided below. Notably, the below summaries aim to provide a historical context only. The most current outputs for these geotechnical domains are presented in Technical Studies (Section 8.9).

- **YEFX Latrobe Road Batters** – the plan for internal overburden dump construction was reviewed in 2010 (GHD 2020) with option to extend stacker dumping to be constructed along the toe of YEFX Latrobe Road Batters. The reconfiguration option of the internal dump was further investigated in 2012 (GHD 2012) and subsequently adopted in the dump design circa 2014. This provided increased stability to these batters buttressed by the internal overburden dump. This not only increased operational reliability but also supports the future lake filling of the mine void.
- **MVF Western Batters** – a geotechnical assessment in 2012 considered a full lake level of RL37m with considerations to stability of this geotechnical mine domain and its proximity to the Morwell River Diversion (MRD). Internal overburden dump and coal strut (block of unmined coal) was planned in the mine design along the toe of these batters to service the mine operational requirements and being complementary to future lake option for mine rehabilitation.
- **MVF Eastern Batters** – a geotechnical review of the Maryvale Field in 2020 (GHD 2020) evaluated a lake level of RL33.4m. The stability cross-sections assessed for this geotechnical mine domain adopted an internal overburden dump constructed along the toe of these batters for a full lake level. The assessment

revealed that the stability of these batters increases with inclusion of a stabilising dump and can assist in achieving the stability requirements for mine rehabilitation.

- **YTF Western Batters** – the stability assessments for coal excavations along these batters in 1980 (SECV 1980) considered a flooded lake of RL50m, RL43m and RL35m. Whilst a toe dump was planned to service operational requirements, the introduction of lake waterbody only marginally reduced the factor of safety for the tested full lake levels.

7.6 Progressive Rehabilitation Summary

A snapshot of the progressive rehabilitation works at Yallourn is given within this chapter; however, works are far more extensive with over 1,500 hectares of progressive rehabilitation works completed. Progressive rehabilitation is an operational environmental key performance indicator as works primarily reduce the coal footprint, limiting exposure to the major risks of fire and dust. Once coal is covered by overburden material, vegetation is essential to protect the cover from washing or eroding away. Vegetation profiles differ depending on where the rehabilitation is taking place. In some cases, normally on steep areas, topsoil is spread to promote fast and long-lasting vegetation growth. However, on flatter areas native vegetation or grass profiles can be established directly on overburden with low erosion risk.

The sum of progressive rehabilitation environmental benefits includes lower fire risk, reduced dust emissions, improved water quality, increased habitat area, and a more visually appealing landform. Furthermore, the experience gained from completing these works generates improved project management and implementation skills which improve delivery throughout final rehabilitation implementation.

Whilst some of the progressive rehabilitation work completed will be lost beneath the final lake level, the work contributes to lower environmental impact today and stabilises the landform as the pit lake level rises by providing resistance to wave action and other erosion forces. The progressive rehabilitation completed also demonstrates that Yallourn Mine is capable of completing infrastructure removal, landform reshaping by dozer push, material cartage through truck and shovel operations, revegetation to grass and native habitat, revegetation by hydroseeding, drainage works, and pit lake filling. These are the primary activities will deliver this DMRP.

Chapter 8 Technical Studies

8.1 Introduction

To ensure that the rehabilitated landform minimises long-term risks to as low as reasonably practicable (ALARP), EAY commissioned an extensive suite of robust technical studies to support the existing site knowledge base outlined in *Chapter 5 Environmental Setting*. Based on the latest available science and engineering, these studies address existing risks identified through mining activities that require mitigation to achieve and safe, stable and sustainable landform. The findings are used to inform final landform design and land use capabilities, risk assessments, and ongoing monitoring and maintenance programs. Where studies identify unresolved items or new issues, these are captured as knowledge gaps to be addressed at a later date.

The technical studies summarised in this chapter are specifically designed to find a safe, stable, sustainable rehabilitation solution (per the project's definition) that accounted for:

- How the geo-physical and environmental constraints of the site (e.g. geotechnical, hydrogeological and hydrological risks) could potentially lead to adverse outcomes for not only the mine, but surrounding receptors, including the Gippsland Railway Line, Princes Freeway, local roads, rivers, private land and townships.
- The legal requirements imposed under the MRSDA and other key legislation.
- Other requirements and expectations, including the implementation principles presented in the LVRRS (refer Section 4.1.1).

Due to the iterative process of rehabilitation planning, the scenarios tested within these technical studies may not be fully consistent with the nominated end land use or landform. However, once combining the findings from each assessment and assessing competing risk events holistically, the technical studies show that the proposed pit lake is the optimal safe, stable, and sustainable solution. Learnings from these technical studies have greatly added to EAYs rehabilitation knowledge base, allowing for sound risk-based decision making on design and implementation decisions.

8.2 Geological Model

8.2.1 Introduction

The focus on this section is the Yallourn Mine Geological Model which builds on information shared in *Chapter 5 Environmental Setting*. Having an accurate geological model allows detailed analysis of groundwater and geotechnical impacts as the site transitions from operations to post closure. This model informs the geotechnical risk assessment and future design considerations.

A site based stratigraphic model covering the full license area, models all major geological and hydrogeological units. The site-based model is generated in a software called Datamine MineScape. This model focuses on coal resource for mining and the hydrogeological units (aquifers) that are critical to mining operations. The model utilises a selection of the available drillhole information and is periodically updated as new data becomes available from intrusive site investigations. Model updates are compiled and maintained by the Mine Geology and Geotechnical Team.

This stratigraphic model forms an essential tool for resource planning, geotechnical analysis and ground management of the site. As part of the mine rehabilitation planning, this stratigraphic site model has been updated to support the mine rehabilitation technical studies. The focus areas of these updates have been to service the following:

- **Groundwater Numerical Modelling** – Section 8.2.2.1 and 8.2.3 presents the outcomes of updated stratigraphic model which form the input to the Groundwater Numerical Model. These focus on meshing the discontinuity of the modelled units, defining the in-fill units such as Yallourn and Morwell formation Interseam.
- **Geotechnical Analysis** - Section 8.2.2.2 and 8.2.4 presents the outcomes the update which form the input to the Geotechnical models. A concerted focus was on the upper stratigraphic layers being the Overburden/Haunted Hills Formation contact with Yallourn coal, the thickness and gradient of Yallourn coal (roof and floor of the seam) and the key sliding surface along the Yallourn Interseam.

8.2.2 Methodology - Yallourn Mine Geological Models

8.2.2.1 Geological Modelling – Groundwater Numerical Modelling

When developing a Groundwater Numerical Model (GWNM) the stratigraphy forms a key input parameter. The site geological and hydrogeological model (modelled in Datamine MineScape software) was updated in another software package called Leapfrog for an improved spatial distribution of the hydrostratigraphic units (HSUs).

The objective of the Leapfrog modelling was not to recreate the geological model but to integrate the existing geological datasets into a single regional scale modelling platform for efficiently building the layers in the numerical groundwater model. This method of modelling, in which the geological contacts within the Leapfrog model are forced to respect the surfaces from pre-existing models, is different from a more traditional approach using borehole logs as the primary input dataset. The Leapfrog model domain covers an area of 1,125 km² (extending well beyond the mining license boundary) and is large enough to fully encompass the groundwater model domain. The resolution of the Leapfrog model is adaptive, featuring a general cell size of 200 by 200 m that reduces to 50 by 50 m in the mine areas with higher-resolution data are available.

The following approach was adopted:

- Establish the pre-mining topography. This was achieved by utilising Vicmap's Digital Elevation Model (DEM), historical elevation maps (Narracan Map 121b, Maryvale Map, 1927) and collar elevations from old bores (validation by spot measurements).
- The stratigraphic units from the existing mine-scale geological models (Yallourn MineScape and Hazelwood Vulcan models) and regional coal model have been correlated with the HSUs, with a priority given to the mine models due to higher resolution and more detailed representation of local geology.
- Beyond the extent of the regional coal model, the hydrostratigraphy is interpreted from the surfaces of the Victorian Aquifer Framework (VAF), which has the lowest resolution and treated with the lowest priority.
- Regionally, due to the distance from Yallourn Mine, the hydrostratigraphy has been simplified by amalgamating Hazelwood Formation with the Haunted Hills Formation.
- Outcrops of the Thorpdale Volcanics and the Basement (Strzelecki Group) have been delineated from published geological maps to constrain the extrapolation of model surfaces towards the edge of the basin.
- A refined two-layer model comprising the basement and basin fill above was first constructed and the basin fill was subsequently refined by incorporating the coal and Interseams layers (thereby restricting the erosion processes of the basin fill and preserving the outcrops).
- Where the Thorpdale Volcanics directly overlie the Basement in the outcropping area, a uniform thickness of 50 m has been applied due to limited data (noting that this area is far from the Yallourn Mine and has not materially impact on the mine scale hydrogeological processes).

8.2.2.2 Geological Modelling – Geotechnical Analysis

The MineScape and Leapfrog models were both evaluated for the purpose of Geotechnical Analysis related to rehabilitation planning for Yallourn Mine. This resulted in the adaptation of the site-based geological model (generated in MineScape software) as the primary geological input for geotechnical analysis. This was then validated along each of the geotechnical cross-section generated for each geotechnical domain (discussed in Section 8.9). Another step to this validation was comparing the results to the Leapfrog geological model. The process of validation is discussed below, along with the key focus areas. Further details are discussed in *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b) (Appendix C – Technical Reports).

This evaluation of the existing geological models focussed on the following key elements:

- The upper two geological units, the HHF and the Yallourn Seam,
- The boundary between the Yallourn Seam and the underlying interseam units (up to 20m below base of Yallourn Seam),
- The above mentioned are the main units and the contact of interest for stability of the mine batters,
- In addition, there has been a brief assessment of the geometry for the underlying interseam units, although these underlying units are not expected to impact on the rehabilitation stability design, and
- The study has also identified the fills and dumps within and adjacent to the mining voids.

The validation focused on the selection of geotechnical cross-section(s) for each Rehabilitation Geotechnical Domain (Figure 3-7) based on:

1. A section line that was broadly representative of:
    a. The typical surface topography,
    b. Representative of the more adverse geology, and
    c. Where there were sufficient boreholes in close proximity to the section.
2. In addition, sections along the Peripheral Catchment (Figure 3-8) valley lines were selected to allow design of the drainage system, if this was not consistent with Item 1.

The general process after the selection of the section lines comprised:

1. The available borehole data was collated and reviewed.
2. The high confidence borehole data was selected.
3. The existing geological models were then tested and evaluated using high confidence borehole and geophysical logging data.
4. The review was focused initially on the immediate areas along the geological sections.
5. However, the borehole data coverage around each section was quite variable and so it was easier to extend the model across the whole of each Rehabilitation Geotechnical Domain on a domain-by-domain basis.

There are approximately 7,900 boreholes from drilling campaigns carried out between 1917 and 2023 and these were assessed in developing the Rehabilitation Geotechnical Domain Models. The range of information available from each of the bore sites was categorised into four categories:

- No geological information (32%),
- General lithological descriptions (15%),
- Formation data only (2%) and
- Both general lithology and formation data (51%).

8.2.3 Findings – Geological Modelling for Groundwater Numerical Modelling

The output generated from the above process ensures that the stratigraphic layers are continuous with all layers interbedded. This supports the requirement of the modelling software USGS MODFLOW which has been utilised to develop the GWNM. Figure 8-1 presents the cross-section lines with the generated cross-sections presented in Figure 8-2.

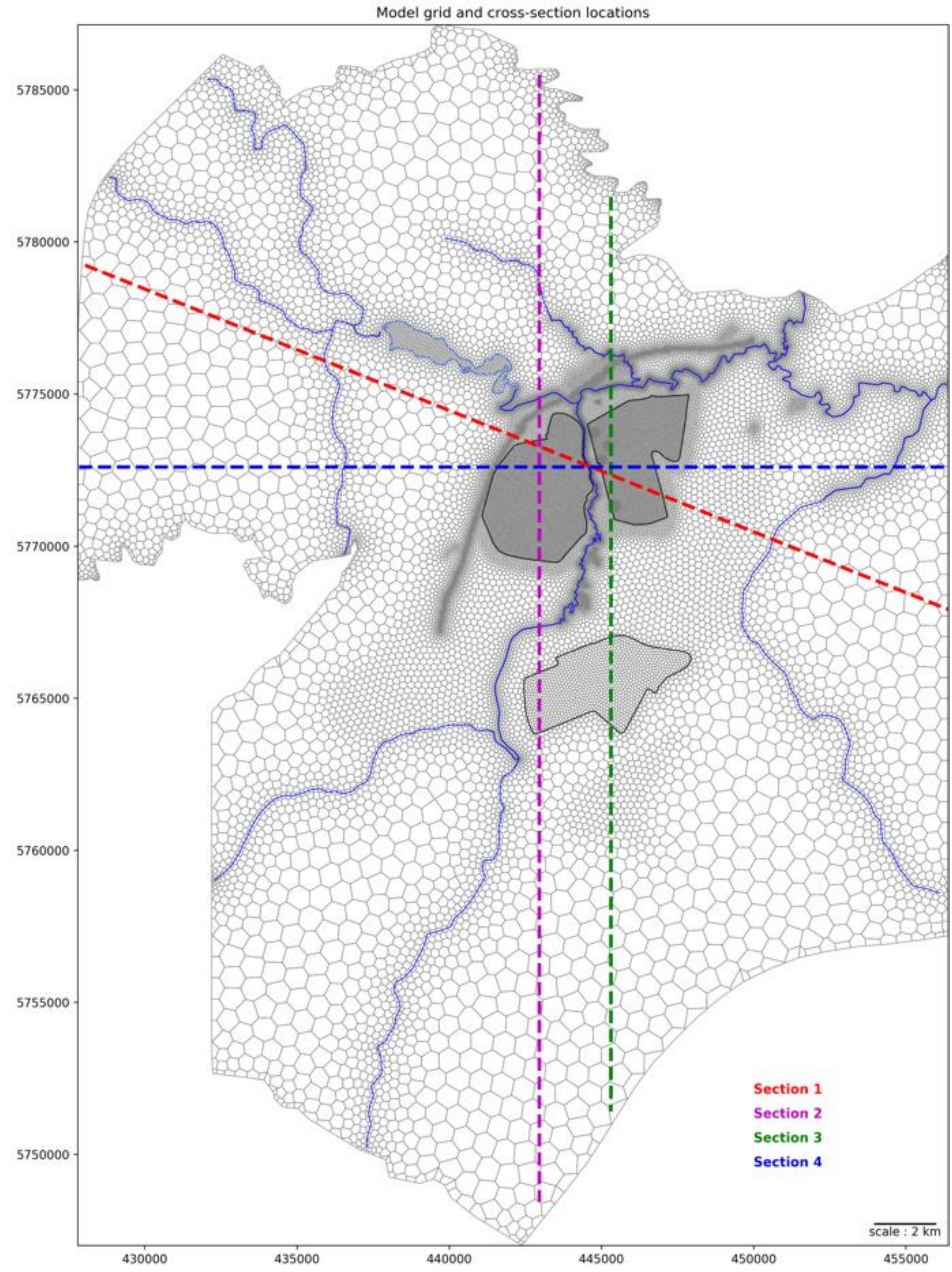


Figure 8-1: Leapfrog Stratigraphy Model – Cross Section Lines (GHD 2025b)

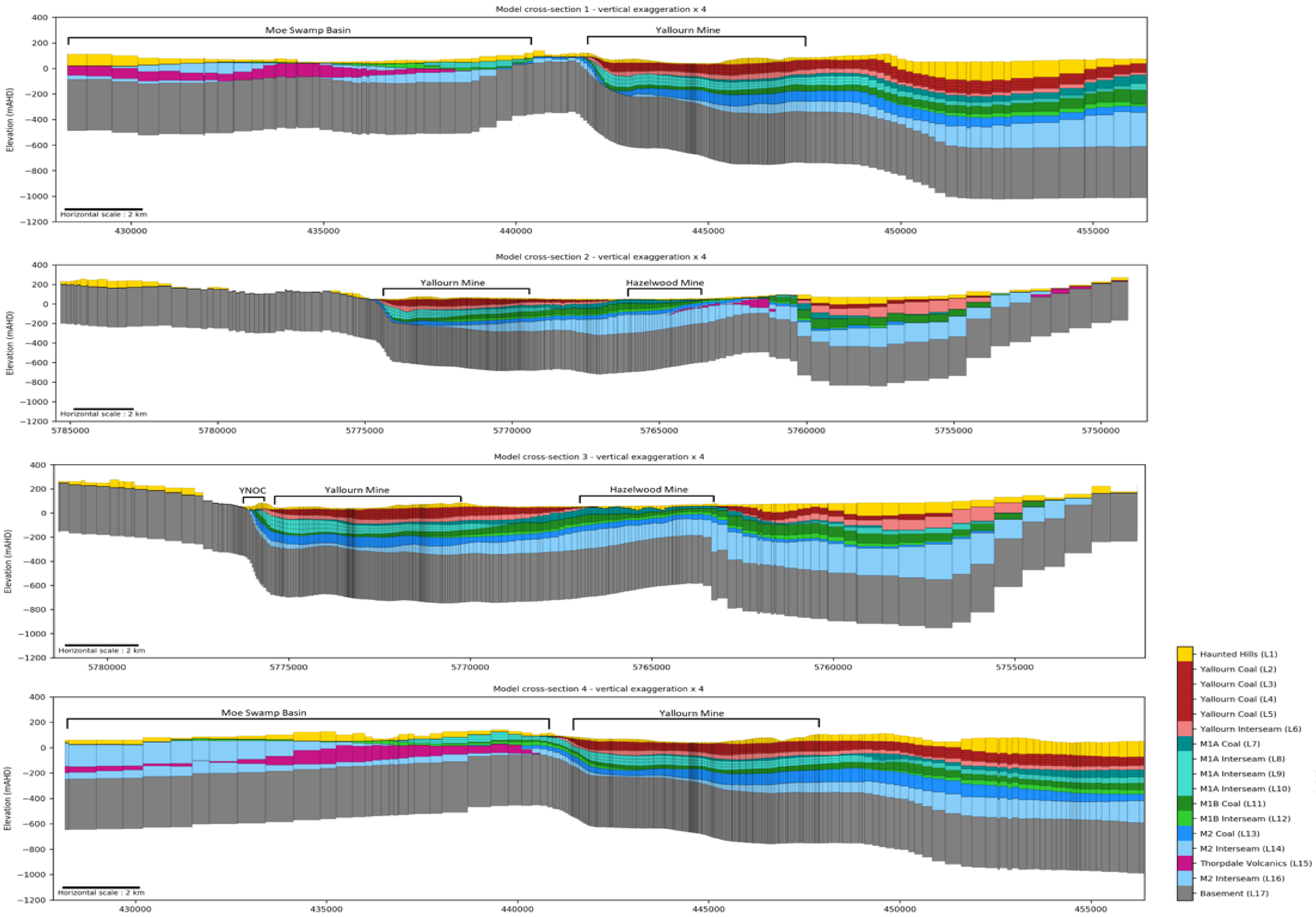


Figure 8-2: Leapfrog Stratigraphy Model – Cross Sections (GHD 2025b)

8.2.4 Findings – Geological Modelling for Geotechnical Analysis

This validation of the geological models for geotechnical analysis revealed the following:

a. There are a valid number of high confidence bores available for the geological modelling to support geotechnical analysis. These are presented in green in Figure 8-3.
b. There are broad consistencies between the MineScape (Figure 8-4) and Leapfrog Models (Figure 8-5).
c. On the scale of geotechnical models for rehabilitation assessment, the stratigraphy inputs to stability models needed to be adjusted to ensure a high level of accuracy (Figure 8-6). Figure 8-7 shows an example of the manual adjustment to model compared to the geophysics along a domain section.

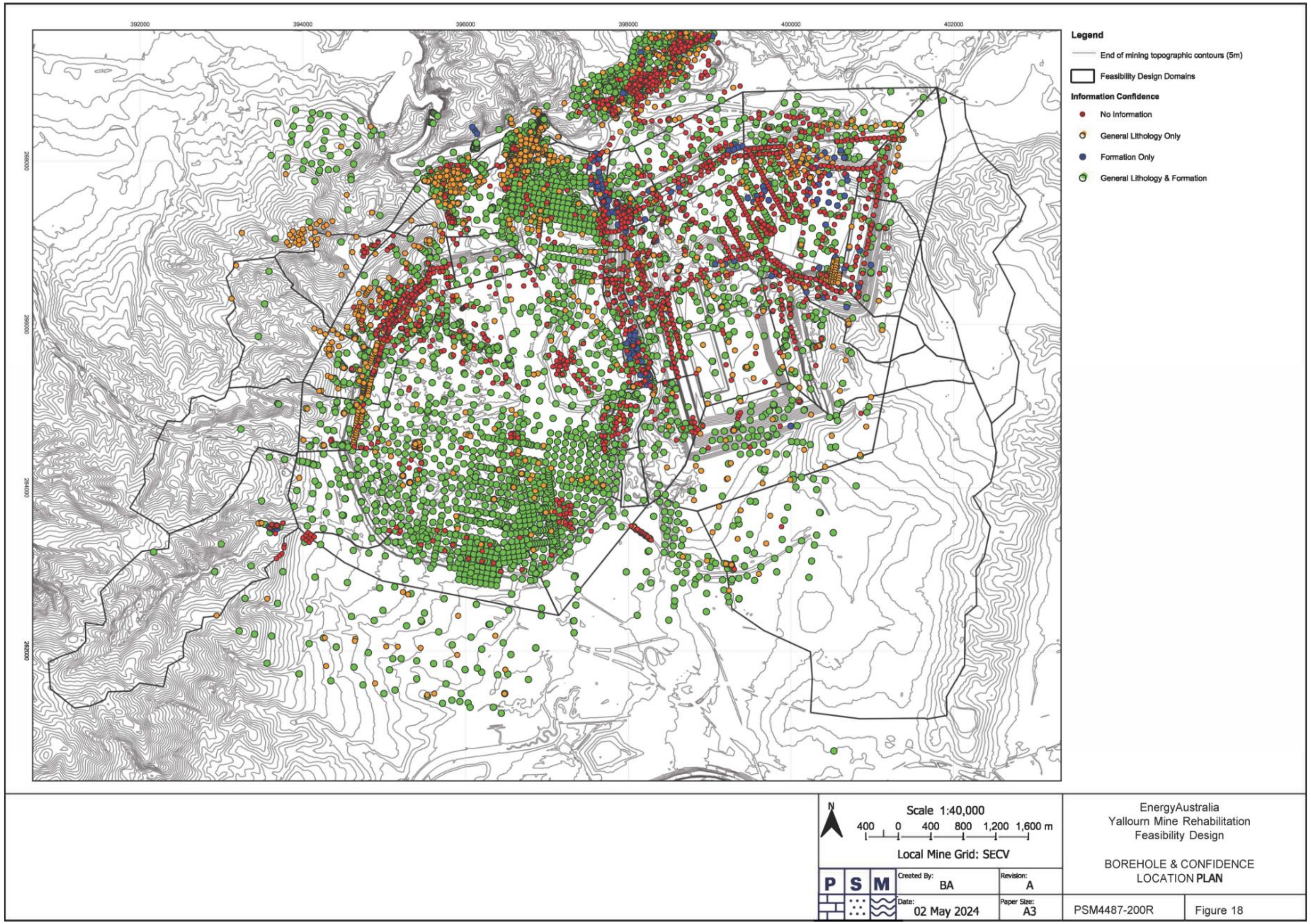


Figure 8-3: Geological Model Boreholes with High Confidence Bores (Green) (PSM 2025b)

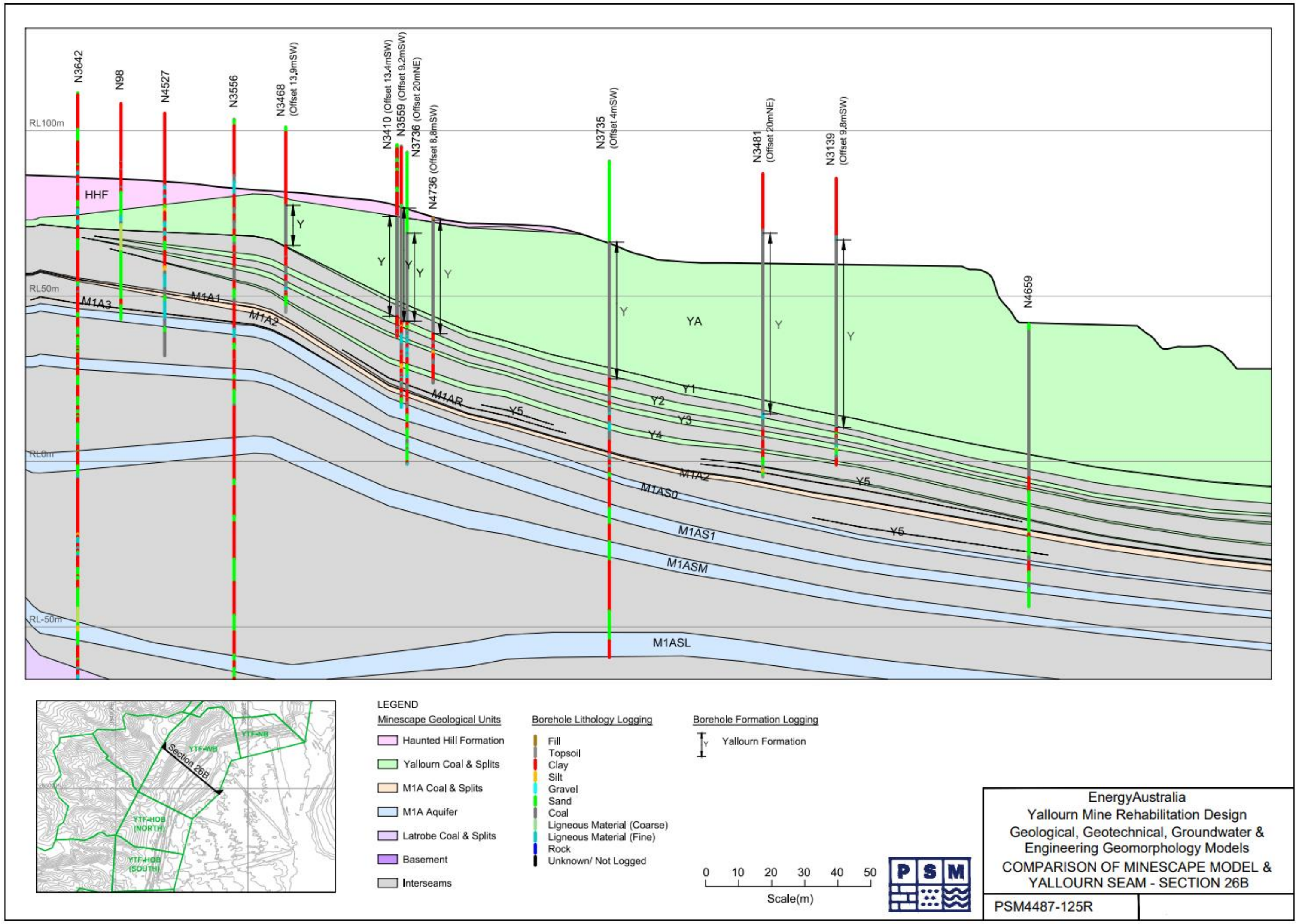


Figure 8-4: Comparison of MineScape Model with Yallourn Seam Geophysics (PSM 2025b)

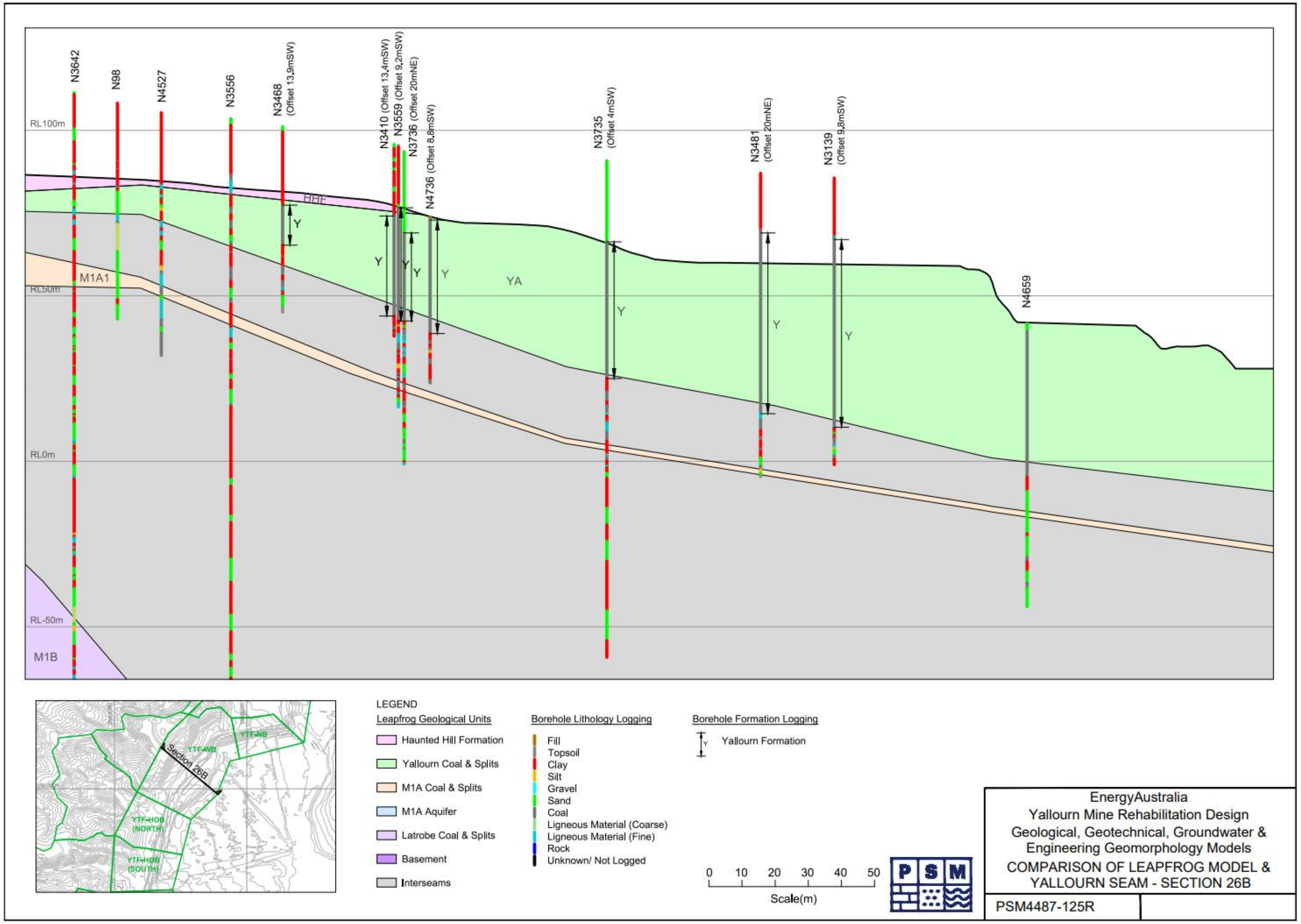


Figure 8-5: Comparison of Leapfrog Model with Yallourn Seam Geophysics (PSM 2025b)

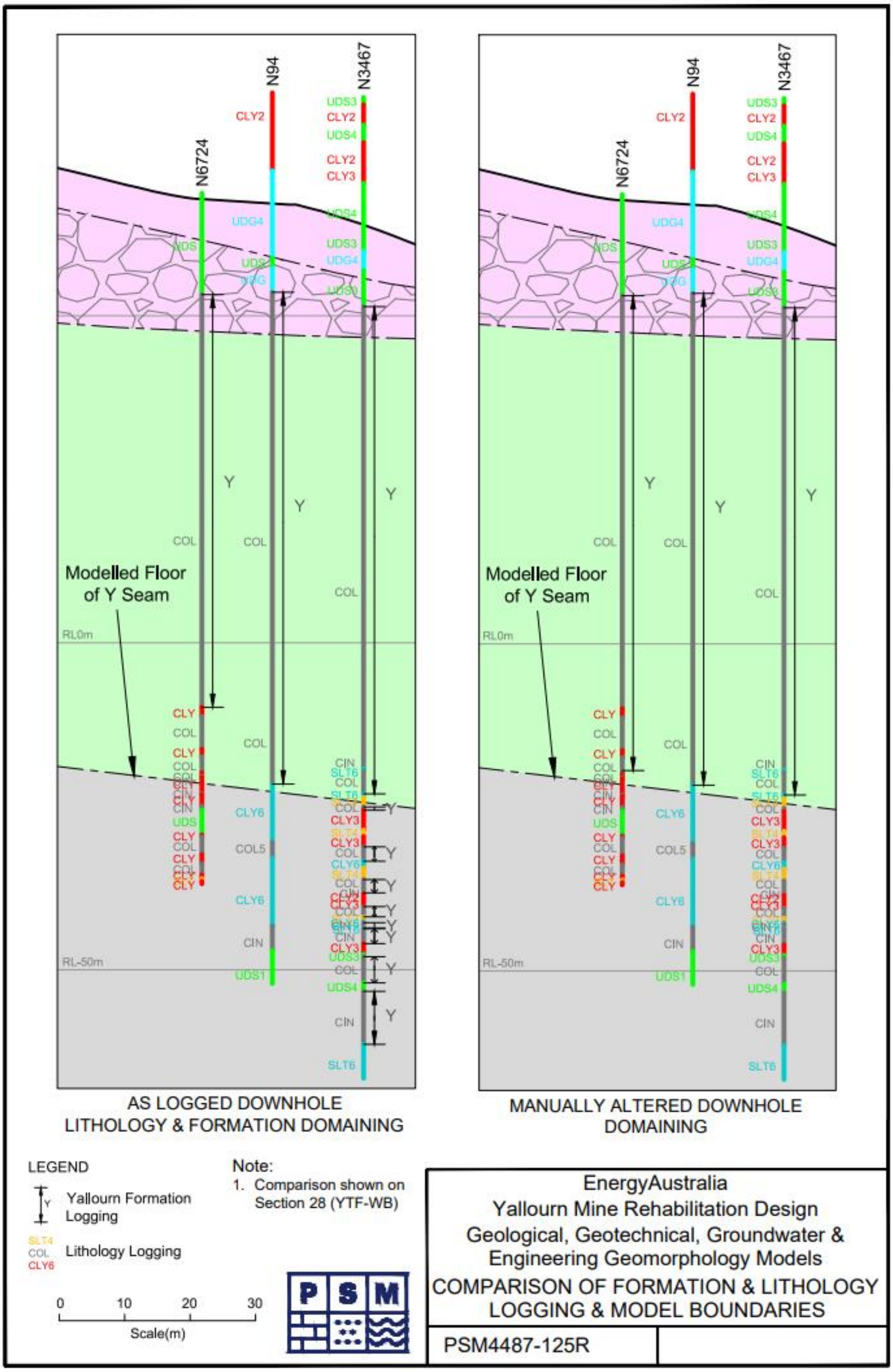


Figure 8-6: Comparison of Formation with Lithology Log & Manual Adjusted Boundary (PSM 2025b)

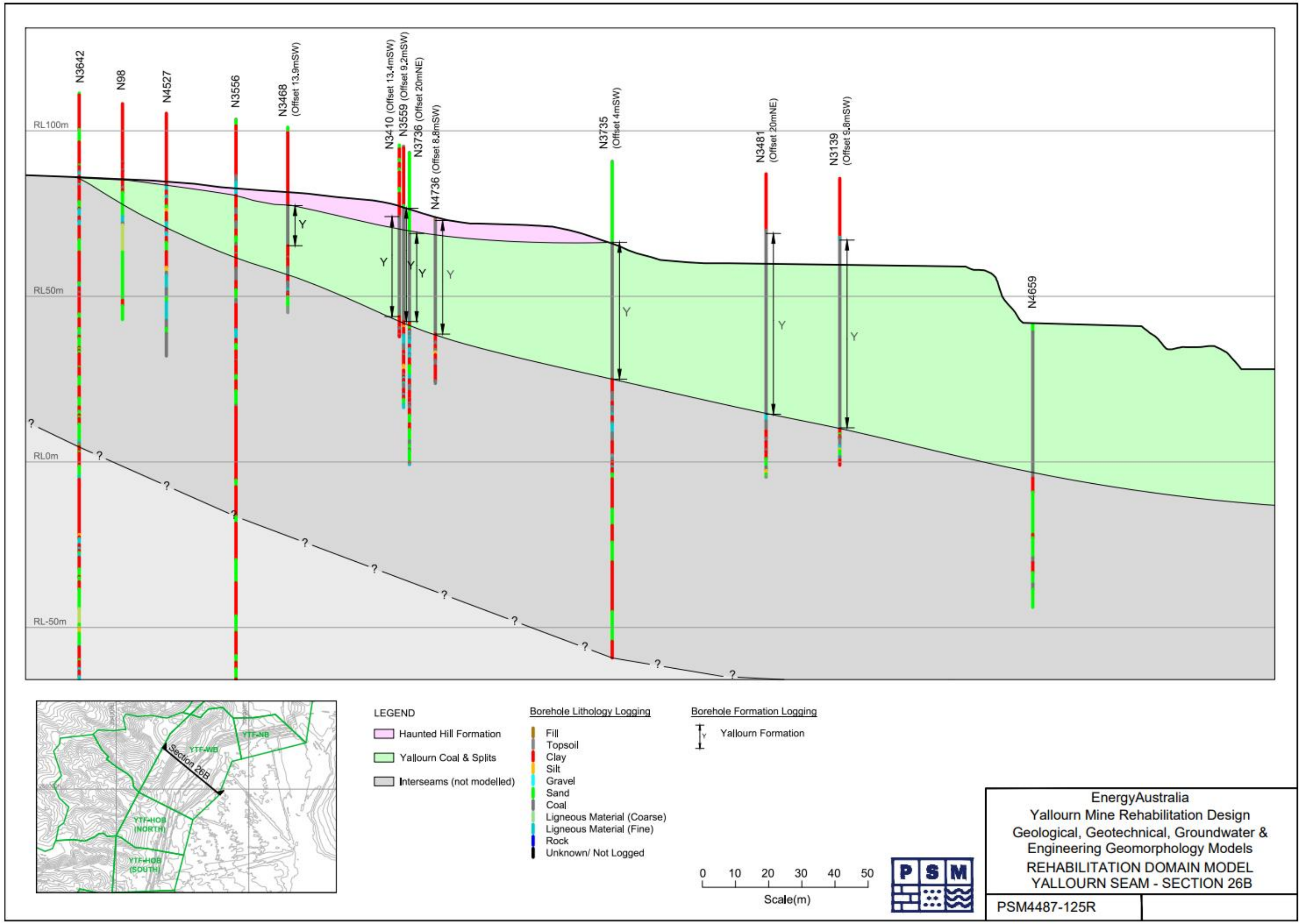


Figure 8-7: Adjusted Yallourn Seam Following Validation Process (PSM 2025b)

8.3 Hydrogeological and Groundwater Assessment

8.3.1 Introduction

The Yallourn Mine groundwater conditions are relatively complex due to the following influencing factors:

- Regional and mine site deep aquifer depressurisation, lowering pore water pressures from relatively deep below the Yallourn Seam
- Surface water bodies, the Latrobe and Morwell Rivers and their associated floodplains
- MRD low and high flow channels
- Peripheral catchments
- HHF with an irregularly developed basal granular layer (HHFA)
- The very thick Yallourn Seam comprising coal of very low permeability but with continuous sub-vertical joints of much higher hydraulic conductivity

Due to this complexity and the role groundwater plays in geotechnical and environmental assessments, a groundwater model is needed to accurately forecast future groundwater changes and fluxes.

Groundwater at the Yallourn site comprises of complex natural systems that govern its behaviours and interactions with surface water systems and groundwater users. These systems have an integral role in all aspects of ground and environmental management of the mine site and its surrounding landform.

The purpose of this section is to present these complex groundwater systems and processes supported by a detailed Groundwater Numerical Model (GWNM) developed and discussed further in this section.

A key component of groundwater management at the site is weight balance management (discussed in Section 8.11). This section explores the contributing mechanisms to weight balance during remaining operating life and the progressive rehabilitation stages. Understanding these systems has assisted in informing identification of associate risks and the required site management processes through the progressive stages of rehabilitation. The site rehabilitation design incorporates the identified risks and necessary groundwater management.

The planned future closure of the Yallourn Mine marks an important hydrogeological transition from the operational phase, when the coal is excavated and aquifers are depressurised to maintain a safe mining condition, to the post-mining phase when the mine will be either flooded to form a pit lake or maintained dry in perpetuity. Cumulative effects associated with successive closure of the Latrobe Valley coal mines, in particular the restoration of piezometric heads within the confined aquifers over the long term, are also unique to the Latrobe Valley hydrogeology and form a critical component of closure planning.

Numerical groundwater modelling is an iterative process, as outlined in the Australian Groundwater Modelling Guidelines (AGMG). The objective of the modelling is that the model must be capable of simulating the changes to groundwater levels and fluxes in response to various closure and rehabilitation scenarios (discussed in subsequent sections). Achieving sufficient resolution and accuracy at the mine has been a key focus of the modelling for closure. This includes relevant processes from the Morwell Formation (M1A) aquifer and overlying formations. The regional effects have been simulated in a simplified manner based on the outputs from the existing Latrobe Valley Regional Model.

The key stages and process adopted to development of GWNM:

- Conceptual Groundwater Model
- Identification of Data Gaps
- Construction and Calibration of GWNM with addressed Data Gaps
- Testing of rehabilitation scenarios in the GWNM, along with sensitivity testing

The abovementioned stages have been supported by peer reviews by industry experts, being ERM. The outcomes of relevant peer reviews for the Hydrogeological Conceptual Groundwater Model has been completed, with summary remarks for the formulation of Groundwater Numerical Model (ERM 2024).

Purpose of GWNM

There is a long history of groundwater modelling in the Latrobe Valley and a substantial amount of modelling has been undertaken to date to support the operation and rehabilitation planning for the Latrobe Valley coal mines using the Latrobe Valley Regional Groundwater Model (LVRGM) (GHD 2025b). The LVRGM was originally designed to simulate the significant aquifer depressurisation effects within the deep confined aquifers and regional subsidence arising from them.

The LVRGM has been an operative tool to understand regional scale responses to depressurisation. For the rehabilitation planning a finer mine scale model has been developed. This is due to the following key factors and reasons:

- The aquifers (confined and unconfined) and hydrogeological processes of interest for the Yallourn Mine are associated with the shallower part of the Latrobe Valley groundwater systems.
- The significant depressurisation of the deep confined aquifers at Hazelwood and Loy Yang, while relevant, is not the key focus of the modelling at Yallourn. There is a greater need to understand the effects of rehabilitation on the shallow groundwater system due to the mine's proximity to major surface water features (such as the Morwell River and Latrobe River).
- The location of the mine adjacent to major geological structures such as the Haunted Hills Fault/Yallourn Monocline and Moe Swamp Basin means the modelling for the Yallourn Mine is required to consider a spatial extent that is different to the domain of the LVRGM.
- This model will provide more granularity on groundwater flux and recovery processes in the deeper aquifers and the stress relief zones that extend a distance behind the mine crest.
- Sensitivity to the abovementioned process and scenarios can then be tested further for various stages of rehabilitation.

For these reasons, the groundwater modelling for the site needed a more targeted approach focusing on specific processes that are relevant to its rehabilitation planning (necessitating a separate model that is locally refined at the Yallourn Mine and relevant hydrological features).

8.3.2 Methodology - Conceptual Groundwater Model

The Conceptual Groundwater Model is also referred to as Conceptual Hydrogeological Model and has been the adopted terminology in this section. The objective of hydrogeological conceptualisation was to clearly outline the existing knowledge of the site hydrogeology and to provide sufficient information and technical basis for supporting the closure planning. It represents a necessary first step in the hydrogeological modelling process, consolidating the current understanding of the key hydrogeological processes of the past and present, and those that may occur in the future. It provides the basis for numerical modelling, which supports technical studies required by resource managers to inform groundwater and surface water licencing aspects of the mine closure water balance.

As per the recommendations of the *Australian Groundwater Modelling Guidelines* (Barnett et al. 2012), Model Planning has been undertaken prior to the development of the conceptual hydrogeological model to set the context for the hydrogeological modelling. The key groundwater related questions associated with the closure of the Yallourn Mine, as identified during model planning, include the following:

- Changes in piezometric heads (aquifer pressures) in response to closure and how would this affect ground movement.
- The nature of aquifer connectivity, both in horizontal and vertical directions, and how would this influence the piezometric heads and batter stability.
- The cumulative effect of closure of all three Latrobe Valley coal mines, especially the effect of recovery of piezometric heads in the confined aquifers below the Yallourn Mine when pumping ceases at the Hazelwood Mine.
- The hydrogeological implications of different closure scenarios, such as pit lake and dry pit.
- Influence and significance of geological structures such as the Yallourn monocline (Yallourn fault) on groundwater flow and water balance.
- The nature of interaction between groundwater and surface water features such as the Morwell River, Ash Ponds and other local features.
- The effect of mine closure on water quality and the potential for acid to be mobilised from the overburden (addressed in section 8.8).
- The long-term effect of mine closure on groundwater resources and potentially groundwater-dependent ecosystems, including the effects of climate change.

The hydrogeological conceptual model detailed in this section and subsequent numerical modelling have aimed at addressing the above questions.

8.3.2.1 Regional Setting

Groundwater is derived from rainwater that percolates through cracks and pores in rocks and sediments. In low-lying areas, groundwater discharges at surface whereas in topographically elevated areas the water table rises to higher elevations. The differences in the elevation of hydraulic heads drives the flow of groundwater from topographically higher levels to topographically lower levels. In the upper part of the groundwater system, a local flow system develops due to local undulations in topography and spatial variations in recharge and evapotranspiration. This results in the water table typically being a subdued reflection of the ground surface. Groundwater interacts with surface watercourses along drainage lines, where groundwater can provide baseflow or receive leakage. In the deeper part of the system, groundwater flows via longer flow paths driven by regional difference in hydraulic heads associated with regional differences in topography (GHD 2023).

Mines in the Latrobe Valley currently form low points in the regional groundwater system, influencing the groundwater levels and flow directions. Anthropogenic stresses, such as groundwater pumping at the mines have depressurised the aquifers and modified natural groundwater flow directions. The geology of the region also has an important control on groundwater flow, with variations in material properties and structures resulting in deflections of flow lines.

In a regional context, the essential components of the hydrological cycle include the mines in the region, topography, hydrology, land use, climate and geology. An overview of regional hydrogeology is presented to provide a context for more detailed descriptions of local hydrogeology at the Yallourn mine.

Topography & Drainage

Key consideration to topography of the landform that surrounds Yallourn Mine are briefly discussed here to support the hydrogeological conceptualisation. The drainage around the Yallourn site, key surface water features and runoffs reporting to the open cut are briefly discussed here. Refer to *Yallourn Rehabilitation Hydrogeological Modelling: Hydrogeological Conceptual Model* report (GHD 2023) for detailed hydrogeological description and Sections 8.7 and 8.6 for detailed local and regional surface drainage and hydrology, respectively.

The landforms of the Latrobe Valley have been developed on sedimentary and volcanic material of Mesozoic and Cenozoic geological age. The Yallourn Mine is located in the valley with Morwell River which flows through the middle of the open cut, into the Latrobe River to the (~200m) north of the mine at RL45 mAHD. The site is bounded to the west by a topographical ridge of around RL190 mAHD and rises to the north towards the Southern Highlands. To the east of the mine, the elevation ranges from RL40 mAHD close to the Latrobe River to RL100 mAHD near Morwell township. The area to the south towards Hazelwood Mine is generally flat between RL40 to 70 mAHD.

Gippsland is drained from the topographically elevated and strongly incised areas of the Great Dividing Range to the coastal strip and lake systems east of Sale. The main rivers draining the Gippsland region, from west to east, are the Latrobe, Tyers, Thomson, Macalister and Avon Rivers. Lake Narracan is a water storage on the Latrobe River approximately 1.5 km upstream of the Yallourn Power Station and supplies cooling water to the Latrobe Valley power stations.

The Thomson and Macalister Rivers join the Latrobe River in its lower reaches, around 10 km west of where it enters Lake Wellington, east of Sale. The Avon River, to the east, also drains into Lake Wellington and is part of the “lakes system”, connected to the ocean via Lakes Entrance, in the far east of the Gippsland region. The lakes system is estuarine (fresh water mixing with saltwater). The flat, low-lying area around Sale and the lakes system is typically very swampy.

The Morwell River is an important hydrological feature of the Yallourn Mine. It is a tributary of the Latrobe River and flows northwards through the mine. It rises in the central and southern Strzelecki Ranges, with a catchment area of 622 square kilometers (km^2) and an average annual discharge of 148,500 mega litres (ML) at the Yallourn Mine (based on the infilled daily SILO data from 1889 to 2015 at gauge 226408). The modern-day Morwell River wetlands are located to the south between Yallourn and Hazelwood Mines.

The original course of the Morwell River has been reshaped and diverted numerous times to allow access for mining at the Yallourn and Hazelwood Mines and for flood protection. The current course of Morwell River passes through the middle of the open cut via the Morwell River Diversion (MRD), commissioned in May 2005. The northern section of MRD was reconstructed between 2012 to 2014 following the breaching of the western embankment over the alignment of the E110 conveyor tunnel in June 2012. Further details of the MRD reconstruction are presented in Section 8.12.

The surface features associated with Yallourn Mine include the following:

- The Fire Service Pond (FSP), which is the mine's dirty water storage with a capacity of around 9,400 ML and is used for mine fire protection, dust suppression and supplemental power station cooling water. The FSP is located in the southeast section of the YOC.
- The Flocculation Pond located to the south of the FSP where excess water is treated prior to discharge to the Morwell River.
- Township Lake (also referred to as Lake Placid) located in the eastern section of the Township Field overburden dump, receives overburden dump drainage (which can be acidic) and wastewater from the Power Station. This allows sediments to settle prior to being discharged to the FSP.
- Witts Gully Reservoir to the southwest of YOC is an external fire service water supply for the mine.
- Ash slurry is deposited in the Twin Ash Ponds located north of the Latrobe River in the former Yallourn North Open Cut (YNOC) where it is dried out before being excavated and deposited in the ash landfills, also located in the YNOC. A new Return Water Basin was constructed in 2016 which receives the decant water from the ash pond for reuse in the Power Station.
- Drainage ponds are located in base of East Field and Maryvale Fields to collect pit runoff.

A site location plan showing these features is presented in Figure 8-65.

Land Use & Vegetation

The site is zoned "Special Use Zone 1 Brown Coal" within the Latrobe City Council. To the north of the mine the Latrobe River frontage is zoned "Public Conservation and Resource" and east of the mine the Maryvale Paper Mill is zoned "Industrial 2". Farming zones are found to between the mine and township of Newborough to the east and Morwell township to the southeast. Land in the region has been extensively cleared for agriculture and commercial forestry. Remnant vegetation is found along watercourses and isolated pockets generally associated with road reserves and drainage lines. Further discussion on Groundwater Dependent Ecosystems (GDEs) in the Yallourn Mine region is found in Section 5.5.5.

8.3.2.2 Climate Consideration – Historical & Future

Historical Climate

The climate in the region is temperate and generally features cool to warm summers and mild to cool winters. Climate data for the conceptual hydrogeological model has been sourced from SILO for the Bureau of Meteorology (BoM) Morwell (Latrobe Valley Airport) climate station (station number 085280). BoM maintains a rainfall record at this site since 1984 and SILO has interpolated the data prior to this period based on the surrounding rainfall records. Mean monthly climate statistics for temperature, rainfall and evaporation are shown in Figure 8-8.

The long-term average annual rainfall is 751 mm with October being the wettest month (76 mm) and February being the driest (46 mm). The long-term average annual evaporation is 1,233 mm and the mean monthly evaporation exceeds the mean annual rainfall September through to April. Rainfall exceeds the evaporation May through to August.

To interpret historic rainfall trends the cumulative monthly precipitation residual (also known as Cumulative Departure from Mean Rainfall) has been calculated from the SILO data. A rise in the precipitation residual indicates above average rainfall and a fall indicates below average rainfall. The annual and monthly rainfall since 1900, along with the cumulative monthly precipitation residual, are plotted in Figure 8-8. The figure indicates periods of generally below average rainfall from 1901 to 1916, 1937 to 1945, 1961 to 1983, 1997 to 2009 and 2012 to 2016. Conversely, periods of generally above average rainfall were recorded from 1916 to 1937, 1945 to 1961, 1983 to 1997 and 2010 to 2012.

Climate is variable across Gippsland. Figure 8-9 presents the spatial distribution of long-term average annual rainfall in the Moe Swamp Basin and the Gippsland Basin, based on BoM's 1976 to 2005 average gridded rainfall data (the most recent 30-year average data available from BoM). Regions of high rainfall occur over topographically elevated areas in the west, including the Narracan Block, Balook Block and Southern Highlands, with the maximum average rainfall of around 1,100 mm/yr. Rainfall decreases to the east and southeast of the Yallourn Mine, from around 800 mm/yr to around 600 mm/yr in the central Gippsland Basin. Figure 8-11 presents the spatial distribution of long-term average annual evapotranspiration across the Gippsland Basin, based on BoM's 1961 to 1990 average gridded areal actual evapotranspiration data (the most recent 30-year average data). Evapotranspiration varies from around 1,100 mm/yr in topographically elevated areas (the Narracan Block and Southern Highlands) to around 1,300 mm/yr in low-lying areas to the east near Maffra.

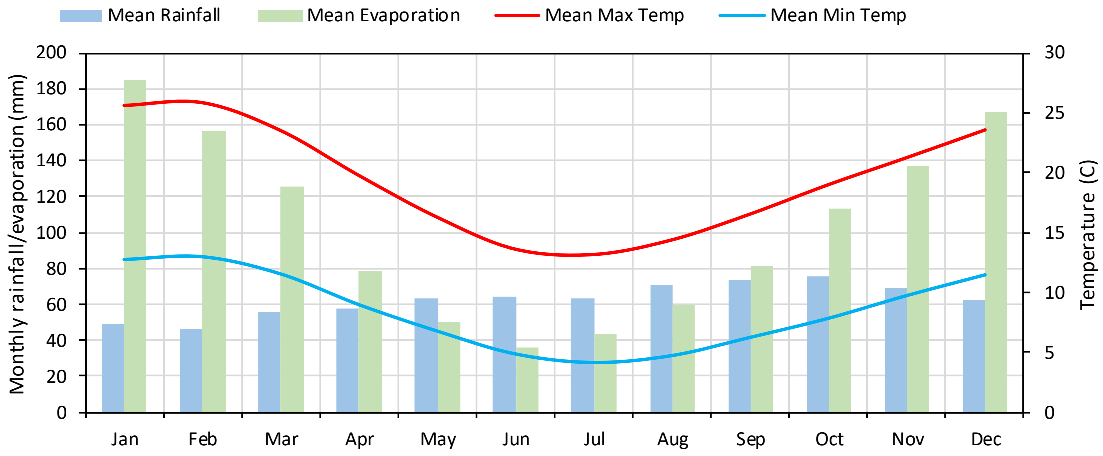


Figure 8-8: Monthly Climate Statistics – Station 85280

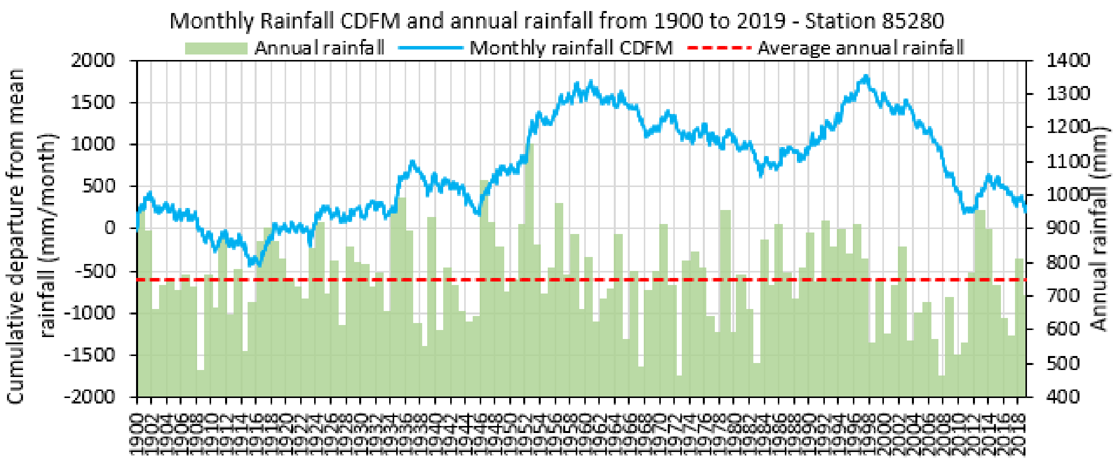


Figure 8-9: Long Term Rainfall Trend – Station 8580

Potential Future Climate

In 2016, the Department of Environment, Land, Water and Planning (DELWP) released "Guidelines for Assessing the Impact of Climate Change on Water Supplies" which documented revised estimates for rainfall, evaporation and runoff factors from 2040 to 2065 for each of Victoria's river basins. The guidelines considered three climate change projections representing low, medium and high impacts on the availability of water from climate dependent sources. Three climate change scenarios are then derived from the 10th percentile, median, and 90th percentile rainfall runoff responses. The guidelines were updated in 2020 (DELWP 2020).

The guidelines also contain recommended methods for estimating climate change impacts on groundwater. The guidelines recognise that shallow unconfined aquifers, classified as those with depth to water of less than 20 m, can respond to climate changes quickly (for example, within 1 to 2 years). The guidelines indicate that for highly responsive unconfined aquifers with a high level of connection to surface water courses (and rainfall), the climate change factors applied to runoff may provide more conservative indications of impacts on groundwater resources than those applied to rainfall.

The guidelines describe the need to apply the best available information to inform the assessment of climate change on recharge, taking into consideration site specific features such as the aquifer types, depth to water and a degree of connection to waterways. The climate change scaling factors may be applied to estimate changes to recharge using simple analytical models or more complex numerical models. In the Latrobe Valley, a combination of rainfall-runoff modelling and numerical groundwater modelling has been used to estimate recharge, which can be readily extended to incorporate the rainfall and evaporation scaling factors from the guidelines to assess potential changes to recharge caused by climate change.

The guidelines state that confined aquifers generally respond slowly or very little to changes in climate and it is unlikely that any climate-induced changes would be discernible within the 50-year planning horizon of the guidelines. Therefore, the guidelines do not consider the effects of climate change on the confined aquifers.

In the context of mine closure planning, and specifically the long response time of deep confined aquifers, there is the potential for the post-mining recovery period to extend well beyond the 50-year planning horizon of the guidelines. This means uncertainty in far future climate trends would need to be factored into the assessment of potential long-term impacts of different closure scenarios on groundwater resources.

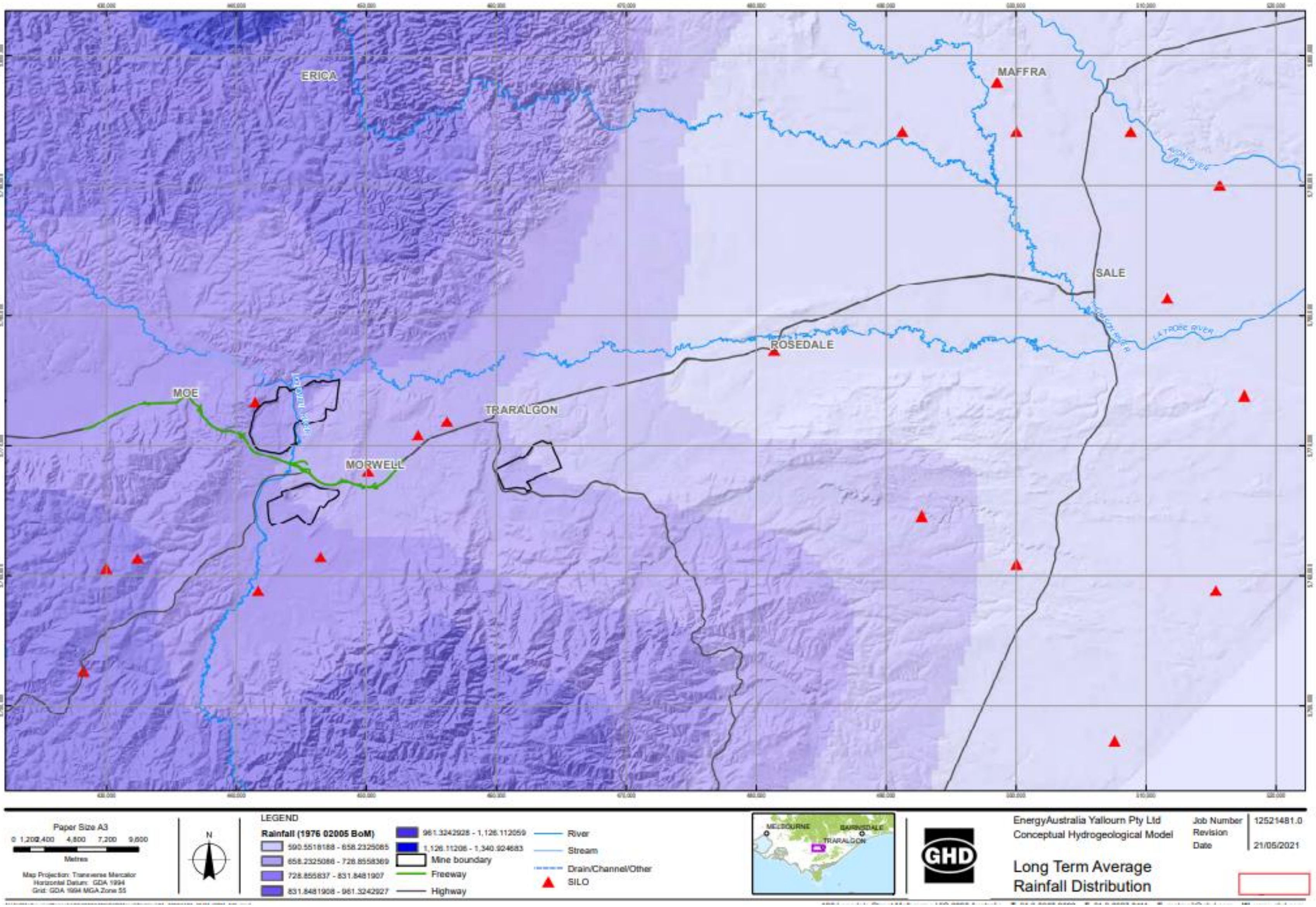


Figure 8-10: Long Term Average Rainfall Distribution (GHD 2023)

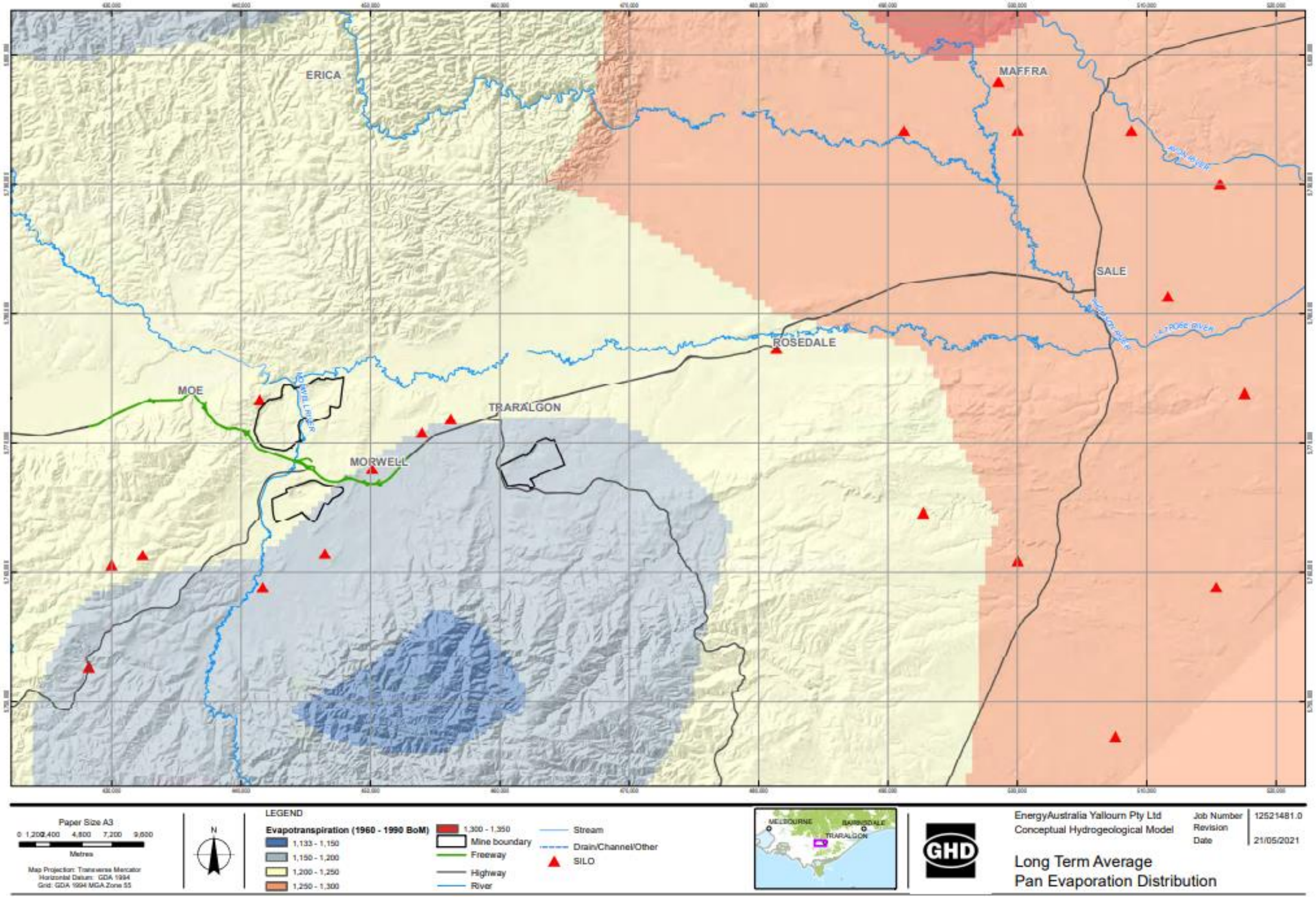


Figure 8-11: Long Term Average Pan Evaporation Distribution (GHD 2023)

8.3.2.3 Regional Geology & Hydrogeology

The regional geology and hydrogeology is presented in Sections 5.4 and 5.5 . These have been a key consideration to formulation of the Conceptual Hydrogeological Model.

8.3.2.4 Data Investigation & Verification

The history of mining in the region is a key consideration in understanding the pathways of groundwater changes from pre-mining environments to current state. A close calibration of such mechanisms in the conceptual model has assisted in making tighter predictions in the numerical groundwater model. A summary of years of operations at Yallourn site and development of mining cycles are further presented in *Chapter 3 Project Overview and History.*

Field Investigations and Data Collection

The knowledge gained from the long history of mining at the Yallourn Mine and collection of a large amount of data over this period has been used to inform the hydrogeological conceptualisation. These have included:

- Drilling and Geological Investigations - Data from long history of drilling investigations completed at the Yallourn Mine is captured in the Latrobe Valley Coal Bore Database (LVCBD) and includes geological, geophysical, bore installation and survey data. This data has been used to construct and update the site and regional geological models. In addition, SECV drilling reports are also available along with an extensive archive of SECV geological, geotechnical and hydrogeological reports. Extensive archive of consultant reports related to site investigations are maintained and were utilised to inform the concept model.
- Aquifer Testing – Estimation of hydrogeological properties are available from aquifer testing completed over the years of mining operations. These records are maintained in the Yallourn site database. These were considered adequate for conceptualisation and the progressive stages of numerical model calibration.
- Groundwater Monitoring - Groundwater levels across the Yallourn Mine are monitored using an extensive network of groundwater monitoring bores typically containing vibrating wire piezometers and standpipes. All monitoring records are maintained in the Geotechnical Database Management System (GDMS) which captures all historical (from SECV) and current groundwater data.

The monitoring database contains over 400,000 groundwater level measurements from almost 1,200 bores/piezometers. Notably, not all groundwater bores are currently active with the monitoring network continually developing to compliment mining development. These data sets come from nested piezometers recording heads in multiple stratigraphic units.

The MRD has a dedicated monitoring network of piezometers. These target specific units of the engineered structure which include fill embankments, sub-surface drainage layer/systems, zonal fills in the foundation layers. The pore pressure profiles in the engineering fills were considered relevant for measuring the engineering performance of the MRD and so were not included in the conceptualisation of hydrogeology. However, the piezometric data for the MRD foundation layers such as the Yallourn Coal, Yallourn Interseam and underlaying stratigraphy were factored in the conceptualisation.

The operators of the three Latrobe Valley coal mines jointly undertake a regional groundwater and land level monitoring and reporting program to assess the cumulative impact of aquifer depressurisation associated with mining operations across the Latrobe Valley. This program was established in the mid-1990s by the SECV and carried forward by the private mine operators as a condition to their respective aquifer extraction licenses. This dataset was utilised and considered satisfactory for the conceptual model. Figure 8-12, Figure 8-13 and Figure 8-14 present the groundwater monitoring bores utilised for representing pressure profiles in Haunted Hills Formation (HHF), Yallourn Interseam and M1A Aquifer, respectively.

- Groundwater Quality Monitoring – Historical data on groundwater quality was considered to be limited during the development of hydrogeological conceptual model. A greater density of data is available for Yallourn North Open Cut (YNOC) area drawn from routine testing programs. Within the mining areas of Yallourn Township Field, East Field and Maryvale Fields, the water quality data had been collected sporadically. These data gaps were addressed with the installation of a network of quality monitoring bores around the site. The water quality and progressive addressing of the data gaps is detailed in Section 8.8.
- Groundwater Extraction – Pumping data was utilised for HHF and M1A Interseam Aquifers. The extractions commenced in 1922 from HHF and terminated in June 2004. In 1994 M1A Aquifers pumping commenced and continues to operate at Yallourn mine. Within the Latrobe Valley, there are multiple license holders that extract water from the aquifers for varying purposes. The inputs of these in the conceptualisation by utilised the Regional Groundwater Model. The annual extraction volumes at Yallourn and other Latrobe Valley Mines are presented in *Yallourn Rehabilitation Hydrogeological Modelling: Hydrogeological Conceptual Model* (GHD 2023) (Appendix C – Technical Reports).
- Hydrology – The implication of water management activities in the regional catchments of Latrobe and Morwell on the nature of surface water - groundwater interactions, particularly the baseflow behaviour, can be difficult to characterise. The regional hydrology is discussed in detail in Section 8.6. In general, Latrobe and Morwell Rivers are considered to be majorly gaining systems, based on Victorian Government studies (GHD 2023). At the scale of this conceptual model, the local groundwater effects and pathways is not captured but are accounted for in the rehabilitation design relevant to the specific mine domain, e.g. MRD.
- Ground Movements – There is an extensive network of surface monitoring at Yallourn Mine. The program for data collection and management is as per Yallourn Mine Ground Control Management Plan (GCMP) (EnergyAustralia 2024c). The monitoring and maintenance are discussed in Chapter 15. External to the mining areas, a network of regional survey marks is also monitored (GHD 2023) (Appendix C – Technical Reports). The settlement responses from this network have informed the conceptualisation.

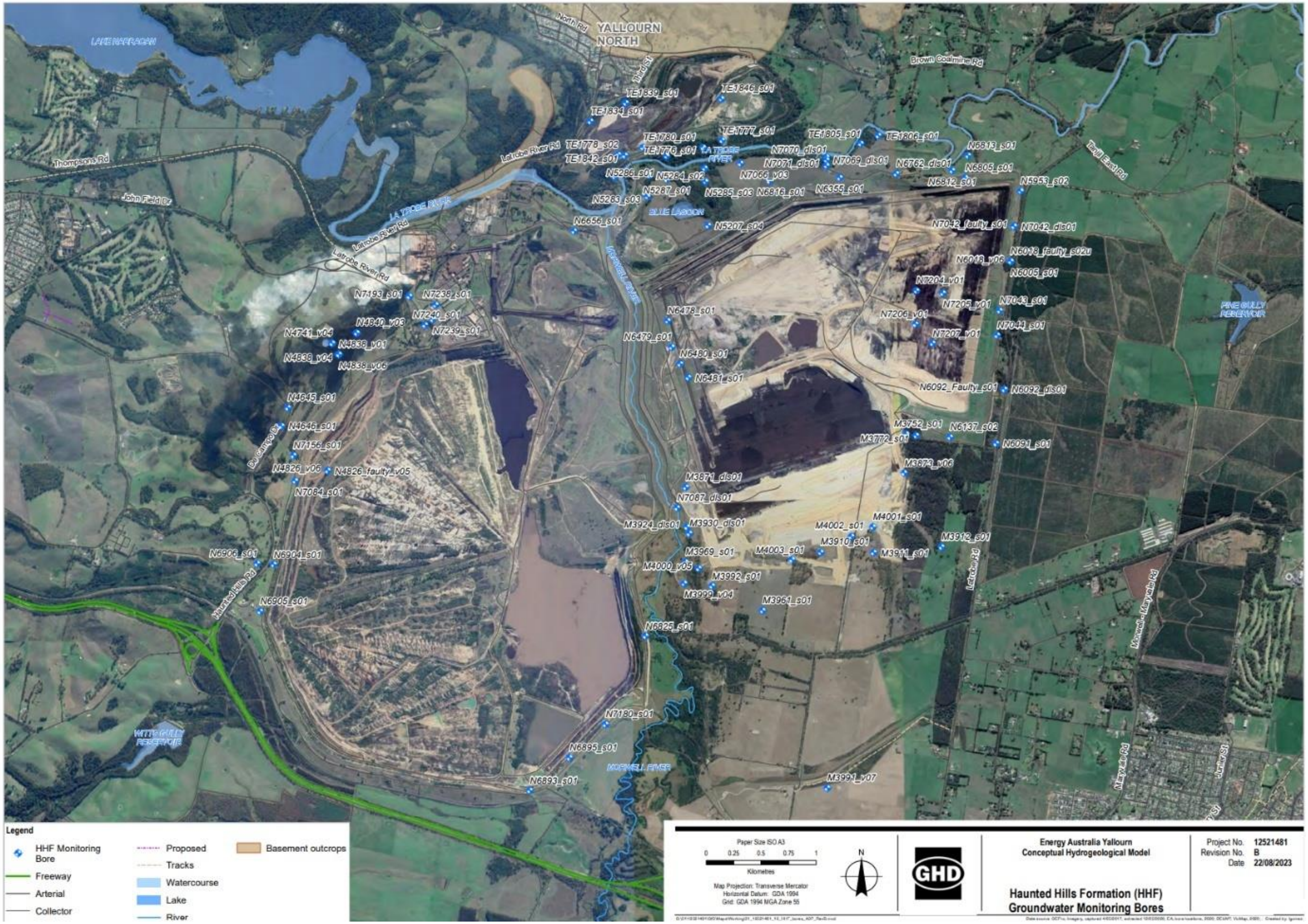


Figure 8-12: Groundwater Monitoring Bores – Haunted Hills Formation (HHF) (GHD 2023)

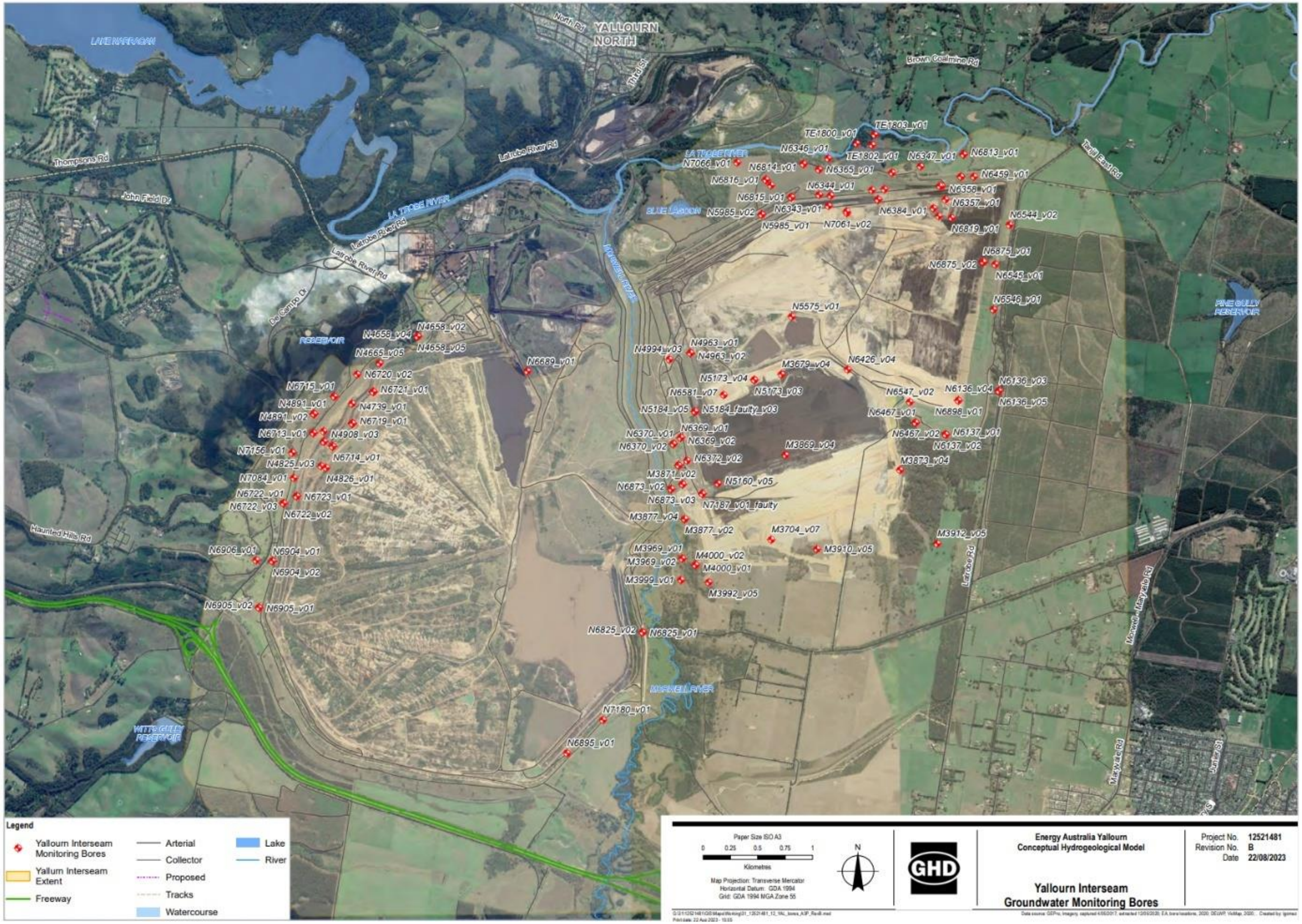


Figure 8-13: Groundwater Monitoring Bores – Yallourn Interseam (GHD 2023)

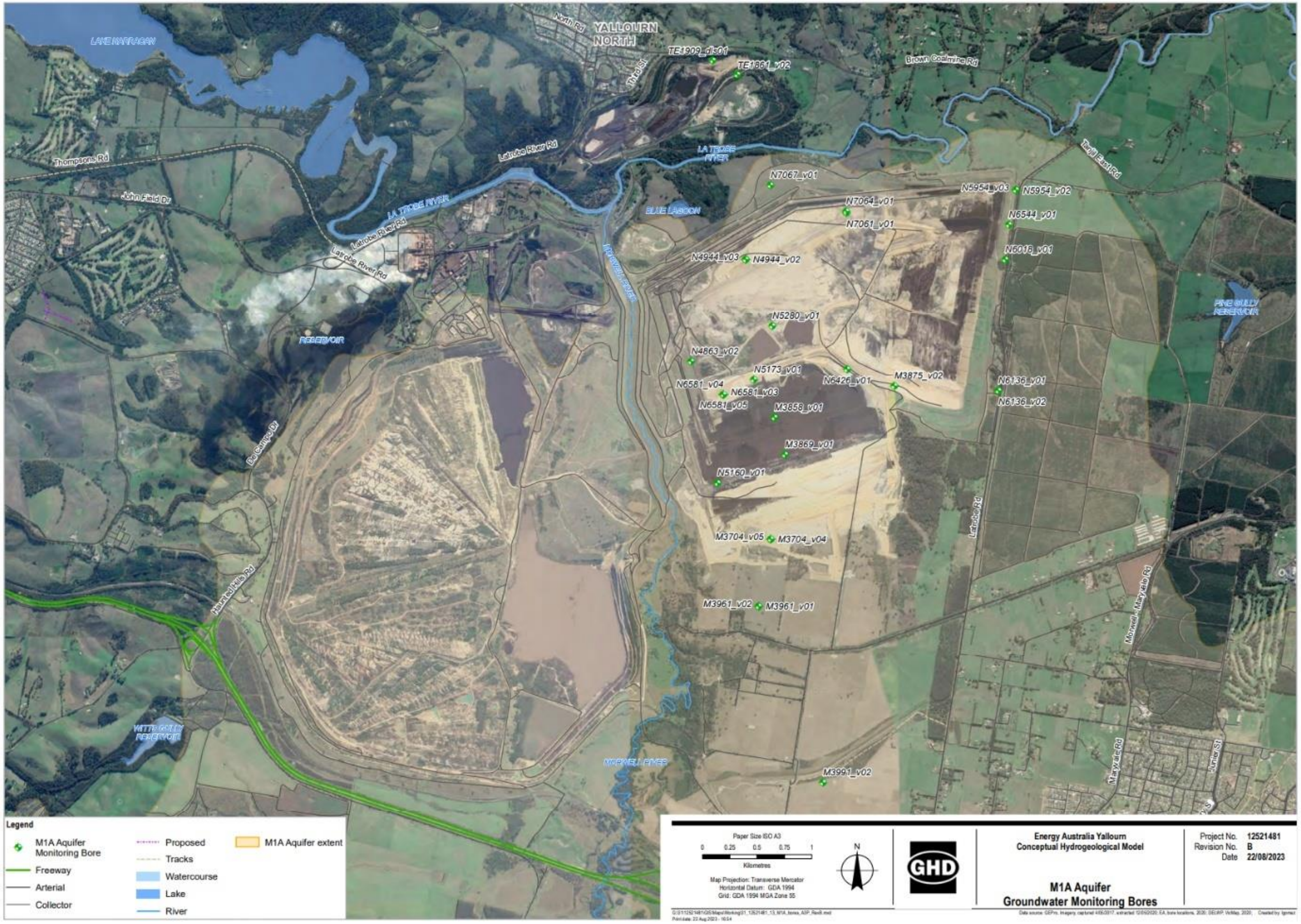


Figure 8-14: Groundwater Monitoring Bores – M1A Aquifer (GHD 2023)

8.3.2.5 Mine Scale Hydrogeological Conceptualisation

This section presents the key components of the Conceptual Hydrogeological Model of Yallourn Mine at a mine scale level. It involves analysis of key hydrological stresses (processes) occurring at the mine, how the system responds to these processes and the nature of the subsurface material that controls the stress-response relationship.

Model Domains

The conceptual model domain defines the extent of the study area, which should be large enough to encapsulate the key hydrological stresses and their area of influence, both in the context of past activities as well as those of the future (Barnett et al. 2012).

The regional hydrogeology of the Gippsland Basin is conceptualised as a semi-enclosed system (GHD 2023). Groundwater within the confined aquifers originates from rainfall-recharge along the basin margin and flows towards the offshore extension of the Gippsland Basin, with limited leakage across the underlying basement rock that acts as an effective hydraulic base of the regional flow system. Hydrologically sensible boundaries of the regional groundwater system therefore align with the edge of the basin and structures, where the flow originates. The conceptual model domain therefore follows the boundary of the Gippsland Basin, with the following two exceptions:

- The domain extends into the Moe Swamp Basin, west of the site, where the groundwater system and its response to mining (or lack thereof) is important for understanding the degree of hydraulic connection across the regionally significant Haunted Hills Fault/Yallourn Monocline.
- The domain extends over the Narracan Block, to the west of the Hazelwood Mine, where the Thorpdale Volcanics outcrop and laterally extend into the Gippsland Basin and interfinger with the MFAS and M2/TFAS, representing a possible pathway of depressurisation to the shallow aquifer.

Figure 8-15 shows the extent of the conceptual model domain. For the purpose of describing the key features of the mine-scale hydrogeological conceptual model, the domain has been limited to the footprint of the mine and the surrounding area that has the potential to directly interact with the groundwater system of the mine.

Notably, the YNOC and MRD mine domains are not assessed in detail by the conceptual model. This is because YNOC is an EPA-licensed area and has a localised response predominantly limited to the footprint of YNOC. Similarly, MRD has a network of dedicated monitoring that informs the structural performance of the engineered structure. For that reason, the mine-scale hydrological responses are considered to be localised. However, the degree of hydraulic connection between YNOC and Yallourn mine are considered, along with surface water and groundwater interactions with the Morwell River upstream reach.

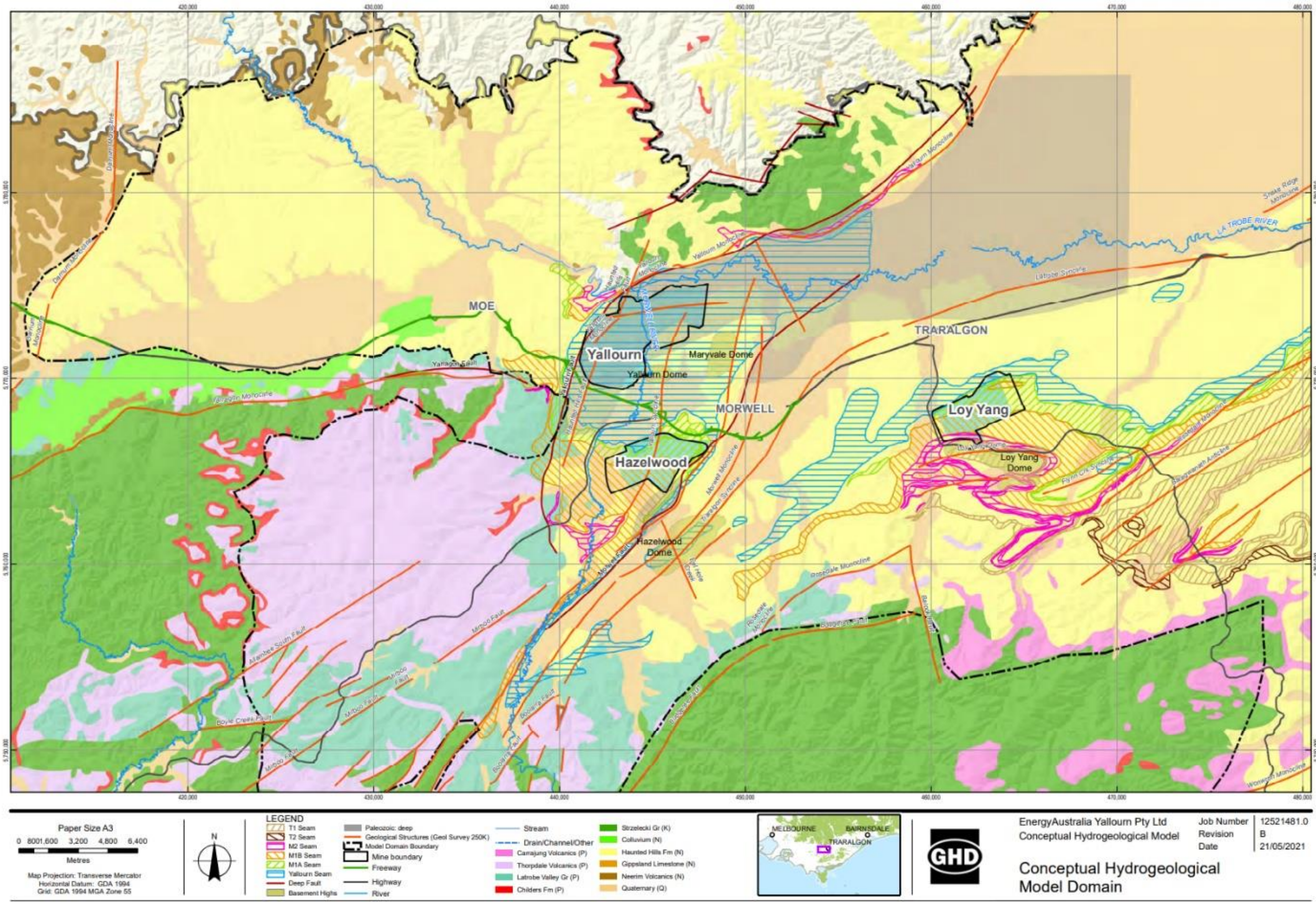


Figure 8-15: Model Domains – Conceptual Hydrogeological Model (GHD 2023)

Hydrostratigraphy

Hydrostratigraphic units (HSUs) are zones within the groundwater system comprising materials of similar hydrogeological properties. They are typically delineated based on stratigraphy although the similarity in hydrogeological properties is more important than the rock type, ensuring that the HSUs behave in a similar manner from the point of view of groundwater flow. The Hydrostratigraphy of the Yallourn Mine is characterised by an alternating sequence of Aquifers and Aquitards. It is a layered aquifer system, consisting layers of unconsolidated sediments (Aquifers) whose inter-connectivity is limited by the presence of intervening coal sequences being the Aquitards.

There are two Shallow Aquifer Systems (SAS) consist of Haunted Hills Formation (HHF) and Overburden (OB). These units are also discussed in Section 5.4.2 and are further detailed in GHD 2023b.

The Deep Aquifer System (DAS) are the confined layers underlying the Morwell Coal formation. These include:

- M1A Interseam underlies the M1A Coal formation (Aquitard) and comprises discontinuous sand layers interbedded with coal, clay and silt. The thickness this unit reduces to the south, through the Maryvale Field area, before pinching out towards the Hazelwood Mine as the M1A and M1B coals merge to form the M1 coal seam. For geological modelling purposes, four discontinuous but persistent sand layers have been identified in the M1A interseam in the Maryvale Field area. These are the "M1Asl", generally within the lower 10 m of the interseam, "M1Asm" found in the middle, "M1As1" in the upper 5 to 20 m and "M1As0" in the upper 5 m below the base of the M1A Coal (GHD 2023). The distribution of these seams is shown in Figure 8-16.
- M1B and M2 Interseams are deeper below M1A formation (Figure 8-16). At the Yallourn Mine these are the lateral equivalent of the M1 and M2 aquifers at the Hazelwood Mine, respectively. These form confined aquifers and are depressurised at the Hazelwood Mine to enable safe mining conditions. M1B pinches to the south of Yallourn Maryvale Field. The M1B and M2 Interseams pressures have not posed a risk to floor stability at Yallourn Mine due to their depth and the effects of depressurisation from the adjacent Hazelwood Mine.

The thick sequences of coal are conceptualised to act as Aquitards, these include the following:

- Yallourn Coal, which is the youngest coal unit in the Latrobe Valley and has a thickness of around 60 to 100 m. It separates the Haunted Hills Formation/Overburden from the Yallourn Interseam.
- M1A Coal, which is less extensive and has a thickness of around 5 to 35 m. It thins out to the north and pinches out in East Field where the overlying Yallourn Interseam and the underlying M1A Interseam become directly connected.
- M1B Coal, which separates the M1A Interseam from the M1B Interseam and has a thickness of around 30 to 60 m. It directly overlies the M2 Coal where the M1B Interseam pinches out.
- M2 Coal, which is split into M2A and M2B, has a combined thickness of up to around 100 m. Where the M1B Interseam pinches out, the M2 Coal and M1B coal form a thick regional aquitard that separates the underlying highly transmissive M2 Interseam from the overlying aquifers.

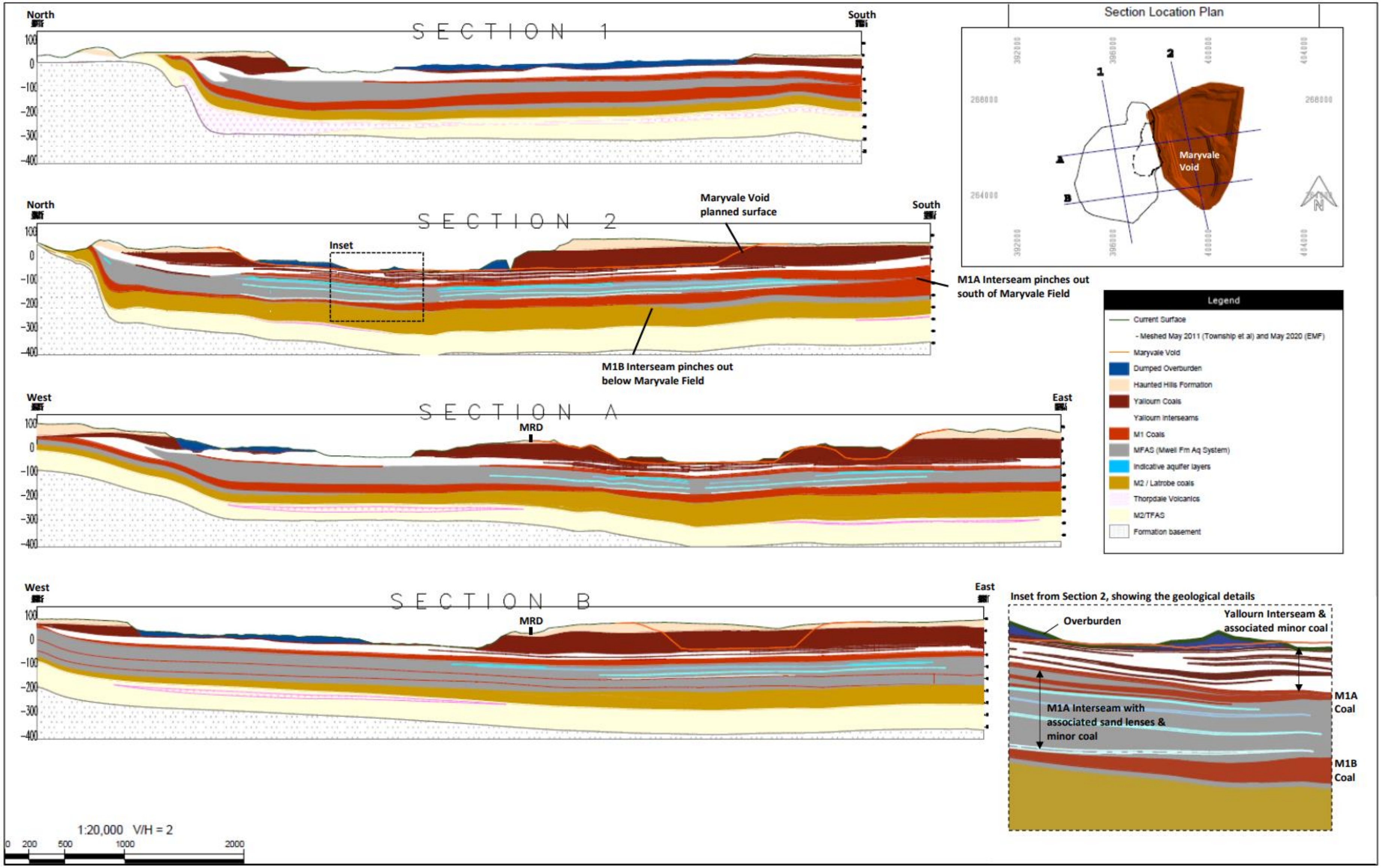


Figure 8-16: Yallourn Mine Hydrogeological Cross-Sections (GHD 2023)

Hydrogeological Properties

The hydrogeological properties for the conceptual model have been adopted from site aquifer and coal seam testing. Aquifer testing results are reported as either hydraulic conductivity (K) or transmissivity (T). Where available, estimates of storage coefficient are provided. These generally lie within the typical range of values for specific yield (Sy) (unconfined) and specific storage (Ss) (confined), potentially reflecting the semi-confined nature of sand horizons within these aquifers. Historical data was available for HHF, OB and M1A Aquifers from as early as 1979 to most recent being 2016.

Coal seam testing results considered historical data available from 1965 (GHD 2023). The permeability of brown coal was summarised to be variable depending on the coal type but generally in a range of 3.6 x 10^{-6} m/d to 3.6 x 10^{-4} m/d (meters/day) at the natural moisture contents and is of the same order as that for natural clays. Golder (2014) summarised the results of constant head field permeability testing of the Yallourn Coal undertaken by SECV, reporting values ranging from 1 x 10-3 to 0.3 m/d (GHD 2023). These are greater than the typical range of values of coal seams determined by the SECV, noting that these high values are potentially influenced by fractures in coal or leakage past bore casing into more permeable materials. The Latrobe Valley Brown Coal Mine Batter Stability Research Project performed in-situ permeability testing of Yallourn mine coal close to the northern part of the Yallourn Eastfield. The packer testing estimated to have hydraulic conductivity of 8.6 x 10-3 to 1.7 x 10-2 m/d (Baumgartl 2020) These were approximately two orders of magnitude higher than the 5.2 x 10-6 to 3.5 x 10-4 m/d hydraulic conductivity estimates derived from laboratory permeability testing, which reflect the differences between the undisturbed coal matrix and batter scale properties enhanced by larger discontinuities in coal. The model derived properties are presented in Table 8-1.

Table 8-1: Model-derived Regional Hydrogeological Properties

Unit	Horizontal Hydraulic Conductivity, Kh (m/d)	Vertical Hydraulic Conductivity, Kv (m/d)	Specific Yield, Sy (-)	Specific Storage, Ss (-/m) / Storage, S (-)
Haunted Hills Formation	5		0.01	
	0.1	0.005	0.02	0.08[a]
	2	0.002 – 4.21	0.1	0.001[a]
	3.2	0.48	0.1	1E-5
Yallourn Coal	2E-6 – 0.1	1E-5		2.5E-5 – 2E-4
	0.002	3E-4	0.1	1E-5
Yallourn Interseam	5E-6 – 0.9	4.6E-4		1E-6 – 2.5E-5
	0.77	0.115	0.1	1E-5
M1 Seam		5E-5		
	2E-6 – 0.1	1E-5		1.4E-6 – 9.3E-4

Unit	Horizontal Hydraulic Conductivity, Kh (m/d)	Vertical Hydraulic Conductivity, Kv (m/d)	Specific Yield, Sy (-)	Specific Storage, Ss (-/m) / Storage, S (-)
	0.045 – 0.22	0.0068 – 0.033	0.02	1E-5
M1 Interseam	4			5E-5
	0.5 – 1.2b			2E-4
	0.2 - 5		0.06	2.5E-5
	7.7E-5 – 40.4	6.4E-4 – 0.052		8E-8 – 1.3E-4
	0.97	0.13	0.1	0.001a
	0.16 – 9.7	0.16 – 1.2	0.1	1E-5
M2 Seam		3E-4 – 1.2E-3[c]		
		1E-6[d]		
	1E-5 – 0.1	1E-5		3.4E-7 – 1E-3
	0.42	0.00112	0.1	0.001[a]
	0.41	0.062	0.1	1E-5
M2 Interseam	0.5 - 12			1E-5
	0.2 - 8		0.015 – 0.06	4E-6 - 5E-4
	4E-4 – 20.7	0.28 – 0.34		1E-6 – 0.056
	1.63	0.3	0.1	0.001[a]
	6.12	0.39	0.1	1E-5
Basement	1E-10 – 1E-5	1E-9		4.5E-6 – 1E-5
	0.0025 – 0.01	6E-4 - 1E-3	0.02	4E-5 – 5E-3
	4E-4 – 2.4E-3	1E-4 - 6E-4	0.1	0.001[a]
	2E-4 – 0.01	1E-5 - 1E-3	0.02	1E-5

Concept Water Balance

The conceptual water balance has been derived from and is a factor of the mine water management, the groundwater recharge and discharge. The summary presented here is from considerations relevant to the Hydrogeological Conceptual model. Details of water balance for the open pit are presented in Sections 8.8.

The key water management features (Figure 8-17) for the mine are:

- Water from Power Station sourced from Latrobe River considering volumes consumed, including losses due to evaporation from cooling towers; Ash slurry pumped from Power Station to YNOC Ash Ponds; Surplus water from Power Station gravity fed to Township Field (reporting to Township Lake); Surface run-off received by the Fire Service Pond in Township Field And, Water pumped from Fire Service Pond to Flocculation Pond (treatment pond) where treated water is then discharged to the Morwell River. The Fire Service Pond is also pumped to Witts Gully Reservoir, which is used for fire mitigation and dust suppression.
- Groundwater recharge within the Gippsland Basin originates from rainfall-derived recharge. Creeks and rivers locally act as a losing system, particularly following periods of high rainfall, supplying recharge to the water table. Recharge to the confined aquifer systems is conceptualised to be primarily via vertical leakage from the SAS, occurring towards the edge of the basin where the confined aquifers subcrop beneath the surficial cover of the SAS. The most recent estimate of diffuse recharge in the area of Yallourn Mine is available from the latest iteration of the LVRGM, which was updated between 2017 and 2019 for ENGIE Hazelwood to inform closure planning of the Hazelwood Mine. The long-term average annual recharge is around 13 mm/yr, with the maximum of around 68 mm/yr. These recharge rates are more consistent with those estimated by Nahm (2002), Schaeffer (2008), SKM (2006) and Varma et al (2010) although the recharge rates were not based on rigorous calibration to piezometric heads at the Yallourn Mine (GHD 2023).
- Groundwater discharge of the M2/TFAS aquifer system, under natural conditions is thought to have flowed to the east and discharged offshore where the sediments are exposed in the continental shelf (GHD 2023). Natural discharge from the confined MFAS is thought to have been in the eastern parts of the basin, including deflection of flow upwards to discharge to the shallow aquifer system due to the lateral facies transition to low permeability marine sediments. The main discharge mechanism for the local (shallow) groundwater system would have included evapotranspiration along drainage lines as well as potential baseflow to surface courses and discharge to low-lying swampy areas. In more recent times, discharge has also been a factor of farming, pumping related to mining, oil & gas, agriculture and other industrial applications. These include groundwater pumping in the three Latrobe Valley mines (Yallourn, Hazelwood & Loy Yang).

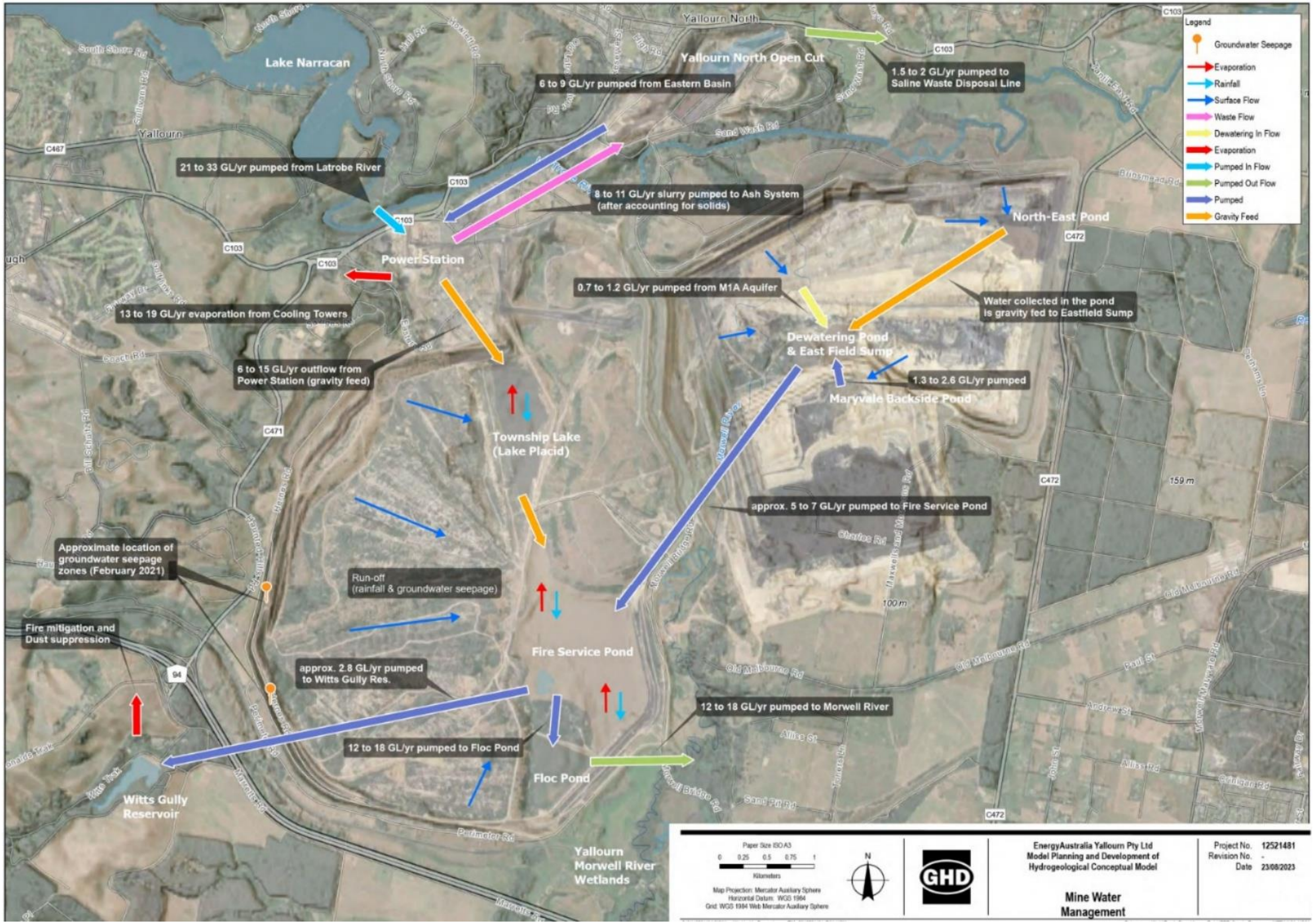


Figure 8-17: Yallourn Mine Water Management Process Concept (GHD 2023)

Groundwater Levels & Flow Directions

The groundwater levels and flow directions consider the pre-mining and existing conditions. Fraser (1980) estimated the pre-mining piezometric heads of the confined aquifers to be around 50 mAHD for the MFAS, similar to the pre-mining ground level and around 60 mAHD for the M2/TFAS (GHD 2023). The bores drilled into the confined aquifers between the Yallourn and Hazelwood Mines encountered flow at surface (artesian condition) with a piezometric head of around 58 mAHD in the deep M2 aquifer prior to dewatering of the Hazelwood Mine. It is likely that the pre-mining piezometric heads at the Yallourn Mine ranged from around 50 to 60 mAHD, similar to those estimated at the Hazelwood Mine.

The existing conditions utilised piezometric heads from 2019. There were large number of data points available 2019 and were considered the most appropriate data set for conceptualisation (GHD 2023). Groundwater levels and flow directions are described with reference to the contours of piezometric heads constructed from piezometers/bores within the key aquifer units that include the HHF/OB, Yallourn Interseam and M1A Interseam. Figure 8-18, Figure 8-19 and Figure 8-20 represent the 2019 piezometric heads in HHF/OB aquifer, Yallourn Interseam and Morwell M1A Interseam, respectively.

There are no groundwater monitoring bores in the M2/TFAS in the Yallourn area as this is not considered a significant aquifer for mining operations at the Yallourn Mine (although it is monitored as part of the regional monitoring network, due to the significant influence of aquifer depressurisation at the other mines).

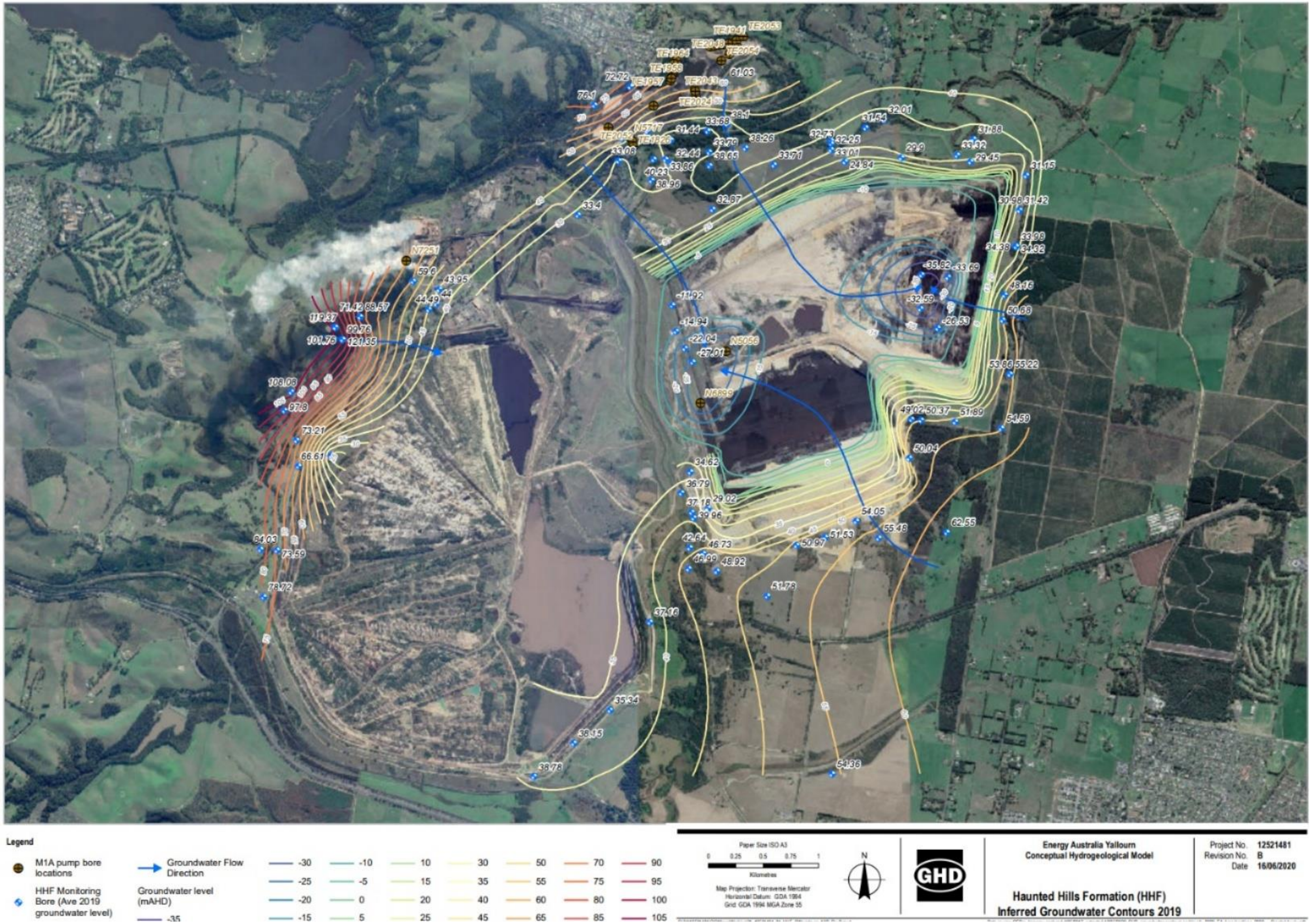


Figure 8-18: Inferred Groundwater Contours, 2019 - Haunted Hill Formation (HHF) (GHD 2023)

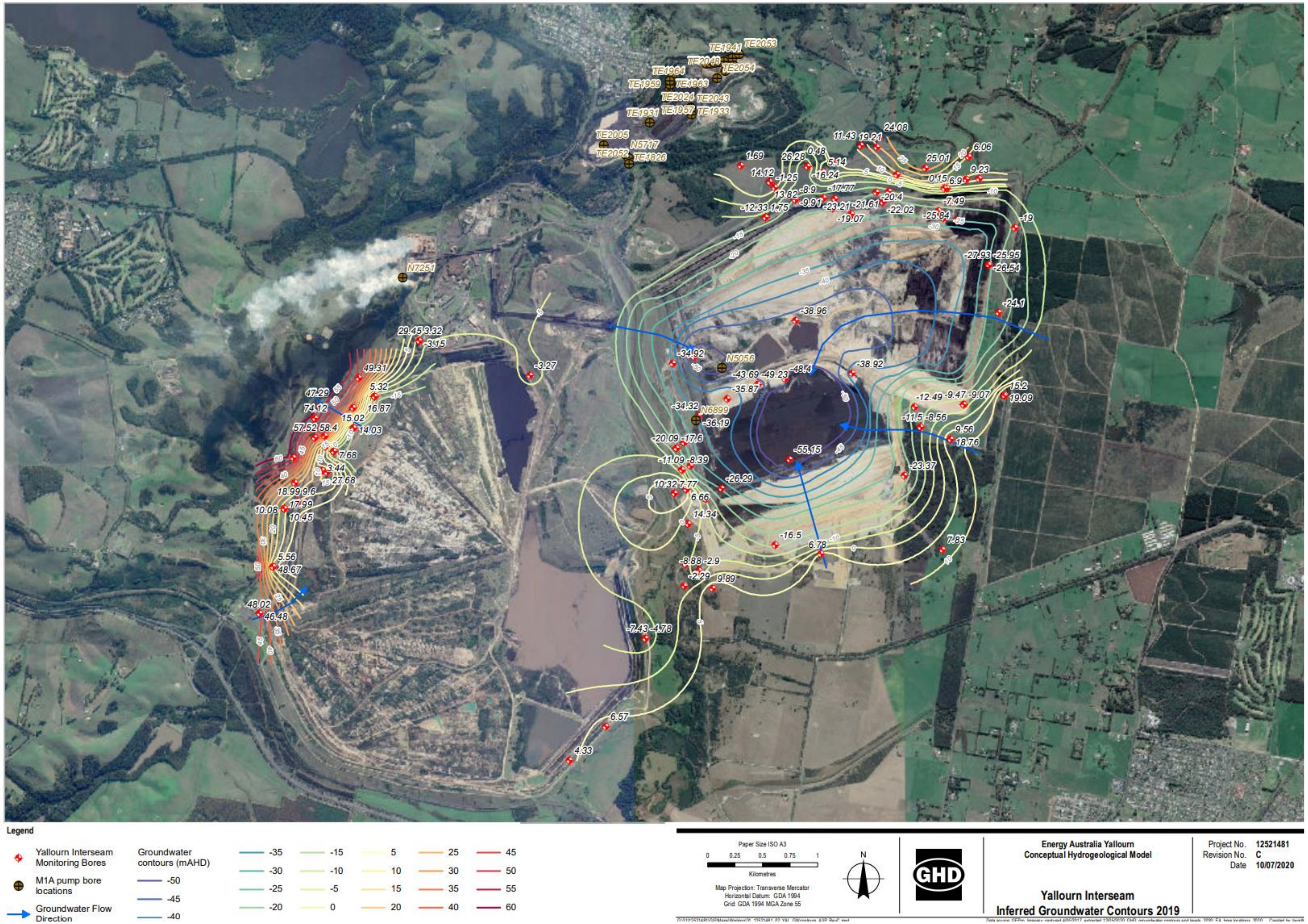


Figure 8-19: Inferred Groundwater Contours, 2019 – Yallourn Interseam (GHD 2023)

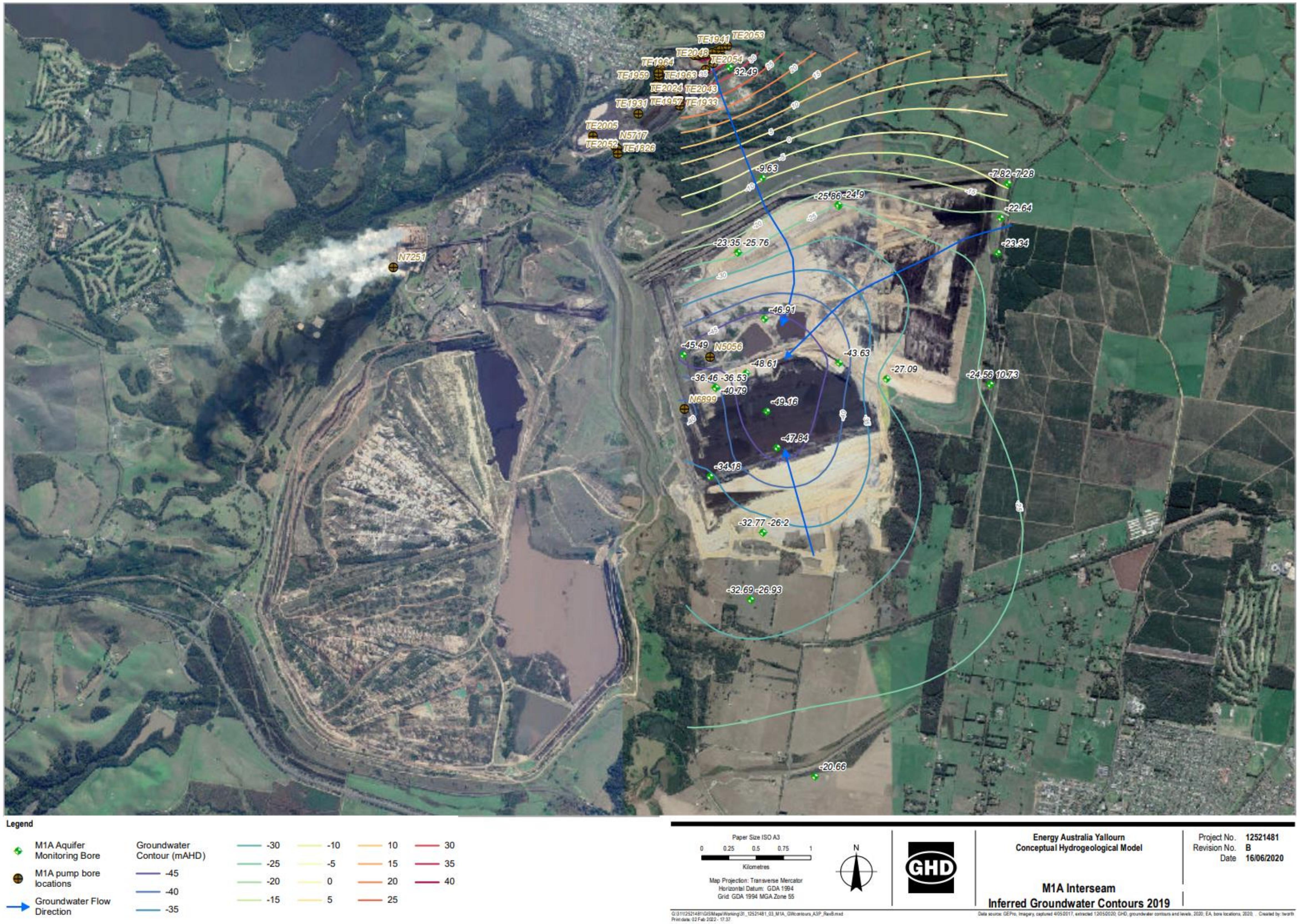


Figure 8-20: Inferred Groundwater Contours, 2019 – M1A Interseam (GHD 2023)

Groundwater Trends

When hydrological stresses such as recharge and pumping are imposed on the hydrogeological system, changes in groundwater levels are observed. Temporal trends in groundwater levels reflect the combined influence of hydrological stresses and how they vary over time in response to climate and mining operations. The stress-response relationships observed in the monitoring data based on the analysis of hydrographs from representative bores/piezometers informs the groundwater trends.

The long-term climate induced trends are represented by the bore data (piezometric levels). Generally, these indicate that groundwater levels rise during wet periods due to cumulative effect of above average recharge replenishing the aquifer storage. During dry periods, there is a net declining trend as recharge is insufficient to maintain the water table.

The bore data (piezometric levels) for the M1A Interseam represent the pumping (groundwater extraction) induced trends. When these are plotted with the extraction rates, a relationship between pumping and groundwater levels can be established. Generally, the hydrographs show a net declining trend over time in response to pumping, with a steeper rate of decline during periods of higher pumping and temporary recovery/stabilisation during the period of low pumping between 2004 and 2008. The decrease in drawdown is observed with increase in distance from the pumping bore(s). The M1A Interseam over the mine shows a radial flow response to pumping typical of a laterally continuous confined aquifer, with spatial differences reflecting spatial variability in aquifer properties.

The piezometric responses in Yallourn Interseam show declining trends that appear to be influenced by pumping occurring in the M1A Interseam, indicating a degree of hydraulic connection between these two HSUs. In summary, pumping in the M1A Interseam is likely a contributing factor for the depressurisation in the Yallourn Interseam albeit to a varying degree depending on the depth of the Yallourn Interseam below the mine floor. The influence of other mining activities and the level of hydraulic connection that exists between the two HSUs is likely to be influenced by the thickness and properties of the intervening M1A Coal.

Other factors that influence the groundwater trends are pressure loading and dissipation. Temporary changes in piezometric heads have been observed due to pressure loading effects associated with the placement of overburden material. These are typically characterised by a sharp spike in the piezometric heads when the load is placed (Figure 8-21, Figure 8-22), followed by a gradual dissipation of pore pressure. The response to the pressure loading effect becomes more subdued deeper in the stratigraphic profile, characterised by a smaller spike that rises more gradually.

Pressure dissipation can be a factor of drawdown of hydraulic pressure in Yallourn coal due to dewatering via sub-horizontal bores drilled in coal and relaxing of the coal joints following mining stress relief. Figure 8-23 shows periods of rapid reduction in pore pressures as mining in Maryvale Field progresses.

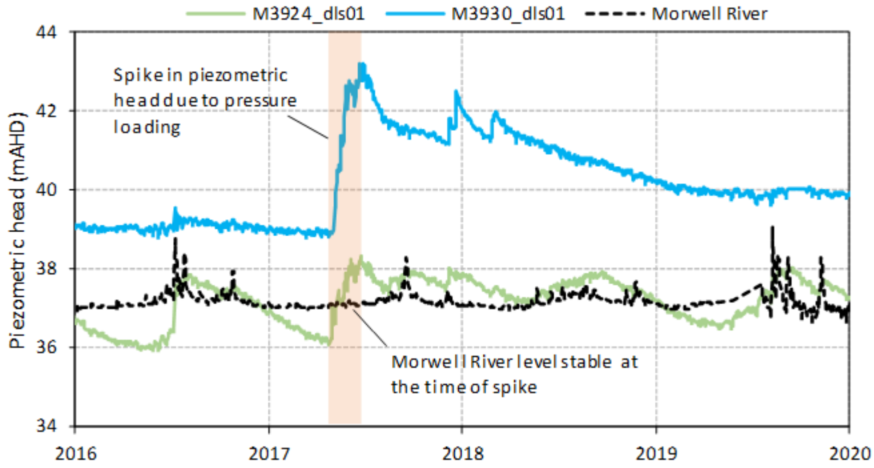


Figure 8-21: Pressure Loading Effect on Shallow Aquifer (GHD 2023)

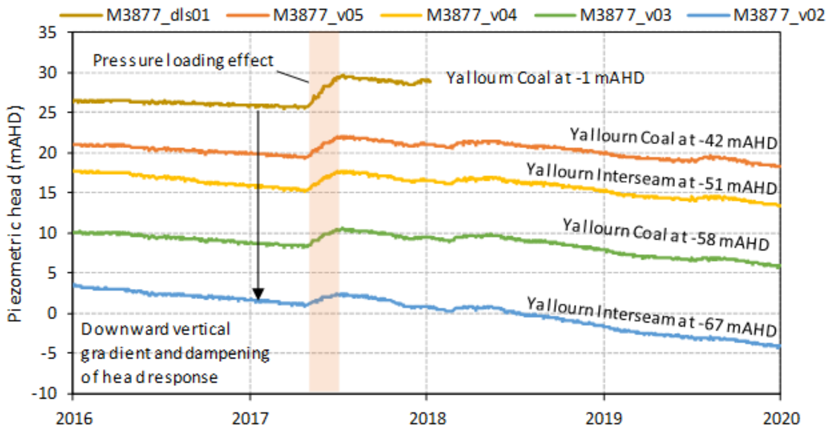


Figure 8-22: Pressure Loading Effect with Depth (GHD 2023)

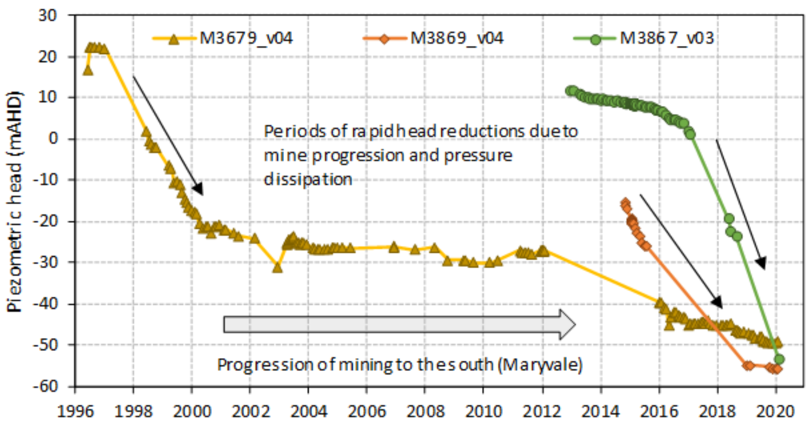


Figure 8-23: Pressure Dissipation Effect (GHD 2023)

Aquifer Interconnections

The interconnectivity between the aquifers considers the vertical and horizontal connectivity. The data from a large network of nested piezometer bores has been utilised to determine the interconnectivity between aquifers.

Vertical connectivity – The vertical hydraulic gradient is generally downwards, reflecting the influence of mining and extraction of groundwater from the confined M1A Interseam imposing a downward vertical hydraulic gradient.

The downward vertical hydraulic gradient is typically around 0.3 to 0.5, which is steep and is consistent with the presence of thick intervening coal layers acting as aquitards, limiting the vertical hydraulic connection by their low vertical hydraulic conductivity.

The downward vertical hydraulic gradient is largest between the HHF/OB and Yallourn Interseam/M1A Interseam. This reflects the influence of the intervening Yallourn Coal and recharge at surface that maintains the shallow groundwater level in the HHF/OB.

Negative vertical hydraulic gradients at some locations indicate upward flow. The upward hydraulic gradient is generally around 0.1, which is smaller than the downward hydraulic gradient measured elsewhere. These occurs at locations some distance from the pumping bores where the influence of pumping in the M1A Interseam is smaller or where the effect of pumping is dampened by the limited vertical connectivity.

The upward vertical hydraulic gradients are also recorded between the Yallourn Interseam and M1A Interseam in Maryvale Field due to pressure dissipation in the Yallourn Interseam as mining progresses. In this area, a downward gradient occurred across the intervening M1A Coal until pressure dissipation in the Yallourn Interseam caused a reversal in the vertical gradient (Figure 8-24).

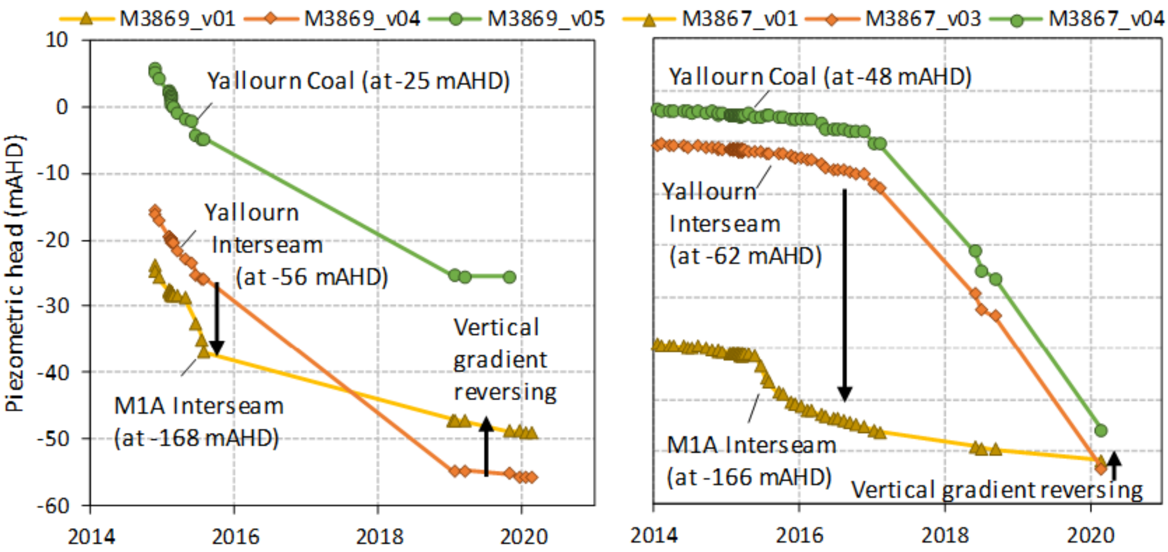


Figure 8-24: Vertical Gradient Reversal Due to Mining (GHD 2023)

Horizontal connectivity - The Yallourn Interseam extends to the northern boundary of the Hazelwood Mine, becoming shallower and thinner as the overlying Yallourn Coal thins to the south of the Yallourn Mine. This interseam is not actively dewatered at the Hazelwood Mine and due to its limited presence, thickness and low permeability, the degree of horizontal connection with the Yallourn Mine is limited.

Brumley and Holdgate (1983) completed a hydrogeological assessment of the Moe Swamp Basin and concluded that it is separated from the western end of the Latrobe Valley Depression by the Haunted Hills Fault /Yallourn Monocline, which forms an effective hydraulic barrier (GHD 2023).

The Yallourn North Open Cut (YNOC) is located on three synclinal basins (Western, Central and Eastern) immediately to the northwest of the Haunted Hills Fault/Yallourn Monocline. The mining of coal within the Morwell Formation (Latrobe Coal) ceased in 1963 and the basin was allowed to be filled initially with water and subsequently by dumped overburden and ash. The YNOC has been conceptualised as a recharge zone of the confined M1 and M2 aquifers because of their proximity to the surface, with hydraulic connection between the lined ash ponds and the aquifers evidenced by the aquifer pressure response to pond levels and deterioration of groundwater quality. The aquifer pressures and groundwater quality have been monitored by a dedicated network of bores and piezometers, with pumping bores operated by EAY to manage aquifer pressures and batter stability.

The degree of horizontal connection of the aquifers at the YNOC with those of the adjacent East Field can be inferred from their physical continuity and differences in groundwater levels measured in piezometers. Over a relatively short distance across the Haunted Hills Fault/Yallourn Monocline, the Morwell and Traralgon Formations plunge steeply. Geological cross-sections presented in a number of earlier works by SEC, Geo-Eng and GHD indicate near vertical layers (GHD 2023), as shown in Figure 8-25.

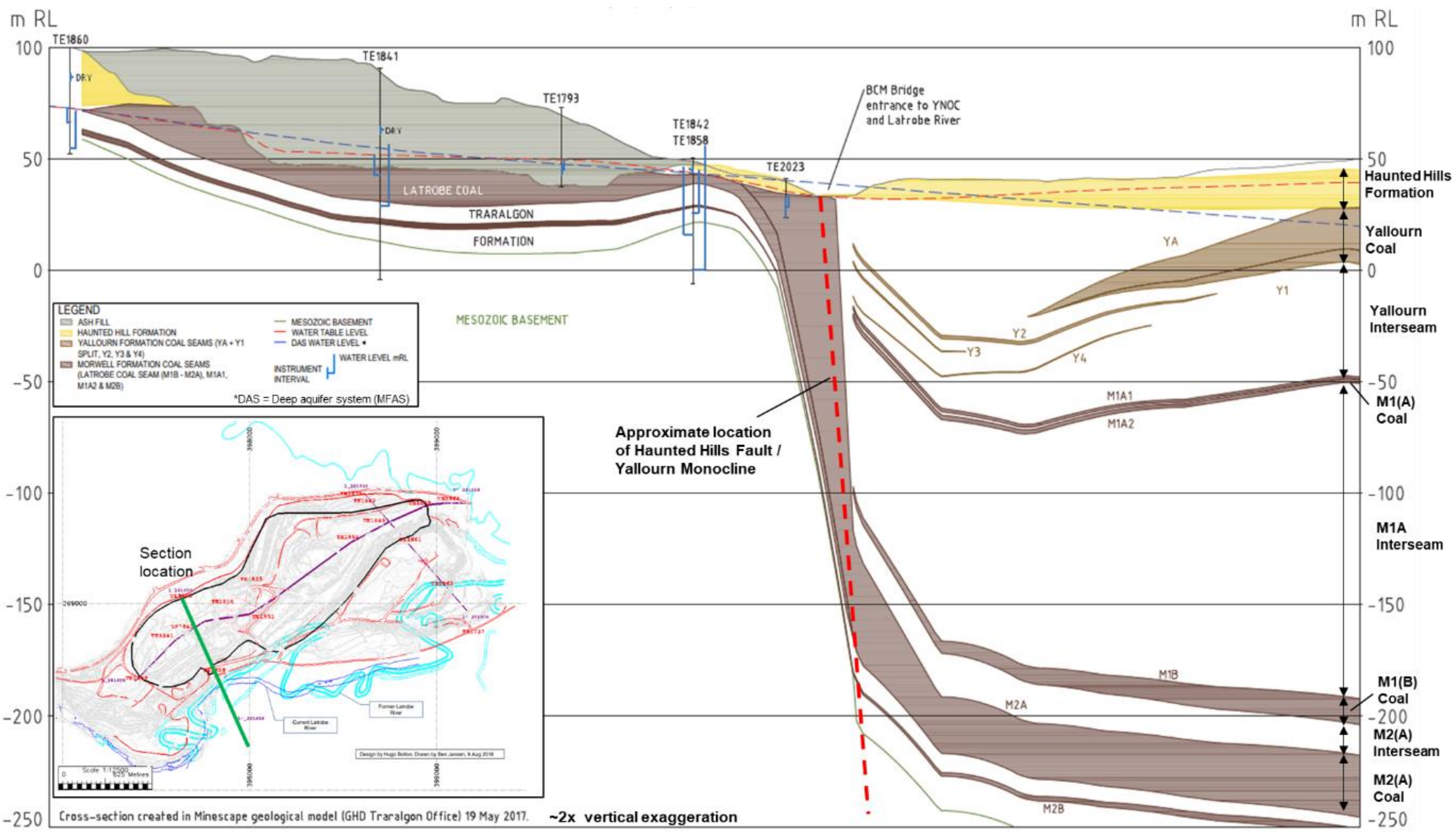


Figure 8-25: Yallourn North Open Cut (YNOC) Cross-section (GHD 2023)

Surface Water Considerations

The surface water interaction for conceptualisation factors the regional water features. The most relevant for the Yallourn site are Latrobe and Morwell River systems. In general, the Latrobe and Morwell Rivers are considered as gaining systems with some seasonal variations during wet periods. At a mine scale level, these rivers have more noticeable variations in selective geotechnical domains. The conceptualisation of these water features are discussed in more detail in Appendix C – Technical Reports (GHD 2023).

Over the past decade, flooding events in the Morwell River in 2012, 2019, and 2021 have shown significant interactions with groundwater levels. The 2012 event caused widespread inundation of the MRD and upstream floodplains. High rainfall in July and August 2019 led to flooding and the formation of a local groundwater mound near Siphon Pipe area (a surficial feature that facilitated the siphon pump operations during the MRD failure in June 2012). In June 2021, another high rainfall event resulted in flooding, with river levels peaking nearly 3 meters above the 2019 levels (Figure 8-26).

Shallow groundwater within the Morwell River floodplain is hydraulically connected to the river, as evidenced by the seasonal variations in the groundwater levels that reflect those of the river level. Hydrographs of shallow bores/piezometers near the Southern MRD Crossing indicate that periods of high river level (wet months) coincide with periods of higher groundwater levels and vice versa (Figure 8-27).

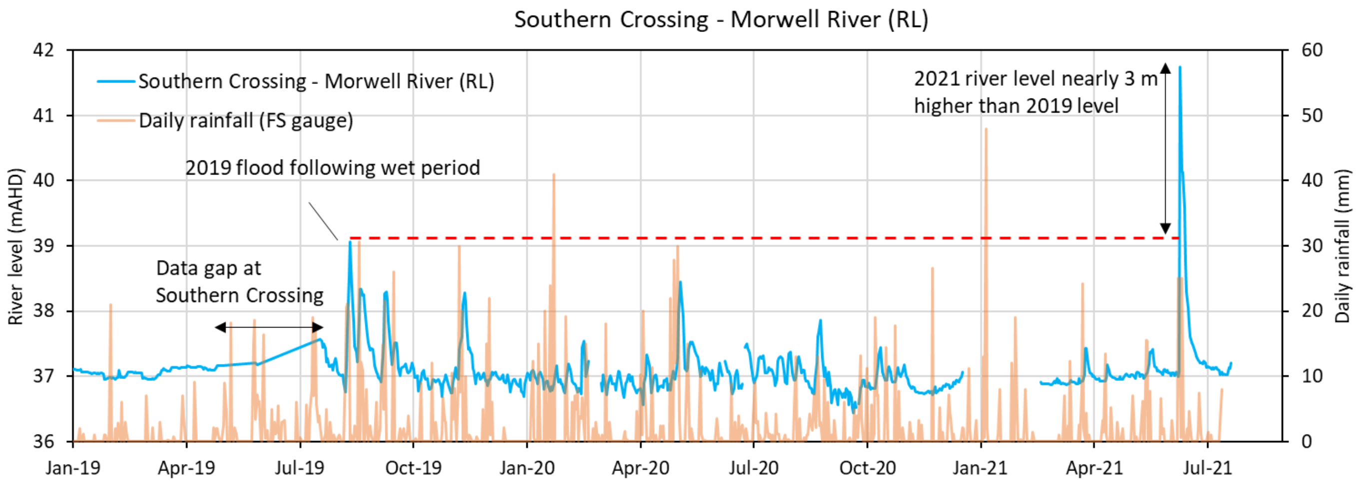


Figure 8-26: Morwell River Level at Southern Crossing of MRD with Rainfall (GHD 2023)

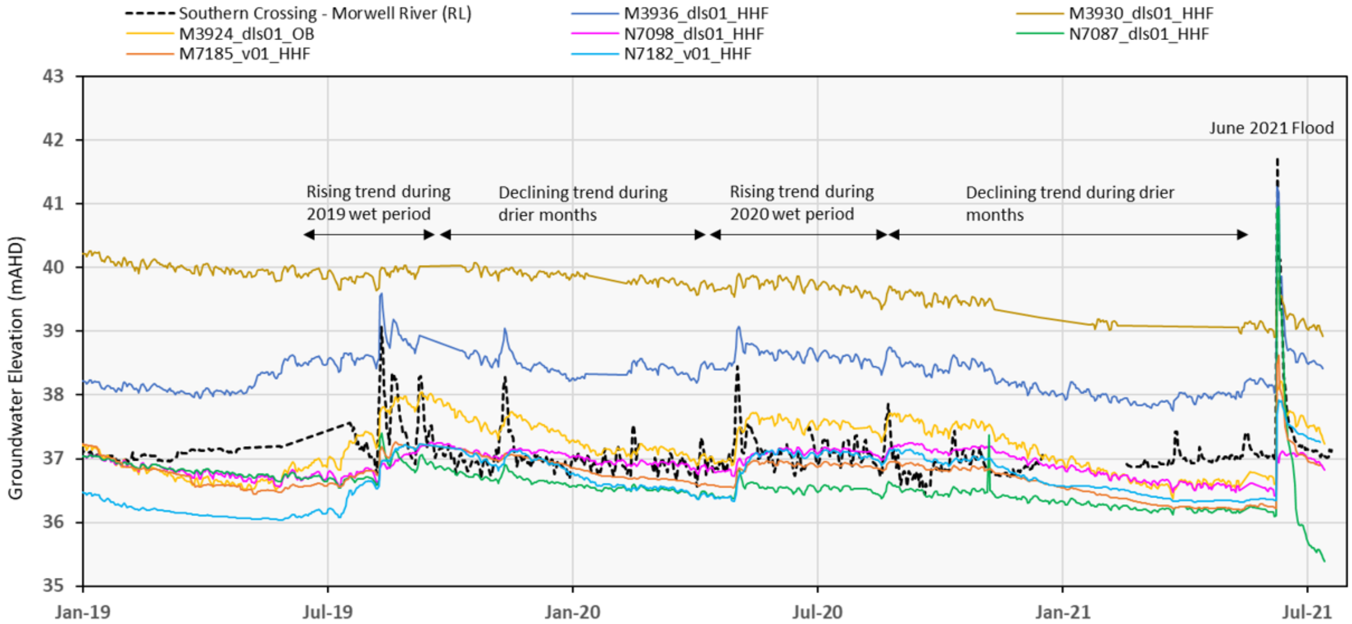


Figure 8-27: MRD Surface & Groundwater Interactions (Near MRD Southern Crossing) (GHD 2023)

The Latrobe River has undergone several realignments to support mining operations, with its original course through YNOC being straightened and shifted south. After the 2007 slip in Yallourn Eastfield, the river was realigned north of the failed section. Groundwater flows towards the Latrobe River from both the north and south, forming a local groundwater divide. This suggests the river gains groundwater, especially near YNOC. Downstream bores indicate groundwater levels decline towards the mine, suggesting southward flow and potential surface water leakage.

Other Surface Water Features - these features include:

- Fire Service Pond (FSP) located in Township Field and Yallourn Morwell River Wetlands.
- The Yallourn Morwell River Wetlands are surface water-fed, although there are currently no groundwater bores in this area to confirm the degree of connectivity with shallow groundwater.

Hydrogeochemistry

The site groundwater quality is discussed in Section 8.8. The summary of that data relevant to hydrogeological conceptualisation indicates the following:

- The salinity of Yallourn Coal ranges from 220 mg/L at the Western Batters- Hernes Oak, to up to 1,200 mg/L observed in the East Field, above the Latrobe River Batters.
- The HHF also shows a wide variability in groundwater salinity, ranging from less than 60 mg/L in areas close to topographic ridges and inferred rechange zones at Hernes Oak (near the bores recording long term climate induced trends), to up to 770 mg/L adjacent to Flocculation Pond Batters. The salinity is higher and more variable in the East Field and Maryvale areas. Similarly, the salinity of bores in the Overburden ranges from 190 mg/L at Hernes Oak and 640 mg/L in East Field.
- The samples of M1A Interseam (aquifer) groundwater collected from pumping bores N6899 and N5056 indicate low salinity, with a Total Dissolved Solids (TDS) concentration of 300 mg/L and 210 mg/L respectively.
- The pH levels range from 5 to 6 pH units for the different HSUs, which is in line with the historical data.
- The piper plot analysis indicates that the four HSUs identified showed a similar distribution, except for the Overburden which showed no dominant type and a wider spread of mixed water types (reflecting their heterogeneous nature). The majority of the samples are characterised as a sodium chloride groundwater type.

Groundwater Dependent Ecosystems

The Australian groundwater dependent-ecosystem (GDE) toolbox provides a framework to assist with the identification of GDEs and their water requirements (ERM 2023a). GDE are discussed in Sections 5.5.5 and 8.4.

8.3.3 Methodology - Groundwater Numerical Model

8.3.3.1 Basis of Design – Groundwater Numerical Model

A Basis of Design was prepared prior to the completion of the design, construction and calibration of the model, following the initial planning process that sets out the modelling objectives and hydrogeological conceptualisation. Focus was on the datasets that are used specifically to inform the design and construction of the numerical model, and subsequent calibration and predictive modelling. As outlined in the Australian Groundwater Modelling Guidelines (AGMG), numerical groundwater modelling is an iterative process with feedback expected between various stages. More detailed descriptions of the model and associated findings are presented in Section 8.3.6.

In general, the basis of design considered all modelling stages as per AGMG ranging from planning, design and construction, calibration, prediction and uncertainty analysis. Details of the attributes associated with these stages is captured in the *Design Basis Memorandum* (GHD 2020) along with the known data sources and assumptions.

8.3.3.2 Approach to Model Design

The development of GWNM has been a staged approach, consistent with the *Australian Groundwater Modelling Guidelines* (Barnett et al. 2012). The key steps to the approach for GWNM are presented here, along with the key assumptions to model inputs. A more detailed discussion is presented in *Numerical Groundwater Model – Design,* *Construction and Calibration Report* (GHD 2025b). The basis of design to all stages of groundwater modelling has been discussed in Section 8.3.1.

Key steps and factors for construction and calibration of the site's GWNM:

1. Establish the model domains with structure of the grid and cells size.
2. Design the model layers based on the stratigraphic model refinement (Section 8.2.2.1) which defines the model surfaces.
3. Define the relationship between the model layers and the HSUs.
4. In consideration to the precipitation runoff derive the recharge variations, evapotranspiration and lateral flows for the groundwater model. These outputs then form the input to USG-Transport Model (Unstructured Grid).
5. Define model boundary conditions in consideration to:
    a. the recharge and evapotranspiration, surface hydraulic features such as stream, rivers. Define the boundary conditions for Wells to simulate extraction of groundwater by pump bores.
6. Deduce the level of parameterisation where determination is made on representation of spatial variability and distribution of aquifer properties in the model. Here a balance is sought between parsimonious (smaller number of varying parameters) and highly parameterised spatial variability.
7. Following the abovementioned processes run the model calibrations considering the parameters relevant to calibration, the period of calibration with concerted focus on the piezometric heads, stream flows and groundwater extractions.

The calibration model was then verified by extending the model simulation for an additional period that extends beyond the calibration period using climate, mining and pumping data for that period. This enabled comparison of the model generated heads with observed heads which provides greater confidence in this model to be used as a predictive tool. This approach was as defined in *Australian Groundwater Modelling Guidelines* (Barnett et al. 2012).

8.3.3.3 Model Design and Construction

Model Layers

The model layers were established by utilising the Leapfrog Hydrostratigraphic model. The Yallourn Coal is the main coal unit that is exposed in the mine batters and will directly interact with the future pit lake. This unit is split into four model layers (layers 2 to 5) of equal proportion, to increase the vertical resolution in areas of steep vertical hydraulic gradients and to assist with the simulation of a future pit lake (for void volume and stage-storage relationship).

The M1A Interseam is the main confined aquifer depressurised by the pumping bores at the Yallourn Mine. This unit is also split evenly into three model layers (layers 8 to 10), to account for the variations in the abundance of sand with depth and to simulate subtle vertical differences in groundwater levels observed at nested piezometers. The M1A Interseam consists of four distinct (albeit discontinuous) sand aquifers (Table 5-6). These were considered impractical to be simulated individually due to an impractically large number of model layers required to do so (four layers for the sand aquifers plus five layers for the intervening coal/clay layers). The splitting into three model layers is considered a reasonable compromise, providing some flexibility for capturing the differences in sand abundance without incurring excessive run time from having a large number of model layers.

All other formations are represented by single model layers. The model layers are presented in Table 8-2.

Table 8-2: GWNM layers and corresponding HSU (GHD 2025b)

Layer	HSU	Active cells	Inactive cells
1	Haunted Hills Formation (Hazelwood Formation)	36,757	2,224
2	Yallourn Coal	28,565	10,416
3	Yallourn Coal	28,567	10,414
4	Yallourn Coal	28,566	10,415
5	Yallourn Coal	28,566	10,415
6	Yallourn Interseam	27778	11,203
7	M1A Coal	26,192	12,789
8	M1A Interseam	27,143	11,838
9	M1A Interseam	27,142	11,839
10	M1A Interseam	27,144	11,837
11	M1B Coal	29,896	9,085
12	M1B Interseam	29,727	9,254
13	M2 Coal	32,011	6,970
14	M2 Interseam	1,102	37,879
15	Thorpdale Volcanics	4,553	34,428
16	M2 Interseam	35,283	3,698
17	Basement	38,981	0

For the pit lake simulation using the USG-Transport LAK package, the cell connections in between the layers had to be represented as a continuous function, with the same grid refinement in all layers. This was achieved by defining a very small layer thickness to replicate the effects of pinching out of the layers without influencing the results generated by the model. The pinch out cells have been reduced to a minimum thickness of 0.1 m and made inactive (through the IBOUND array of USG-Transport), as defined in Table 8-2. The model has a total of 701,658 cells, with 457,973 active cells (below 500,000 active cells is a sensible practical limit).

Precipitation Runoff Modelling System (PRMS)

An integrated modelling approach was adopted using physical-based distributed rainfall-runoff. This derives spatial and temporally varying recharge, evapotranspiration and lateral flows. This accounts for:

- The influence of topography, vegetation, soil zones, land use and climate variability.
- Ability to account for total and transient stream flows.
- the use of daily climate data, which is well suited to incorporating the effects of climate change based on the scaling factors of the Victorian government's climate change guidelines (DELWP 2020) that are applied directly to the underlying climate data (such as rainfall and evaporation).

The PRMS model domain fully encloses the groundwater model domain, with a larger upstream area to account for the contribution of lateral flow (runoff and interflow) from the wider catchment. The stream flows originating from the upstream catchments were then simulated by directing gauged flows into the model. The PRMS grid uses a regular structured grid, which is required for incorporating the cascading flow effects. A cell size of 250 m by 250 m is used, with a total of 16,861 active cells covering an area of around 1,054 km^2. The surface elevation of the model grid is derived from the Vicmap DEM, which was converted into a "hydrologically correct" DEM by the Cascading Routing Tool (CRT) to fill local depressions and enforce downward drainage (preventing circular flow paths).

The outputs from the PRMS model were used to generate the following inputs to the USG-Transport model:

- Runoff assigned to each segment of the stream boundary condition, using the lateral flow (runoff and interflow) computed by PRMS
- Evapotranspiration, using the unused PET (Potential Evapotranspiration) computed by PRMS. This represents the portion of PET not used (lost) by the surface processes above the water table such as interception and soil (unsaturated) zone evapotranspiration, which is available for plants to uptake directly from the water table (where the root depth is within the saturated zone).
- Recharge, using recharge (deep drainage) computed by PRMS.

Figure 8-28 is a graphical representation of linkage between PRMS and USG-Transport.

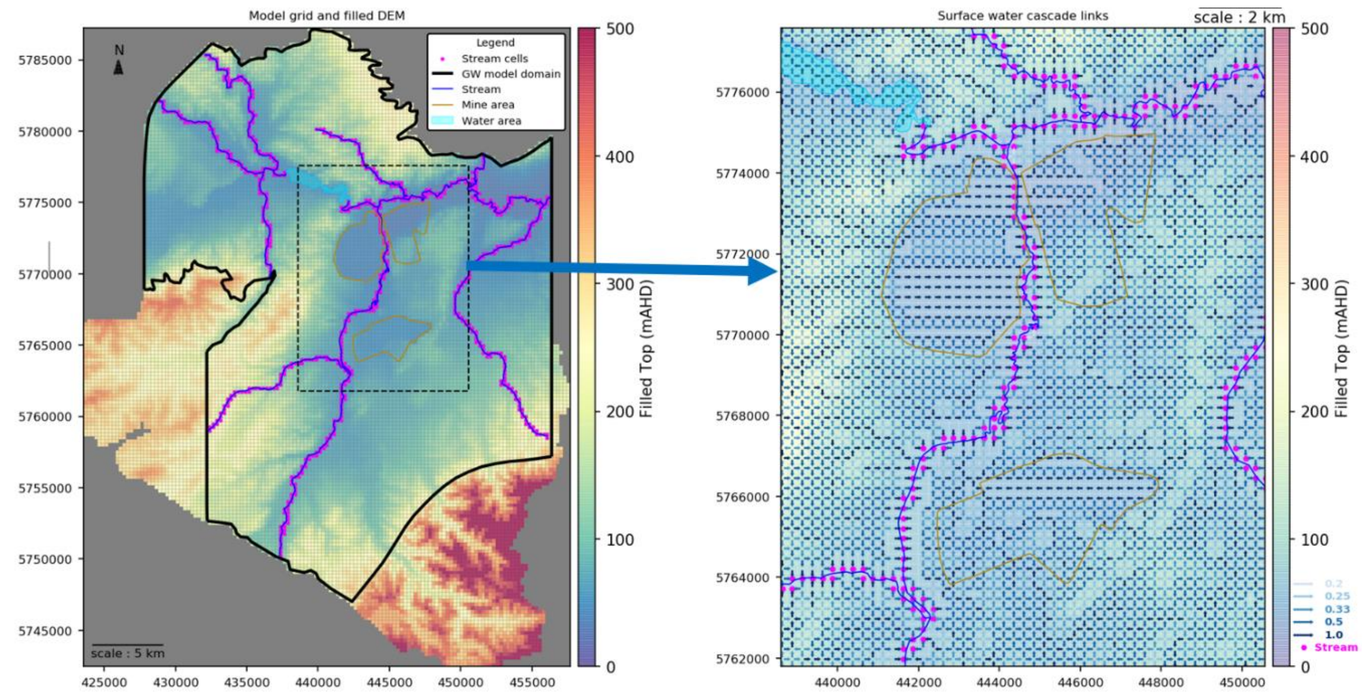


Figure 8-28: PRMS Model Grid and Flow Cascades (GHD 2025b)

Model Boundary Conditions

The **recharge and evapotranspiration** (derived from PRMS model) were assigned using USG-Transport Recharge (RCH) and Evapotranspiration (EVT) packages, respectively. Automatic recharge was assigned directly to the uppermost active cells and evapotranspiration to uppermost active nodes.

The **stream boundary condition** was applied by using stream cells to simulate major watercourses within each model domain. This utilised the Stream Flow Routing (SFR2) package and shown in Figure 8-29. Stream bed elevations are defined based on the 20 m resolution Vicmap DEM, with enforced topographic fall down the stream network. Channel widths are varied based on broad inspection of aerial imagery. Stream bed thickness is set to 0.5 m except along sections of the Morwell River Diversion (MRD) underlain by clay and geosynthetic liners, where a thicker stream bed of 3 m is assumed (a representative thickness of the constructed liners across the width of the channel). Stream length within each model cell is calculated rigorously based on the mapped stream geometries from Vicmap (and refined using aerial imagery). Hydraulic conductivity of the bed material (and hence the stream bed conductance) is adjusted during model calibration using discrete zones.

The inflows from streams have been assigned using gauged historical data on main rivers and creeks. The surface water diversion for mining operations occur from Latrobe River downstream of Lake Narracan and have been accounted for by utilizing the gauges downstream of Narracan Dam. The discharge of mine treated water to Morwell River is assigned as a flow component to the stream segment closest to the discharge point (being west of Flocculation Pond).

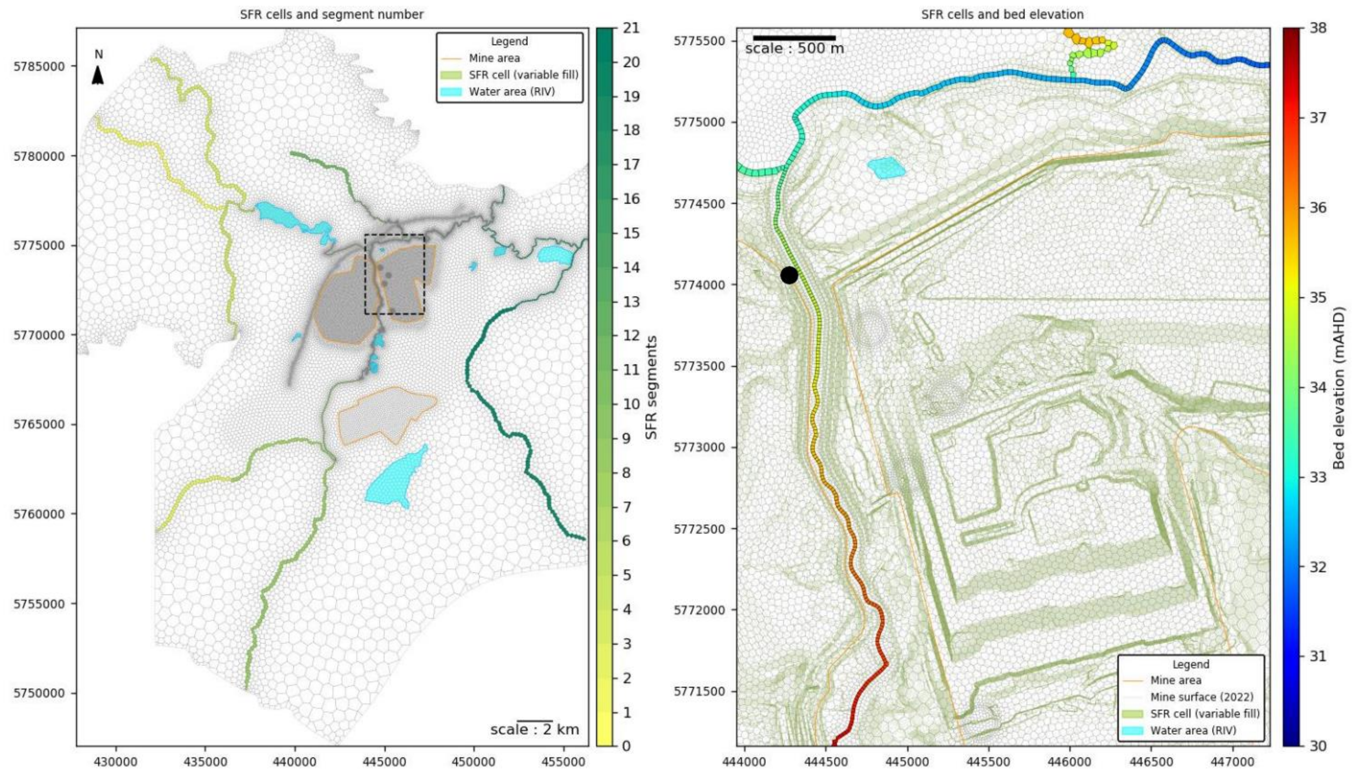


Figure 8-29: Stream Flow Routing (SRF) Boundary Condition (GHD 2025b)

The **River Boundary Condition** has been simulated using the River (RIV) package of USG-Transport. Water features outside of the Yallourn Mine void include Blue Lagoon, Lake Narracan, Witts Gully Reservoir, Pine Gully Reservoir, Morwell River wetlands, Hazelwood Cooling Pond and Australian Paper Maryvale lagoon and aeration pond. With the exception of the Morwell River wetlands, which were constructed around 2001, all these water features have been present for the majority of the historical calibration period (commencing in 1960) and are simulated using time-constant RIV stage estimated from Vicmap DEM and other publicly available information (except for Lake Narracan, where time-varying RIV stage has been applied from 2001 based on the storage level recorded at gauge 226236A). The mine water features applied to the RIV stages are shown in Figure 8-30.

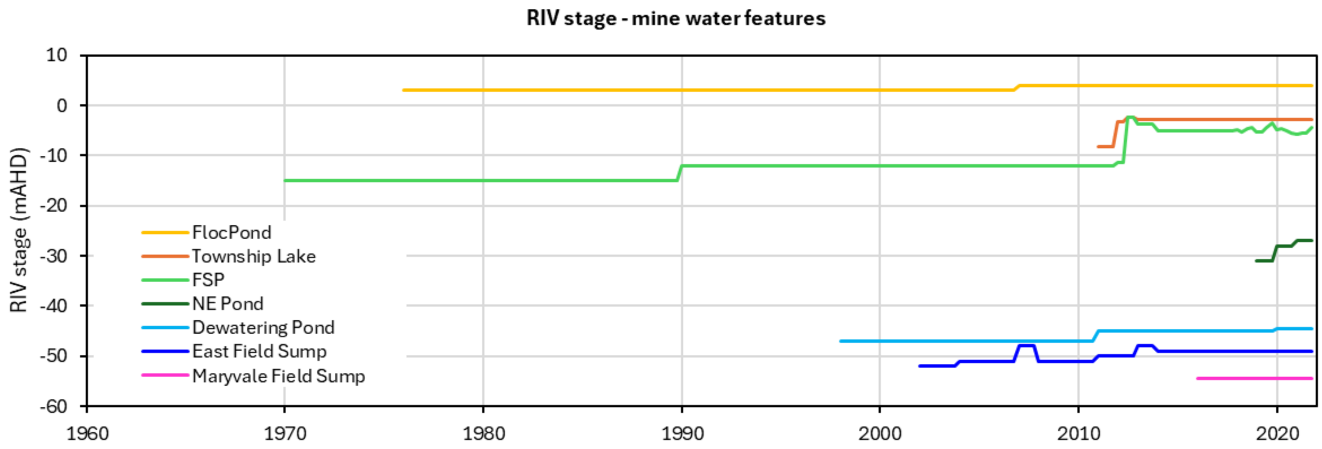


Figure 8-30: RIV Stage for Mine Water Features (GHD 2025b)

The **Drain Boundary Condition** utilises the Drain (DRN) package to simulate the excavation of overburden and coal at the mine site, aligning with the mine development plans. The location and elevation of DRN cells have been derived from a series of historical mine survey drawings and digital mine plans. For periods prior to 1994, the mine progression in Township Field covering Yallourn Open Cut, South Field and Township Field has been interpreted from the mine development plan published in 1989 (GHD 2025b) with the DRN elevation set equal to the bottom of the Yallourn Coal (assuming excavation of the full thickness of the coal). From 1994 onwards, detailed digital mine surfaces from 1994, 1999, 2004, 2009 and annually from 2014 to 2022 have been used to accurately define the DRN elevations and mine progression. The elevation of DRN cells has been linearly interpolated between the mine surfaces that are more than one year apart, to simulate the mine progression on annual increments

The DRN cells are assigned to the lowest layer within which the base of the mine is located. The DRN cells are also assigned to all of the overlying layers, with the DRN elevation set equal to the cell bottom to fully dewater the cells that occupy the void space. As mining progresses over time, the total number of DRN cells increases as the mine floor deepens over an increasingly wider area. For each DRN cell, a conductance value of 100 m^2/d is applied, high enough to fully DRN the cells to the specified DRN elevations. The DRN surface elevation for select periods at Yallourn are shown in Figure 8-31. Similar parallel process was applied to adjacent Hazelwood mine (GHD 2025b).

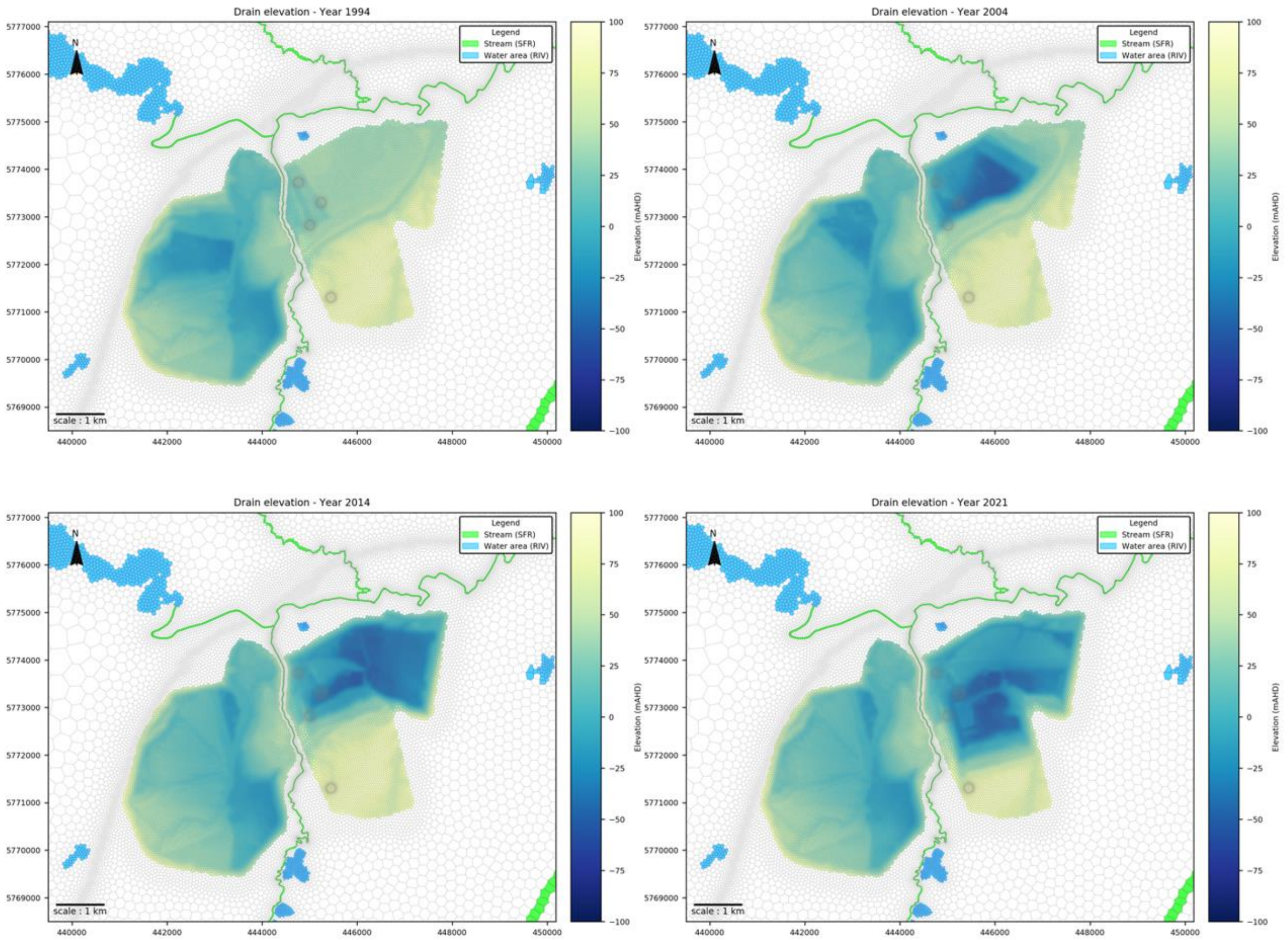


Figure 8-31: Yallourn Mine DRN surface elevation (GHD 2025b)

The **Well Boundary Conditions** have utilised the Well (WELL) package of USG-transport where groundwater extraction from pump bores were simulated. The pumping bores have been mapped to the nearest node based on their location and screen interval/aquifers. A total of 51 bores are incorporated into the model to simulate the historical extractions. For the pumping bores in the M1A Interseam at the mine, the WEL node has been assigned to the correct model layers (8,9,10) based on the intersection of the screen interval with the model layers representing this aquifer. Pumping bores N6899 and M4203 have multiple screen intervals, intersecting more than one model layer. In this case, two WEL nodes are used to simulate the effect of pumping from each bore with the pumping rate split evenly between the two nodes (model layers 9 and 10 for N6899 and 8 and 10 for M4203). The annualised extraction rates applied are summarised in Figure 8-32 The historical and active pump bores at Yallourn mine are shown in Figure 8-14.

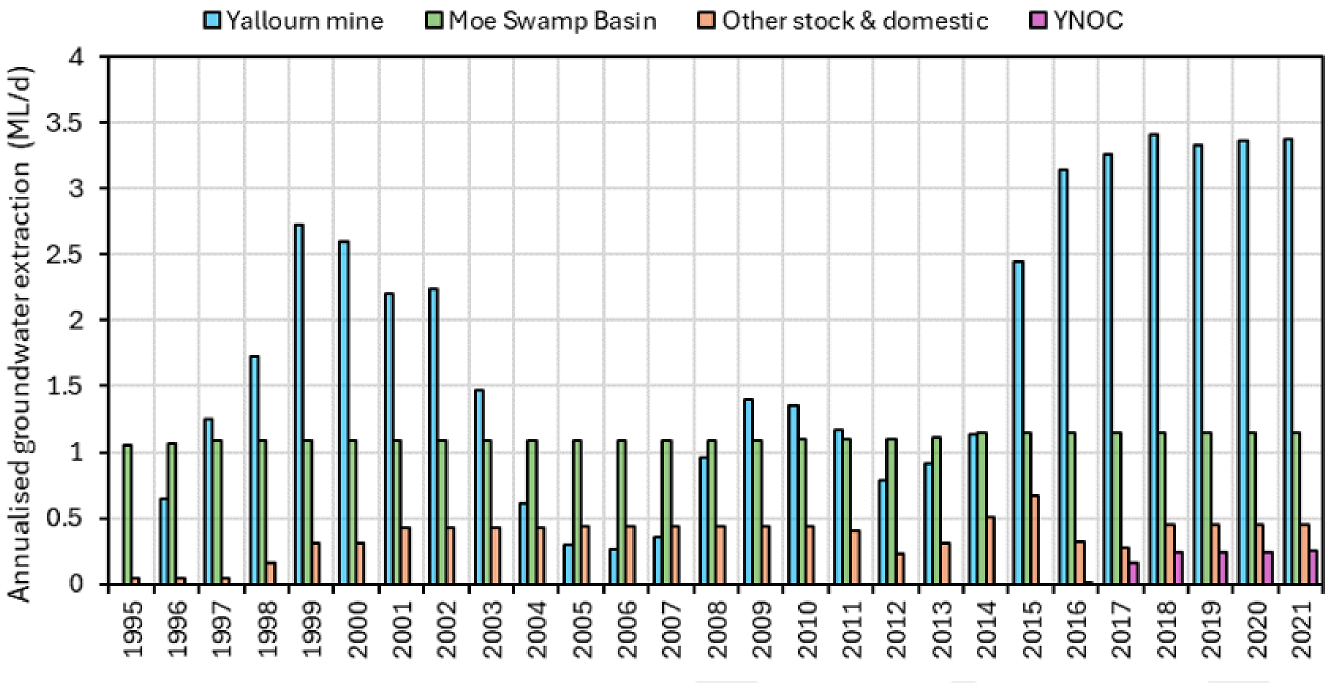
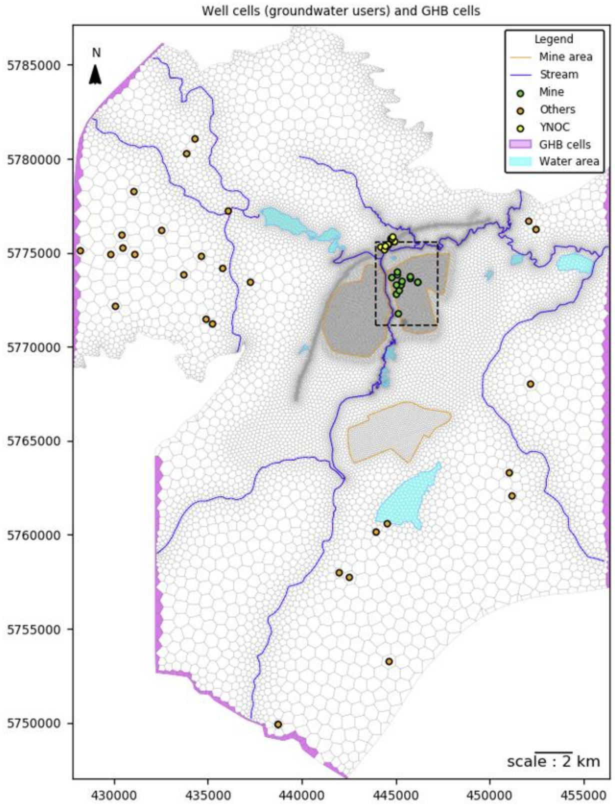


Figure 8-32: Modelled Annualised Groundwater Extraction Rates (GHD 2025b)

The **General Head Boundary Condition** utilises GHB package of USG-Transport to simulate the throughflow of groundwater across the model boundaries (outer edges of the model) based on groundwater levels specified along the boundaries. The GHB boundary condition is assigned along:

- The entire length of the eastern boundary to simulate regional changes in piezometric heads, primarily due to the cumulative effect of the confined aquifer depressurisation at the Loy Yang Mine. The time-varying heads are extracted from the LVRGM along the length of the boundary and assigned to the nearest GHB cells.
- The western boundary across the Narracan Block to simulate the head changes within the outcropping Thorpdale Volcanics and throughflow of shallow groundwater. The time-varying heads are extracted from the LVRGM along the length of the boundary and assigned to the nearest GHB cells.
- The western boundary along the Moe Swamp Basin to simulate the throughflow of groundwater into the basin. Given the substantial distance of this boundary to the Yallourn Mine and Haunted Hills Fault/Yallourn Monocline, a time-constant value of 68 mAHD has been assigned to simulate the regional throughflow (based on the groundwater levels recorded in regional monitoring bores near this boundary).



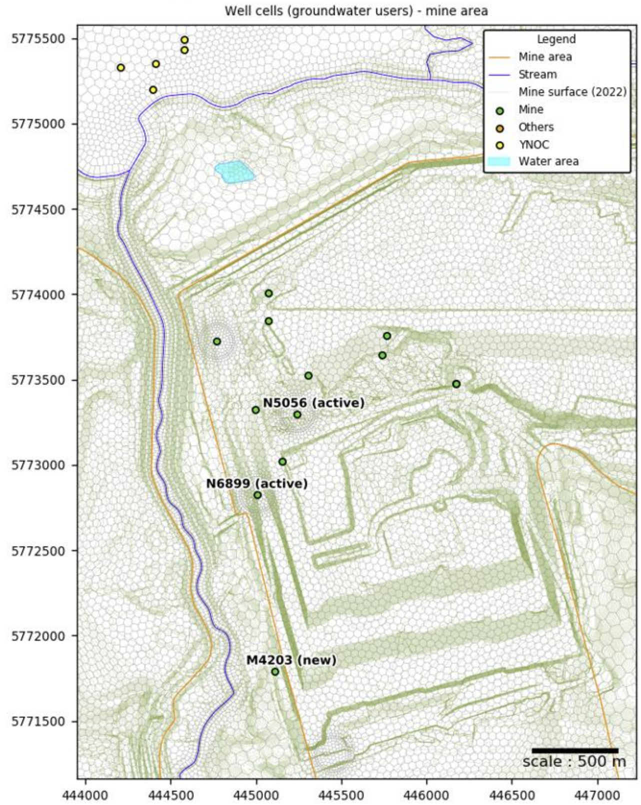


Figure 8-33: Well and General Head Boundary Condition (GHD 2025b)

The **Horizontal Flow Barrier** (HFB) was used to simulate the resistance to flow that occurs along the Haunted Hill Fault/Yallourn Monocline. The location of HFBs is based on the fault alignment with adjustments made during calibration based on piezometric head differences observed and simulated at monitoring bores located on either side of the fault.

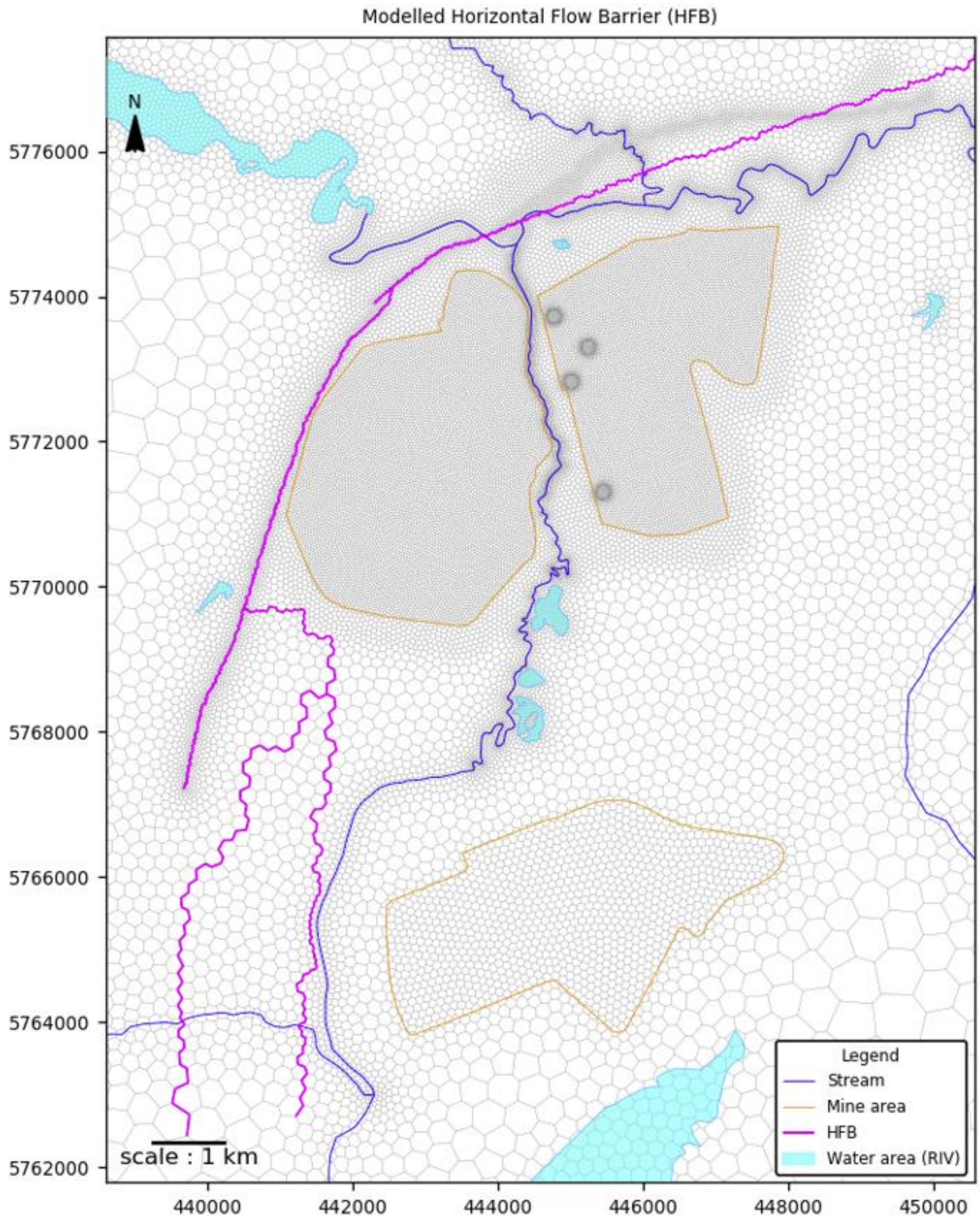


Figure 8-34: Horizontal Flow Barrier (GHD 2025b)

Model Parametrisation

The model is parameterised based on the HSU, however hydraulic conductivities have been varied spatially within each aquifer unit using percentage sands. The percentage sand grids provide an efficient means to incorporate hydrogeologically sensible distributions of hydraulics conductivity. For the M1A Interseam, the percent sand grid has been generated for each of the three model layers representing this aquifer (layers 8,9 and 10) by calculating the total thickness of sands intersecting each model layer and dividing this by the layer thickness (as shown schematically in Figure 8-35 below.

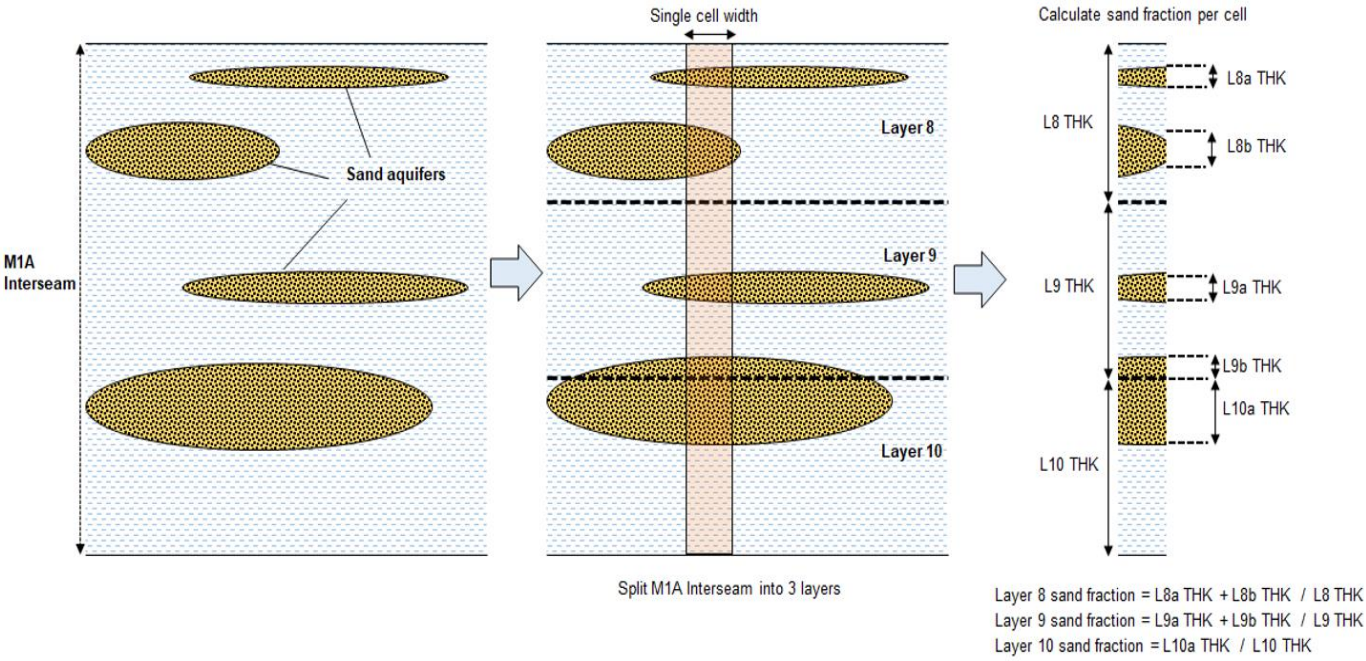


Figure 8-35: Schematic Representing Sand Fraction Calculation of M1A Interseam Layers (GHD 2025b)

Time Variant Material properties have been applied to account for mining excavations and the responsive stress relief leading relaxation of the batters. The relaxation of the batters leads to opening of the coal joints with dilation being greatest near the crest of the mine, gradually radiating away from the excavation zones. two broad zones of material property changes are defined based on the information supplied by EAY. These include:

- A zone of highly fractured coal along the floor of the mine and coal batters, where open joints, many with large apertures, are present and the hydraulic conductivity is most enhanced.
- A zone of moderately fractured coal, extending 100 to 700 m from the batter crests, where open joints are present albeit with smaller apertures and larger spacing (lower density) compared to the highly fractured zone. Beyond this zone, the undisturbed (in-situ) coal material properties are assumed based on no movement mechanisms to open the coal joints.

The time variant stress zones and periods are shown in Figure 8-36 and a schematic of implementation of material property changes is presented in Figure 8-37.

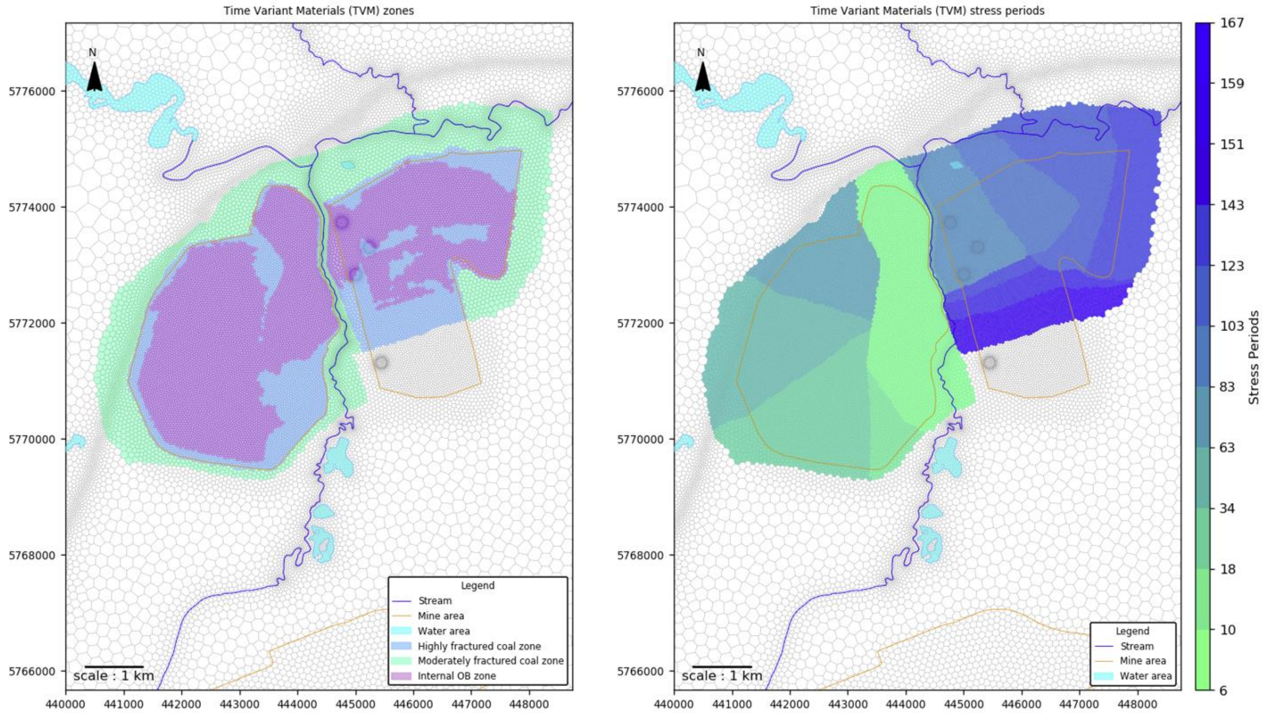


Figure 8-36: Time Variant Material Zones & Stress Periods (GHD 2025b)

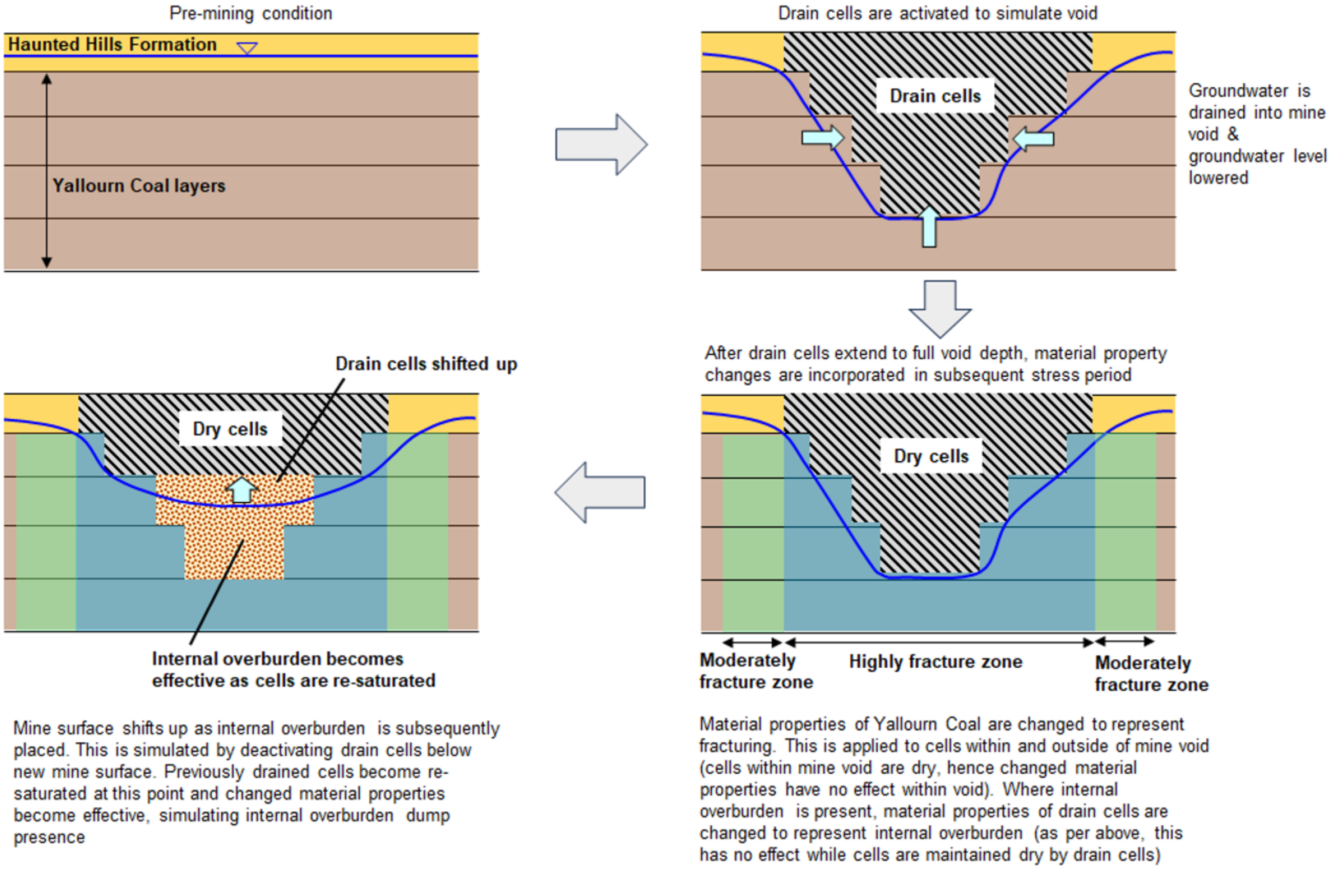


Figure 8-37: Schematic of Time Variant Materials Implementation (GHD 2025b)

8.3.3.4 Model Calibration Results & Verification

The **calibration of the model** is commensurate with the following target inputs and parameters:

- Calibration period (commences January 1960, extending to December 2021)
- Calibration Head Targets (Piezometric Heads from groundwater bores)
- Stream stage and flows (River gauges along MRD, Morwell River and Latrobe River)
- Groundwater extraction targets (pump bore extraction at Yallourn mine and simulated depressurisation at Hazelwood mine using the DRN boundary condition)
- PRMS and USG-Transport parameters (adjusted during model calibration)

The rigorous automated Parameter Estimation (PEST_HP) procedure was used in a highly parallelised computing environment. Calibration was done in regularisation mode, using preferred parameter values as prior information to ensure minimal deviation unless necessary for model improvement. The calibration results show good performance against groundwater levels and trends. Key hydraulically sensitive and responsive areas, as well as benign areas, are presented to ensure appropriate coverage around the large mine site. Detailed calibration results can be found in *Numerical Groundwater Model – Design, Construction and Calibration Report* (GHD 2025b).

The modelled groundwater levels for the Haunted Hills Formation (HHF) show local drainage due to mining and seasonal variations. These levels align closely with responses in the Internal Overburden (OB) Dump and Yallourn Coal water levels. Surface water systems influence groundwater responses in HHF and OB, with modelled and observed heads in close agreement. Shallow groundwater levels near the Morwell River floodplain are sensitive to river flows, which are challenging to simulate without a more granular model. However, the modelled levels and seasonal variations are broadly consistent with observations, providing reliable calibration for the GWNM. Detailed river hydrology and hydraulics are discussed in Section 8.6 for MRD rehabilitation design. Groundwater levels for Yallourn Coal and Internal OB were harder to replicate due to changes in material properties over time, linked to mining stress relief and subsequent stress reversals. Despite this, the model broadly calibrated the overall declining trend in coal water and OB groundwater levels.

The groundwater levels in the Yallourn Interseam are influenced by the removal of overlying Yallourn Coal, re-placement of internal OB, formation of internal water bodies, and depressurisation of the M1A aquifer. The model has successfully calibrated these responses in most areas, particularly in the zone of the 2007 YEF Latrobe River Batter failure, where lower modelled heads reflect the fractured failure zone. Outside this zone, modelled heads align with observed heads.

Groundwater levels in the M1A Interseam generally match observed heads, sensitive to groundwater pumping. Some exceptions in the central west of YEF between 2005 and 2008 indicate local compartmentalization, supporting historical hypotheses. The M2 Interseam is too deep to affect Yallourn Mine but is influenced by groundwater extractions at Hazelwood and Loy Yang Mines.

The calibrated model was then verified by extending the model simulation for an additional period that extends beyond the calibration period using climate, mining and pumping data for that period. This enabled comparison of the model generated heads with observed heads which provides greater confidence in this model to be used as a predictive tool. This approach was as defined in AGMG (Barnett et al. 2012). The verification process was based on over 6000 head observations from 341 bores. The verification responses are shown in Figure 8-38 to Figure 8-41.

There are extensive sets of hydrographs and contour plots generated for model calibration. For the purpose of demonstration here, examples of results (hydrographs and contour plots) from selected mine domains are presented here. The full set of results can be referred to in (GHD 2025b) (Appendix C – Technical Reports). These figures show the calibration period of 1960 to 2021 and the verification period of 2021 to 2023.

- Figure 8-38 - Calibration hydrograph and contour plot for HHF.
- Figure 8-39 - Calibration hydrograph and contour plot for Yallourn Coal.
- Figure 8-40 - Calibration hydrograph and contour plot for Yallourn Interseam.
- Figure 8-41 - Calibration hydrograph and contour plot for M1A Formation.

The groundwater responses in the upstream reach (upstream of the engineered MRD) has been been a key area to calibrate due to the geological features in this area, along with the historical performance of the area (June 2021 Mine Incident). The calibrated results for this area covering the HHF , Yallourn Interseam and M1A Interseam layers are presented in Figure 8-42, Figure 8-43 and Figure 8-44.

Groundwater responses in YEF Latrobe River Batters (YEF North) have been somewhat unique due to changes induced following the 2007 Latrobe River failure into the open pit. The calibrated results for HHF and Yallourn Interseam area presented below.

Figure 8-44 presents the M1A Interseam calibration for select bores in YEF and comparing them to YNOC bores. These show the influence of the horizontal flow barrier along the northern boundary of YEF and the groundwater divide with YNOC.

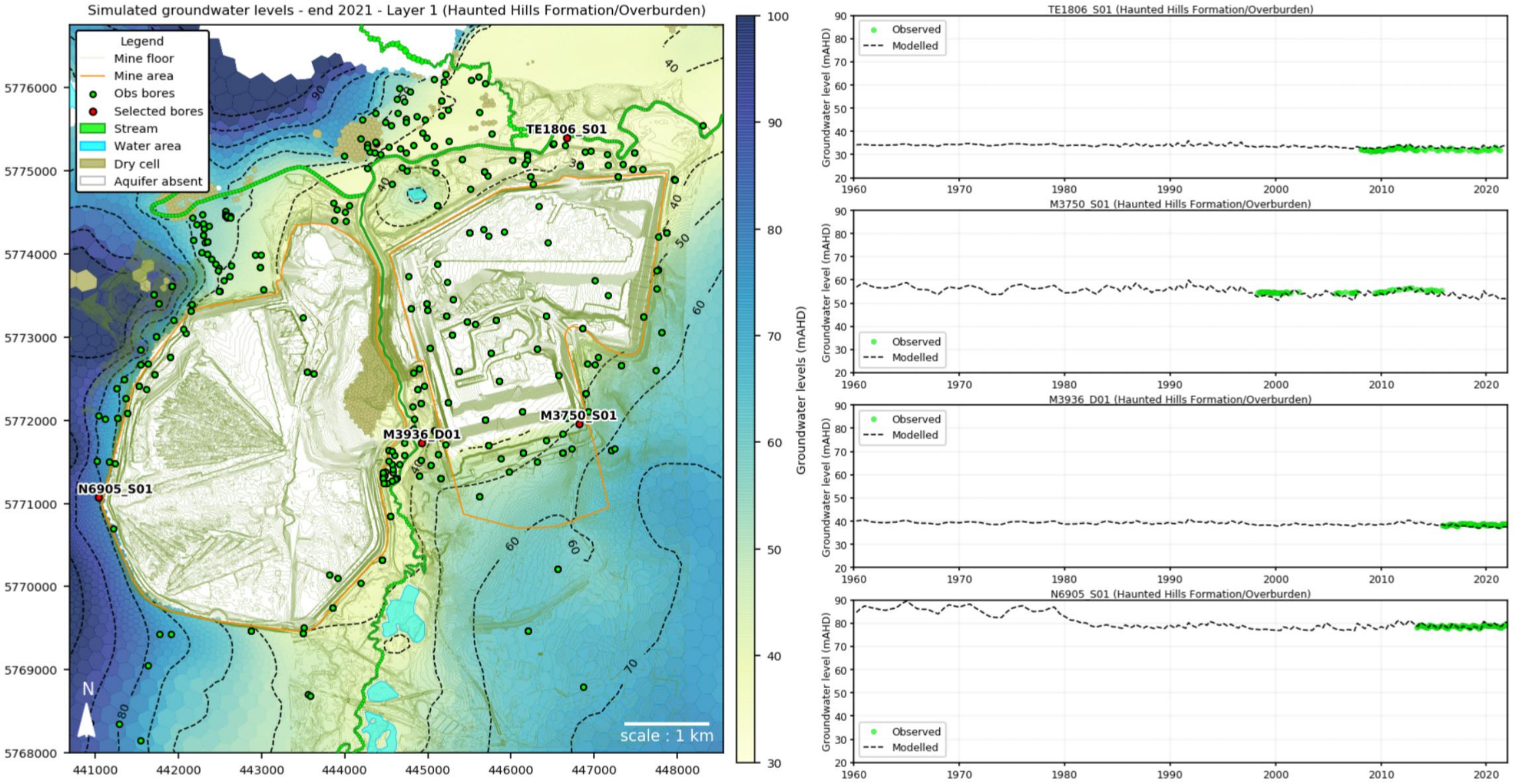


Figure 8-38: Calibration Hydrographs (select bores) and Contour Plot – HHF (GHD 2025b)

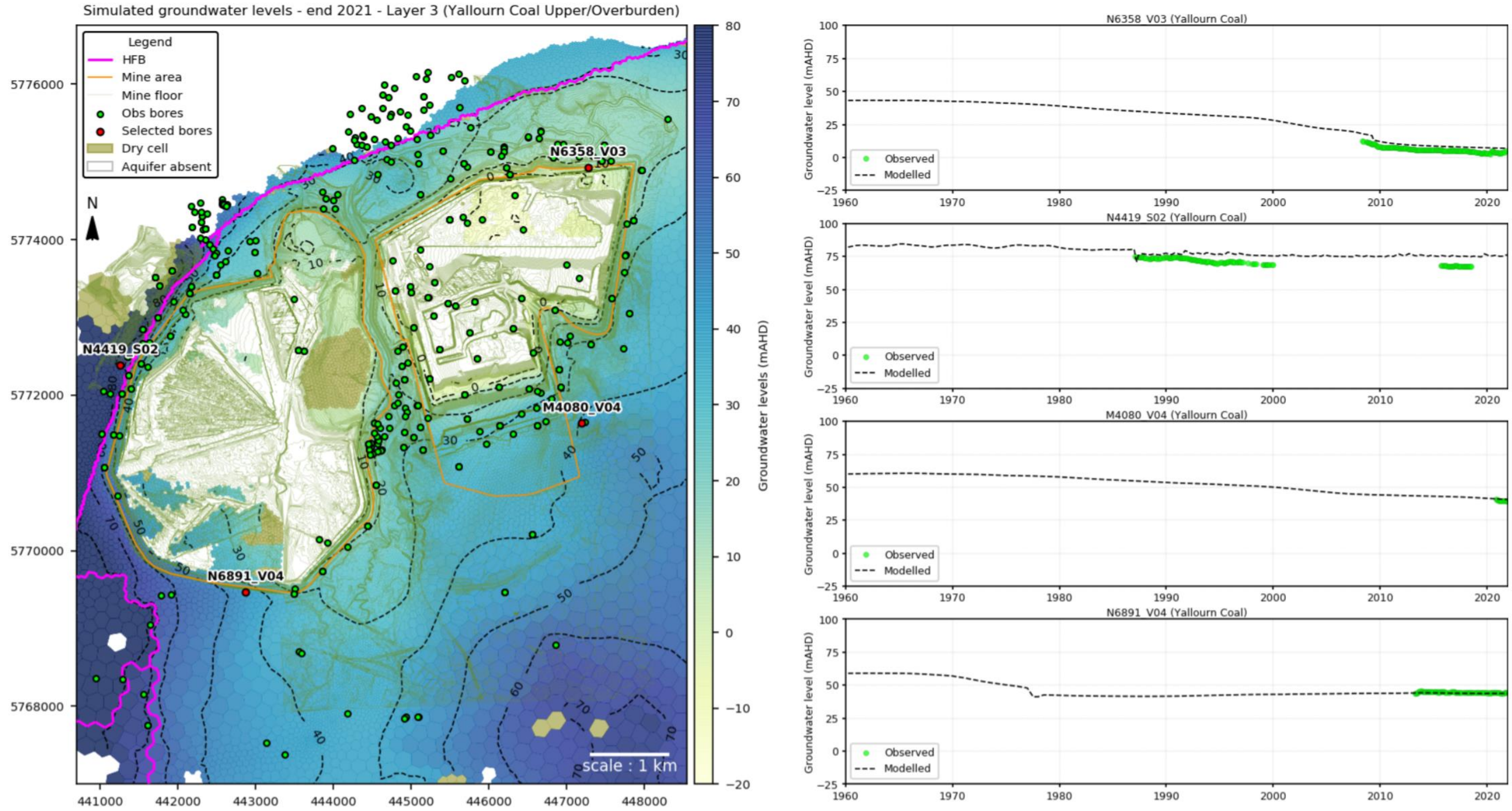


Figure 8-39: Calibration Hydrographs (select bores) and Contour Plot – Yallourn Coal (upper) (GHD 2025b)

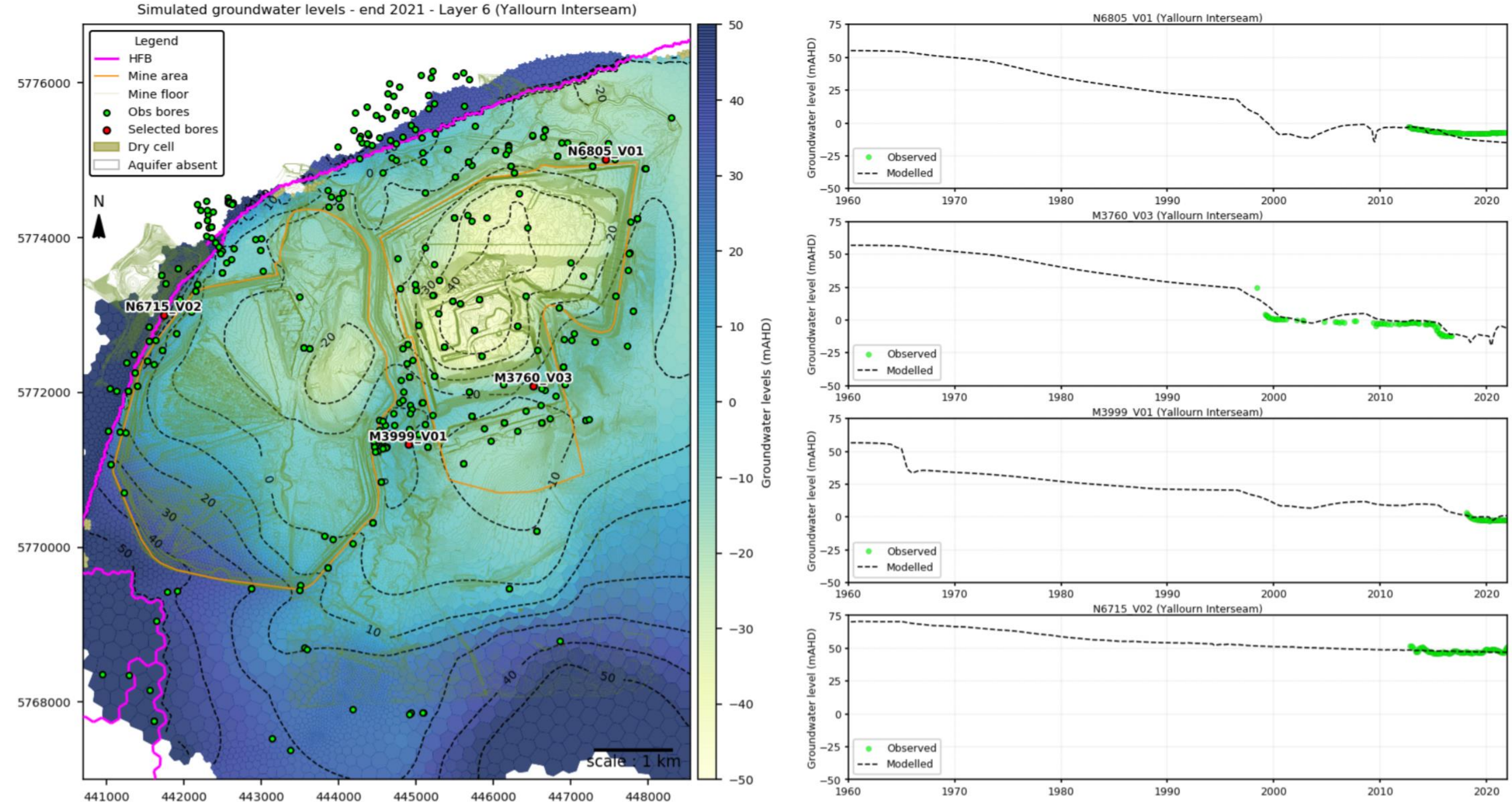


Figure 8-40: Calibration Hydrographs (select bores) and Contour Plot – Yallourn Interseam (GHD 2025b)

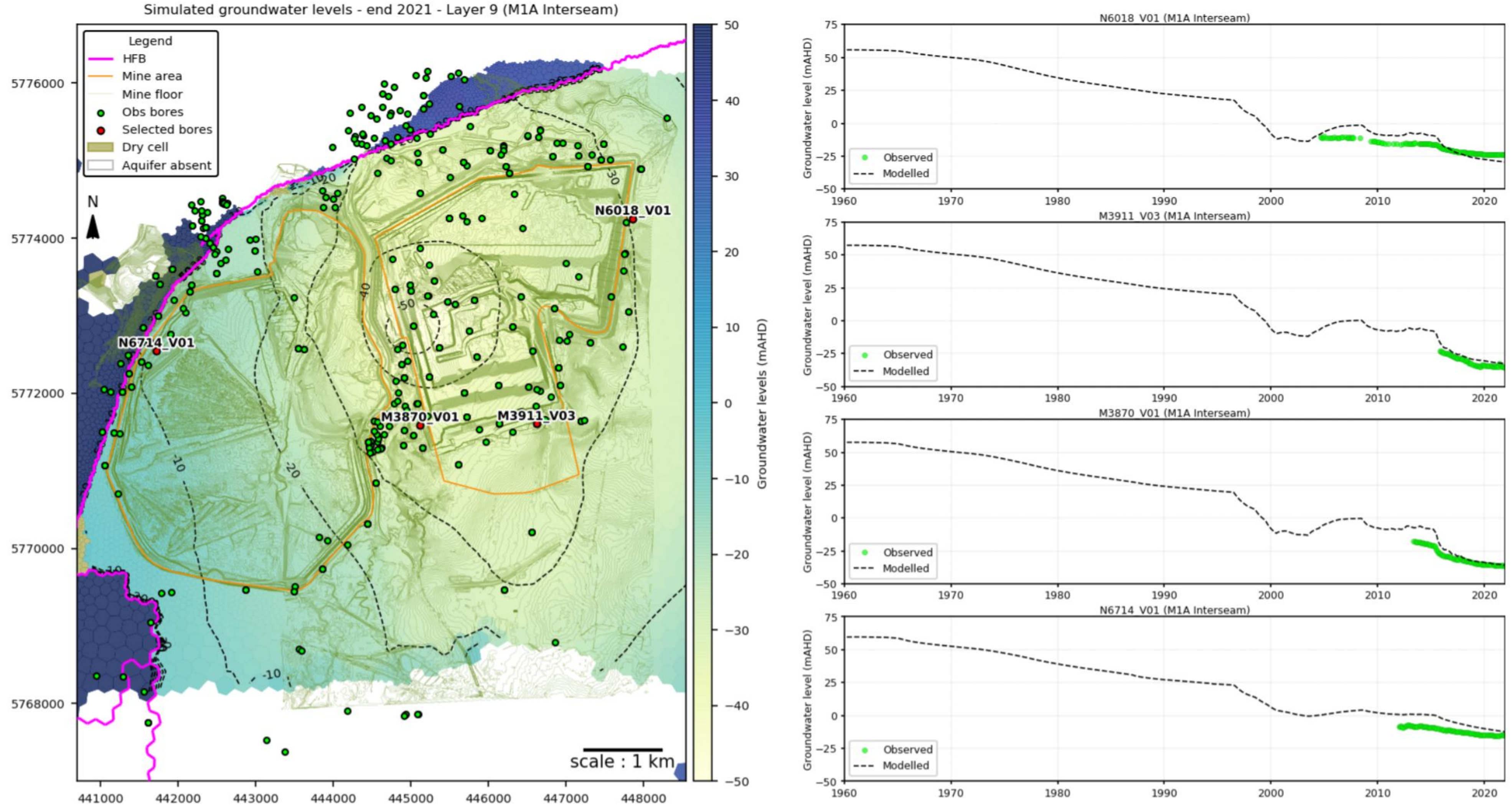


Figure 8-41: Calibration Hydrographs (select bores) and Contour Plot – M1A Interseam (GHD 2025b)

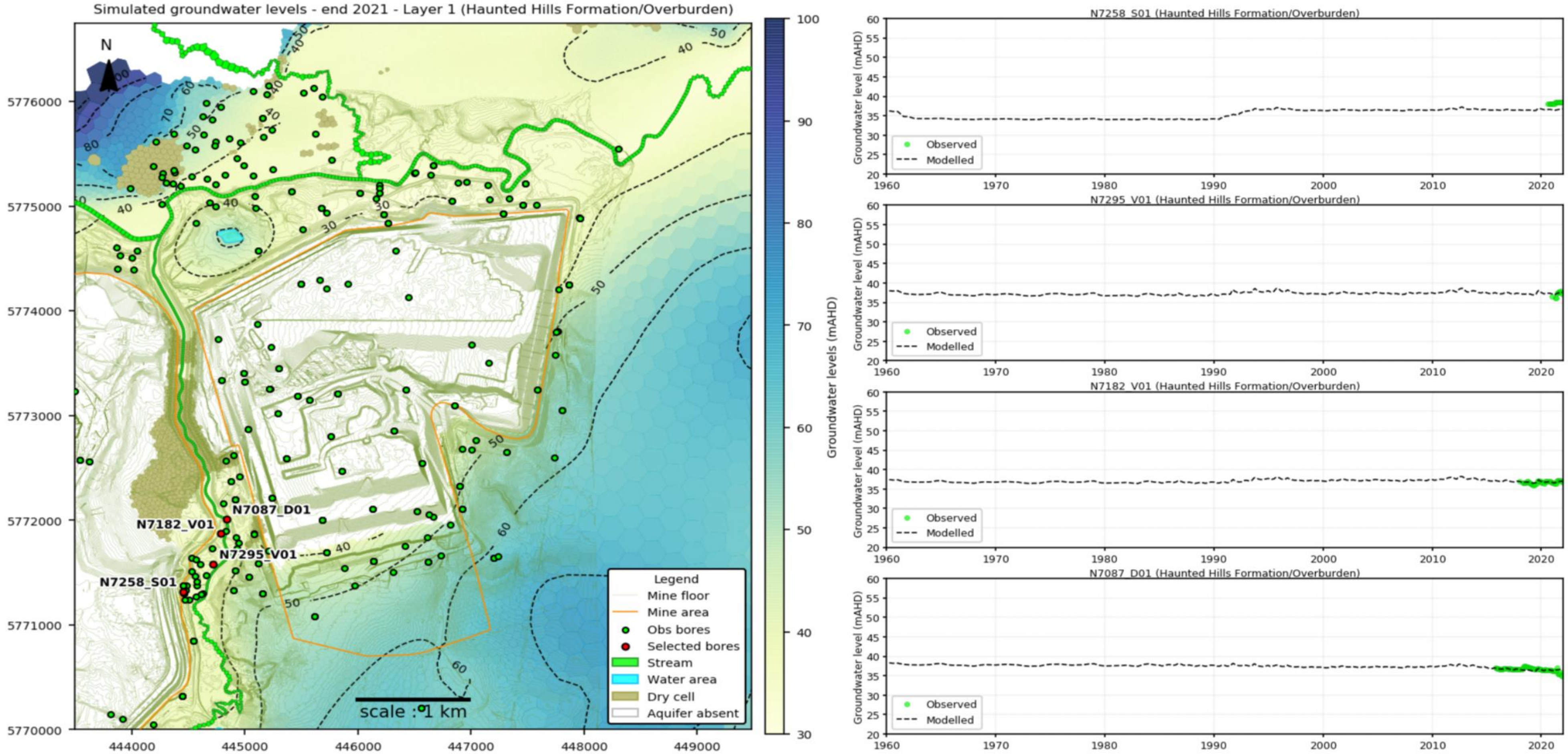


Figure 8-42: Calibration Hydrographs & Contour Plot – HHF, MRD Upstream (GHD 2025b)

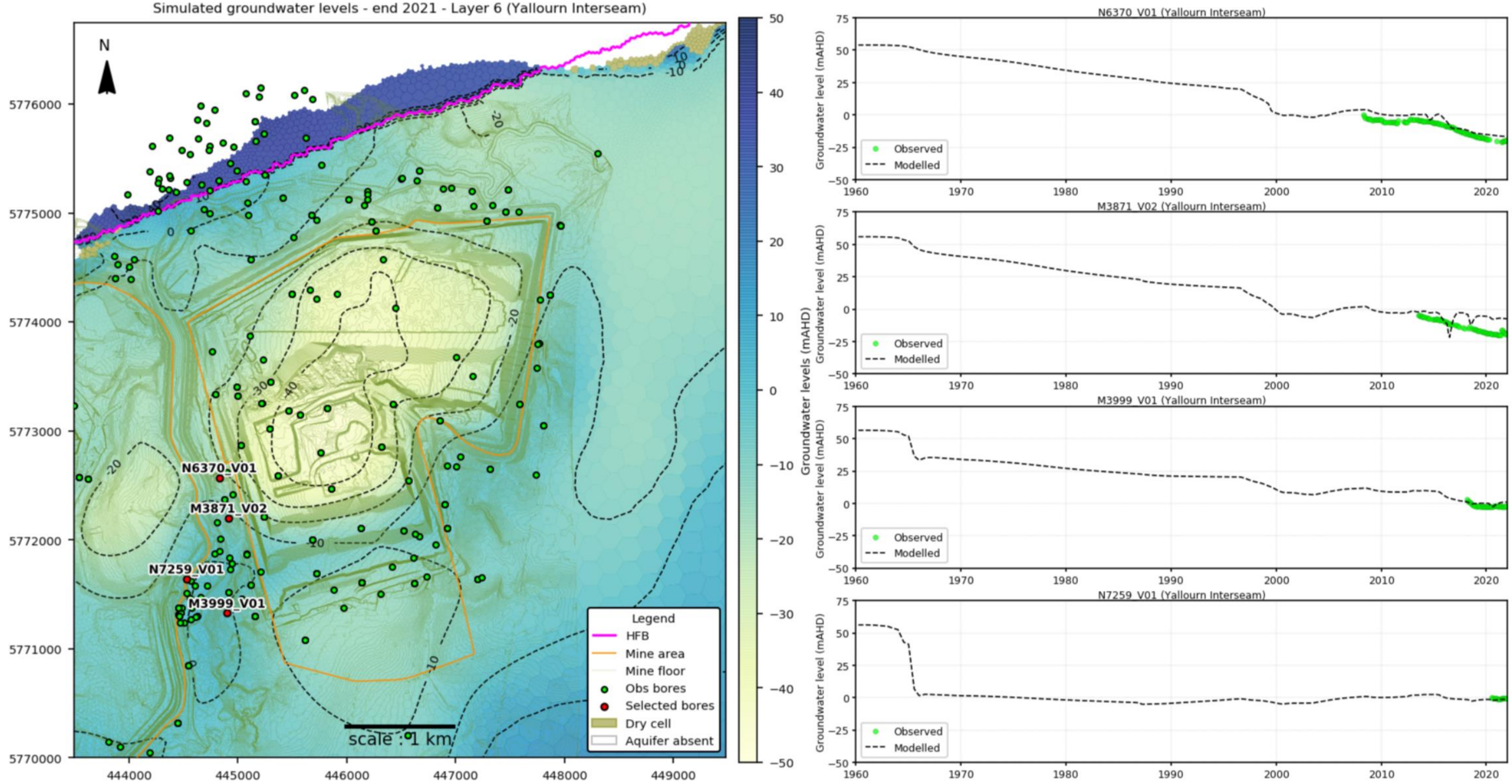


Figure 8-43: Calibration Hydrographs & Contour Plot – Yallourn Interseam, MRD Upstream (GHD 2025b)

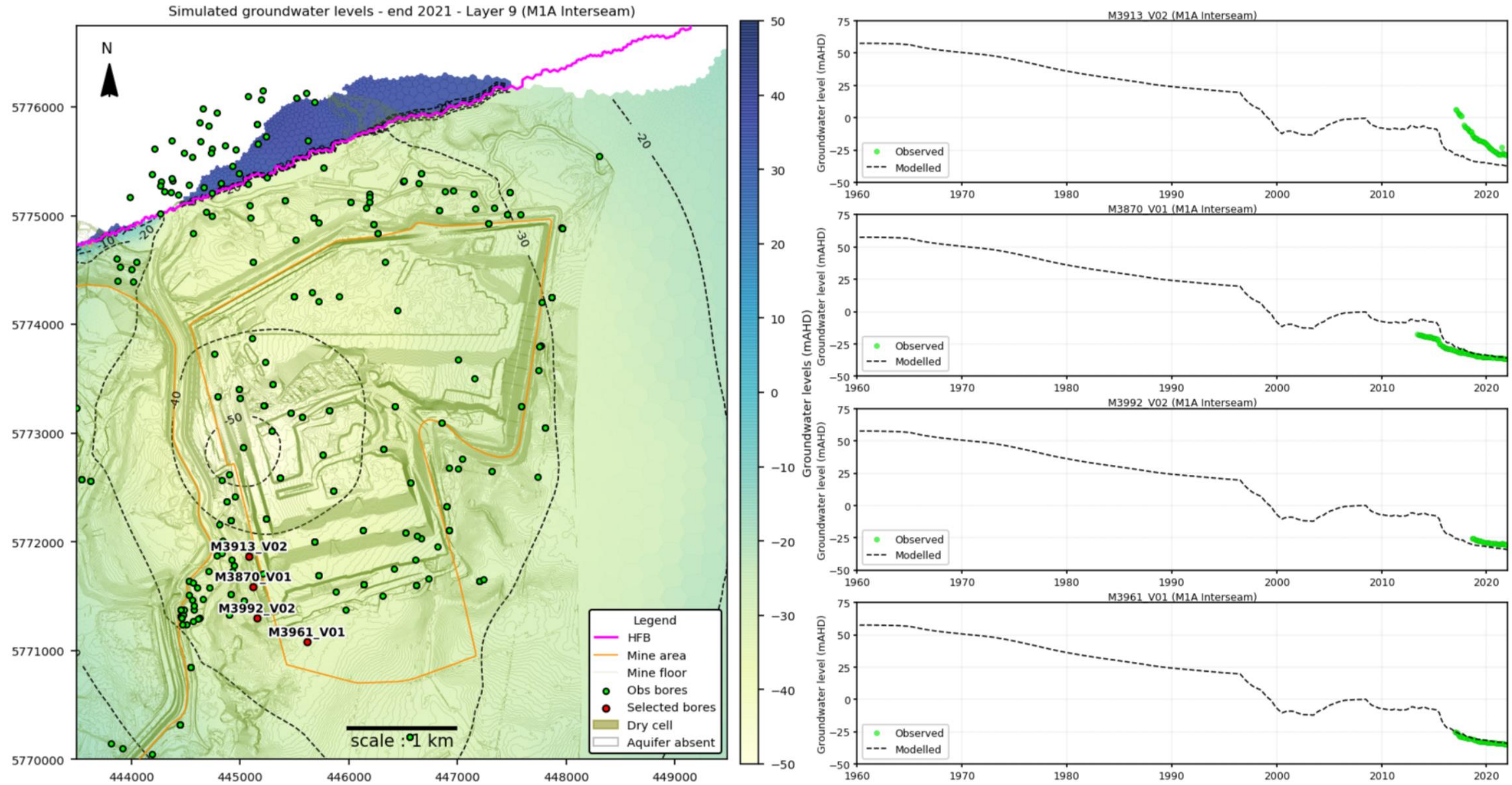


Figure 8-44: Calibration Hydrographs & Contour Plot – M1A Interseam, MRD Upstream (GHD 2025b)

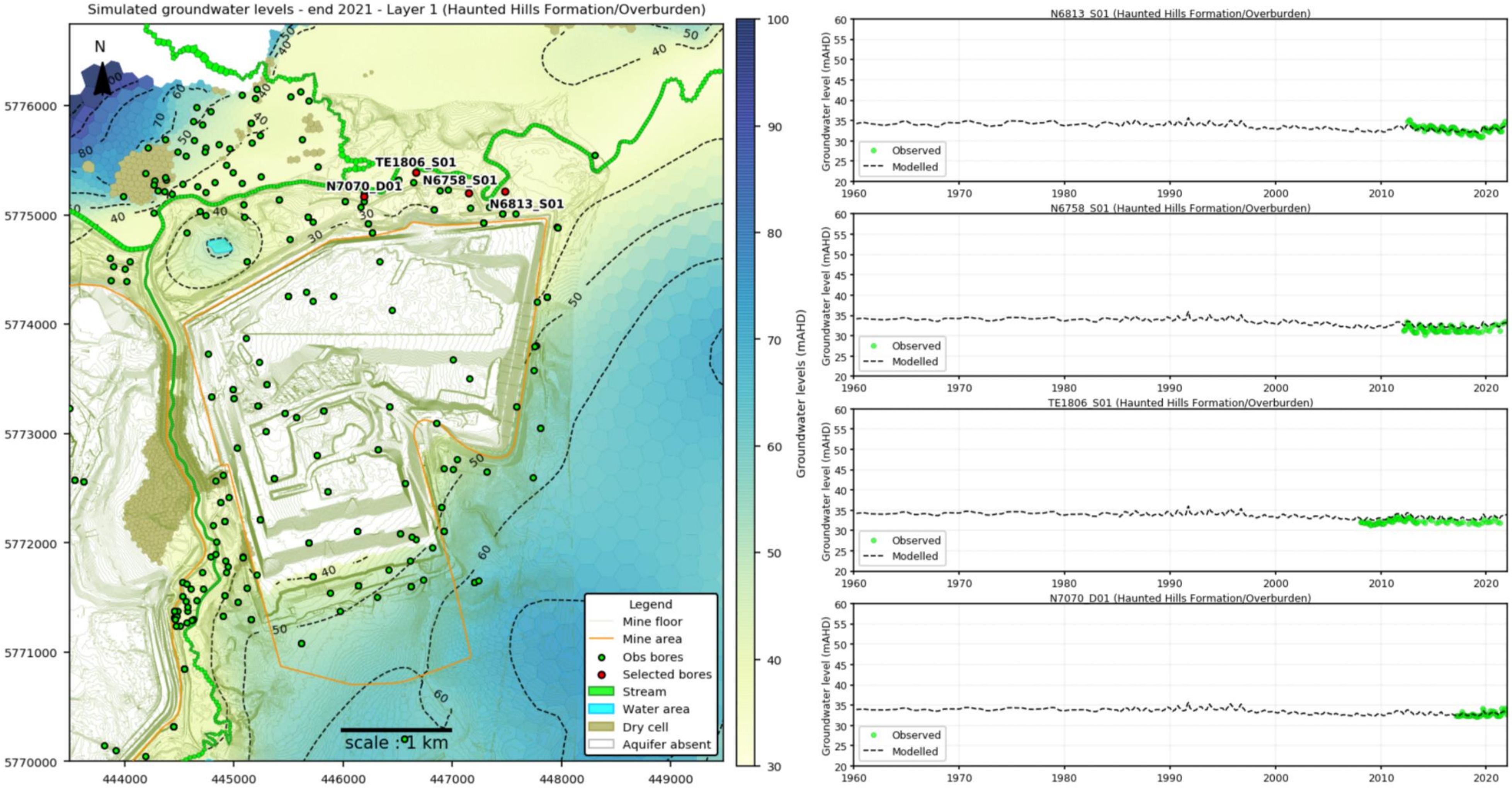


Figure 8-45: Calibration Hydrographs & Contour Plot – HHF, YEF Latrobe River Batters (YEF North) (GHD 2025b)

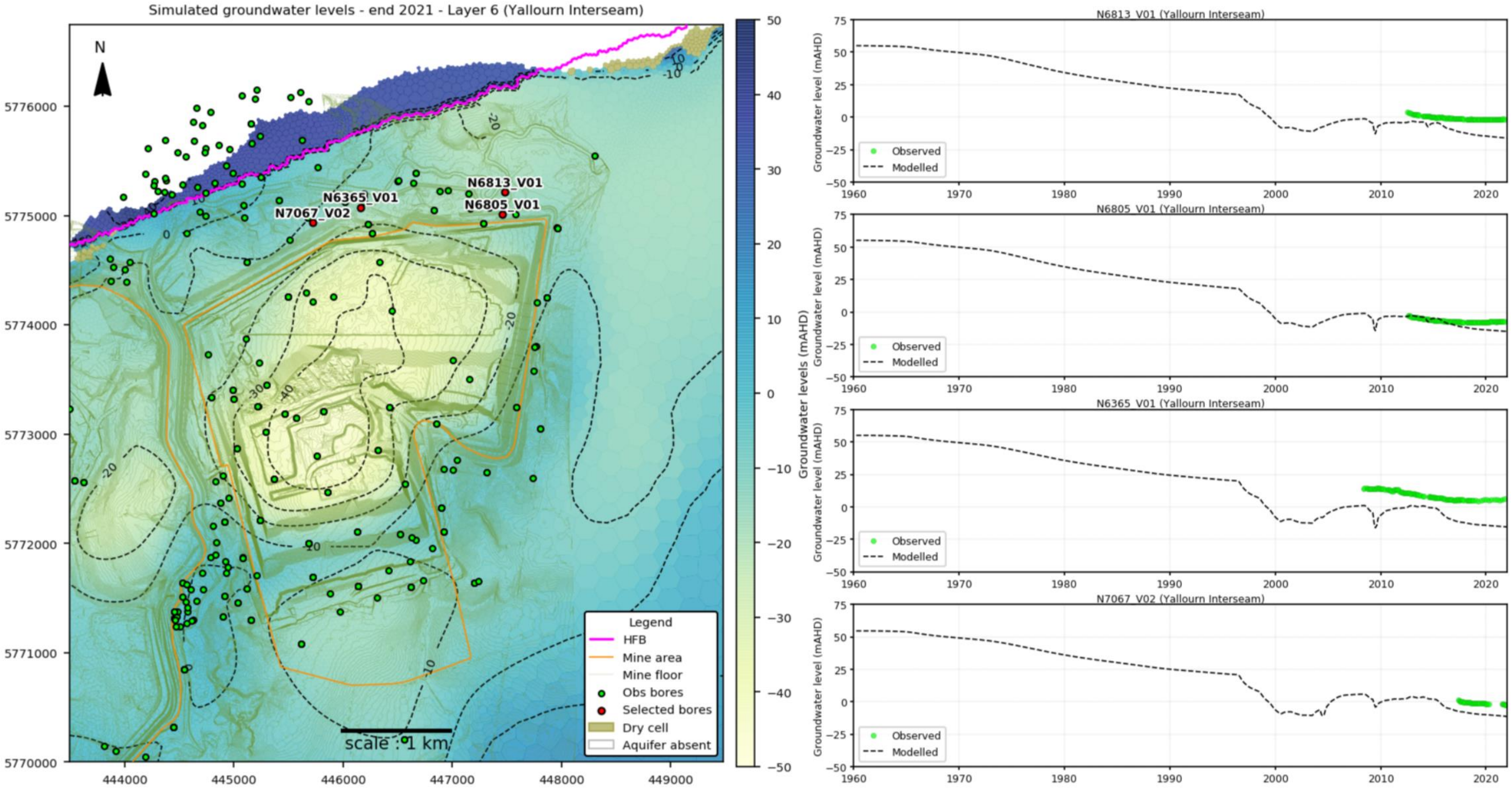


Figure 8-46: Calibration Hydrographs & Contour Plot – Yallourn Interseam, YEF Latrobe River Batters (YEF North) (GHD 2025b)

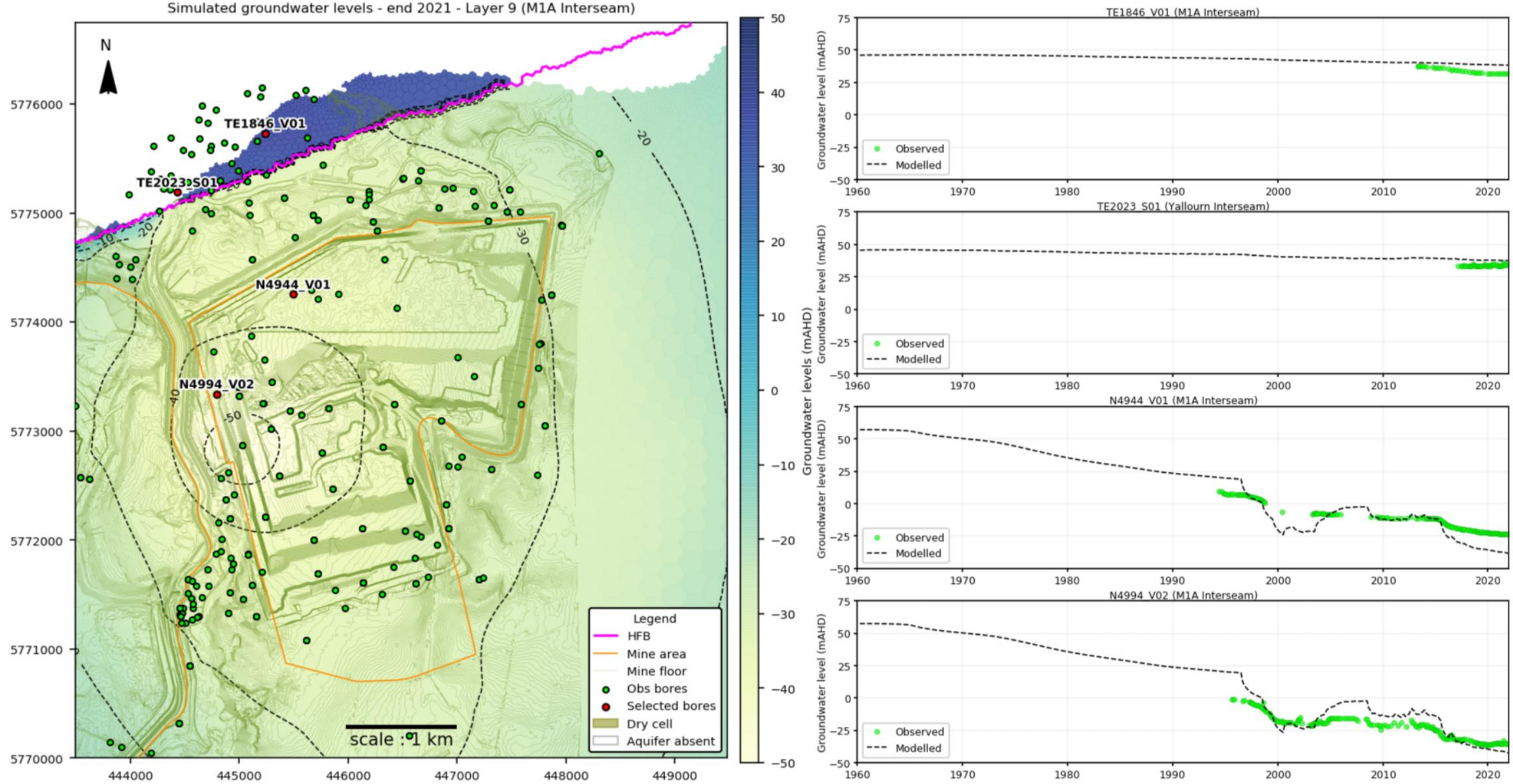


Figure 8-47: Calibration Hydrographs & Contour Plot – M1A Interseam, YEF & YNOC Comparison (GHD 2025b)

8.3.4 Rehabilitation Scenarios Testing for the GWNM

This section summaries the methodology for the GWNM modelling setup to test the rehabilitation scenarios. A detailed discussion on this section is presented in the *Numerical Groundwater Model – Rehabilitation Scenario Modelling Report* (GHD 2025c) (Appendix C – Technical Reports).

8.3.4.1 Yallourn Mine Rehabilitation Scenarios

The calibrated GWNM has been utilised for testing the rehabilitation scenarios for Yallourn Mine. The rehabilitation scenarios tested comprise of a 'Base Case' and 'Preferred Scenario'. These test case are the modelled scenarios run in the GWNM. The outputs generated allow for an assessment of groundwater level changes and groundwater driven flux movements through the HSUs with passage of rehabilitation stages and post lake fill to RL +37m.

- **Base Case scenario**, which represents the maintenance of the final mine void without active filling from external water sources. In this case, water accumulating within the mine void is limited to rainfall, runoff and retention of pumped groundwater (due to the requirement for ongoing pumping to maintain floor stability). The scenario is intended to assess the mine water balance and hydrogeological conditions in the absence of external water sources to fill the void, necessitating ongoing maintenance and aquifer depressurisation in perpetuity to ensure a stable condition.
- **Preferred Filling scenario**, which involves active filling of the final mine void to form a full pit lake at RL +37 mAHD, using a combination of natural and external sources of water. It represents the preferred rehabilitation scenario, designed to achieve a safe and stable landform in the most efficient and effective manner. The scenario assumes diversion of flood waters or high flows from the Morwell River, to reduce the filling time. Once the full pit lake is formed, groundwater pumping can be ceased to allow the confined aquifer pressure to recover. The pit lake would be maintained at RL +37 mAHD post-filling, using top up water as necessary.

8.3.4.2 Rehabilitation Scenarios

The model setup for testing of the rehabilitation scenarios was carried over from the boundary conditions set out in Section 8.3.3.3 for GWNM Construction and Calibration stage. In addition, a boundary condition for this scenario testing stage was introduced being the Lake Boundary Condition. The scenario testing further required considerations to climate factors, summarised below.

Lake Boundary Condition - The Lake (LAK) software package simulates the retention of water in the mine void and the formation of a full pit lake. It accurately accounts for the lake water balance and stage-storage relationship, ensuring consistent interaction between the lake and groundwater systems. The LAK package models lakes as volumes within the grid, with connections to adjacent aquifer cells. Two lakes, Yallourn Township Field (YTF) and Yallourn East Field (YEF), are simulated separately, becoming hydraulically connected at RL +11 mAHD, connecting through the MRD tunnels. The lake stage is maintained at RL +37 mAHD with a spill point for surplus water removal. Despite some limitations, the LAK package results are consistent with the GoldSim pit water balance model outputs discussed in Section 8.8. A schematic of the full model setup for scenario testing stage is shown in Figure 8-48.

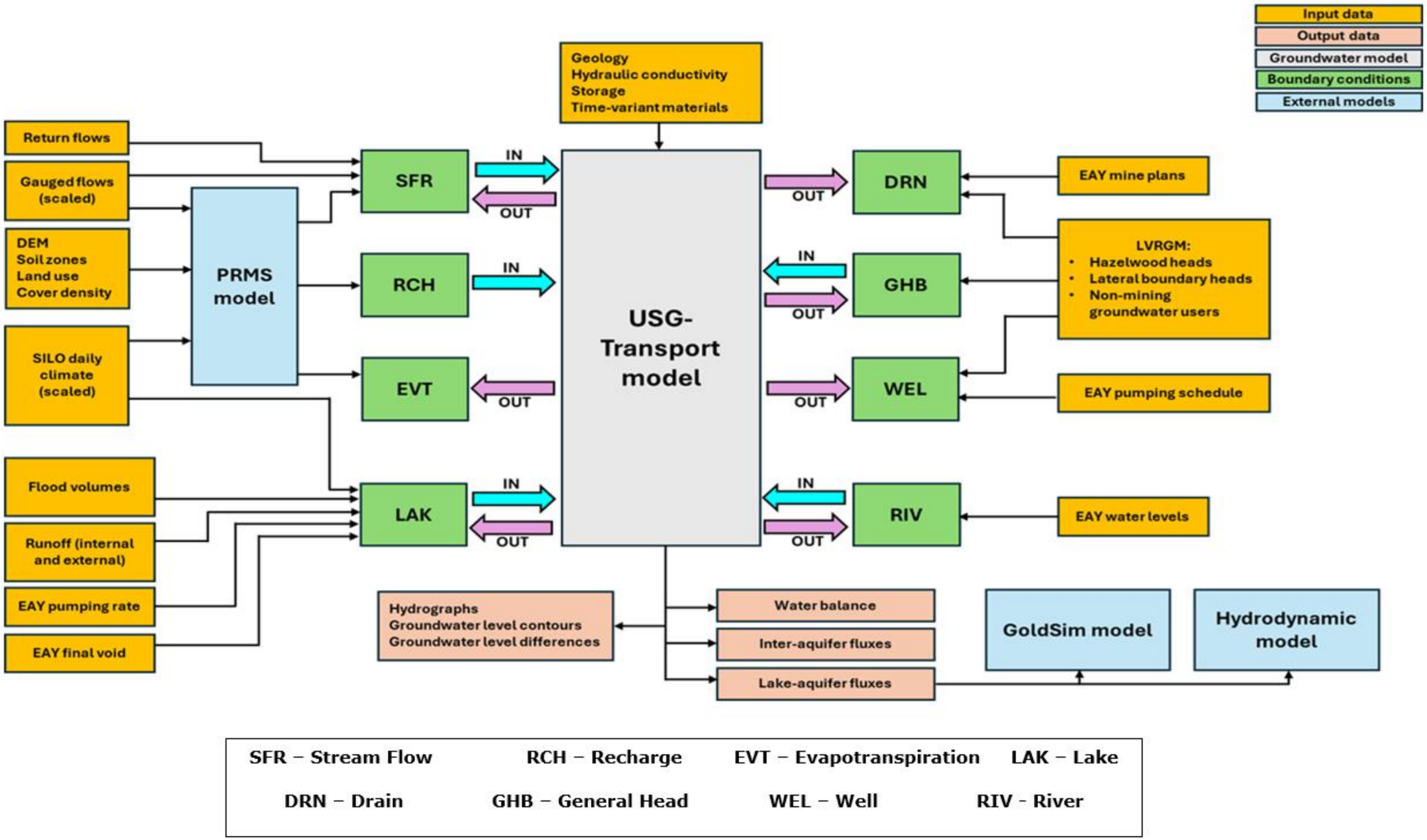


Figure 8-48: Schematic of Model Setup for GWNM Scenario Testing (GHD 2025c)

Climate Change Conditions - The future climate conditions influence the computation of recharge, evapotranspiration, and stream flow, which are critical for groundwater system interactions. For rehabilitation scenario modelling, a synthetic future climate sequence was generated by re-sampling historical climate data and scaling it according to the Victorian Government's climate change guidelines. This deterministic approach repeats historical climate data to construct future climate scenarios, applying climate change factors for accuracy. The guidelines provide projections for key climate parameters under different climate change conditions and emission scenarios. The study adopts the more conservative RCP 8.5 scenario, scaling climate parameters up to 2040 and 2065, with adjustments for periods beyond 2065. The medium climate change projection is used for the rehabilitation scenarios. Figure 8-49 shows the projected percentage of changes in rainfall and potential evapotranspiration (PET) applied to this project, based on the guideline values for Latrobe River basin.

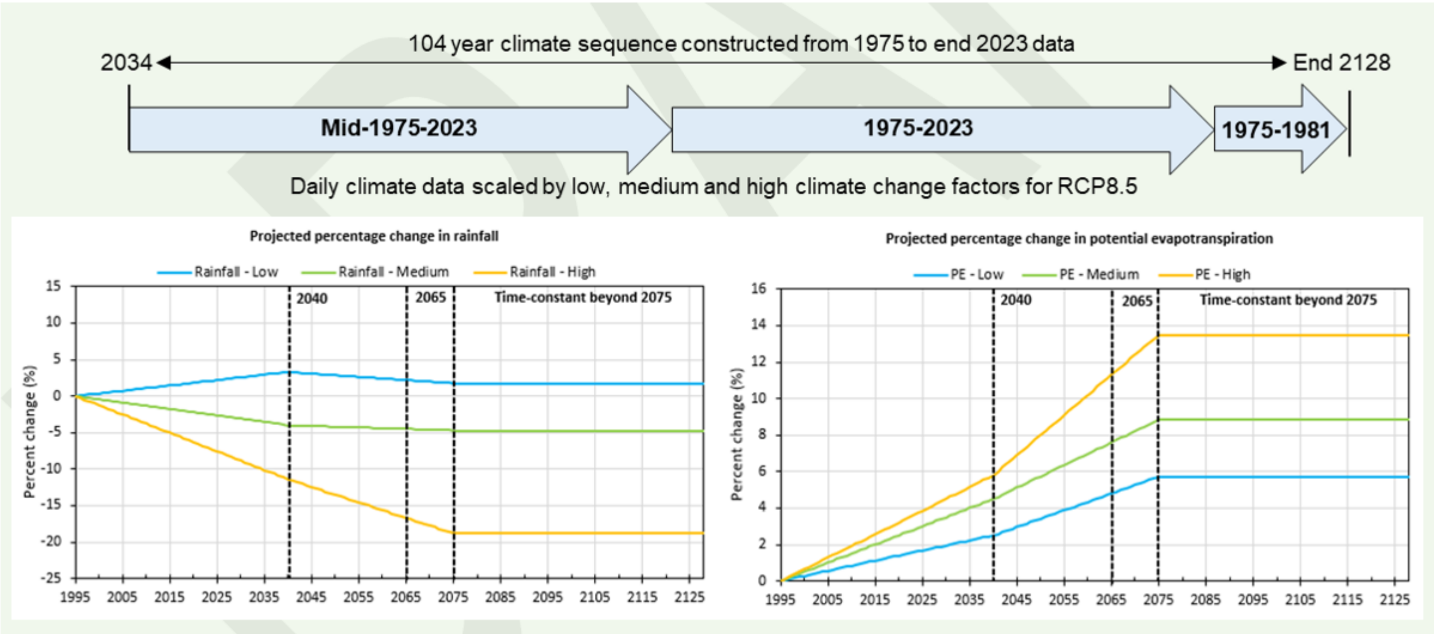


Figure 8-49: Climate Sequence and Climate Change Factors (GHD 2025c)

8.3.5 Findings – Hydrogeological Conceptual Model

Following mining, there will be a long period of recovery of the groundwater system, which will tend towards the pre-mining condition except where the conditions have been permanently modified from those of the past. The mine rehabilitation of a full pit lake will result in a new dynamic equilibrium with the groundwater system, with respect to the final landform that will be different to the pre-mining condition. The surrounding groundwater extraction activities will also have an important influence on the recovery of the groundwater levels.

Processes that influence the groundwater system before, during and after mining occur at different spatial and temporal scales. Schematic representations of key hydrogeological processes are included in Figure 8-50 and Figure 8-51, showing how these processes have changed over time (from before and during mining) and how they may change in the future (during and after rehabilitation). These are projected onto a north to south cross-section through the Yallourn Mine and Hazelwood Mine, showing the distribution of major units and their relationship with the hydrogeological processes such as pumping and seepage. The best rehabilitation option for groundwater recovery and passive management is the full pit lake. However, this will be supported by ongoing pumping during filling and decommissioning of pumping bores once the filling has been completed.

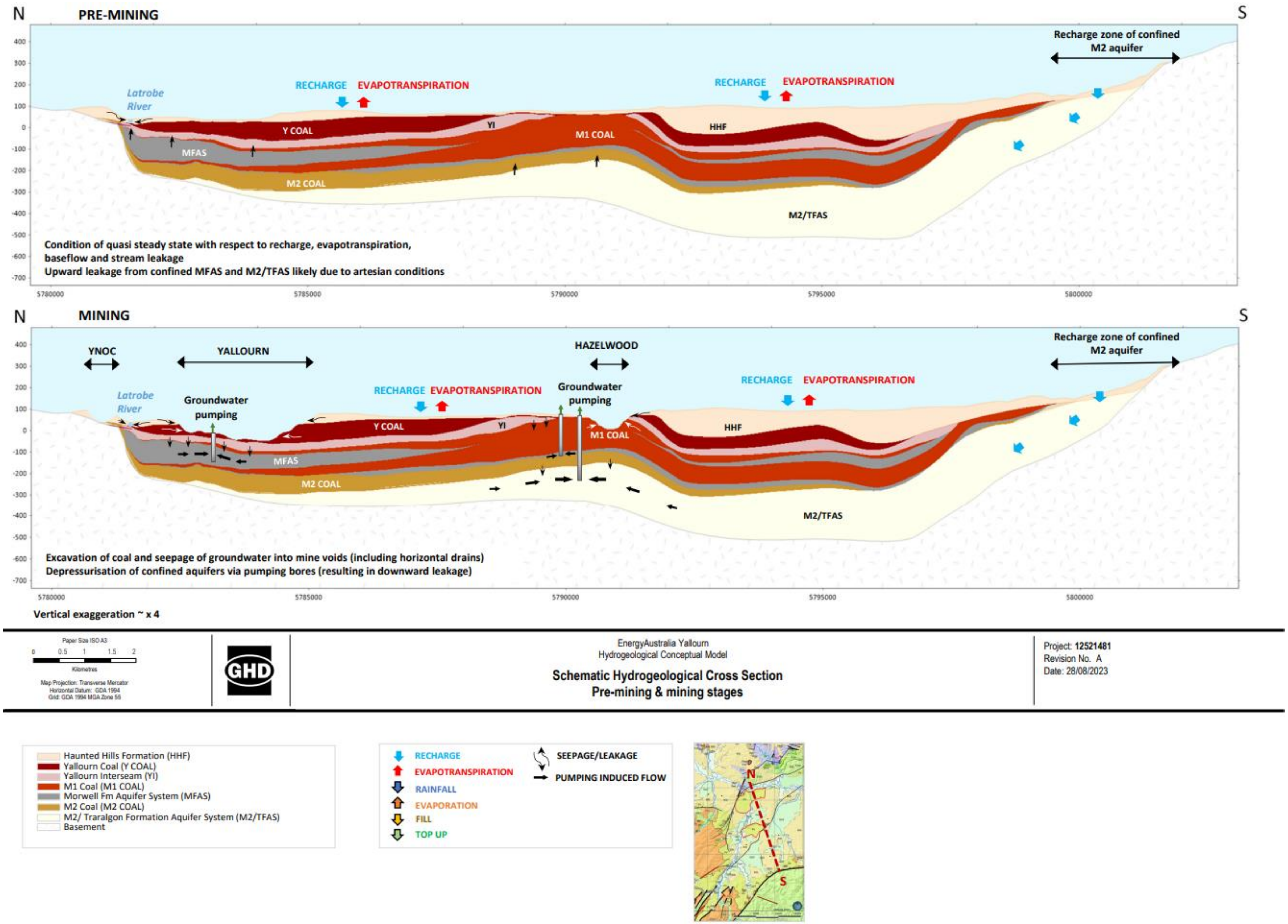


Figure 8-50: Hydrogeological Cross Section – Pre-mining & Mining Stages (GHD 2023)

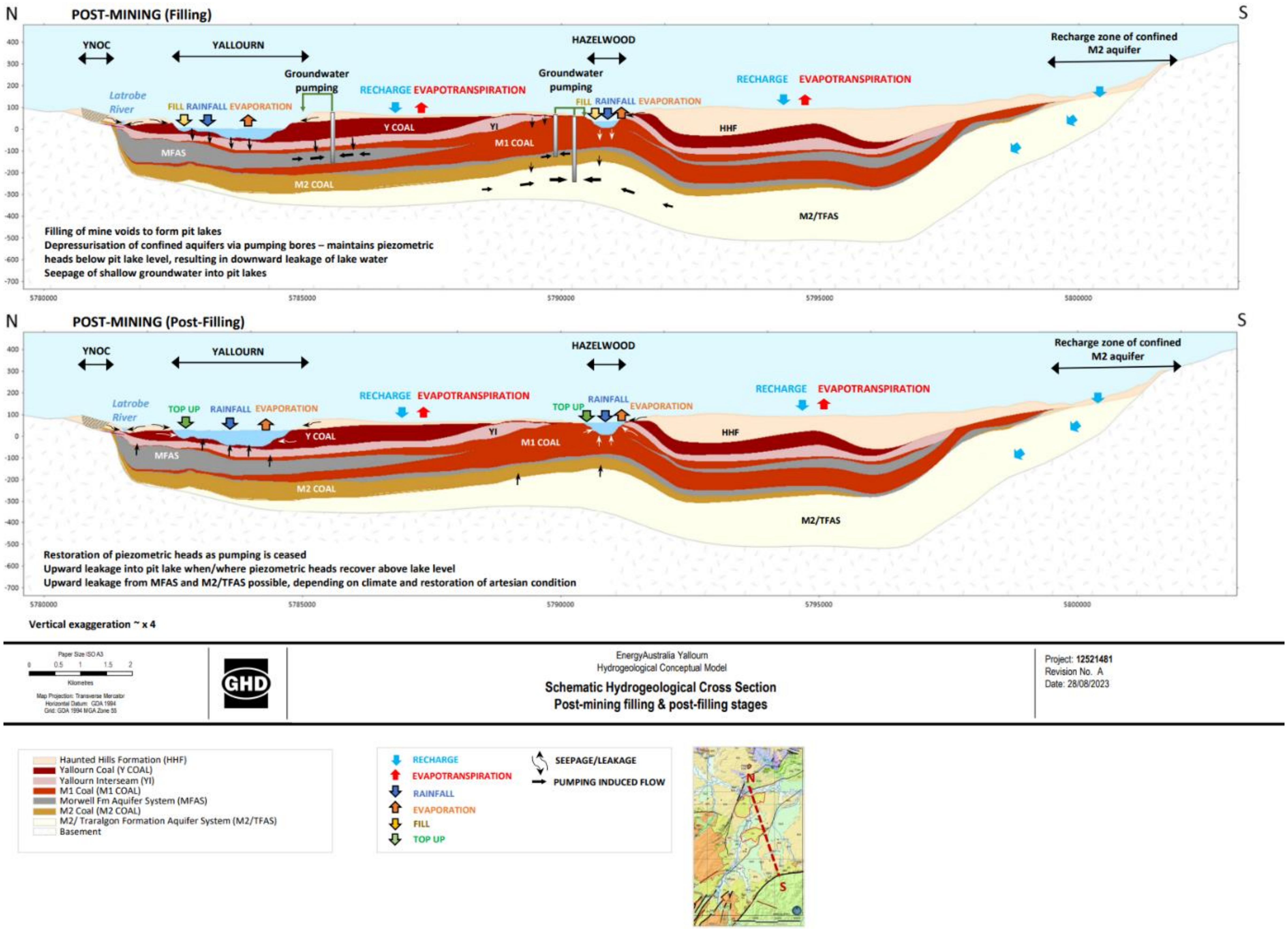


Figure 8-51: Hydrogeological Cross Section – Post-mining Filling & Post-Filling Stages (GHD 2023)

8.3.6 Findings – Groundwater Numerical Model (GWNM)

The summary of outcomes for the construction and calibration of GWNM for Yallourn Mine rehabilitation are as follows:

- A GWNM was used to simulate mine scale processes that predict groundwater heights and flows.
- The model compiles the larger spatial interactions and responses from the regional Latrobe Valley and Gippsland region aquifer extractions and flow regimes.
- The elaboration of the Hydrostratigraphy at a mine scale level in Leapfrog forms a high-resolution input to the development of GWNM, endorsing confidence in calibration reliability.
- The model boundary conditions have delivered alignment with the responses reflective of effects from mining related hydrogeological processes (responses to water features, streams drain etc), extractions from wells and geological structures such as Yallourn Monocline.
- Recharge and evapotranspiration derived from the PRMS is hydrologically sensible, along with the computed runoffs.
- Parametrisation of the aquifer layers based on percentage sands has been validated with the quality of calibration by allowing for allocating spatial variability in hydraulic conductivity in an effective manner.
- The GWNM is well calibrated against the responses to depressurisation at adjacent Hazelwood Mine. This has allowed for more accurate predictive modelling, discussed in latter sections.
- The modelled observations confirm the lack the regional effects to mine scale effects and to the deeper stratigraphic units such as M2 Interseam.
- The calibrated model heads are in close agreement with the observed heads in HHF, Yallourn Coal, Yallourn Interseam and M1A Interseam. This forms a critical alignment in utilising the GWNM to be used as a predictive tool for rehabilitation planning at Yallourn Mine.

The groundwater modelling demonstrates a good understanding of the geology, hydrostratigraphy, flow paths, levels, and fluxes. The groundwater model outputs form an input to validation of the groundwater gradients adopted in geotechnical stability analysis discussed in Section 8.9.

8.3.7 Findings – Rehabilitation Scenario Testing - Concept Overview of Effects on Groundwater

The rehabilitation of the mine will involve filling of the two mine voids with water to form a full pit lake. The sources of water for the filling would include direct rainfall, runoff from external and internal (in-pit) catchments, groundwater seepage from pit walls, pumped groundwater from aquifer depressurisation, flood flows and external supplies. The filling would initially result in the formation of two separate pit lakes with different starting water levels due to the presence of in-pit water features such as the Fire Service Pond. The two pit lakes will become connected when the lake level in one of the pit lakes reaches the elevation of the conveyor tunnels (located below the MRD), resulting in the transfer of water from one lake to another until both lakes reach the same level and rise as one connected lake. The proposed final lake level is RL +37 mAHD.

Groundwater levels in HSUs will change due to the effects of aquifer depressurisation, both locally at the Yallourn Mine and regionally due to the extraction of groundwater at the Hazelwood and Loy Yang mines. As the pit lake is formed, the groundwater levels will also be modified at the mine due to the interaction between the pit lake and the groundwater system. During filling, the groundwater levels in the HSUs below the mine floor will be maintained lower than the pit lake level by groundwater extraction. This would create a downward vertical hydraulic gradient that would result in some leakage of water out from the pit lake, causing the underlying groundwater levels to rise locally. The pit lake will also receive groundwater seepage from the pit walls, where shallow groundwater naturally discharges at elevations above the pit lake level. As the pit lake level continues to increase over time, the groundwater levels would also rise in parallel albeit at a reduced rate depending on the balance between the rate of leakage from the pit lake and the rate of removal of groundwater by pumping from below. The ongoing aquifer depressurisation by pumping would ensure the groundwater levels below the mine floor would remain lower than the pit lake level during filling, creating a low point in the piezometric (aquifer pressure) surface relative to the surrounding area. This implies that most of the pit water (and solutes contained within it) leaking into the underlying HSUs would be retained within the mine area or ultimately captured by the pumping bores.

When the pit lake reaches the full lake level of RL 37 m, the weight of water above the mine floor becomes sufficient to counter the upward aquifer pressure, rendering ongoing depressurisation unnecessary for achieving weight balance. At this point, the groundwater extraction can be ceased, initiating the recovery of the aquifer pressure. The groundwater levels would be expected to initially rise rapidly as the aquifer storage is replenished by groundwater flow from the broader area under steep hydraulic gradients created by prior pumping. The rate of recovery would reduce progressively over time as the hydraulic gradients (and the rate of groundwater flow towards the mine) reduces, leading to a long period of post-filling stabilisation. As discussed in the *Hydrogeological Conceptual Model* report (GHD 2023), the confined aquifers below the floor of the mine were likely to have been sub-artesian to artesian with the pre-mining groundwater levels estimated to be in the range of RL +50 to +60 mAHD. Although the future climate condition are unknown (and expected to be different from that of the past), it is highly likely that the groundwater levels in the confined aquifer would ultimately recover to levels above the RL 37 m pit lake level. This means the pit lake would act as a local sink to the groundwater system over the long term, with seepage of small quantities of groundwater occurring under the influence of small upward vertical hydraulic gradients.

The conceptual model for the hydrogeological changes expected during and after rehabilitation is described in GHD (2023b), using regional hydrogeological cross-sections. Additional and more locally refined schematic hydrogeological cross-sections are presented in this section to set the context for the detailed model results and discussions provided in the subsequent sections of the report. When reviewing these cross-sections (and the outputs of the modelling), it is important to note that only some of the HSUs are exposed in the mine and would directly interact with the pit lake. The rate and direction of fluxes exchanged with the pit lake would also depend on the groundwater levels and material properties of each HSU, with different groundwater levels or piezometric surfaces occurring in different units. This concept is demonstrated schematically in Figure 8-52 below, showing groundwater rising to different levels in bores constructed within different HSUs (focusing on the surficial and interseam layers that act as aquifers/zones of preferential groundwater flow, separated by intervening low hydraulic conductivity coal layers). In this example, the groundwater level decreases with depth, which indicates a downward vertical hydraulic gradient (and downward groundwater flow).

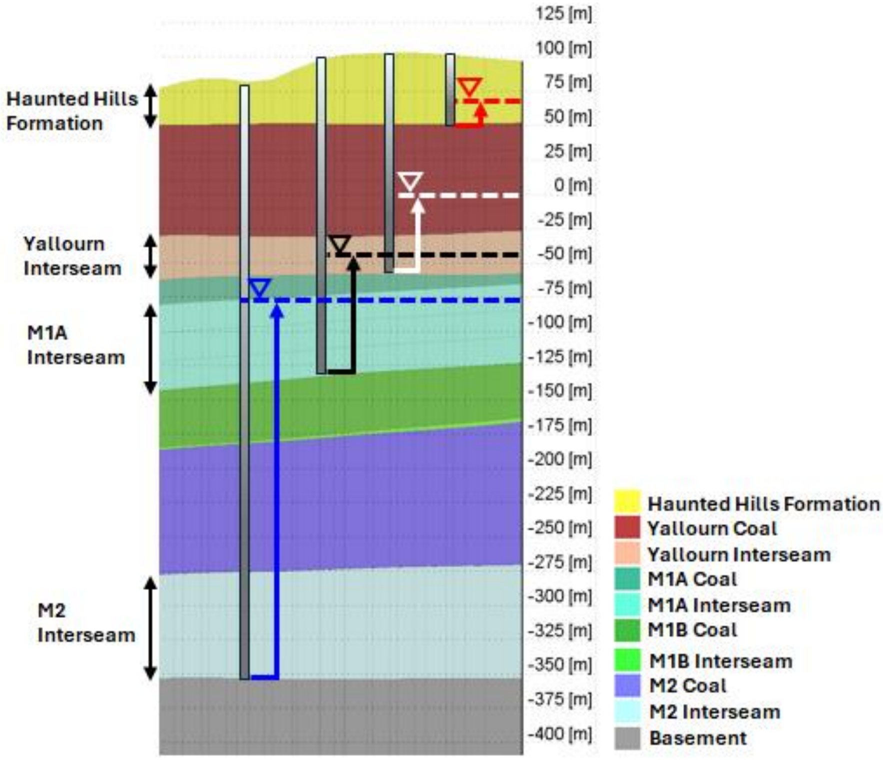


Figure 8-52: Relationship between Hydrostratigraphic Units and Groundwater Levels (GHD 2025c)

Figure 8-54 and Figure 8-55 are schematic (vertically exaggerated) cross-sections across the two mine voids (in northeast to southwest orientation) showing the relationship between the pit lake level and groundwater levels in key HSUs when the lake level is at RL +11 mAHD (approximate elevation of the conveyor tunnels, when the two pit lakes become hydraulically connected, also discussed in Section 8.8). The two mine voids are referred to as the Yallourn Township Field (YTF) void in the west and Yallourn East Field (YEF) void in the east, for simplicity. Arrows are used to show the directions of expected flow, with larger arrows used to indicate preferential flows in the horizontal direction towards the pumping bore (M4203) in the M1A Interseam and regionally towards the Hazelwood Mine (due to pumping in the deep M2 Interseam). Smaller arrows in the vertical direction indicates flow out from the pit lake and flow across the layers due to the downward vertical hydraulic gradient (with the rate of flow limited by the low hydraulic conductivity of the Yallourn Interseam and M1 Coal). The phreatic surface (water table) in the Haunted Hills Formation is maintained by rainfall recharge at ground surface and is largely unaffected by the pumping in the M1 Interseam due the presence of the thick Yallourn Coal. Shallow groundwater from the Haunted Hills Formation discharges into the pit lake.

Figure 8-55 is the conceptualisation of the post-rehabilitation condition along the same cross-section, when the groundwater system has reached dynamic equilibrium with respect to the full pit lake of RL +37mAHD. The groundwater levels in the confined aquifers (interseams) are expected to recover towards the pre-mining level, above the final lake level. This would result in small upward vertical flows into the pit lake, with the lake forming a sink in the regional groundwater system.

The changes to the hydrogeological regimes expected during and after filling are further demonstrated using a localised north to south cross-section through the YEF void. The cross-section runs through the deepest point of the mine, where the Yallourn Interseam interacts directly with the pit lake and the piezometric surface becomes locally elevated due to the absence of Yallourn Coal/overburden dump to limit hydraulic connection (see Figure 8-56, when the lake level is at RL 0 mAHD, before the in-pit pumping bore N6899 is decommissioned). Also shown in the cross-section is the presence of the regionally significant Haunted Hill Fault/Yallourn Monocline acting as a hydraulic barrier. Figure 8-57 shows the post-rehabilitation condition along the same cross-section. The final pit lake level is shown to be above the base of the Haunted Hills Formation in an area adjacent to the northern batters. This is expected to result in re-saturation of the Haunted Hills Formation where shallow groundwater has been previously drained by the mine, leading to the restoration of the water table to a condition similar to the natural state prior to mining.

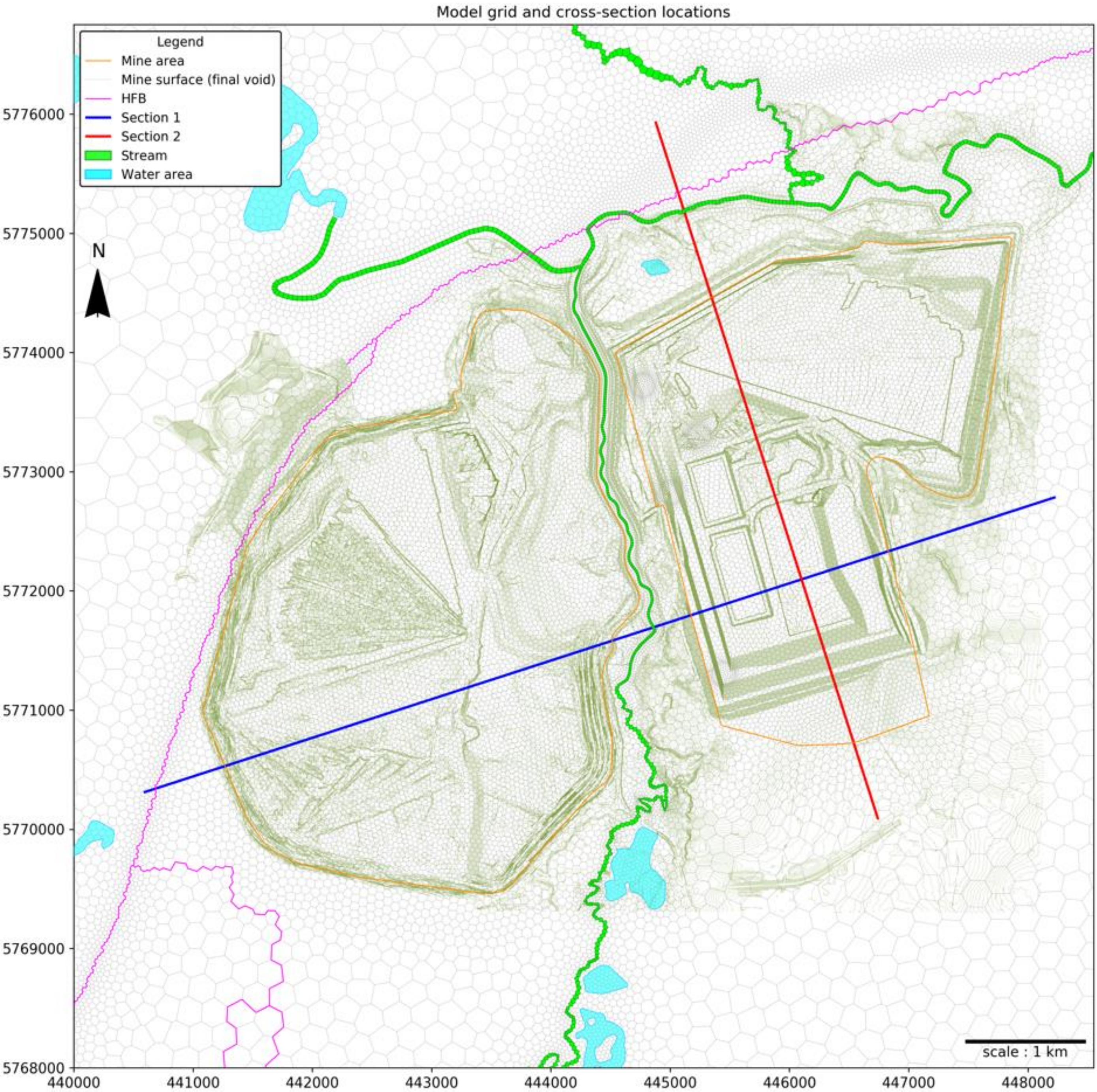


Figure 8-53: Schematic Cross-section Locations (GHD 2025c)

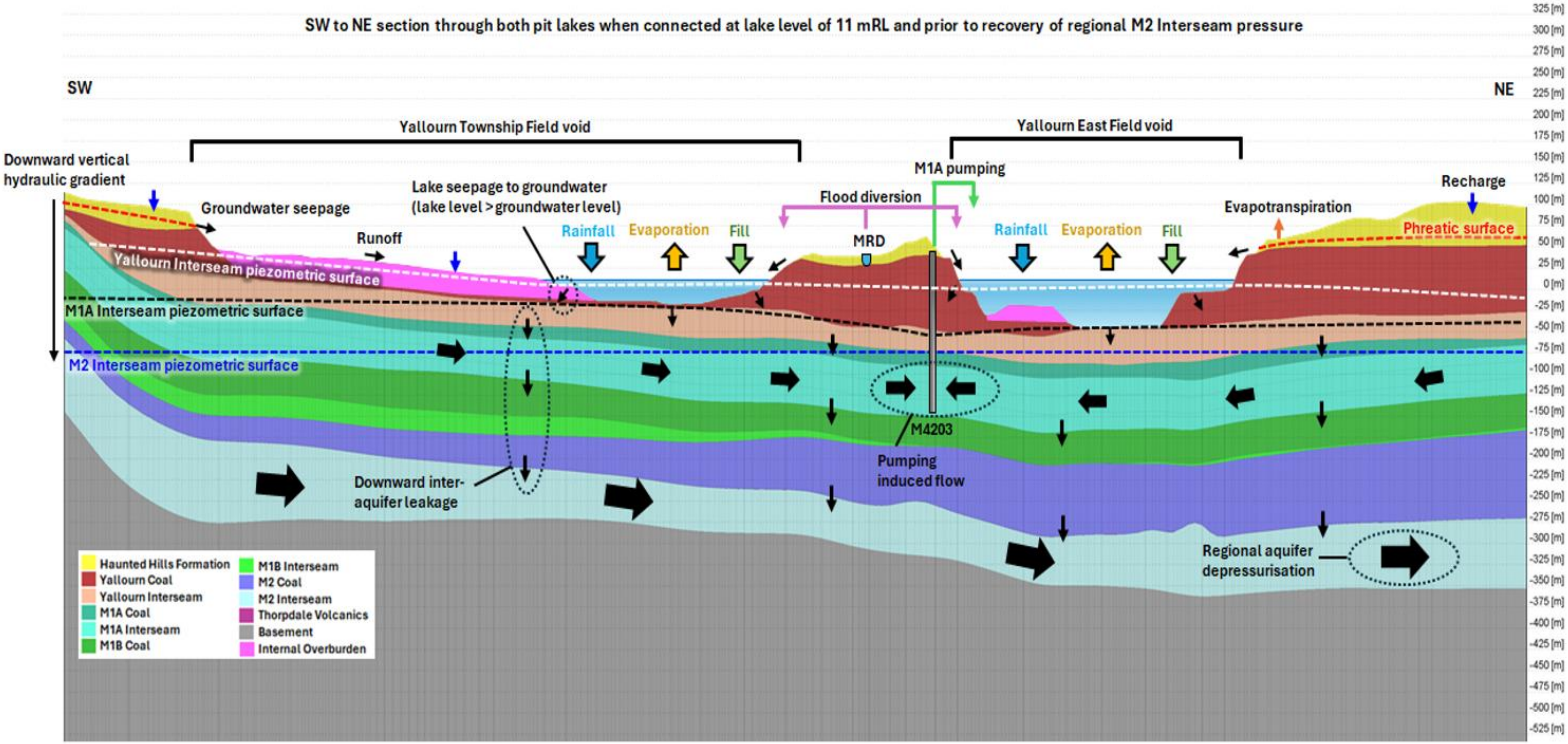


Figure 8-54: Section 1 - Schematic SW to NE Hydrogeological Section at RL 11m Lake Level (GHD 2025c)

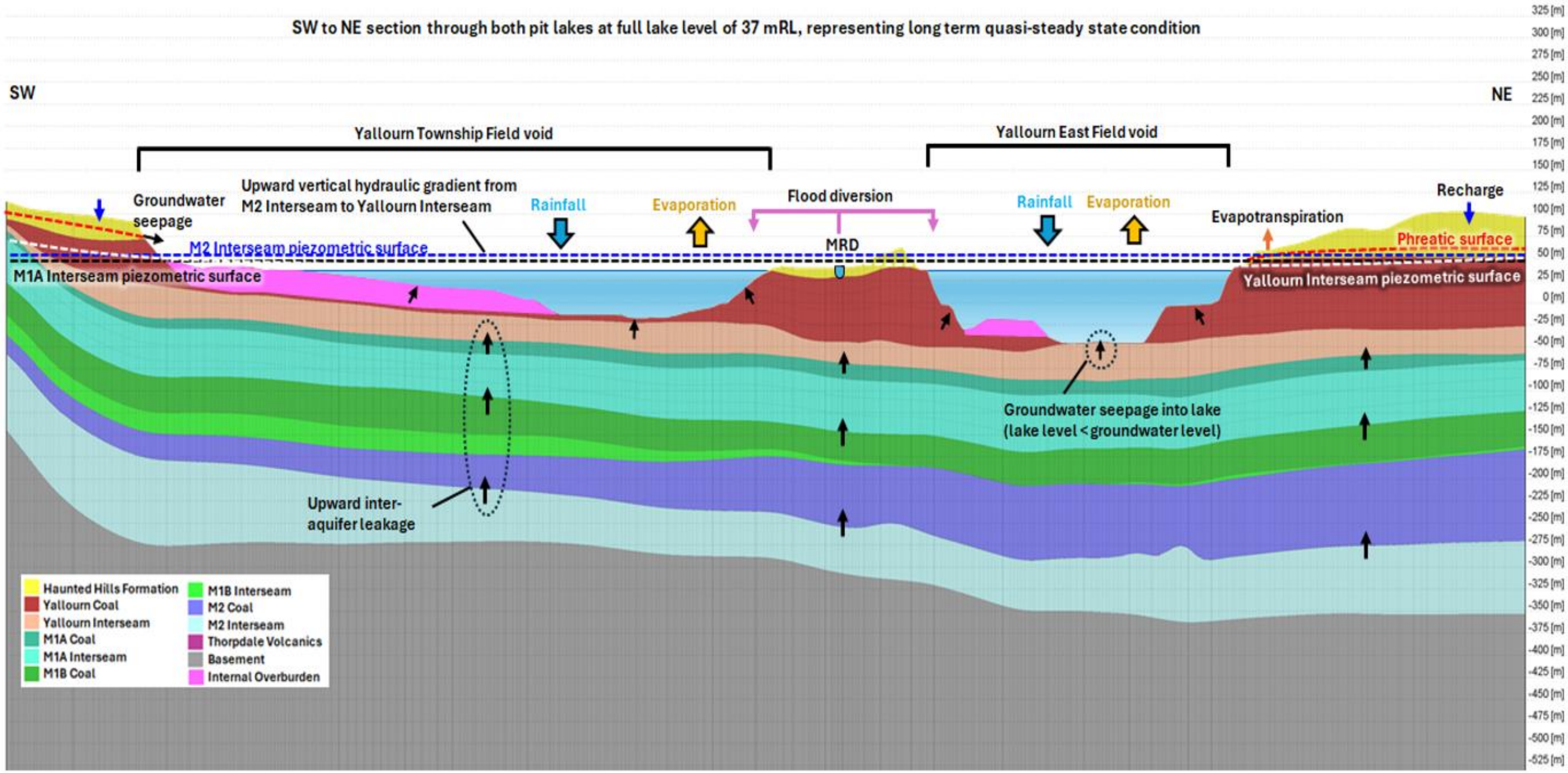


Figure 8-55: Section 1 - Schematic SW to NE Hydrogeological Section at RL 37m Lake Level (GHD 2025c)

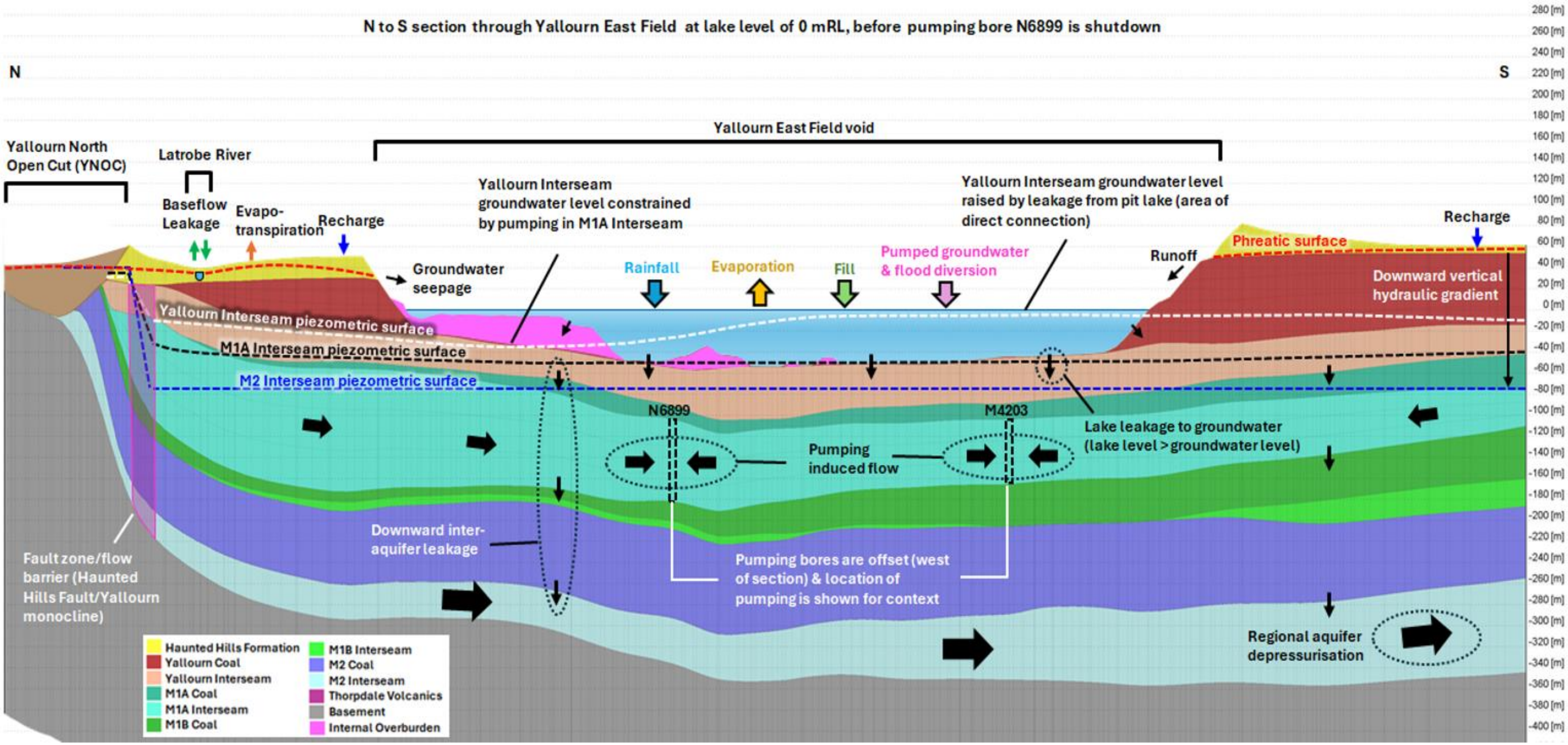


Figure 8-56: Section 2 - Schematic N to S Hydrogeological Section at RL 11m Lake Level (GHD 2025c)

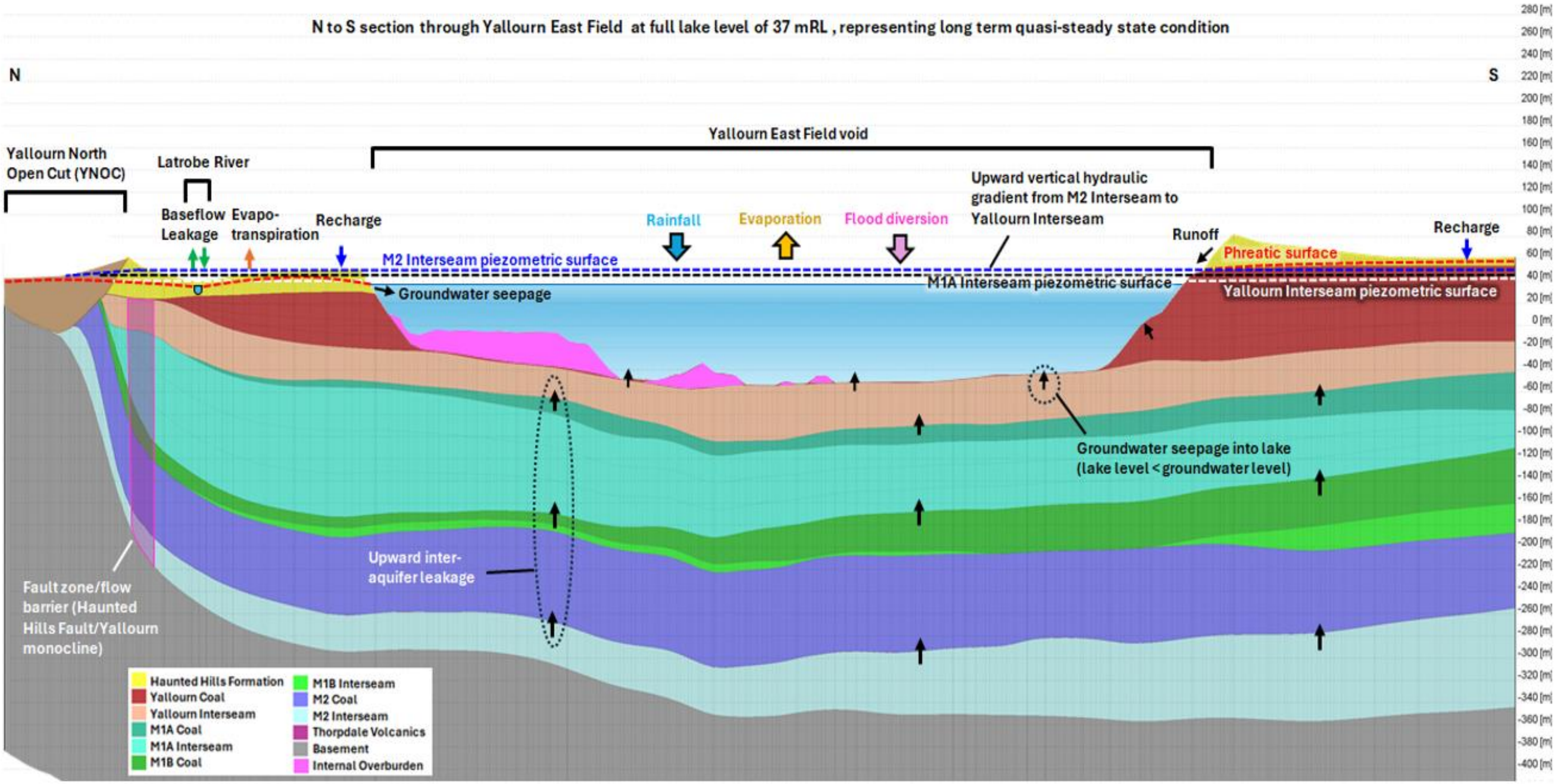


Figure 8-57: Section 2 - Schematic N to S Hydrogeological Section at RL 37m Lake Level (GHD 2025c)

8.4 Groundwater Dependant Ecosystems

8.4.1 Introduction

Planning for rehabilitation includes assessment of potential impacts (both positive and negative) on Groundwater Dependant Ecosystems (GDE).

GDE are defined as ecosystems that require access to groundwater to meet all or some of their water requirements to maintain the communities of plants and animals, ecological processes they support, and ecosystem services they provide (ERM 2023a).

GDE can be classified by:

- **Subterranean:** Aquifer and cave ecosystems (Type 1) where groundwater-inhabiting ecosystems (e.g. stygofauna) reside, commonly in karst and fractured rock aquifer systems
- **Aquatic:** Ecosystems dependent on the surface expression of groundwater (Type 2), including wetlands, lakes, seeps, springs, and river baseflow systems where the water table extends above the land surface as a visible expression
- **Terrestrial:** Ecosystems dependent on subsurface presence of groundwater (Type 3), including terrestrial vegetation where the root zone lies within the capillary fringe of the water, either permanently or episodically

EAY has identified GDE relevant to the Yallourn Mine to gain a strong understanding of the GDE that require consideration when planning and implementing the rehabilitation solution. The process for determining relevant GDE is outlined below.

8.4.2 Methodology

The detailed investigation to determine relevant and potentially relevant GDE comprised of the following phases:

- Data review of:
  - Publicly available information such as the:
    - Groundwater Dependent Ecosystem Atlas (BOM 2023),
    - Visualising Victoria's Groundwater database (FedUni 2023),
    - Protected Matters Search Tool (DCCEEW 2023), and
    - Mapshare Vic (DEECA 2023b)
  - Rehabilitation technical studies
- Identification of all GDE from available mapping sources
- Truthing of the potential GDE to determine if they are likely to be present and realistic, and the potential dependence on groundwater based on:
  - current mining conditions (e.g. reviewing mapped GDE within mined out areas)
  - groundwater contour plans from rehabilitation studies
  - recent groundwater level results from available bores
  - review of conceptual understanding of geology, groundwater, surface water and topography in the area
  - likelihood that the GDE may be affected by the mine rehabilitation
- Summary of GDE with descriptions and likelihood of being relevant to the mine

8.4.3 Findings

This phase of work focused on rationalising the GDE that were present within 2km of the Yallourn mine to provide an understanding of the GDE that are relevant to the site. Relevant and potentially relevant aquatic and terrestrial GDE are show in Figure 5-11 and are located around the Latrobe River and Morwell River floodplains area. A summary of each sub-region is provided in Table 5-8.

Subterranean GDE were not identified from the search of publicly available information. Further assessment of stygofauna and subterranean ecosystems is not considered relevant for the Yallourn Mine.

Future phases of work related to GDE include:

- Prioritisation of GDE that may be influenced by the pit lake and a field-based review of those GDE (KG01 in Table 17-1).
- Review of GDE with consideration of the groundwater numerical modelling finding to estimate any impacts from the lake (KG01 in Table 17-1).

8.5 Water Access for Latrobe Valley Mine Rehabilitation

8.5.1 Introduction

This technical assessment was developed to support the implementation of the LVRRS amendment, specifically providing guidance on how water from the Latrobe River system might be accessed for mine rehabilitation (Alluvium and HARC 2023). Commissioned by DEECA, this report explores the impacts and potential conditions under which water could be allocated to mine licensees, ensuring that this does not negatively affect:

- Traditional Owner values
- Environmental values
- Existing water users, including rural, urban, and industrial sectors

The assessment does not allocate water or prescribe entitlements but provides evidence to inform future decisions by the Victorian Government. It aligns with principles outlined in the *Central and Gippsland Region Sustainable Water Strategy* (DELWP 2022) and *Latrobe Environmental Water Requirements Investigation* (Alluvium 2020), aiming to secure water availability and protect ecosystems and cultural values.

8.5.2 Methodology

A water resource model of the Latrobe basin (known as the Latrobe Source Model) was used for this technical assessment. The Latrobe Source Model, developed by DELWP, is considered the most contemporary model for the system. It runs on a daily time step and includes the wet, average, dry and drought years that have occurred over a 63-year period of assessment. The model represents current water use and entitlements, and includes major reservoirs, farm dams, and urban, rural, power generation and environmental water use. Reference baseline conditions in the water resource model represent the water supply system as at 2020. The model was then adapted to represent water management for mine rehabilitation under a range of potential scenarios. The baseline and all scenarios were modelled under the post-1975 historic climate reference period and projected low, medium and high climate change conditions for the year 2065.

8.5.3 Findings

8.5.3.1 Water Access Scenarios

Water access scenarios developed for this study ranged from baseline conditions to only limited water availability for mine rehabilitation. A summary of these scenarios is shown below.

- Scenario 1 (full entitlement use): Increased risk to environmental and cultural values; reduced flows in summer-autumn; decreased reliability for rural diverters by 12%.
- Scenario 2 (net historical use): No increased risk to Traditional Owner or environmental values; modest (8%) decrease in rural water reliability.
- Scenarios 3–5: Introducing seasonal restrictions and limits on releases further reduced risks while maintaining supply reliability for mine rehabilitation.

8.5.3.2 Impacts on Users

A range of impacts were modelled for each scenario with summaries of each shown below. Whilst urban and industrial supply was unaffected across all scenarios, private diverters, environmental and traditional owner values show impacts against baseline conditions. These impacts were tested by the scenario modelling and scenario 5 showed an overall improvement to the existing risk profile.

8.5.3.3 Climate Change Risks (2065)

Applying climate change factors to the model showed potentially decreased values in the future.

- Low scenario: Similar to current conditions.
- High scenario: Catchment inflows reduced by ~42%; potential for negligible mine water availability in dry years (~1 GL/year); significantly lower water reliability across all users.

8.5.3.4 Impact on Yallourn Mine Rehabilitation

After consideration of the modelled scenarios and the LVRRS Amendment (DEECA 2023a), EAY has drafted a Bulk Water Entitlement application that follows the conditions outlined in Scenario 5. These conditions are used for the BWE application shown in 3.7.4.

8.6 Latrobe and Morwell River Flood Study

8.6.1 Introduction

This section presents the hydrology of Latrobe and Morwell River systems, and the regional hydrologic implications associated with mine rehabilitation at Yallourn Mine. The key aspects of the assessment include the following:

- Geomorphology and ecology context statement,
- Event based hydrology and hydraulics modelling for Latrobe River system for existing and design conditions, and
- Regional water balance modelling for both a base case and proposed mine closure arrangements including environmental flow compliance assessment.

Presented here is a preliminary assessment of the impacts of the preferred closure arrangements on the Latrobe River system, considering the assessment of flood hydrology and hydraulics. This also interlinks with the water balance and environmental flow compliance assessments, presented in Section 8.5.

8.6.2 Methodology

The rehabilitation option for a pit lake at Yallourn Mine requires consideration on issues that impact on both the site and the broader Latrobe River system. The assessment thus considers:

1. The management of the Morwell River Diversion through the site, and
2. The use of water resources to fill the mine void and maintain the pit lake

Figure 8-58 summaries the process of this assessment and the methodology adopted. The items in 'Blue' denote the process that form part of the regional assessment with item noted in 'Green' (pit water balance) that form input to the regional assessment.

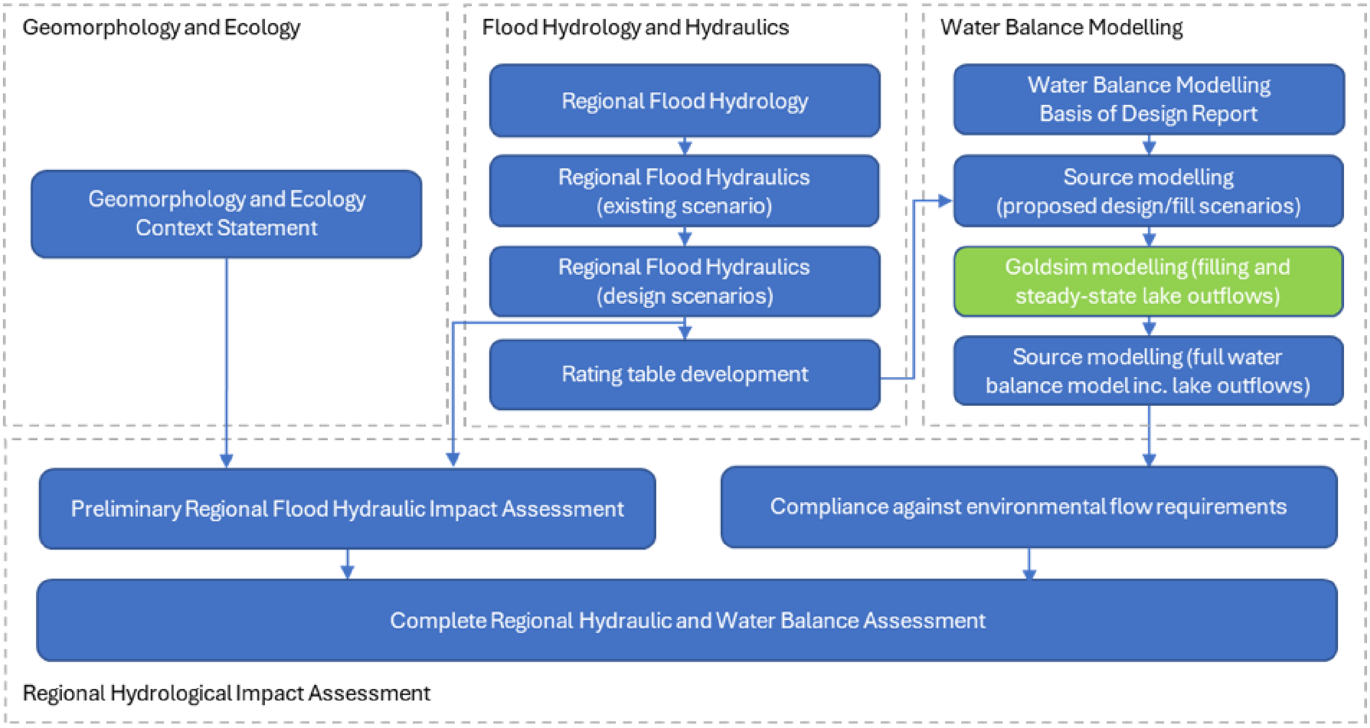


Figure 8-58: Overview Method of Regional Hydrology and Water Balance Assessment (Alluvium 2025)

8.6.2.1 Geomorphic and Ecological Design

The following key hydrologic, geomorphic and ecological function design principles are relevant to the regional hydrologic assessment:

- Hydrologic regime. The arrangement should provide for both:
  - longitudinal hydrologic connectivity
  - lateral floodplain connectivity
- Geomorphic processes. The arrangement should:
  - not be subject to accelerated high rates of erosion and deposition
  - be robust i.e. resistant to change and have the ability to adapt and repair following change without comprising the other values and outcomes
  - provide for ongoing longitudinal and lateral bed load sediment movements
- Ecological condition and processes
  - Provides for ongoing benthic (bottom of water body) ecological processes
  - Meets instream and riparian habitat and transfer (e.g. fish passage) requirements

Additionally, a number of key design stability conditions have were identified in the Yallourn rehabilitation project risk workshops, including the potential for the catastrophic failure / collapse of the MRD associated with ongoing channel and embankment stability. These are discussed in detail in Chapter 11.

Rehabilitation Design Concept for Regional Hydrology & Hydraulics

The current MRD structure has been assessed to be a vulnerable structure in various geotechnical assessments. The current state of the MRD and its limitations in servicing the mine rehabilitation requirements are discussed in Section 8.12 and *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b). When considering the ecological value, the key risks associated with a catastrophic failure of the MRD structure include the following and become key factors to the rehabilitation design for MRD:

- Major channel incision that could lead to potentially catastrophic upstream impacts associated with large-scale Morwell River channel deepening and widening
- Cessation of bedload sediment supply and benthic processes, exacerbating the existing sediment starvation and accelerated rates of bank erosion the Latrobe River
- Cessation of baseflows to Latrobe River system, loss of benthic process in the Morwell River system and loss of fish passage through the Morwell River

A preferred option for the rehabilitation design for MRD is presented in *Chapter 9 Post Mining Landform and Land Use*. This preferred rehabilitation option of a partially connected Morwell River retains the passing of all environmental flows via the retained MRD low flow and high flow channel. This option seeks to address the abovementioned risks by increasing the robustness of the existing MRD by not confining all flood events within the MRD. The option seeks to provide controlled spill of floodwaters from Morwell River (and/or MRD) to the pit lake. This spilled water can then be returned to the Morwell and/or Latrobe Rivers via return flow spillway and/or lake outflow.

8.6.2.2 Regional Hydrology Assessment

An event based regional hydrologic model has been developed for both the Morwell and Latrobe Rivers systems. This model and the model outputs have been used to inform the hydraulic modelling task. The regional hydrology was split into two components.

Morwell River hydrology

The existing regional flood study, *Estimation of the flow rate and exceedance probability June 2021 flood event in the Morwell River – Detailed investigation* (Alluvium 2021), was reviewed and used to build the greater Latrobe River Runoff Routing Model (RORB), as below.

Latrobe River hydrology

Model flow rates for the Morwell and Latrobe Rivers for events up to the 0.05% Annual Exceedance Probability (AEP) event was required as input to the hydraulic modelling. No suitable, existing hydrological model was available for this purpose. As such a new RORB model of the Latrobe River system was built, incorporating the Morwell River existing RORB model extending downstream of the Yallourn Mine. The model was calibrated using available rainfall and gauge information on the Morwell and Latrobe systems.

Details of the model development process, the calibration and validation, and generating design flows corresponding to AEP events of 50%, 5%, 2%, 1%, 0.5%, and 0.2%, and the 0.05% AEP, as well as climate change analysis can be found in (Alluvium 2025).

Results

The combined calibrated model has been used to undertake a comparison of hydrographs at the Morwell River/Latrobe River confluence and assess timing of corresponding peak flows in the Morwell and Latrobe River. The critical flow rates and durations of all design flooding events are shown in Table 8-3 and Figure 8-59.

Table 8-3: Critical flow rates and durations for design flooding events (Alluvium 2025)

Latrobe River @ Yallourn				Morwell River @ Yallourn		
AEP	Critical duration	Temporal pattern	Critical flow (m^3/s)	Critical duration	Temporal pattern	Critical flow (m^3/s)
50%	120 hrs	6	60	96 hrs	5	40
5%	48 hrs	6	480	48 hrs	4	240
2%	48 hrs	6	770	48 hrs	4	370
1%	48 hrs	10	1000	48 hrs	4	480
0.5	48 hrs	1	1180	36 hrs	1	560
0.2	48 hrs	1	1680	36 hrs	1	740
0.05	48 hrs	1	2600	36 hrs	1	1090

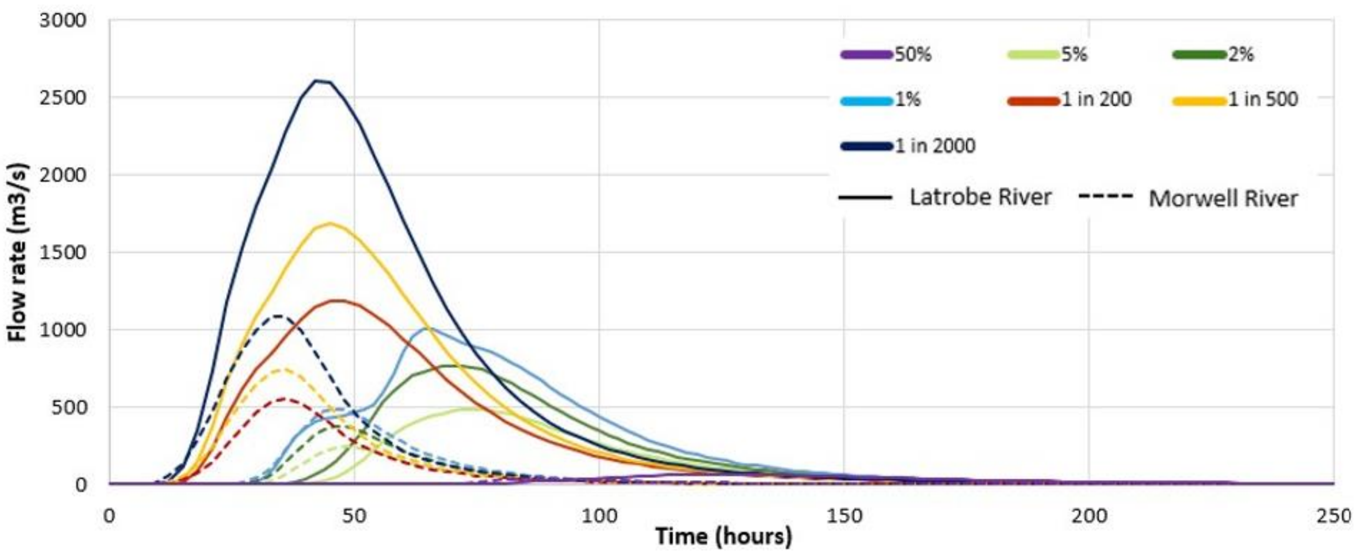


Figure 8-59: Combination of the Critical Hydrographs, Illustrating the Relative Magnitude of the Flows between Morwell and Latrobe Rivers (Alluvium 2025)

A climate change analysis has been undertaken for this study following the draft update to the climate change considerations chapter in *Australian Rainfall and Runoff: A Guide to Flood Estimates* (ARR) Book 1 (Alluvium 2025). The RORB models for Latrobe and Morwell Rivers catchments were run with the climate change projected rainfall depths and initial losses. The peak flow rates for the Latrobe River and Morwell River catchments at Yallourn Mine for the SSP5-8.5 scenario are set out in Table 8-4. The catchment overview of the Latrobe and Morwell River systems are presented in Section 5.7.

Table 8-4: Critical flow rates for design flooding events with climate change, SSP5-8.5 (Alluvium 2025)

	Latrobe River @ Yallourn			**Morwell River @ Yallourn**		
AEP	Current and near-term (m^3/s)	Medium-term (m^3/s)	Long-term (m^3/s)	Current and near-term (m^3/s)	Medium-term (m^3/s)	Long-term (m^3/s)
50%	90	110	200	60	70	120
5%	610	700	980	300	350	470
2%	930	1050	1400	450	510	670
1%	1210	1350	1760	580	640	830
0.5	1450	1640	2180	660	740	940
0.2	2020	2250	2940	860	950	1200
0.05	3080	3420	4360	1260	1380	1720

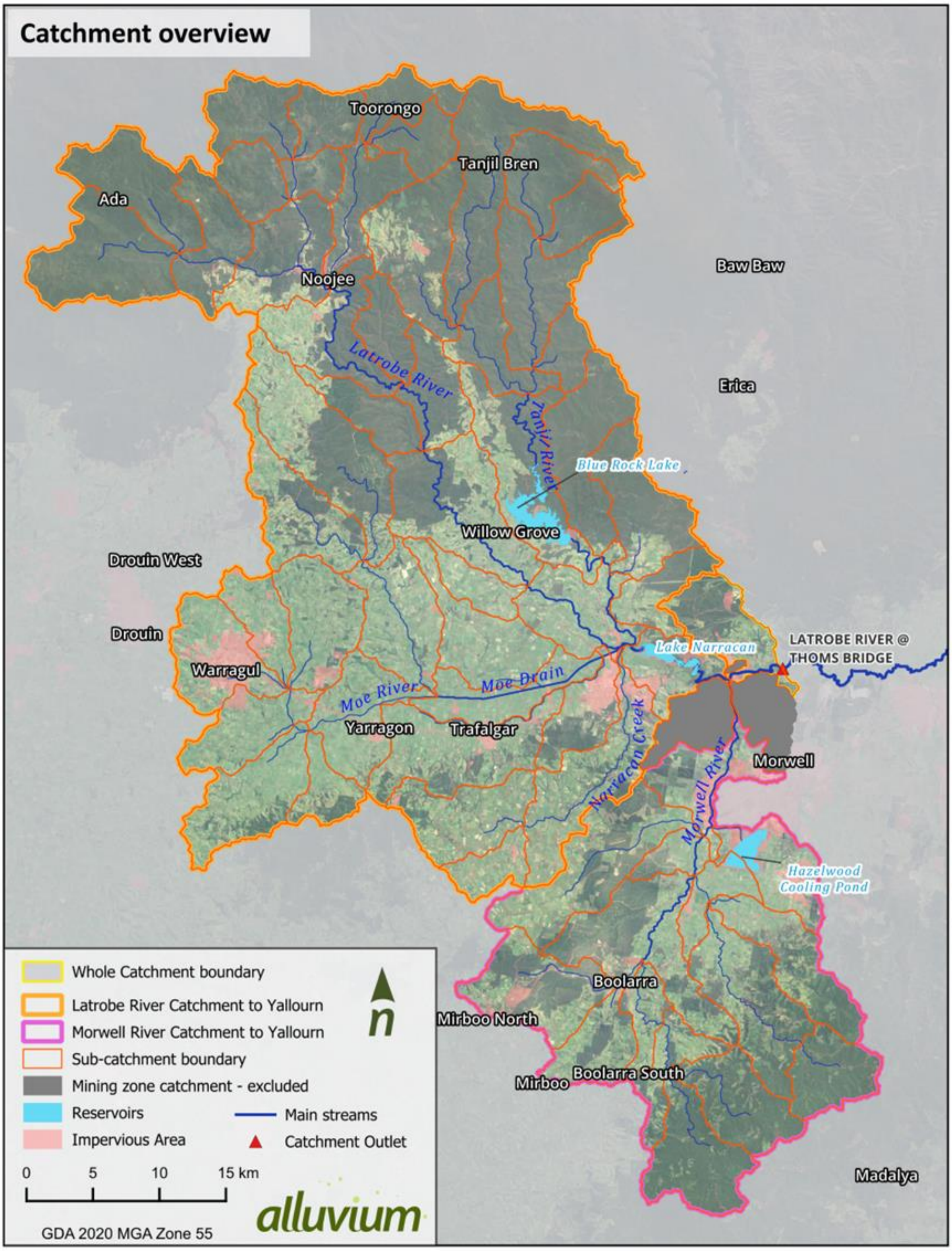


Figure 8-60: Overview of Latrobe & Morwell River Catchment for Event Based Hydrologic Modelling (Alluvium 2025)

Regional Hydraulic Assessment

Regional hydraulic modelling has been undertaken to investigate and analyse the current flow regime and the proposed design scenario and the complex flow connections into the pits from the Morwell River, flows between the pits, and outflows from the pits. Analysis of these flow behaviours and hydraulic stream parameters (depth, elevation, shear stress and velocities) have been undertaken and used to assess the 'Partially Connected Morwell River Option' against the key hydrologic, geomorphic and ecological function design principles defined in Section 8.6.2.1.

Model development

The Two-Dimensional Unsteady Flow (TUFLOW) model encompasses the area extending 15 km along the Morwell River and Morwell River Diversion (MRD) upstream of the Morwell and Latrobe Confluence, and 8 km of the Latrobe River. The model terminates approximately 6 km downstream of the confluence with the Morwell River. An 8-metre grid size was chosen for the model, striking a balance between computational efficiency and capturing the necessary detail of the Morwell and Latrobe River.

Model summary

Table 8-5: Summary of hydraulic model modifications

Item	Comments
Existing Hydraulic Models	Morwell River Diversion Hydraulic Model. This model was developed by HARC for Hazelwood which explored two scenarios, a baseline model with no offtake and no weir, and an as-built model including an existing weir and existing offtake diversion. This model would form the base for the development of the modelling for Yallourn.
Existing Hydrologic Model	A detailed hydrologic model was developed in RORB modelled the entire catchment to estimate peak flow and provide hydrographs for this hydraulic study.
Bathymetry	No bathymetric datasets have been used in the modelling to date within the study area. LiDAR capture have typically been captured during periods of low water inundation.
Field Survey	Field survey data have been captured at various locations within the model domain, namely: • Southern Coffer Dam • MRD South • MRD North • Eastern and Western Pits • Pump station This survey data has been used to generate surfaces at these localised sites.
LiDAR	1 m resolution LiDAR captured in 2018 was utilised by the modelling undertaken by HARC and has been retained in this model. This LiDAR was supplemented by 50 cm resolution data captured in 2020 by the Victorian Government and 2023 by the West Gippsland CMA, these areas cover the Latrobe River downstream.
Photogrammetry	In addition to the LiDAR, 10 m resolution photogrammetry DEMs from Elvis provided complete coverage of the study area in areas where there was no LiDAR coverage.
Key hydrometric data	Morwell River at Yallourn (226408), Latrobe River at Yallourn (226400B), Latrobe River at Thoms Bridge (226005) along with flow level data at the MRD Cofferdam, MRD South and MRD North.

Model verification

The updated TUFLOW model was verified by comparing model results to gauge reading for two events. The gauge readings were from two locations on the MRD. One smaller flood and one high flow event were selected to verify the hydraulic model. Gauge recordings (elevation and inferred flow sourced from data.water.vic.gov.au) were used to calibrate the model. The model calibration results for both the high and low flow events show reasonable match to the gauge readings.

Existing conditions modelling

The existing here implies the adoption of MRD in its current state, without any modifications. This is to demonstrate a base case output that could overwhelm the limitations posed by current state of MRD. Key points from the existing conditions modelling include the following:

- Peak flood depths in the Morwell River Diversion are dominated by Latrobe led events, reflecting the larger catchment area and peak flow events in the Latrobe River.
- Peak flood levels are contained within the MRD for all events tested including the 1 in 2000-year Latrobe led event. In this event the water level rises to RL 45.3m AHD. Water at this elevation is known to compromise the structural integrity of the MRD. The current status and condition of MRD is further discussed in Section 8.12.
- While peak inundation is dominated by Latrobe led events, peak velocity and shear stress through the Morwell River diversion are highest during Morwell led events.

Table 8-6: Hydraulic Modelling Results For Existing Conditions (Alluvium 2025)

		0.05% AEP	0.2% AEP	0.5% AEP	1% AEP	2% AEP	5% AEP	50% AEP
Existing conditions peak elevation (m AHD)	Latrobe led	45.3	43.9	43.2	42.6	42.0	40.7	37.4
	Morwell led	43.3	42.3	42.3	41.3	41.0	39.7	37.5
Existing conditions peak velocity (m/s)	Latrobe led	0.9	0.9	0.9	1.0	1.7	0.2	0.7
	Morwell led	2.2	1.9	1.8	1.8	1.8	1.7	0.8
Existing conditions Peak bed shear stress (N/m^2)	Latrobe led	5.6	5.5	6.0	7.9	20.9	0.3	5.4
	Morwell led	27.8	25.6	24.0	22.8	22.3	21.2	7.4

Selection of initial layout for design configuration

A primary purpose of the hydraulic modelling was to develop and assess a potential long-term configuration for the levees and spillways for the MRD and the pits. The intent was to develop a preliminary design configuration that supports the long-term structural integrity of the levees that bound the MRD and to investigate how overflows through spillways to and from the pits behave during extreme events, while not impacting on environmental water requirements for the system.

The existing model configuration was modified via trial and error to:

1. Prevent water levels within the MRD rising above elevations that compromise the structural integrity of the MRD. A peak of RL +42.5m AHD for the 1 in 2000-year ARI (0.05% AEP) event was adopted for this purpose.
    a. Elevation: RL +42.5m water surface elevation that provides acceptable levels of confidence in the ongoing structural integrity of the existing levees adjoining the MRD. This is based on the current capability of MRD and is within the structure’s upper operating limit, as determined by the geotechnical assessment of MRD (discussed in Section 8.12).
    b. Design event: The 1 in 2000-year ARI event was selected based on attainment of an acceptable level of risk given the consequence of failure of the structure.
2. Ensure that events do not create excess differential water surface elevations between the pit lakes on the west (Township Field) and east (East and Maryvale Fields) of the MRD. A maximum water differential water surface elevation between the Township Field and the East Field pit lakes of up to 6 metres was adopted for design, as supported by the geotechnical capabilities of MRD (PSM 2025b). This criterion was adopted to prevent excess lateral loads on the MRD that could result in lateral movements of the MRD.
3. Ensure flood events do not generate erosion of the Morwell River floodplain and hence do not lead to erosion led failure of the adjoining levees and related infrastructure. A maximum velocity of 1.8m/s and shear stress of 80 N/m^2 (the maximum permissible velocity and shear stress for tall native bunch grasses, refer Fischenich 2001 Impacts of stabilisation measures) were adopted for the design.
4. Ensure that any such configuration does not divert flow from the Morwell or Latrobe Rivers that impacts on essential environmental water requirements of the Latrobe River system (including the Latrobe River). Spillways were set at elevations that ensure that flow rates in the Latrobe and Morwell River exceed 3,200 ML/day before any water is captured by the pit lake. This flow rate is required to ensure the flushing of the Latrobe River estuary of salt water at the current offtakes for the watering of the Dowd Morass and the Heart Morass on the lower Latrobe River.

The placement and sizing of the proposed spillways that control the flow in and out of the pits are presented below. The design configuration considered is presented in Table 8-7 with the locations presented in Figure 8-61.

Table 8-7: Design Configuration of Spillways Considered for Hydraulic Assessment

Spillway No.	Name/Description	Width (m)	Spillway RL (m AHD)
Spillway 1	Morwell River (upstream of MRD) to Township Field	50	41.5
Spillway 2	MRD to East Field	100	40
Spillway 3	MRD to Township Field	50	40.5
Spillway 4	East Field to Latrobe River	150	37
Other	MRD Tunnels	Modification of the existing tunnels under the MRD to equalise water levels between the pit lakes.	

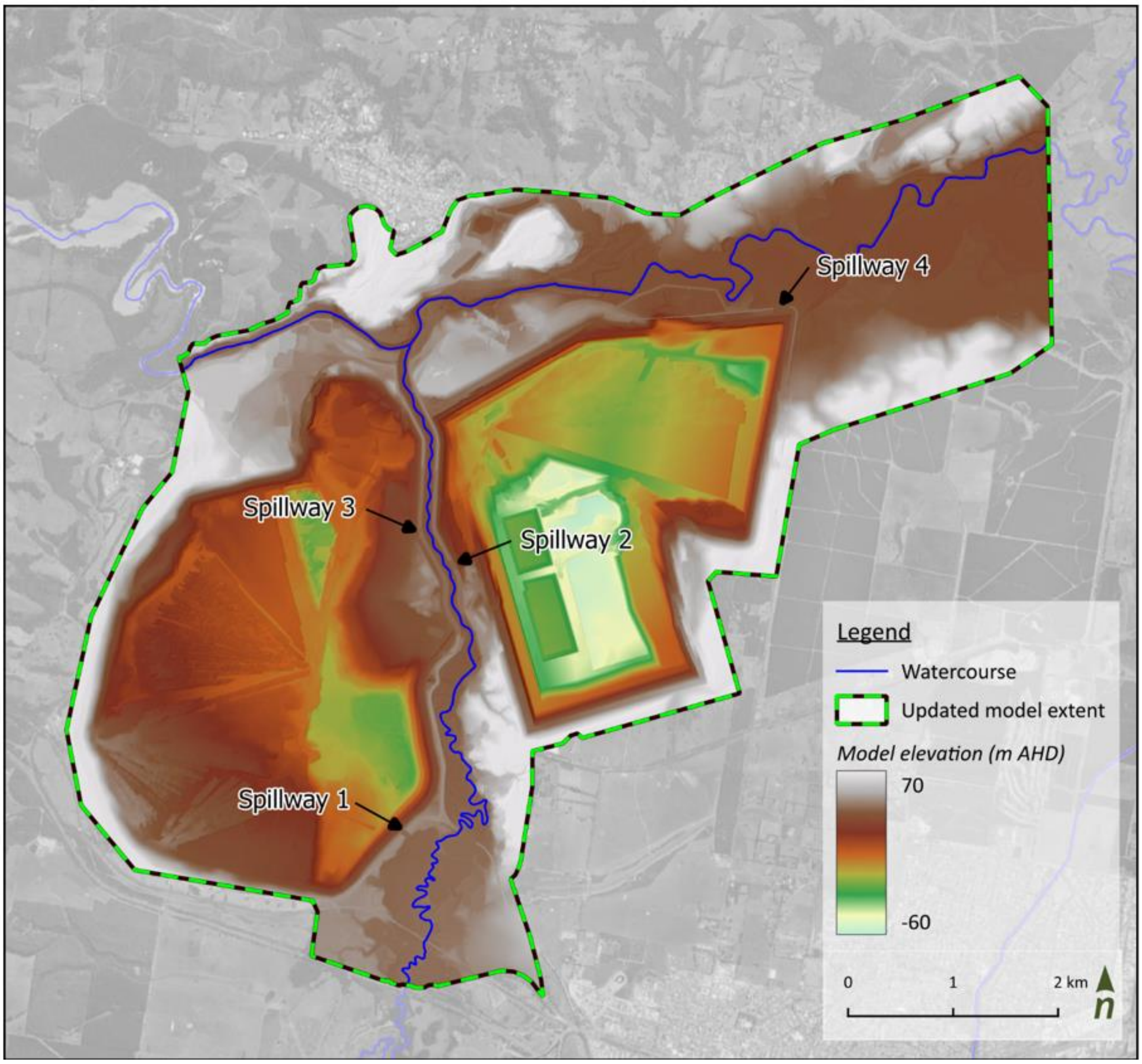


Figure 8-61: Preliminary Design Arrangements & Locations for Spillways (Alluvium 2025)

Preliminary Design Arrangement Modelling Results

Similar to existing conditions, the hydraulic modelling revealed flood levels to be dominated by the Latrobe led events, while the flow velocities and the resulting bed shear stresses in the MRD are more relevant during Morwell led events. The hydraulic modelling has revealed:

- Attainment of a maximum water surface elevation of approximately RL42.5m AHD for the 1 in 2000-year ARI event
- Figure 8-62: 0.05% AEP Latrobe River led event - Max Flood Depth – Design Conditions (Alluvium 2025) i.e. consistent with the design criteria for maximum water levels within the MRD.
- Maximum difference in head between Township Field and The East Field pits of 3.3 metres during flood events. i.e. less than that required to prevent lateral movement of the MRD
- Velocity (Figure 8-63) and shear stress that do not exceed:
    - That identified for the existing conditions
    - Non-scour velocity and shear stress for native bunch grasses
  - Note: The maximum shear stress has been quoted for the MRD floodplain not in the immediate vicinity of the proposed spillways.
- Spillway 1 being the first spillway to commence to flow. This spillway commencing to flow at a 5% AEP (approx.) event in the Morwell River at 3,500 ML/day (approx.). i.e. in excess of that required to flush the Latrobe River estuary of salt water at the points of inflow to the Lake Wellington fringing wetlands (Heart Morass and Dowd Morass).

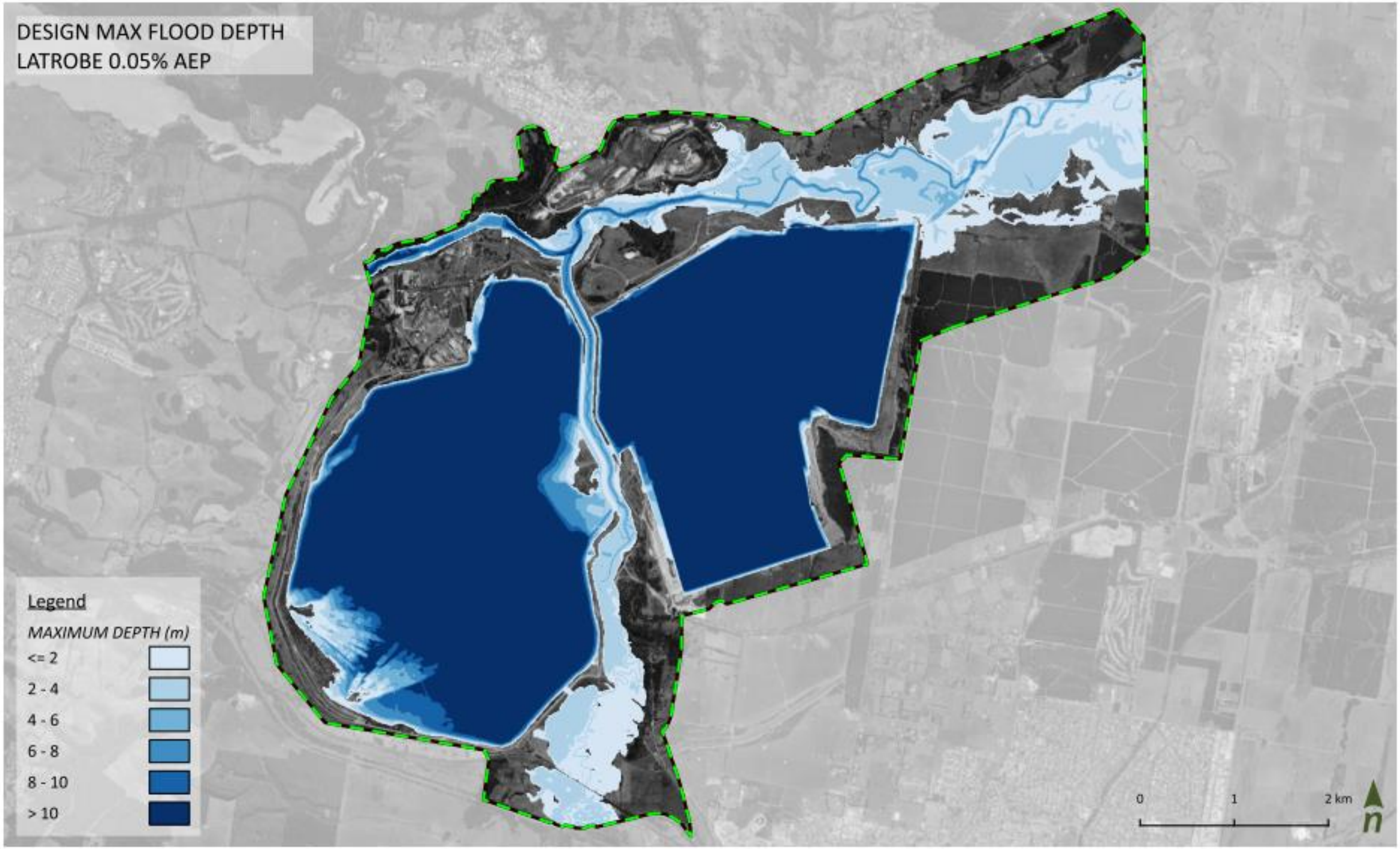


Figure 8-62: 0.05% AEP Latrobe River led event - Max Flood Depth – Design Conditions (Alluvium 2025)

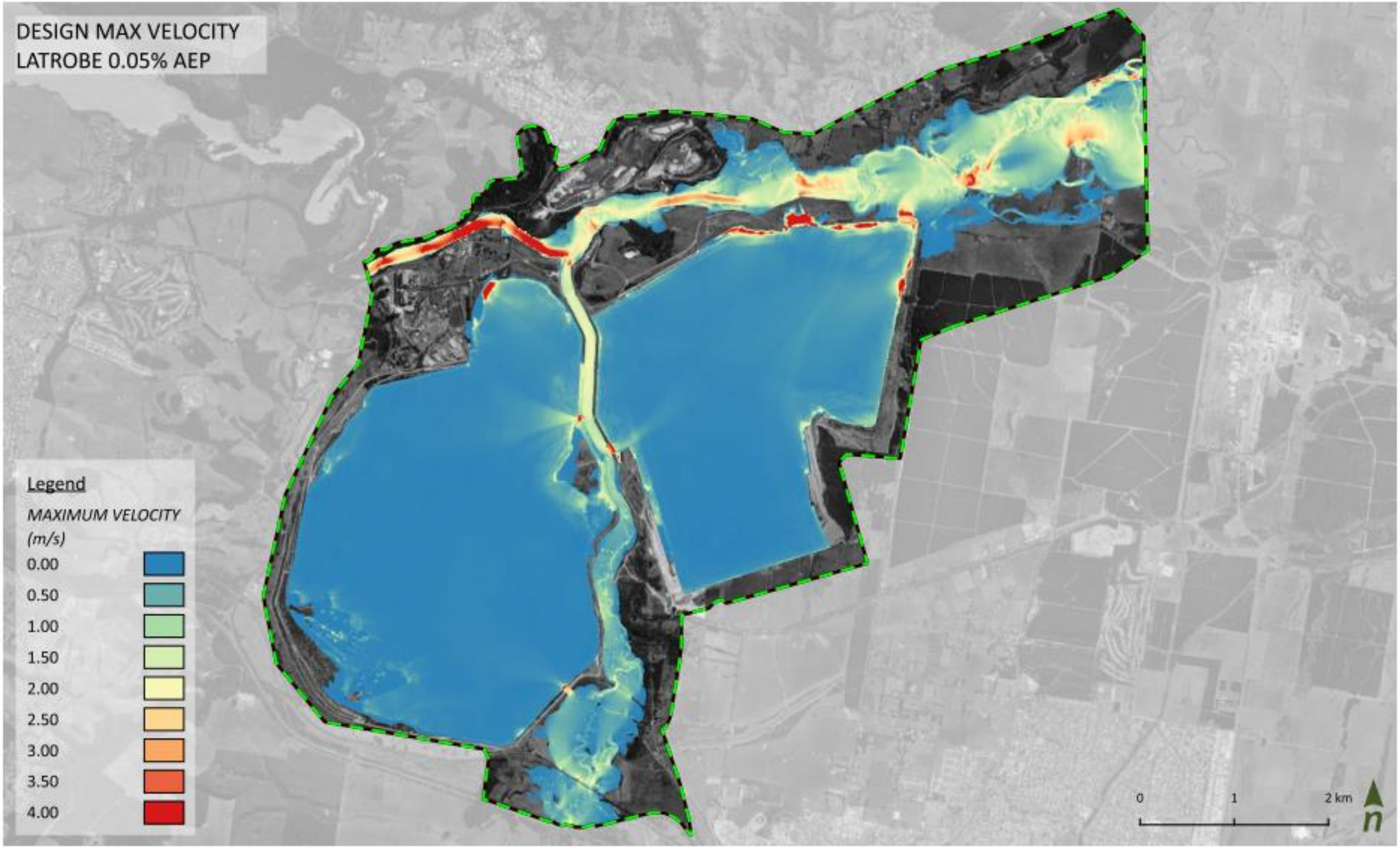


Figure 8-63: 0.05% AEP Latrobe River led event - Max velocities – Design Conditions (Alluvium 2025)

Table 8-8: Hydraulic Modelling Results for Design Conditions (Alluvium 2025)

		0.05% AEP	0.2 % AEP	0.5% AEP	1% AEP	2% AEP	5% AEP	50% AEP
Post fill conditions peak elevation (m AHD)	Latrobe led	42.5	42.1	41.7	41.4	41.1	40.4	36.9
	Morwell led	41.3	41.3	41.3	40.5	40.5	38.7	36.9
Post fill conditions peak velocity (m/s)	Latrobe led	1.5	1.1	0.8	0.5	1.3	0.1	0.6
	Morwell led	1.8	1.7	1.7	1.7	1.6	1.4	0.7
Post fill conditions Peak bed shear stress (N/m^2)	Latrobe led	12.5	7.1	5.9	7.5	19.1	0.5	5.3
	Morwell led	27.3	25.0	24.0	23.5	22.9	20.9	6.7

The hydraulic modelling has also revealed shear stress and velocity outcomes over, and in the immediate vicinity of, the proposed spillways, that exceed the design criteria. Further assessment and design effort will be required to develop configuration arrangements that ensure the long-term performance of these structures. In addition, the velocity and shear stress criteria for existing and any proposed vegetated surfaces on the MRD floodplain are a function of the duration of events, with decreasing performance with increasing duration of inundation. Further investigations will be required to confirm the longevity of any proposed vegetative arrangements for MRD instream and floodplain erosion control, under extended flood events.

Regional Water Balance and Water Quality

A regional water balance study (Alluvium 2025) was completed considering the proposed rehabilitation design with a particular focus on the influence to water balance from proposed MRD remediation design (technical assessment discussed in Section 8.12). The proposed MRD design is presented in Section 12.3.

The results of this study supports the Yallourn Mine rehabilitation design and demonstrates that there are no adverse influences on regional water balance. The study further confirms that proposed MRD remediation design allows all environmental flows to pass through MRD, along with flood flows up to the design levels.

Regional water quality impacts require further determination of the input parameters and is noted as a knowledge gap (KG15, Chapter 17).

8.6.3 Findings

A preliminary spillway design arrangement has been developed and assessed for the site based on the Partially Connected Morwell option and its potential to meet key hydrologic, geotechnical, geomorphic and ecological criteria.

Event based hydrologic modelling was undertaken to inform (TUFLOW) hydraulic modelling. The hydraulic modelling was used to develop and assess a preliminary design configuration for the site.

The preliminary design configuration is as per Table 8-7.

Regional water balance modelling was undertaken using the Latrobe Source model to identify the implications of water use on the environmental water requirements for the Latrobe River system (and tributaries). The assessment was based on reducing the risks of elevated water levels (stream flows) in the MRD during the fill phase and hence the operation of the spillways during the fill phase.

The performance of the proposed arrangement has been assessed against the design principles set out in the geomorphic and ecological context statement discussed in Section 8.6.2.1:

Hydrologic regime

Criteria: The arrangement should provide for both:

- longitudinal hydrologic connectivity
- lateral floodplain connectivity

Outcome: The spillways have been set at elevations that ensure that flow rates in the Latrobe and Morwell River reach 3,200 ML/day before any water overflows into the lake. This flow rate provides for both longitudinal continuity of flow and ongoing floodplain inundation through the MRD following the construction and operation of the proposed spillways.

Geomorphic processes

Criteria: The arrangement should:

- not be subject to accelerated high rates of erosion and deposition
- be robust i.e. resistant to change and have the ability to adapt and repair following change without comprising the other values and outcomes
- provide for ongoing longitudinal and lateral bed load sediment movements

Outcome:

- Erosion: The proposed arrangements have been found to not increase peak velocity and shear stress beyond that present in the existing conditions. The proposed arrangements result in a reduction in the peak velocity and shear stress in the MRD and retention of velocity and shear stress within the range that can be accommodated by nature based (vegetative) erosion control works. However, it is noted that the performance of such erosion control measures declines with increasing duration of events. The long-term success of nature-based erosion control works will require further assessment and design. Further, more specific design development is required for the proposed spillways to ensure their enduring performance.
- Robustness: The maximum water surface elevation of approximately RL42.5m AHD for the 1 in 2000-year ARI event, meets the design criteria, and represents a 3 metre (approx.) reduction from peak water elevations under the current conditions and increased confidence in the long-term performance of the MRD.
- Sediment transport: The proposed spillways increase the confidence in the long-term functioning the MRD and

hence the long-term potential to provide ongoing bed load sediment transport to the Latrobe River. The proposed spillways while increasing the confidence in the longevity of the MRD have the potential to reduce sediment transport when compared to existing conditions. However, as events up to the 5% event in the Morwell River are not impacted by the spillway operation, any reduction in long term sediment transport is likely to be insignificant. Further investigations will be required to confirm the change in bed load sediment transport capacity of the MRD and the implications of any such change on sediment deposition on the environmental stability and longevity of the MRD. This will be a consideration in the detailed design phase.

8.7 Peripheral Catchment Study

8.7.1 Introduction

This section presents the surface drainage features and their characteristics that extend around the peripheral of the mine void. Yallourn Mine perimeter extends approximately 26 kms when measured around the mine crest. When this is considered with the pre-mining geomorphology of the site, it shows the substantial catchment that can influence the rehabilitation design at Yallourn Mine.

While some peripheral catchments report to the mine, others flow behind and along the crest. Over the history of mining at Yallourn, several surface flows have been diverted away from the pit to facilitate mining operations and maintain ongoing stability of the mined-out batters. The surface water catchment domains extend several hundred meters behind the mine crest for some domains due to extended topographic relief behind the mine crest. The surface drainage closely intertwines with the geotechnical performance of the mined batters. They form a key driving factor to the geotechnical stability of the batters through all stages of rehabilitation and post-rehabilitation. Failure of a surface drain can lead to recharge of the underlying coal joints, creating a destabilising hydraulic head that can lead to batter movement and/or instability. The mechanisms of these driving factors to batter stability are discussed in Section 8.9. In addition, surface drainage systems assist in appropriate management of surface runoff that can adversely influence surface soil erosion and vegetation capping layer(s).

A detailed study of the all the peripheral catchments around the mine void was completed by PSM Geotechnical Consultants. The key aspects of the methodology adopted for development of a site surface drainage design for all peripheral catchments are summarised below. Key findings of this study are presented here, with details presented in *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b), (Appendix C – Technical Studies).

Other relevant sections for surface water:

- The mine void forms a very large internal catchment area. These include surface flows that are currently directed to the mine void, the runoff from mined slopes, benches and berms, and the internal overburden dumps. This is discussed in Section 8.8.
- Two major rivers flow along and through the Mine, namely Latrobe River along the northern boundary of the site. The other being Morwell River that flows along south-east boundary and then through the middle of the pit via an engineered structure (the MRD). The regional catchments that contribute to the flows in these river systems are a key consideration to the overall surface flows that need to be serviced by the rehabilitation design.

8.7.2 Methodology

The approach to design of the peripheral catchment is interdependent with the geotechnical design approach. They share common aspects to the methodology since by minimising water loading events, the geotechnical reliability of the design is greatly increased. The following are the key aspects to the approach for peripheral catchment study and the derived rehabilitation design. The details are presented in *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b), (Appendix C – Technical Studies).

8.7.2.1 Risk Based Design Approach

The scale and variability of settings around the mine result in a large number of complex, interrelated technical factors that must be assessed and incorporated into the designs. To effectively capture all elements required for rehabilitation, a specific risk approach combining technical and conventional risk consequence evaluations has been employed.

This approach has been adopted for Yallourn rehabilitation planning because conventional risk matrices are too coarse, potentially overlooking essential technical elements. The technical risk classification systems have been developed from first principles, focusing on critical rehabilitation risk design factors for Yallourn within each surface water domain. The EAY consequence ratings closely align with the draft guidance provided by DEECA, incorporating likelihood and consequence analysis to address safety, environmental impact, land and property, and cultural heritage issues.

The consequence ratings are a step in the process to assist with:

- Selection of the design flows and probability of exceedance within the design intent periods (Section 0) and
- Focussing on the remediation design in the domains with Major and Critical Consequence ratings.

The risk evaluation thus entails a two-tier risk process:

1. The first tier uses separate evaluations of the geotechnical and surface water technical risk ratings for every domain in the mine. The geotechnical risk evaluation process and ratings for the geotechnical domains are discussed in 8.9.2.2 with domain boundaries presented in Figure 3-7. The surface water domains risk rating are presented in Figure 3-8 (Section 3.7.10).
2. The second tier uses a conventional consequence rating and ensures the designs effectively deal with the potential consequence issues around safety, environment, land and property; and cultural heritage.

Geotechnical risk assessment is the first step where the base conditions are defined. These form the underlying factors that determine inherent risk. The system responses are then evaluated to identify how geometry, environmental exposure, and time may exacerbate these risks.

Similarly, surface water risk is assessed by first analysing the base conditions, such as catchment size and peripheral water sources, which categorise each domain. Subsequently, complicating factors are identified to determine those that may increase future design complexity.

Consequence Classification for Post Mine Land Use (PMLU)

The surface water assessment of peripheral catchment and the geotechnical assessment consider the potential risks related to intended future use of land, known as Post Mine Land Use (PMLU). The intended PMLU is presented in Chapter 9 and this affects the potential consequence of any deformations or failure of the ground. Such an outcome is considered as being driven from a coupling response from geotechnical and surface water factors, for the purpose of determining the risks here.

Five categories of consequence ratings have been developed for the risk-based rehabilitation design:

- Severity 5 – Critical – highways and railway lines,
- Severity 4 – Major – rivers,
- Severity 3 – Moderate – secondary public roads,
- Severity 2 – Minor – picnic spots or areas of temporary human occupation (for a few hours),
- Severity 1 – Insignificant – farmland or areas with no extended or permanent human occupation.

8.7.2.2 Mine Peripheral Catchments

Figure 8-65 shows the peripheral catchments and infrastructure around the Yallourn Mine. The total catchment area (including the pits) is approximately 57 km². Of this currently approximately 30 km² of catchment is diverted around the mine via existing drainage infrastructure.

There is a significant amount of existing water diversion infrastructure around Yallourn Mine. Most of this infrastructure is located west and south of Yallourn Township Field (YTF), with a lesser amount to the east and south of Maryvale Field (MVF). The performance of some of the main elements of this infrastructure has been reviewed as part of the rehabilitation study.

The existing diversion infrastructure associated with the current surface water management of the peripheral catchments include, Figure 8-65:

- Rifle Range Gully Dam – located in the low point of the gully, to the west of Township Field pit crest. The surface run-off that reports to this feature is pumped out to a discharge point located to the south of Rifle Range Gully Dam using a submersible electrical pump. From there, it flows south, reporting to the Melbourne Swamp Drain via a gravity drain. This allows the storage basin to remain virtually empty all the time and keeps water out of the mine void. This storage basin can hold about 43 MLs, in the instance of pump outage, along with a four-pipe concrete spillway that reports to the pit.
- ANCOLD Safety Rating - Low
- Witts Gully Dam – located south-west of the Township Field. This dam forms part of the firefighting network for the mine. Water is pumped up to this dam storage to maintain a full head of water which then charges (pressurised) the fire service pipe ring main that runs around the perimeter of the mine. In addition, the dam has a catchment to the south, as shown in Figure 8-65. An open channel spillway is located along the west of side of dam wall. Any overflows that flow via the spillway drain under the M1 Princes Freeway via a series of culverts and then report to the Melbourne Swamp Drain.
- ANCOLD Safety Rating – High B
- Existing diversion drains, including Melbourne Swamp, Morwell West, Remnant Morwell West, and Hancock Victorian Plantations diversion drains.
- The existing railway line along the southern edge of YTF with culverts under the rail embankment transferring water towards the mine and into the Morwell River system.
- Existing public roads, including M1 Princes Freeway, Marretts Road, De Campo Drive, Haunted Hills Road and Latrobe Road.

Storm events can lead to increased flows in these abovementioned features. With consideration to the uncertainties around variability of climate factors through the design intent period, the rehabilitation design for surface drainage has been developed. The runoff factors can be further exacerbated following bushfires, where sheet flows increase due to damaged vegetation cover in the catchments.

8.7.2.3 Critical Aspects for Closure

The control of surface water is inherently linked to the geotechnical performance of the rehabilitation slopes via:

- The need to control surface water and mitigate the risk of tension cracks being charged with water and triggering a block sliding slope deformation and/or failure, and
- The need to create the pit lake as part of measures to improve stability of the pit slopes.

Down-batter drains, which link the peripheral catchments to the proposed pit lakes, are a crucial component of the concept to address the aforementioned aspects. Any long-term water control structures installed as part of future rehabilitation will need to be simple, deformable structures with high design capacity and integrity. The design intent is to achieve minimal maintenance where possible through passive management.

To estimate design flows from the peripheral catchments over the closure period, the following critical hydrologic aspects need to be understood:

- The current climate hydrological response of Haunted Hills Formation catchments
- The impacts of climate change on the rainfall-runoff response
- The impacts of bush fire on the rainfall-runoff response, noting that climate change has the potential to increase the frequency of bush fires, and
- The impacts of forestry logging on the rainfall-runoff response for the domains that have forestry areas.

Estimating design flows for sub-catchments within each domain will help assess closure drain design options and the potential catchment area diverted into the pits. This diversion affects the water balance of the pit lakes, influencing pit filling time and final lake level maintenance.

8.7.2.4 Design Steps to Peripheral Catchment

The steps for the peripheral catchment drainage design for each domain are to:

1. Establish conceptual options for drain type and siting based on the geotechnical slope stability analyses and the DAC (Design Acceptance Criteria), including risk framework during different rehab periods.
2. Establish the design hydrologic likelihood for each geotechnical domain, based on the qualitative risk for drain design. The hydrologic likelihood, and the equivalent AEP (Annual Exceedance Probability), should be established with consideration of climate change, bushfire and logging considerations.
3. An iterative review process to confirm alignment with the rehabilitation strategy.
4. Calculate the design flow for the design.
5. Estimate drain sizes. The calculation methods are discussed in PSM 2025b.
6. Optimise drain design across the rehab landform.

8.7.2.5 Design Hydrologic Likelihood vs AEP

The Annual Exceedance Probability (AEP) describes the likelihood of an event occurring in any given year. Combined with the structure's intended operational period, or 'design intent period,' it helps assess the likelihood of a larger event occurring during this time. This likelihood, along with the consequences of failure, is used to evaluate the overall risk for a structure designed to a specific AEP.

The hydrologic likelihood can be calculated using the following formula where the conditions in the catchment are constant:

P_f [%] = Hydrologic Likelihood = $100 \times (1 - (1 - AEP)^{L})$

Where *AEP* is the Annual Exceedance Probability as a fraction, and *L* is the design intent period in years. Based on this, the hydrologic likelihoods for a range of design AEPs and design intent periods are presented in Table 8-9 below:

Table 8-9 Hydrologic likelihood (%) (PSM 2025b)

AEP	Design Intent Period (Yrs)				
	20	30	50	75	100
1 in 10	87.8	95.8	99.5	>99.9	>99.9
1 in 50	33.2	45.5	63.6	78.0	86.7
1 in 100	18.2	26.0	39.5	52.9	63.4
1 in 200	9.5	14.0	22.2	31.3	39.4
1 in 500	3.9	5.8	9.5	13.9	18.1
1 in 1,000	2.0	3.0	4.9	7.2	9.5
1 in 2,000	1.0	1.5	2.5	3.7	4.9
1 in 5,000	0.4	0.6	1.0	1.5	2.0
1 in 7,500	0.3	0.4	0.7	1.0	1.3
1 in 10,000	0.2	0.3	0.5	0.7	1.0
RED	Likelihood > 50%		Probable or more likely over the DIP		
ORANGE	20%< Likelihood < 50%		Possible to even chance over the DIP		
YELLOW	10% < Likelihood < 20%		Very low to low chance over the DIP		
BLUE	1% < Likelihood < 10%		Very improbable / very unlikely over the DIP		
GREEN	Likelihood < 1%		Almost impossible over the DIP		

Based on these values above, the hydrologic flow estimation approach has focused on storm parameters for events up to 1:10,000 AEP.

8.7.2.6 Types of Down Batter Drains and Liner Systems

There are a number of down batter drain types to direct concentrated peripheral catchment flows into the pit, including:

1. Batter drains with surface protection such as Grass lined, Earthlok liner system, Articulated Concrete Mattress Drain, Coarse Rockfill Chute Drain
2. HDPE Pipes with Inlet Pit and/or with Embankment Inlet.

The design of each down batter drain is unique as each drain needs to consider a specific combination of:

- Available drain width
- Longitudinal slope
- Catchment area / Design flow
- Erosion potential
- Geotechnical stability, and
- Acceptable hydrologic likelihood.

The various types of surface protections considered for the batter drains are presented in Table 8-10 below. Further discussion is presented in *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b) (Appendix C – Technical Studies).

Table 8-10: Types of Down Batter Drains and Key Features

Drain Type	Key Features
Articulated Concrete Mattress (ACM) (Figure 8-64)	• Highly durability. Concrete mix durability guidance can be developed based on the *AS 5100.5 Bridge Design Part 5 Concrete* standard. • Minimal soil preparation. Recommended to use woven geotextile under the ACM. • Low permeability and infiltration • Concrete needs to be pumped into the mattress close to or at the installation site. Poses challenges for access and may require extensive preparatory works to site. • Liner & related materials sourced externally.
Earthlok Concrete Mat (ECM) (Figure 8-64)	• High durability (100 years as per manufacturer's specifications) • Permeability is higher than ACM. • Can be vegetated, e.g. grass in between concrete blocks. • Requires subgrade preparation dictated by local conditions. A woven geotextile is required below the ECM liner. • Easier installation than ACM as the ECM liner comes precast from the manufacturer, ready to install. • Liner & related materials sourced externally.
Coarse Rockfill Chute Drain	• High durability, dictated by design and construction on site. • Variable permeability can be achieved. Subgrade can be prepared with an Earth-fill liner or manufactured textile liner to achieve design permeability targets. • Rockfill material required to be imported to site, making earthworks cost prohibitive. • Most Earth-fill materials can be sourced onsite but poses limitations on volumes (not quantified) available.
HDPE Pipes	• High reliability with the 1600mm HDPE thick wall pipes, dictated by the inlet design option adopted. • Inlet design can include a drop-pit similar to roadside drainage, to transfer flows to pipe inlet. • Inlet design can be a piped embankment • Most material available onsite
Herringbone Drains	• Useful for managing sheet flows and erosion. • Typically considered for areas on grass level onsite where surface runoff is not of significant volume. • Typically grass-lined or similar vegetation cover which can complement the landform and geomorphology. • Useful for bifurcation of catchments to assist with surface water management.

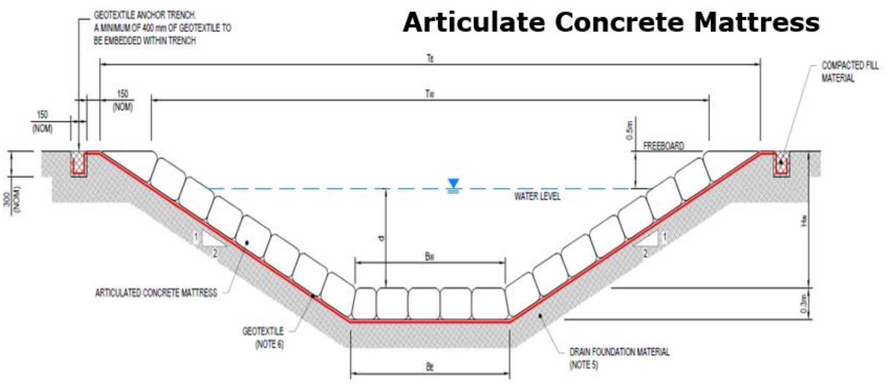


Figure 8-64: Example Layout - Articulated Concrete Mattress and Earthlok Concrete Mat (PSM 2025b)

8.7.3 Findings

The surface water domains have been derived based on the catchments that report to these areas, Figure 3-8 discussed in Section 3.7. These domain boundaries closely align with the geotechnical domains presented in Figure 3-7.

8.7.3.1 Summary of Results

A summary of the drainage design for mine rehabilitation is presented in Table 8-11. This table presents the surface water risk ratings for each domain, the determined hydrologic likelihood and equivalent AEP (Annual Exceedance Probability) that then informs the type of drainage measure suggested for the rehabilitation design.

Figure 8-65 shows the existing surface drainage pathways for the mine peripheral catchments. The plan shows the mapped drainage pathways that interact with the public infrastructures, external landholders & diversion drains, public roads and townships adjacent to the pit. Management of these drainage pathways are considered critical to delivering reliability of the rehabilitation outcome and meeting the rehabilitation objectives for the site. The total catchment size that reports to the pit is discussed in Section 8.8. Comparative to the overall Latrobe catchment, only about 2% report to the pit.

The key observations drawn from the assessment of the existing condition are summarised below:

- The current state of the drainage systems requires improvements to the flow capacities in harmony with the Design Intent Period of the rehabilitation design.
- The current drainage pathways include numerous complex diversions that have been progressively constructed over the long history of mining at Yallourn. The purpose of these surface diversions service the mining operational requirements for the site but are not considered appropriate to service the rehabilitation design intent period.
- Some of the peripheral catchment boundaries extend well outside of the mining license areas and are not on EA controlled land. This poses a limitation on the management of surface drainage and features on these extended boundaries.
- The interaction between of the drainage pathways and public assets poses a risk to the assets and meeting rehabilitation objectives.
- Any failures of the drainage systems could adversely impact the geotechnical performance of the area, compromising the rehabilitation objectives.

These key observations have informed the considerations and aspects that inform the risk factors. The risk factors and assessed outcomes for all stages of rehabilitation and post-rehabilitation are discussed in Chapter 11. Driven by these key observations to the current drainage systems, a surface drainage plan has been developed that addresses the limitations to the current drainage system, Figure 8-66.

Further details of the feasibility design for surface catchment drainage system are discussed in *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b) (Appendix C – Technical Studies). The next stage of rehabilitation planning will review these proposed design options in detail (KG09 Table 17-1), in harmony with the detailed geotechnical and landform design.

Table 8-11: Summary of Drainage, Stability and Risks by Domain

Domain	Initial surface water Risk Rating	EA Consequence Rating		Design life & Construction timing	Qualitative risk for drain design	Hydrologic Likelihood	Equivalent AEP	Peripheral Drainage Description	Other Works required / indicative drain type
		EOM	Rehab complete						
YTF – LS	L	4	1	N/A : No specific drains are required	N/A (Very Low)	N/A	N/A	No drainage works required	N/A
YTF – RCB	L	3	1	N/A : No specific drains are required	N/A (Very Low)	N/A	N/A	No drainage works required; keep current drainage lines	N/A
YTF – NB	L	3	1	N/A : No specific drains are required	N/A (Very Low)	N/A	N/A	No drainage works required; keep current drainage lines	N/A
YTF – WB	M/H	3	1	Permanent structures to be constructed around EOM. 100-year design life	Medium	30%	1 in 300	Aim to protect mine batters and buttress from adverse water loads North: a series of down batter drains from regrading of batter South: a single large batter drain down the mine and across buttress.	Small down batter drains – grass lined
YTF – HOB North	M/H	3	1	Permanent structures to be constructed around EOM. 100-year design life	Medium	30%	1 in 300	Consider long term future of Rifle Range Gully Dam. North: downstream of dam – down batter drains South: simple down batter drains	Down batter drains – may need to be lined depending on flow and gradient
YTF – HOB South	H	3	1	Permanent structures to be constructed around EOM. 100-year design life	High (if road remains) Medium (if road re-aligned)	5% (if road remains) 30% (if road re-aligned)	1 in 2000 (High) 1 in 300 (Medium)	2 drainage structures required. Direct water in Melbourne Swamp Diversion into the pit before flowing into SWB	Drains – need to be lined Rework landform, which may include Haunted Hills Road
YTF – SWB	H	5	5	Permanent structures. 100-year design life	High	2% (5% drain) for batter drain	1 in 2000 to 1 in 5000 (High)	Permanent drain along Section 20 to in-pit dump. Do not take water from HOB S in Melbourne Swamp Drain.	Complex ownership Down batter drains – need to be lined and extend to in-pit dump
YTF – SB	H	5	5	Permanent structures. 100-year design life	high	2% (5% drain) for Melbourne Swamp diversion 5% for batter drain north of railway	1 in 2000 to 1 in 5000 (High)	Consider: Remove all existing culvert diversions (simplify and remove interactions with third party infrastructure) Upgrade Melbourne Swamp diversion to take all flows Catchment north of the railway simple batter drain into pit	Complex surface drainage layout, land ownership. Additional geotechnical investigations to improve the geotechnical model. Down batter drains – need to be lined and extend to in-pit dump,
YTF – FPB	L	4	4	N/A : No specific drains are required	N/A (Very Low)	N/A	N/A	No drainage works required	N/A

Domain	Initial surface water Risk Rating	EA Consequence Rating		Design life & Construction timing	Qualitative risk for drain design	Hydrologic Likelihood	Equivalent AEP	Peripheral Drainage Description	Other Works required / indicative drain type
		EOM	Rehab complete						
YTF – FSPB	L	4	4	N/A : No specific drains are required	N/A (Very Low)	N/A	N/A	No drainage works required	N/A
YEF – NB (West)	L	4	2	N/A : No specific drains are required	N/A (Very Low)	N/A	N/A	No drainage works required; keep current drainage lines	N/A
YEF – NB (East)	L	1	1	Drain conversion works to be done before lake filling. 100-year design life	N/A (Very Low)	99% (overtopping not critical to stability)	1 in 10	No drainage works required; conversion of existing drainage lines to simple down batter drains	N/A
YEF – LRB	L	4	4	N/A : No specific drains are required	N/A (low)	N/A	N/A	No drainage works required (catchment is limited by the diversion bund, therefore stability and integrity of the bund is paramount)	Infilling of the in-pit sump River is close – risk of meander migration - Reinforce diversion bund with internal buttress
YEF – LREB North	M/H	3	1	Drain upgrade works to be done any time during rehab. 100-year design life	Medium	30%	1 in 300	Upgrade Culvert No. 4 Option 1: lined down batter drain around Culvert 4. Option 2: upgrade existing drain to Latrobe River	Option 1: line HHF and batter Option 2: grass lined Complex ownership Complex existing drains
YEF – LREB South	M	3	1	Drains need to be constructed before lake filling. 100-year design life.	Medium	30%	1 in 300	Single structure at Culvert 7 from Latrobe Road into the pit The main drain at Culvert No. 7 needs to divert water to prevent a block sliding mechanism.	Complex ownership Complex existing drains Due to high HHF drains should be lined to protect from erosion.
YEFX – SB	M	1	1	Drain construction works to be done any time during rehab. 100-year design life	Very low	99% (overtopping not critical to stability)	1 in 10	Single structure from mine crest to in-pit dump	
MVF – EB	M	2	2	Drain construction works to be done any time during rehab. 100-year design life	Very low	99% (overtopping not critical to stability)	1 in 10	Use valley as main surface water control with minor drains discharging into the valley.	Unlined. Works on the remnant Morwell West Drain to reverse direction and connect it to the pit directly
MVF – SB	M (for remnant drain)	1	1	Drain construction works to be done any time during rehab. 100-year design life	Low (not for Morwell West Drain)	99% (overtopping not critical to stability) (MWD is different)	1 in 10 (MWD is different)	Maintain current Morwell West Drain diversions Single structure along valley at Section 12	Assumes diversion of majority of water via Morwell West Drain – the integrity and capacity of the MWD needs to be checked and maintained Due to catchment size this should be lined

Domain	Initial surface water Risk Rating	EA Consequence Rating		Design life & Construction timing	Qualitative risk for drain design	Hydrologic Likelihood	Equivalent AEP	Peripheral Drainage Description	Other Works required / indicative drain type
		EOM	Rehab complete						
MVF – WB	L	3	1	N/A : No specific drains are required	N/A (Very Low)	N/A	N/A	No drainage works required; keep current drainage lines	N/A

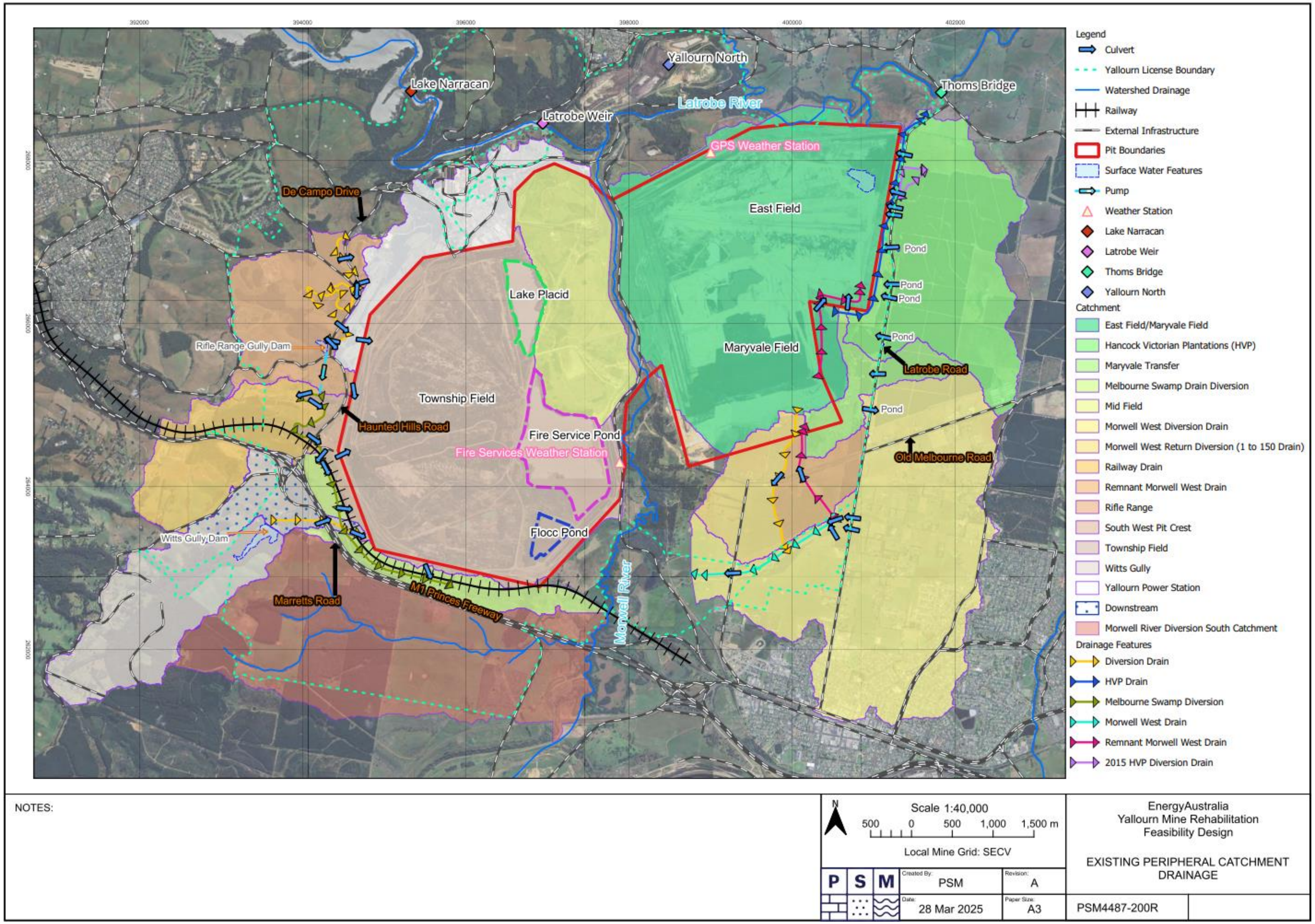


Figure 8-65: Yallourn Mine Existing Peripheral Catchment Drainage Plan, Showing Flow Directions (PSM 2025b)

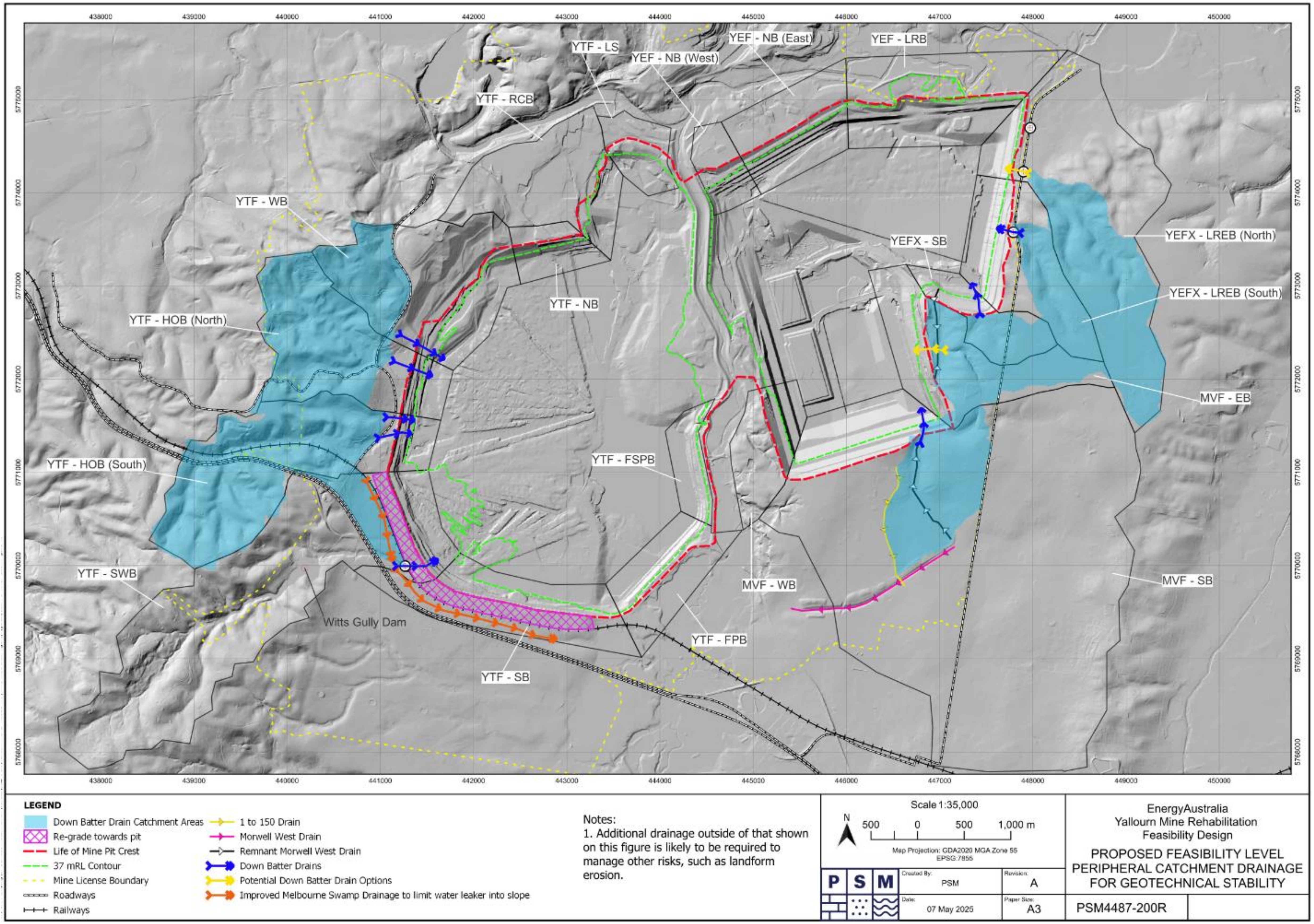


Figure 8-66 Yallourn Mine Proposed Peripheral Catchment Drainage Plan Yallourn Mine Rehabilitation (PSM 2025b)

8.7.3.2 Drainage System Trial

As part of rehabilitation planning, an on-site drainage field trial is being conducted to assess the performance of one of the proposed down batter drain liners. An open drain has been constructed on site using the Earthlok Concrete Mat (ECM) liner (see Figure 8-67). The trial is designed to test the performance of the liner under a range of flows and slope gradients, providing site-specific data that can be incorporated into the detailed surface water management design. This trial aims to verify the suitability of the ECM liner under realistic site conditions, which will aid in the detailed design phase.

Figure 8-67: Drainage Trial Using Earthlok Concrete Mat liner, Photo Taken Shortly After Construction

The drain has been constructed in a valley between the northern side of the YTF FSPB and the Midfield OB Dump. It has been excavated into uncompacted dumped materials comprising clayey sands and sandy clays, with some gravels and loose coal present – resulting in poor subgrade conditions. Minimal subgrade preparation was completed, which will provide a meaningful test of the ECM's effectiveness in preventing erosion of and seepage.

A representative cross section of the ECM drain is shown in Figure 8-68. The upstream half of the drain has a longitudinal grade of approximately 4H:1V, while the downstream half is flatter at about 10H:1V. Two types of anchor trenches were constructed to evaluate performance and ease of installation (Figure 8-68). A woven geotextile layer is installed beneath the ECM liner along the entire length of the drain. In the final ~50m of the downstream section, an HDPE liner is also installed beneath the geotextile. The surrounding area has been seeded with grass. These construction variations will allow for comparative analysis of liner behaviour under different installation configurations, slope conditions, and subgrade characteristics.

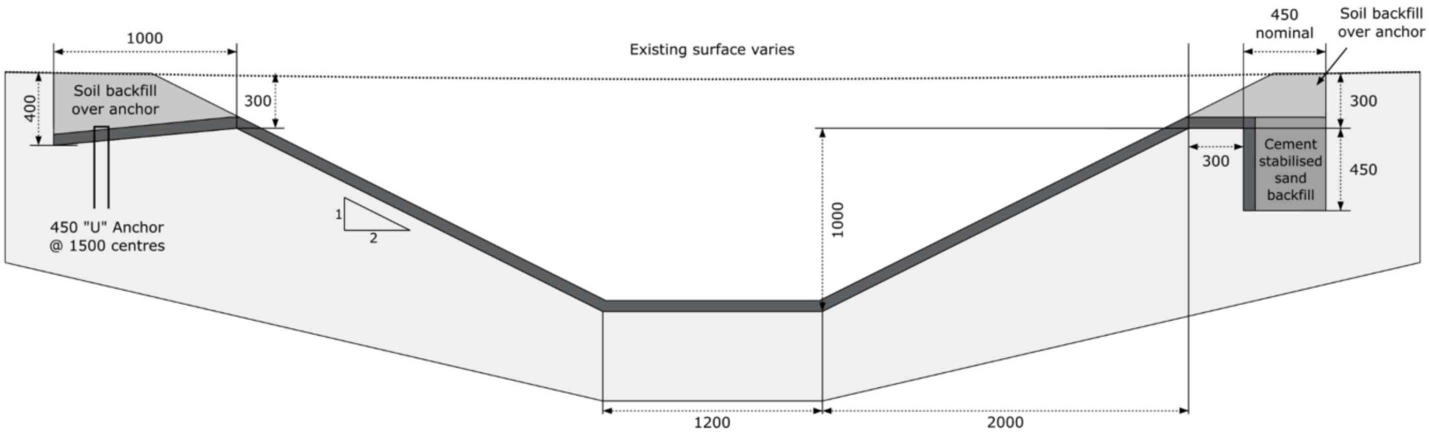


Figure 8-68: Standard Cross Section of ECM Drainage Trial

Vibrating Wire Piezometers (VWP's) are installed at various locations along the drain to monitor porewater pressure in the subgrade, offering insight into potential leakage. Flow meters are installed to measure inflow and outflow. At the drain outlet, an earthen headwall lined with HDPE contains a polypipe inlet. Water flows through this pipe, via a flow monitor, and discharges into the Fire Service Pond. Both VWPs and flow meters are connected to online telemetry for continuous data collection. This instrumentation setup allows for real-time monitoring and detailed performance assessment of the drain system over time, especially during and after rainfall events.

At the upstream end, a pipe from the Maryvale Field dewatering line passes through a valve that can direct water into the ECM drain or divert it into a pair of polypipes discharging to the Fire Service Pond. This allows control of flow rate and duration. Additionally, runoff from a local catchment on the Midfield OB Dump, which historically drained into this valley, has been directed into the ECM drain. All flows are measured at the downstream flow meter. This system provides flexibility in simulating a range of hydraulic conditions and facilitates assessment under both natural and controlled inflow scenarios.

Observations and results from the trial will inform the detailed design phase of the rehabilitation project. The insights gained will be critical in confirming design assumptions, validating erosion control measures, and optimising future surface water infrastructure across the site.

8.8 Pit Water Balance and Water Quality Modelling

8.8.1 Introduction

The construction of a numerical Water Balance/Water Quality model (WB/WQ model) was commissioned by EAY and prepared by RGS to help inform the mine rehabilitation planning (RGS 2025).

The key objectives of the WB/WQ model were to.

- Predict the pit lake(s) quality for a number of 'rehabilitation scenarios' at closure and forecast how it evolves into the future.
- Understand the demand for water to fill and maintain (top up water) for the pit lake(s) over the short, medium and long terms.
- Understand the flows and interactions between the Morwell River, the proposed pit lake(s) and the Latrobe River.
- Determine how long it will take to fill the pit void(s) to the "full pit" scenario; and,
- Understand how climate change and climate variability affect the water balance and water quality of the pit lake(s) over the long term.

The full report can be found in Appendix C – Technical Studies.

8.8.2 Methodology

The numerical model was developed using 'GoldSim' which is a probabilistic simulation software developed by GoldSim Technology Group. The model was developed as a decision support tool for assessing closure options. For this reason, it was developed with flexibility to allow the user to run a series of different "what-if" scenarios and sensitivity analyses, by varying different inputs and model switches. The model used a daily time-step, to run probabilistic simulations for a period of up to 100 years starting on 1/1/2029.

The model development is expressed visually in Figure 8-69 and depicts the key components of the model, which includes the water balance and water quality. The water balance (direct rainfall, groundwater and surface water contributions to the lake) is controlled by climate (rainfall and evaporation) and external water sources. Each of the key source of water to the lake contributes a water quality (source term) derived from a combination of inferred (e.g. Geochemical testing and measured data).

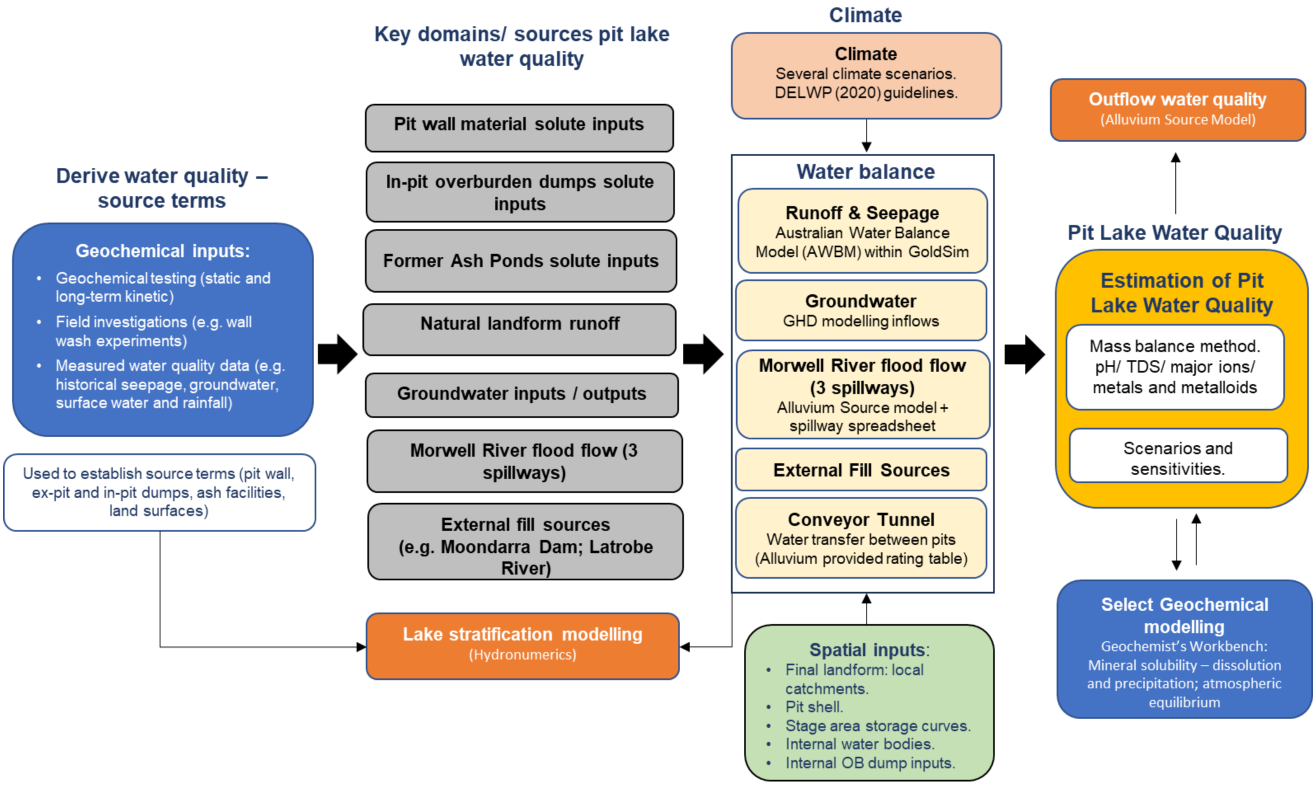


Figure 8-69: Water Balance and Water Quality Model Process Diagram (RGS 2025)

8.8.2.1 Key Assumptions

- The Morwell River flood flows are connected via three spillways which are introduced at the start of the model start date. Flows from each spillway are provided by Alluvium as part of the 'Latrobe and Morwell River Flood Study 2025' (Alluvium 2025)
- The YEF lakes will overflow at RL 37m via spillway 4. Overflows are unconstrained by spillway capacity and/or tailwater conditions in the MRD/Latrobe.
- Lake filling water will be introduced to YTF as a seamless fill whereby the lake is filled to RL +37 m AHD without pause using the predicted average of 24 GL/yr
- Filling water will be transferring to YEF via the redundant conveyor tunnels
- Final operating level of the lake will be between RL 36-37m. Top up water from the Latrobe will be introduced if lake reaches RL36m after initial fill
- Climate modelling will follow the approach recommended by DELWP presented in "*Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria* (DELWP 2020)".
- Groundwater Flux for the pit is provided by GHD as part of the Hydrogeological Modelling Project (GHD 2025c)

8.8.2.2 Modelling Scenarios

There were six modelling scenarios / sensitivities undertaken as part of the WB/WQ modelling which are outlined in Table 8-12 below. The modelling included a natural fill base case scenario (Scenario 1) along with several project scenarios (Scenario 2 to 6).

Table 8-12: WB/WQ Modelling Scenarios

Scenario ID	Fill Sources (annual until reach RL + 37m AHD)	Morwell River connected?	Top-up water	Climate
Scenario 1	Local catchment flows, natural groundwater & pumped groundwater (1.5 GL to RL 0; 1 GL to RL 37; 0 GL ongoing).	No	No	Median
Scenario 2	Local catchment flows, natural groundwater, pumped groundwater (1.5 GL to RL 0; 1 GL to RL 37; 0 GL ongoing) & 24 GL Latrobe water.	Yes (flood flows only)	Yes	Median
Scenario 3	Local catchment flows, natural groundwater, pumped groundwater (1.5 GL to RL 0; 1 GL to RL 37; 0 GL ongoing), 34 GL Latrobe water & 14 GL Moondarra water.	Yes (flood flows only)	Yes	Median
Scenario 4	Local catchment flows, natural groundwater, pumped groundwater (1.5 GL to RL 0; 1 GL to RL 37; 0 GL ongoing) & 24 GL Latrobe water.	Yes (all)	Yes	Median
Scenario 5	Local catchment flows, natural groundwater, pumped groundwater (1.5 GL to RL 0; 1 GL to RL 37; 0 GL ongoing) & 24 GL Latrobe water.	Yes (flood flows only)	Yes	Dry
Scenario 6	Local catchment flows, natural groundwater, pumped groundwater (1.5 GL to RL 0; 1 GL to RL 37; 0 GL ongoing) & 24 GL Latrobe water.	No	Yes	Median

8.8.2.3 Climate approach

The climate simulated in the numerical WB/WQ model includes rainfall, evaporation and evapotranspiration. The base climate for the model is derived from *Scientific Information for Land Owners* (SILO) point interpolated data for the location of the Yallourn Township Field (geographic reference: -38.20, 146.35). The datasets were used to generate 100 stochastic realisations of 100-year long climate records for rainfall and evaporation for use in GoldSim. These Base Climate realisations could then be modified by climate change factors to generate the required climate to suit the modelling scenarios.

8.8.2.4 Application of DELWP Climate Factors

The DELWP '*Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria* (DELWP 2020) climate factors were applied for the period of up to year 2065. However, to run the model for the proposed 100 years, an additional ~67 years of predicted climate factors were necessary but not available. For this modelling, RGS linearly extrapolated the climate factors from 2040 to 2065 up to the year 2075 (according to DELWP guidelines) and then re-applied the factor for 2075 forward for the remainder of simulated 100 years forecast.

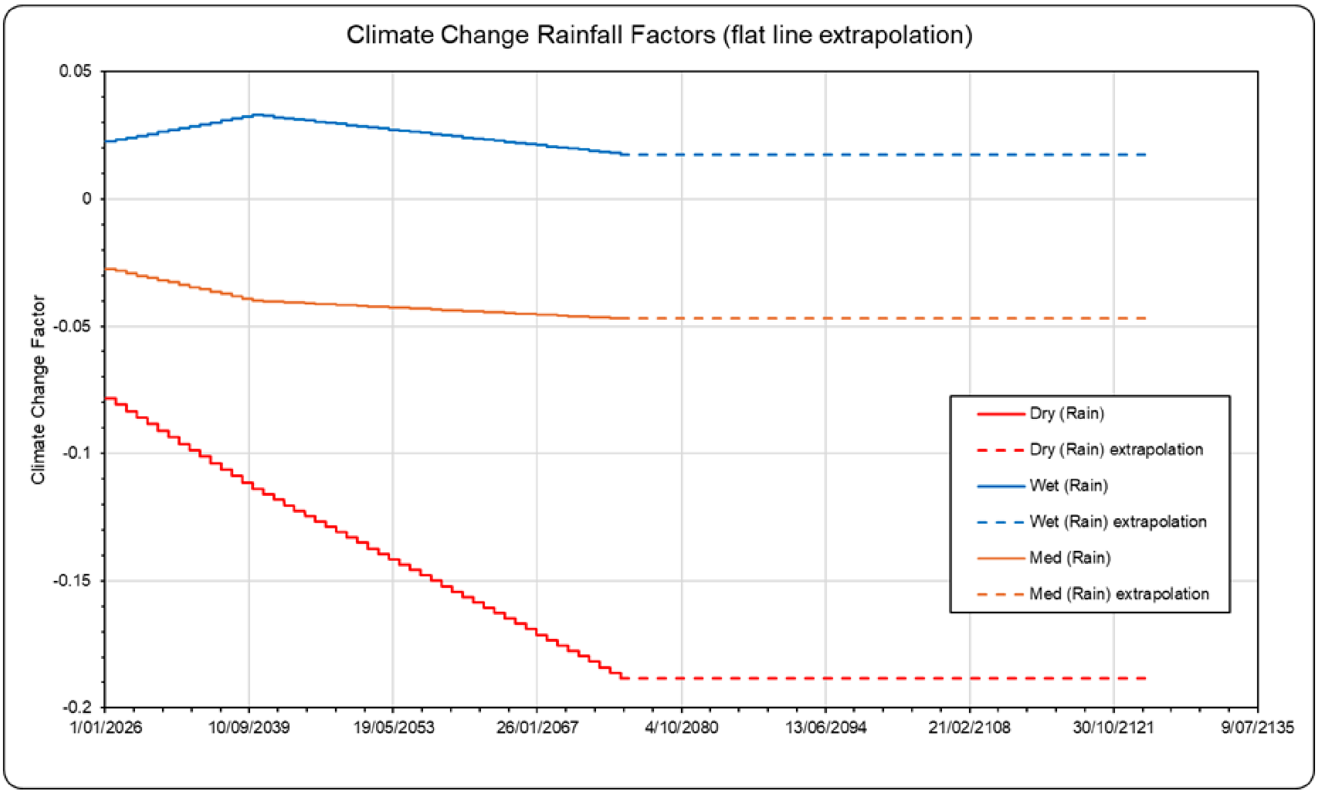


Figure 8-70: Climate change rainfall factors (RGS 2025)

8.8.2.5 Final Landform Modelling

The “final” landform surface of the pit voids and surrounding catchment area was provided by EAY in .dxf format in June 2022 (Figure 8-71)

The final landform surfaces were used in Deswik (geospatial and CAD software) to produce a range of input data to the GoldSim numerical model, including pit physical characteristics and stage curves and catchment areas. A summary of the pit(s) geometry inputs is provided in Table 8-13.

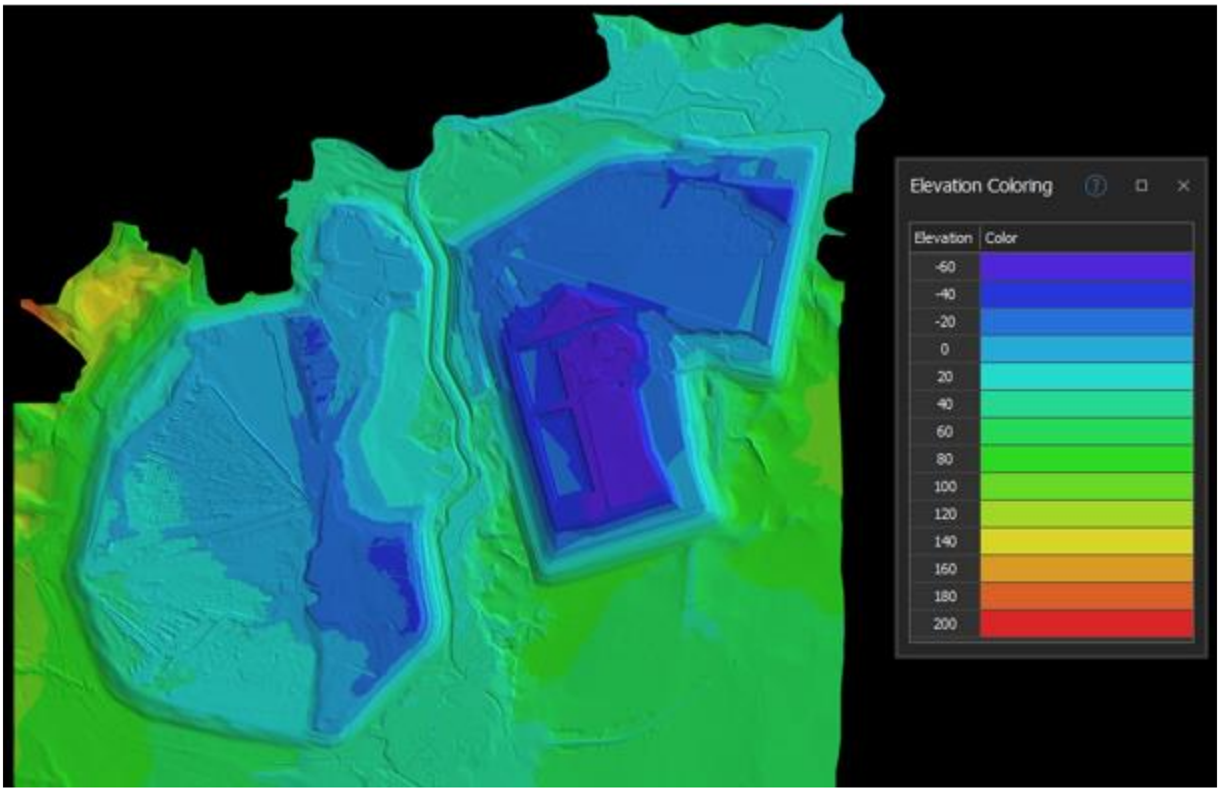


Figure 8-71: Final landform surface for YCM and surrounds (RGS 2025)

Table 8-13: Pit Void Geometry Summary

Pit Geometry Dataset	Description	Value
Pit maximum elevation	The elevation at which the pits are considered as "full". At this elevation, external pit fill sources will be switched off in the model. The pits will not require top-up at or above this elevation	RL +37 m
Pit maximum volume	Volume corresponding to the pit(s) maximum elevation. This is the volume at which the pits are considered as "full". At this volume, fill sources are switched off in the model and the pit does not require any top-up.	YTF: 249,278 ML YEF: 414,255 ML Total: 663,533ML
Pit freeboard elevation	The elevation at which the pit would spill/ overflow or flow through to the Latrobe River.	RL +37 m

8.8.2.6 Surface Water Catchments

The local catchment area draining to the pit was provided by (PSM) as an outcome of their surface water peripheral catchment study works (PSM 2025b) (Figure 8-72).

The catchments were then subdivided based on land use type by identifying different landform features to represent different land types. The catchments were then further sub-divided based on land use type was important in the model construction.

The different land use types assigned to a particular catchment and the rationale used to categorise each area is provided in Table 8-14.

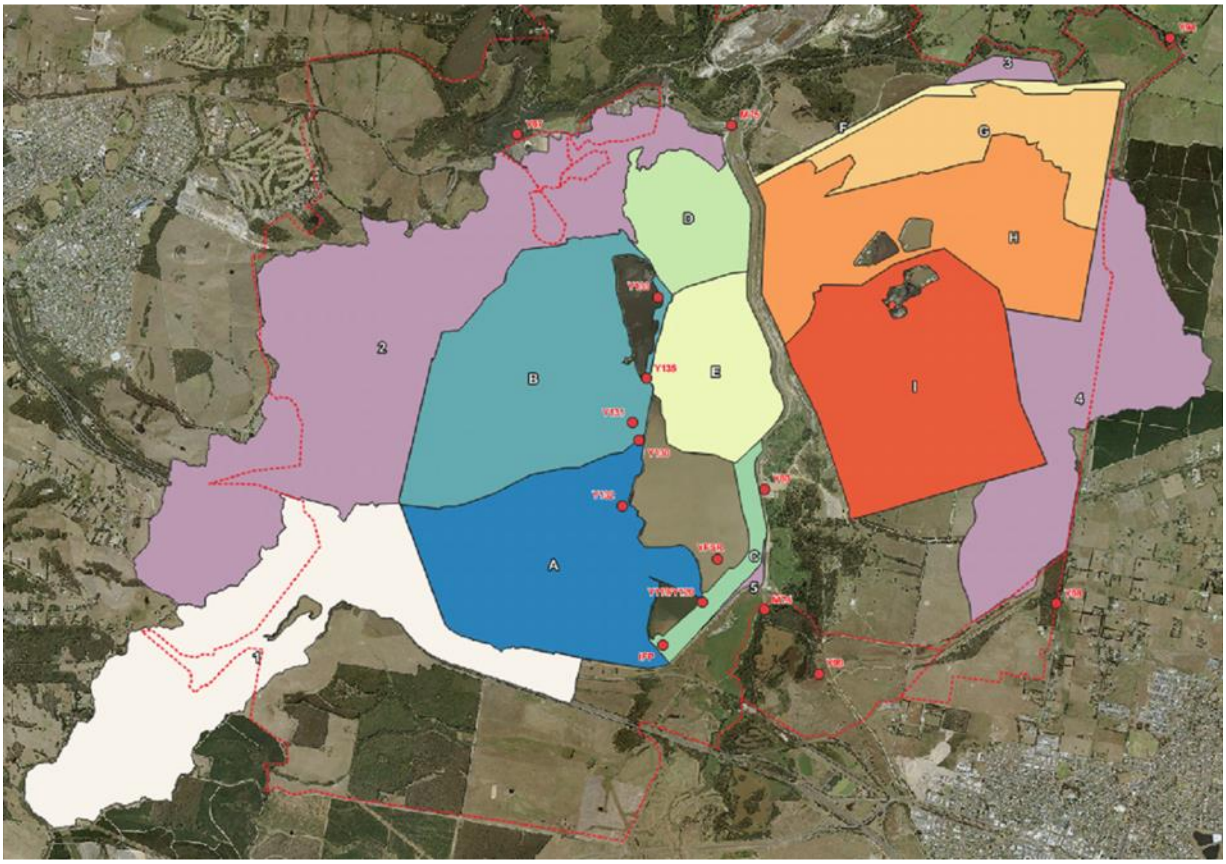


Figure 8-72: Sub-catchment boundaries draining to pit (RGS 2025)

Table 8-14: Sub catchment area descriptions

Land Use Type	Assigned Catchment	Description
Overburden	A, B, C, D, E, F, G, H, I.	Comprising the internal pit areas (pit floor and walls, up to the top of the batters), noting the majority of the pit floor is/ will be covered with overburden (bare spoil).
Natural undisturbed area	1, 2, 3, 4, 5.	Any area that remains in it’s natural, pre-mining project state and has not been disturbed by the pit or overburden areas. This includes all ex-pit catchments.

Table 8-15 summarises the sub-catchments and their areas determined using Deswik.CAD.

Table 8-15: Sub-catchment areas (RGS 2025)

Sub-catchment	Area (km^2)
Catchment 1: Witts Gully	5.1
Catchment 2: Railway Drain, Rifle Range Gully and Power Station	7.6
Catchment 3: North of YEF Northern Batters	0.2
Catchment 4: Hancock Victorian Plantations (HVP)/ Maryvale Transfer	3.7
Catchment 5: Above YTF MRD Batters	0.04
Catchment A: YTF Southern Overburden Dump	3.7
Catchment B: YTF Northern Overburden Dump	4.1
Catchment C: YTF MRD Batters	0.4
Catchment D: Midfield North	1.2
Catchment E: Midfield South	1.6
Catchment F: YEF North Batters	0.3
Catchment G: East Field	1.9
Catchment H: YEF Extension	3.4
Catchment I: Maryvale Field	4.1
Total	37.4

8.8.2.7 Surface Water Run Off

All local surface water inflows to the pit (and within the pit) and their hydrological response are simulated within the GoldSim model itself, using the Australian Water Balance Model (AWBM) as an in-built module.

The AWBM is a daily timestep hydrology model which takes in rainfall and evapotranspiration data, then simulates the infiltration, soil storage based on antecedent rainfall conditions, and the hydrological lag response in the catchment and produces runoff as a daily timestep. Figure 8-73 shows a schematic of the model logic. The model is able to simulate both surface runoff and shallow baseflow runoff, which together make up the total runoff.

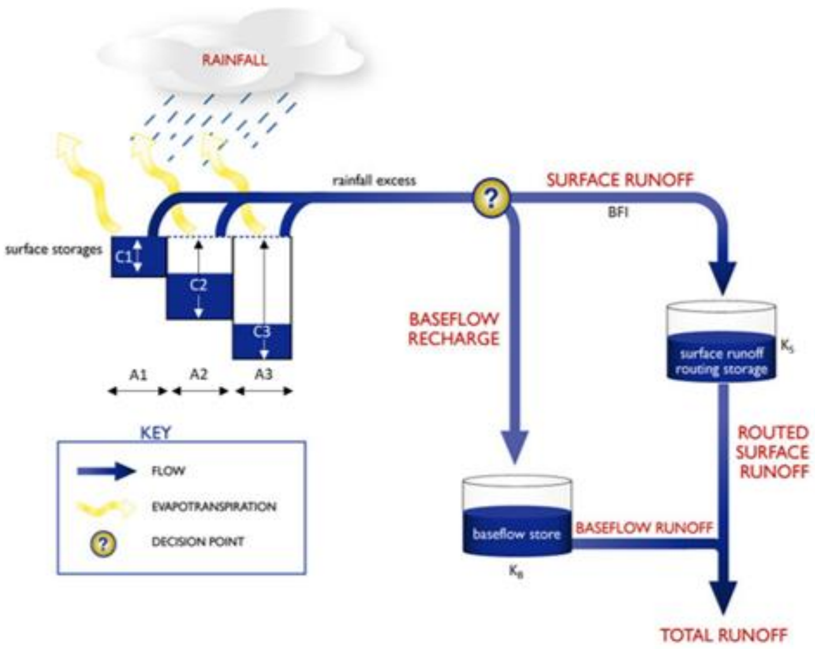


Figure 8-73: Schematic of the Australian Water Balance Model (RGS 2025)

Geochemical Source Terms

The source terms (geochemical inputs) are used in the WB/WQ model to estimate how the lake(s) water quality may evolve over time. The source terms have been generated from a combination of inferred, assumed and measured data. The general data used to derive the source terms is provided in Table 8-16.

Surface water and groundwater quality source terms were generally developed from historical site monitoring data. Seepage water quality for each of the overburden dumps and the Former Ash Ponds was inferred from measured groundwater data collected from bores installed in each of the dumps/ ash pond. Pit wall and overburden dump runoff water quality was inferred from wall washing experiments conducted on site.

When water quality data was below instrumental detection limits, concentrations equal to half the detection limit were applied to the source terms. As part of the Quality Assurance and Quality Control (QA/QC) process unit errors were corrected, and in some cases spurious results were deleted.

Median water quality data was applied to the model; however, the option of applying the 95th percentile is included in case of sensitivity analysis.

Some metals and metalloids may become significantly diluted in flood waters during high-rainfall (flood) events, while nutrients tend to be higher. For the Morwell River flood flow input, the median value was conservatively used in the model.

The historical groundwater measurements are missing sodium (Na) from the analysis suite, so a value 2/3 of the chloride concentration is applied in the model, this can be updated in future iterations of modelling.

Since pH is on a logarithmic scale, pH was converted to H^+ so that median and 95th percentile could be calculated for source term inputs.

The source terms for natural land runoff were conservatively inferred using median Rifle Range Gully data and Latrobe River water (Location Y97).

Table 8-16: Geochemical data to derive source terms

Type	Water Quality Input	Type	Description
Direct Precipitation	Rainfall	Measured water quality	Measured site rainfall measurements 14/06/2022 and 12/10/2022.
Pit fill and top-up potential waters	Latrobe Water (fill and top-up)	Measured (routine monitoring)	Latrobe River @ old Yallourn Pumphouse.
	Pumped Groundwater (fill and top-up)	Measured (routine monitoring)	M1A aquifer (sampling bores N5056 and N6899).
	Morwell River (flood flows)	Measured (routine monitoring)	Morwell River @ Pump House.
Surface Water	Natural catchments (Catchment 1, 2, 3, 4 and 5)	Inferred (routine monitoring)	Combination Rifle Range Gully and Yallourn River water (sampling location Y97).

Type	Water Quality Input	Type	Description
	Lake (starting water quality)	Measured (routine monitoring)	Combination of Fire Service Pond, Flocculation Pond and Lake Placid.
	Haunted Hill Formation (HHF) groundwater	Measured (routine monitoring)	HHF shallow aquifer (YTF): monitoring bores - (N6904, N7156, (N5207, N6656). HHF shallow aquifer (YEF): monitoring bores - (N7043, N5207, N6656).
Groundwater (flux)	Yallourn Coal	Measured (routine monitoring)	Yallourn Coal (YTF): monitoring bores - (N6904, N7156). Yallourn Coal (YEF): monitoring bores - (N7043).
	Yallourn Interseam	Measured (routine monitoring)	Yallourn Interseam (YTF): monitoring bores - (N6713, N6722, N6904, N7156). Yallourn Interseam (YEF): monitoring bores - (N6815).
	Seepage Catchment A: SOB Dump	Measured (routine monitoring)	Shallow groundwater bores: (N7430, N7428).
Seepage/ runoff water quality	Seepage Catchment B: NOB Dump	Measured (routine monitoring)	Shallow groundwater bores: (N7426, N7425).
	Seepage Catchment D: Former Ash Ponds	Measured (routine monitoring)	Shallow groundwater bores: (N7450, N7452, N7449).
	Seepage Catchment E: Midfield Dump	Measured (routine monitoring)	Shallow groundwater bores: (N7431, N7433).
	Catchment G and H: Eastfield Dump	Measured (routine monitoring)	Shallow groundwater bores: (N7442, N7438).
	Runoff/ baseflow Catchment C: Fire Service Pond & Flocculation Pond batters	Inferred pit wall experiments	Wall wash experiment data for three sites (2 weathered coal wall & 1 overburden wall; fire service pond & flocculation pond batters).
	Runoff Catchment A, B, D & E (overburden dumps)	Inferred pit wall experiments	Wall wash experiment data (overburden wall); Southern overburden batters.
	Runoff/ baseflow Catchment F: Latrobe River and Northern batters	Inferred pit wall experiments	Wall wash experiment data for two sites (2 weathered coal); Latrobe River and Northern batters.

Type	Water Quality Input	Type	Description
	Runoff/ baseflow Catchment I: Maryvale Field	Inferred pit wall experiments	Wall wash experiment data for two sites (1 weathered coal; 1 fresh coal); Maryvale field floor.

8.8.3 Findings

The following results section will be focusing on Scenarios 2 (Preferred Scenario) & 5 (Dry Climate Sensitivity) as the others modelling scenarios do not represent the lake design adopted. The alternative scenarios modelled were to help assess impacts of benefits of different closure options namely**,** Additional fill water (Scenarios 3), a complete MRD integration (Scenario 4) and no MRD integration (Scenario 6).

8.8.3.1 Water Balance

The water balance results are discussed below in terms of the time it takes to fill the lake(s) to the target water level (RL +37 m AHD) and the top-up volume required to maintain the lakes level. The sensitivity of the water balance to climate is also discussed.

8.8.3.1.1 Key inflows

The dominant water balance inputs are as follows (in approximate order of largest volume to smallest):

- Pumped Latrobe water fill
- Morwell River flood flows
- Direct rainfall
- For the YEF, tunnel transfer from the YTF.
- External catchment runoff.
- Internal catchment runoff
- Pumped groundwater.

8.8.3.1.2 Key Outflows

- The dominant outflows post filling is evaporation, except during those years when overflow occurs via Spillway 4
- For YTF the exchange of water to YEF (through the tunnels) is also a dominant outflow, particularly when there are Morwell River flood flows introduced which might cause a slight head imbalance between the two pits.
- Groundwater outflow (seepage) is generally very small relative to the other outflows.

Table 8-17 and Table 8-18 below summarise the **key pit inflows /outflows during the filling and post filling phases**

Table 8-17: Indicative annual pit inflows and outflows during filling

Scenario		2			5		
Statistic		Min	P50	Max	Min	P50	Max
Fill time		22.3	24.5	26.5	24.8	27.5	29.5
Indicative annual pit lake inflows (GL)							
Direct rainfall	YTF	1.59	5.57	10.55	1.50	4.28	9.84
	YEF	0.59	5.50	9.34	0.53	4.81	8.48
Internal catchments	YTF	0.08	0.70	3.50	0.06	0.77	3.04
	YEF	0.05	0.52	3.37	0.05	0.46	3.06
External catchments	YTF	0.31	1.70	5.84	0.25	1.30	4.76
	YEF	0.11	0.53	1.79	0.09	0.41	1.47
Groundwater inflow	YTF	0.65	0.80	1.42	0.55	0.86	1.42
	YEF	1.03	1.11	1.46	0.88	1.18	1.46
Groundwater pumped	YTF	0.00	0.00	0.00	0.00	0.00	0.00
	YEF	1.00	1.00	1.50	1.00	1.00	1.50
Conveyer transfer in	YTF	0.00	0.00	0.23	0.00	0.00	1.01
	YEF	8.01	11.93	49.57	6.03	12.73	42.81
MRD spillways	YTF	0.00	0.00	19.11	0.00	0.00	18.30
	YEF	0.00	0.00	15.59	0.00	0.00	15.24
Latrobe pumped in to first fill	YTF	23.98	23.98	24.05	23.98	23.98	24.05
Moondarra pumped in	YTF	0.00	0.00	0.00	0.00	0.00	0.00
Indicative annual pit lake outflows (GL)							
Evaporation	YTF	4.39	9.50	12.16	4.41	7.92	12.54
	YEF	1.26	9.28	10.29	1.22	8.93	10.62
Groundwater seepage	YTF	0.02	0.06	0.08	0.02	0.06	0.08
	YEF	0.01	0.06	0.08	0.01	0.04	0.08
Conveyor transfer out	YTF	8.01	11.93	49.57	6.03	12.72	42.81
	YEF	0.00	0.00	0.23	0.00	0.00	1.01

Table 8-18: Indicative annual pit inflows and outflows post filling

Scenario		2			5		
Statistic		Min	0.5	Max	Min	0.5	Max
Fill time		22.3	24.5	26.5	24.8	27.5	29.5
Pit lake inflows							
Direct rainfall	YTF	3.26	7.03	12.68	2.79	6.02	11.03
	YEF	2.77	5.97	10.78	2.37	5.12	9.37
Internal catchments	YTF	0.03	0.35	1.22	0.01	0.21	0.90
	YEF	0.03	0.39	1.37	0.01	0.23	1.00
External catchments	YTF	0.14	1.60	6.54	0.03	0.95	4.65
	YEF	0.06	0.50	2.01	0.02	0.31	1.43
Groundwater inflow	YTF	0.44	0.71	1.32	0.44	0.71	1.32
	YEF	0.80	1.00	1.35	0.80	1.00	1.35
Conveyer transfer in	YTF	0.00	0.00	1.12	0.00	0.06	1.22
	YEF	0.00	0.38	30.33	0.00	0.13	15.20
MRD spillways (not annual event)	YTF	0.00	0.00	30.43	0.00	0.00	15.73
	YEF	0.00	0.00	21.70	0.00	0.00	13.90
Latrobe topup after first fill (not annual event)	YTF	0.00	0.00	13.41	0.00	0.21	13.72
Pit lake outflows							
Evaporation	YTF	11.11	12.34	12.49	11.17	12.86	12.99
	YEF	9.81	10.48	10.57	9.96	10.93	11.01
Groundwater	YTF	0.04	0.05	0.07	0.04	0.05	0.07
	YEF	0.06	0.07	0.10	0.06	0.08	0.10
Conveyor transfer out	YTF	0.00	0.38	30.33	0.00	0.13	15.20
	YEF	0.00	0.00	1.12	0.00	0.06	1.22
Overflow	YEF	0.00	0.00	48.21	0.00	0.00	28.51

Note that Morwell River inflows and Latrobe water top-up is not an annual event so annual pit inflow statistics for these inputs are misleading. A full summary of the cumulative water balance results for each of the key contributing inflows and outflows is provided in the *Lake balance and water quality* report (RGS 2025).

8.8.3.1.3 Pit Fill Time

The results in Table 8-19 below show the time required to fill the lake to an elevation of RL +37 m AHD, while

Table 8-20 shows the volume of pumped water required to achieve first fill.

Table 8-19: Timeframes required to achieve the desired water level for each scenario

Scenario	Time to fill (years)					
	Mean	Min	P5	P50	P95	Max
2	25.3	23.0	23.6	25.5	26.6	27.4
5	28.1	25.7	26.6	28.4	29.5	30.0

Table 8-20: Volume of pumped water to achieve first fill for each scenario

Scenario	Volume pumped water to achieve first fill (GL)					
	Mean	Min	P5	P50	P95	Max
2	606.4	551.8	567.0	610.9	637.5	658.1
5	674.8	616.0	637.3	681.0	707.1	720.0

Figure 8-74 and Figure 8-75 below shows the lake level progression of the YTF and YEF respectively for all of the modelled scenarios using the 50th percentile results

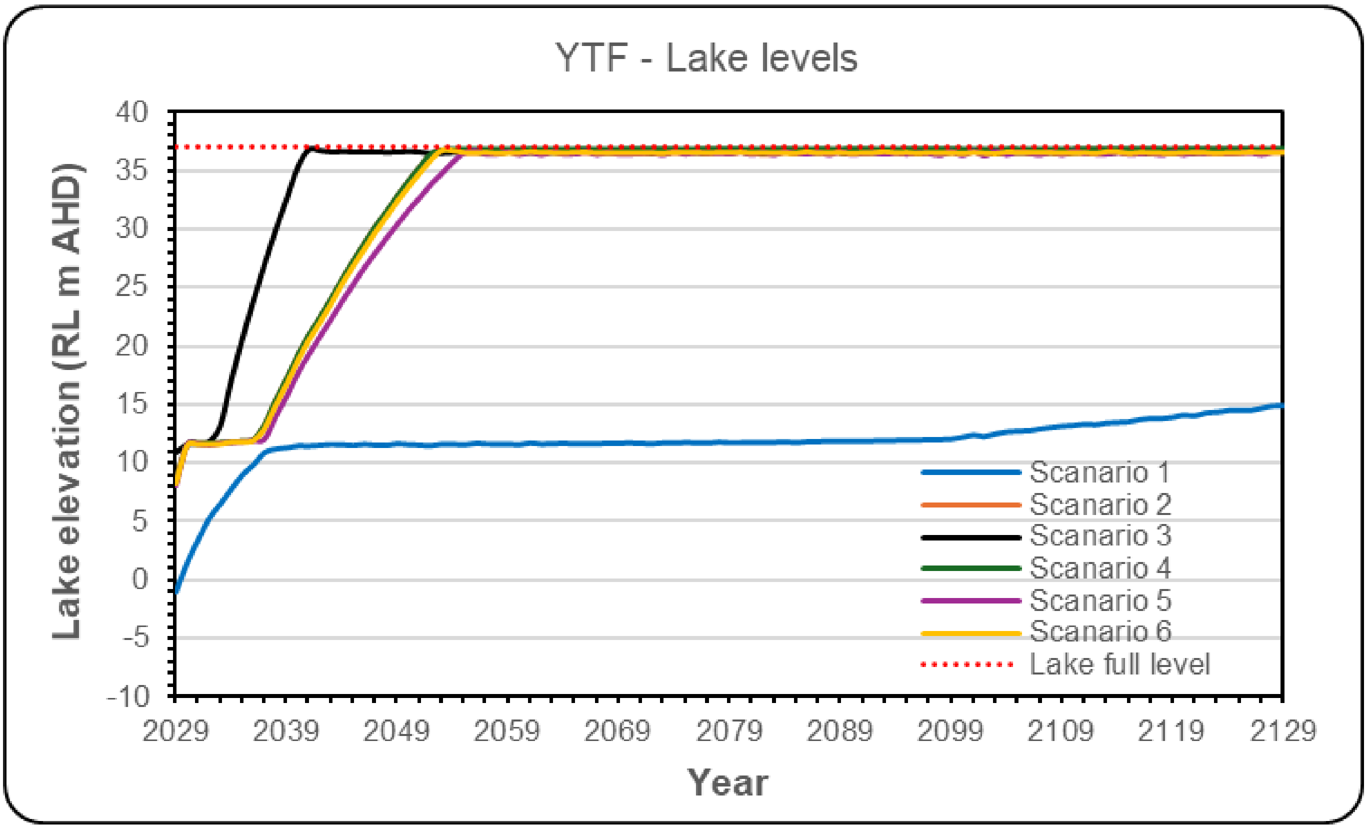


Figure 8-74 Pit lake water level for YTF (50th percentile)(RGS 2025)

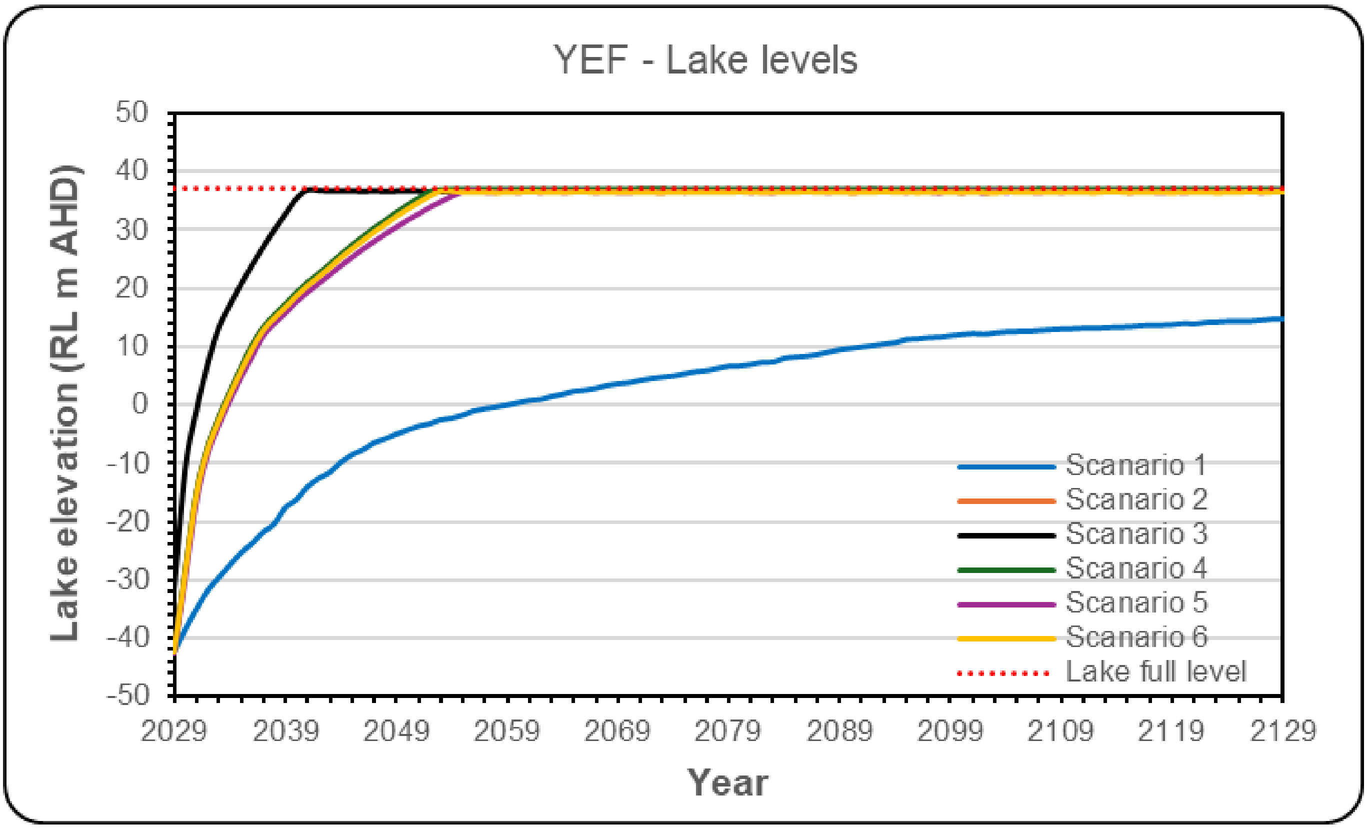


Figure 8-75: Pit lake water level for YEF (50th percentile) (RGS 2025)

8.8.3.1.4 Top Up Water

Pit top-up volumes are defined as the 'on going' inflow volumes from Latrobe water required to maintain the lake elevation at around RL +37m AHD. For both scenarios, the top-up takes place when the pit water level falls below minimum elevation of RL +36 m and it stops when the lake reaches the maximum elevation of RL +37 m

Table 8-21: Indicative annual pit top-ups (averaged over the years post filling), whilst

Table 8-22 shows the total volume of top-up required over the duration of the simulation (i.e. 100-years) for both scenarios.

Table 8-21: Indicative annual pit top-up (post initial fill)

Scenario	Indicative annual top-up (GL)					
	Mean	Min	P5	P50	P95	Max
2	2.61	2.10	2.23	2.62	2.96	3.17
5	4.66	4.13	4.35	4.66	5.00	5.10

Table 8-22: Volume of pumped water to maintain lake water levels (post initial fill)

Scenario	Indicative top-up volume over simulation period of 100 years (GL)					
	Mean	Min	P5	P50	P95	Max
2	170.0	0.0	147.5	172.5	194.9	198.6
5	324.7	291.2	309.3	324.5	341.8	351.3

Note the frequency for top-up is not an annual event.

The main factors that influence the lake top up water requirements include.

- Lake operating range
- Surface water catchment run off
- Evaporation
- Climate variability

The relatively narrow concept operating level of lake (i.e. 1m) results in the need to periodically top-up the pit from external water sources. Because there is notionally less time between large rainfall and flood events that would allow the lake to fill again naturally. By increasing the operating range of the lake, top up water requirements would decrease. However, this potentially adds complexity and costs to the lake design/construction with implications to the stability of the MRD and wave erosion requirements.

Another major factor influencing the top up water demand, is the surface water runoff from the local catchments that report to the lake post filling period. The catchments adopted within this modelling (as per above) constitute a 30% decrease in catchment area when compared to previous rehabilitation plans. This is mainly due the perceived practicality and requirements to implement diversions into the pit. By increasing the catchment area that is reporting the pit, the requirements for top of water would be reduced

In alignment with the LVRRS (DJPR and DELWP 2000), Morton's Shallow Lake Evaporation has been used as the basis for the initial modelling, this method gives an annual average evaporation of 1,068 mm for Yallourn which is 24% higher than the traditional pan evaporation converted lake evaporation.

Additionally, the decrease in rainfall over time, especially for the dry climate scenario, results in potential increase in annual top-up volume over time reducing direct rainfall and surface water runoff amounts

8.8.3.1.5 Climate Variability

The climate sensitivity analysis for the preferred scenario (Scenario 2 versus Scenario 5) show substantial differences for top-up requirements. For example, the mean top-up required in dry climate (Scenario 5), is approximately 30% more than required for the median scenario.

8.8.3.2 Water Quality

Hydrogeochemical modelling of the lakes water quality is an iterative process similar to the water balance modelling, with results for daily time steps available for the scenarios. Key results were exported from the model to summarise the key water quality results. A full summary of the water quality results can be found in *Lake balance and water quality* report (RGS 2025) (Appendix C – Technical Studies).

The modelled concentrations presented in this and following sections are all dissolved, and total concentrations are likely to be significantly higher (due to the contributions from particulates) especially for runoff from surrounding landforms. It also needs to be highlighted that the mass balance approach does not include mineral(s) precipitation (which would reduce dissolved concentrations in the lake for chemical species associated with the precipitated mineral), so the modelled results are considered conservative.

The modelled lake water qualities are compared to the revised *Australian and New Zealand Guidelines for fresh and marine water quality guidelines* – freshwater aquatic ecosystem (95% species protection) and livestock drinking water guidelines (ANZG 2018), as well as the *Australian Drinking Water Guidelines* (NRMMC 2011).

8.8.3.2.1 General Water Quality Trends

The general water quality trends for the lakes varies for different modelled parameters and reflect the dominant water balance inputs and geochemical source terms during the fill phase (Latrobe water fill, direct rainfall, catchment runoff and Morwell River flood flows) and the post fill phases (direct rainfall, catchment runoff, Latrobe water top-up and Morwell River flood flows).

The modelling shows that the estimated water qualities for each of the lakes (YTF and YEF) are different even through there is water transfer via the conveyor tunnels. Generally, the water quality of the YEF is marginally better for most modelled parameters than YTF, due a combination of the following points:

- The poorer seepage water quality associated with internal overburden dumps (NOB Dump, SOB Dump) and the Former Ash Ponds into YTF.
- The effects of evapoconcentration are greater for YTF lake due to its greater surface area and shallower depth.
- Solutes are generally released from YEF during flood events via Spillway 4 (once full).

8.8.3.2.2 Lake PH

The results for each of the modelled scenarios indicate that (mass balance) pH is slightly acidic to neutral over the simulation period, with a pH range of ~ pH 4.95 min to pH 5.56 max across scenarios 1 & 2. The pH of the YTF being approximately a 0.5 pH unit less than the modelled YEF. The modelling shows an estimated lake of pH of 5.05 & 5.5 (50th Percentile) for scenario 2 at the end of the 100-year period. A summary of the lake pH over the time period is shown in Table 8-23 below.

Table 8-23: Estimated pH values for YTF and YEF over time using mass balance approach

Parameter		pH					
Scenario		2			5		
Statistic	Year	Min	50%	Max	Min	50%	Max
YTF	5	4.25	4.31	4.45	4.24	4.29	4.40
	10	4.35	4.44	4.58	4.31	4.40	4.48
	25	4.65	4.99	5.15	4.62	4.65	4.96
	50	4.95	5.05	5.19	4.93	5.02	5.07
	75	4.95	5.05	5.18	4.93	5.02	5.11
	100	4.95	5.05	5.27	4.92	5.01	5.07
YEF	5	6.23	6.28	6.42	6.26	6.31	6.47
	10	6.29	6.32	6.33	6.30	6.32	6.33
	25	5.56	5.83	6.23	5.89	6.25	6.28
	50	5.42	5.50	5.58	5.40	5.47	5.54
	75	5.42	5.50	5.54	5.40	5.47	5.52
	100	5.42	5.50	5.56	5.40	5.46	5.54

The mass balance approach of modelling pH excludes key geochemical reactions, thermodynamic constraints and atmospheric equilibrium. When these reactions were applied it resulted in the pH of YTF decreasing from 5.09 to 4.50 (50th Perc) and the YEF increasing from 5.5 to 7.51 (50th Perc) in year 2079 as per Table 8-24

Table 8-24: Model estimated pH for the YTF and YEF pits for Scenario 2 after application of solubility controls and atmospheric equilibrium

Parameter	pH		
Pit	**Water Balance (50th Perc.)**	**Equilibrated with atmosphere**	**With mineral precipitation and sorption**
YTF	5.09	6.62	4.5
YEF	5.5	7.61	7.51

The thermodynamic modelling results indicate the YTF pit lake water quality lacks significant acid buffering capacity. Iron (oxy)hydroxide precipitation combined with other acidity sources (e.g. acid seepage from waste rock or pit walls) will likely consume available alkalinity resulting in acid pH conditions.

However, it should be noted that the iron inputs from the WB/WQ modelling may be significantly overestimated due to colloids passing through 45 µm filters, as applied to characterise source terms from field water samples. If this is the case, iron (oxy)hydroxide precipitation may not release enough acidity to neutralise the available alkalinity in the YTF pit water. Similarly, groundwater inflows from the HHF may oxidise prior to entering the lake; this would also result in a decrease in the iron inputs. Further detailed thermodynamic modelling and/or surface water monitoring of source terms and pit lake water may be required to resolve this.

8.8.3.2.3 Lake salinity and major ions

The estimated water qualities for the lakes are dominated by the major ions sulfate (SO_4), chloride (Cl), sodium (Na), with lesser magnesium (Mg), calcium (Ca) and potassium (K). Iron, not a major ion, is also a dominant contributor to the lake water quality; however, this is likely overly conservative due to the mass balance approach of modelling and the potential overestimation of iron concentrations due to colloids passing through filtration (RGS 2025).

The estimated TDS concentrations for the lakes varies only slightly between Scenario 2 & 5 being 575 mg/L (minimum) to 591 mg/L (maximum) for YTF lake and 465 mg/L (minimum) to 476 mg/L (maximum) for YEF lake. The tight range in estimated TDS values is due to the fill and top-up water qualities dominating the lake water balance regardless of scenario.

The TDS and major ion concentration probabilities (maximum and minimum) at 5, 10, 25, 50, 75 and 100 years were compared with the assessment criteria shown in Table 8-25 below. TDS, Sulfate and Calcium are all well below the guideline (2,400 mg/L, 1,000 mg/L and 1,000 mg/L, respectively) for both of the scenarios.

Table 8-25 - Summary of model estimated TDS and major ion water qualities for each of the project scenarios at select years.

Guideline			TDS (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Magnesium (mg/L)		Potassium (mg/L)		Sodium (mg/L)		Sulfate (mg/L)	
ADWG (NRMC, 2011)			-		-		-		-		-		-		-	
Freshwater aquatic ecosystem (ANZG, 2018)			-		-		-		-		-		-		-	
Livestock Drinking Water (ANZG, 2018)			2400		1000		-		-		-		-		1000	
Sc	Pit	Ye	Min	Ma	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2	YTF	**5**	46	489	6.21	6.53	123	127	29	30	1.25	1.37	80	84	173	185
		10	51	558	6.81	7.60	130	138	32	35	1.33	1.48	86	91	198	221
		25	54	588	6.87	7.46	144	156	33	36	1.35	1.50	95	103	200	216
		50	57	591	7.25	7.56	153	156	35	36	1.44	1.52	101	103	211	217
		75	57	591	7.24	7.61	153	156	35	36	1.43	1.53	101	103	211	217
		10	57	591	7.25	7.66	152	157	35	36	1.43	1.55	101	104	211	217
	YEF	**5**	49	510	5.29	5.50	305	323	29	30	2.55	2.63	209	222	74	79
		10	50	515	5.19	5.35	331	341	29	30	2.61	2.65	227	234	68	70
		25	47	497	4.49	5.09	327	333	28	29	2.48	2.67	227	231	59	66
		50	46	478	4.38	4.58	325	333	28	29	2.45	2.51	226	231	57	59
		75	46	476	4.38	4.50	324	332	28	28	2.45	2.50	225	231	57	59
		10	46	476	4.38	4.55	325	332	28	28	2.45	2.50	226	231	57	59
5	YTF	**5**	47	489	6.22	6.46	124	127	29	30	1.25	1.34	81	84	175	186
		10	50	545	6.64	7.39	129	136	31	34	1.30	1.42	84	90	192	214
		25	53	579	6.85	7.30	141	154	33	35	1.35	1.44	93	101	199	213
		50	57	591	7.26	7.46	153	157	35	36	1.43	1.48	101	103	212	218
		75	57	591	7.26	7.44	153	157	35	36	1.43	1.48	101	103	212	218
		10	57	591	7.26	7.44	153	157	35	36	1.43	1.47	101	103	211	218
	YEF	**5**	49	517	5.31	5.53	307	324	29	30	2.55	2.65	210	222	74	80
		10	50	517	5.21	5.29	334	342	29	30	2.62	2.65	229	234	69	69
		25	48	509	4.79	5.15	329	340	29	30	2.59	2.68	228	234	62	67
		50	46	476	4.38	4.53	326	333	28	28	2.45	2.50	227	231	57	59
		75	46	475	4.38	4.47	326	332	28	28	2.45	2.49	226	231	57	58
		10	46	475	4.37	4.49	325	332	28	28	2.45	2.50	226	231	57	59

8.8.3.2.4 Lake Metals and Metalloids

The minimum and maximum metal and metalloid statistics probabilities have been compared with the revised *Australian and New Zealand Guidelines for fresh and marine water quality guidelines* – freshwater aquatic ecosystem (95% species protection) and livestock drinking water guidelines (ANZG 2018), as well as the *Australian Drinking Water Guidelines* (NRMMC 2011) shown in Table 8-26**.** These guidelines are provided for context only as the modelling excludes key biogeochemical processes which may affect solute concentration results. For example, some minerals may become supersaturated (beyond saturation point) and are therefore likely to precipitate out of the lake (forming minerals) which would reduce the estimated modelled concentrations for the associated chemical species. Similarly, some metals and metalloids may co-precipitate with the mineral(s) or adsorb to the surface of mineral(s) reducing their dissolved concentrations in the lake. The mass balance approach to modelling metal and metalloid concentrations is therefore considered conservative.

Table 8-26: Summary of estimated metal and metalloid concentrations at select years

Guideline			Aluminium (mg/L)		Arsenic (mg/L)		Cadmium (mg/L)		Chromium (mg/L)		Copper (mg/L)		Lead (mg/L)		Manganese (mg/L)		Molybdenum (mg/L)		Nickel (mg/L)		Selenium (mg/L)		Zinc (mg/L)	
ADWG (NRMC, 2011)			-		0.01		0.002		0.05		2		0.01		0.5		0.05		0.02		0.01		-	
Freshwater aquatic ecosystem (ANZG, 2018)			0.055		0.024		0.0002		0.001*		0.0014		0.0034		1.9		-		0.011		0.011		0.008	
Livestock Drinking Water (ANZG, 2018)			5		0.5		0.01		1		1		0.1		-		0.15		0.02		0.02		20	
Scenario	Pit	Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2	YTF	5	0.145	0.164	0.0023	0.0025	0.00003	0.00003	0.00032	0.00035	0.0019	0.0019	0.0014	0.0014	0.47	0.5	0.00045	0.00046	0.0062	0.0066	0.0006	0.0008	0.084	0.09
		10	0.154	0.175	0.0024	0.0025	0.00003	0.00003	0.00032	0.00034	0.0021	0.0023	0.0013	0.0014	0.54	0.61	0.00046	0.00048	0.0068	0.0073	0.0007	0.0008	0.09	0.095
		25	0.16	0.179	0.0027	0.003	0.00003	0.00003	0.00035	0.0004	0.0021	0.0023	0.0015	0.0017	0.55	0.59	0.00049	0.00054	0.0074	0.008	0.0007	0.0009	0.096	0.104
		50	0.17	0.182	0.0029	0.003	0.00003	0.00003	0.00037	0.00039	0.0022	0.0023	0.0016	0.0017	0.57	0.59	0.00052	0.00054	0.0078	0.008	0.0008	0.0008	0.102	0.104
		75	0.169	0.185	0.0029	0.003	0.00003	0.00003	0.00037	0.0004	0.0022	0.0023	0.0016	0.0017	0.57	0.59	0.00052	0.00054	0.0078	0.008	0.0008	0.0009	0.102	0.104
		100	0.17	0.187	0.0029	0.003	0.00003	0.00003	0.00037	0.0004	0.0022	0.0023	0.0016	0.0017	0.57	0.59	0.00052	0.00055	0.0078	0.008	0.0008	0.0008	0.102	0.104
	YEF	5	0.267	0.274	0.002	0.0021	0.00007	0.00007	0.0005	0.00051	0.0009	0.001	0.0058	0.0062	0.21	0.23	0.00058	0.0006	0.0094	0.0099	0.0017	0.0018	0.224	0.238
		10	0.265	0.271	0.002	0.002	0.00007	0.00007	0.00049	0.0005	0.0008	0.0009	0.0061	0.0063	0.2	0.2	0.00058	0.00059	0.01	0.0103	0.0018	0.0018	0.232	0.239
		25	0.298	0.31	0.002	0.0021	0.00007	0.00007	0.0005	0.00053	0.0007	0.0008	0.0069	0.0076	0.17	0.19	0.00053	0.00058	0.0097	0.01	0.0019	0.002	0.263	0.282
		50	0.296	0.306	0.002	0.002	0.00007	0.00007	0.00049	0.00051	0.0006	0.0007	0.0073	0.0077	0.16	0.17	0.00052	0.00054	0.0097	0.0099	0.0019	0.002	0.278	0.284
		75	0.296	0.304	0.002	0.002	0.00007	0.00007	0.00049	0.00051	0.0006	0.0007	0.0074	0.0077	0.16	0.17	0.00052	0.00054	0.0096	0.0099	0.0019	0.002	0.278	0.284
		100	0.296	0.305	0.002	0.002	0.00007	0.00007	0.00049	0.00051	0.0006	0.0007	0.0074	0.0077	0.16	0.17	0.00052	0.00054	0.0097	0.0099	0.0019	0.002	0.278	0.284
5	YTF	5	0.145	0.159	0.0024	0.0025	0.00002	0.00003	0.00031	0.00034	0.0019	0.0019	0.0014	0.0014	0.48	0.5	0.00044	0.00046	0.0063	0.0066	0.0006	0.0008	0.085	0.089
		10	0.151	0.164	0.0025	0.0025	0.00003	0.00003	0.00032	0.00034	0.002	0.0022	0.0014	0.0014	0.53	0.59	0.00045	0.00047	0.0067	0.0071	0.0006	0.0007	0.089	0.094
		25	0.16	0.171	0.0027	0.0029	0.00003	0.00003	0.00034	0.00038	0.0021	0.0022	0.0015	0.0016	0.54	0.58	0.00049	0.00052	0.0072	0.0079	0.0007	0.0008	0.095	0.102
		50	0.17	0.176	0.0029	0.003	0.00003	0.00003	0.00037	0.00039	0.0022	0.0023	0.0017	0.0017	0.58	0.59	0.00052	0.00054	0.0078	0.008	0.0007	0.0008	0.102	0.104
		75	0.169	0.175	0.0029	0.003	0.00003	0.00003	0.00037	0.00039	0.0022	0.0023	0.0016	0.0017	0.58	0.59	0.00052	0.00054	0.0078	0.008	0.0007	0.0008	0.102	0.104
		100	0.169	0.174	0.0029	0.003	0.00003	0.00003	0.00037	0.00039	0.0022	0.0023	0.0016	0.0017	0.57	0.59	0.00052	0.00054	0.0078	0.008	0.0007	0.0008	0.102	0.104
	YEF	5	0.265	0.275	0.0021	0.0021	0.00007	0.00007	0.0005	0.00051	0.0009	0.001	0.0058	0.0062	0.21	0.23	0.00058	0.0006	0.0095	0.01	0.0017	0.0018	0.225	0.236
		10	0.266	0.268	0.002	0.0021	0.00007	0.00007	0.00049	0.0005	0.0008	0.0009	0.0061	0.0063	0.2	0.2	0.00058	0.00059	0.0101	0.0103	0.0018	0.0018	0.236	0.239
		25	0.276	0.307	0.002	0.0021	0.00007	0.00007	0.0005	0.00053	0.0007	0.0008	0.0065	0.0072	0.18	0.19	0.00056	0.00059	0.0099	0.0102	0.0018	0.002	0.248	0.275
		50	0.296	0.303	0.002	0.002	0.00007	0.00007	0.00048	0.0005	0.0006	0.0007	0.0075	0.0077	0.16	0.17	0.00052	0.00053	0.0097	0.0099	0.0019	0.002	0.278	0.284
		75	0.296	0.301	0.002	0.002	0.00007	0.00007	0.00049	0.0005	0.0006	0.0007	0.0075	0.0077	0.16	0.17	0.00052	0.00053	0.0097	0.0099	0.0019	0.002	0.278	0.283
		100	0.296	0.302	0.002	0.002	0.00007	0.00007	0.00049	0.0005	0.0006	0.0007	0.0075	0.0077	0.16	0.17	0.00052	0.00053	0.0097	0.0099	0.0019	0.002	0.278	0.283

The comparison of the results against the guidelines is summarised in the following points:

Aluminium exceeds the freshwater aquatic ecosystem (95% species protection) guideline (ANZG, 2018) (0.055 mg/L) for both scenarios in both lakes. Aluminium was well below livestock drinking water guidelines (5 mg/L), and no trigger level exists for ADWG. The cause of the aluminium exceedance, relative to freshwater aquatic ecosystem (95% species protection) guideline (ANZG, 2018), is due to several source term inputs which also show exceedance: Latrobe water (median = 0.27 mg/L), Morwell River (median = 0.26 mg/L), groundwater (median = 0.07 to 0.4 mg/L) and Latrobe top-up (median = 0.17 mg/L) (amongst other sources). It is common for colloidal aluminium (and iron) to pass through size 45 µm filter paper resulting in an overestimation of the dissolved concentration.

Copper exceeds the freshwater aquatic ecosystem (95% species protection) guideline (ANZG, 2018) (0.0014 mg/L) for all scenarios in the YTF; noting copper concentrations are below guidelines in the YEF copper is well below livestock drinking water guidelines (1 mg/L), and ADWG (2 mg/L). The cause of the copper exceedance, relative to freshwater aquatic ecosystem (95% species protection) guideline (ANZG, 2018), is mainly due to Latrobe water (median =0.001 mg/L), Morwell River (median =0.002 mg/L), groundwater (median =0.002 to 0.003 mg/L) and local rainfall quality (median = 0.005 mg/L).

Zinc exceeds the freshwater aquatic ecosystem (95% species protection) guideline (ANZG, 2018) (0.008 mg/L) for both scenarios. Zinc was well below livestock drinking water guidelines (20 mg/L), and no trigger level exists for ADWG. The cause of the zinc exceedance, relative to freshwater aquatic ecosystem (95% species protection) guideline (ANZG, 2018), is due to multiple sources, including rainfall (median =0.044 mg/L) and groundwater (median =0.025 to 0.039 mg/L) (amongst other sources).

Lead exceeds the freshwater aquatic ecosystem (95% species protection) guideline (ANZG, 2018) (0.0034 mg/L) in the YEF while lead in the YTF is below the same guideline for both scenarios. The cause of the lead exceedance, relative to freshwater aquatic ecosystem (95% species protection) guideline (ANZG, 2018), is due to seepage and runoff water quality source terms associated with the pit walls and floor.

Manganese marginally exceeds the ADWG (0.5 mg/L) for all scenarios in the YTF lake; noting that there are no exceedances for manganese in the YEF lake. Manganese generally exceeds the ADWG guideline after 10 to 25 years. The cause of the manganese exceedance, relative to ADWG, is due mainly to seepage from the Former Ash Ponds and NOB Dump.

Copper and zinc levels are elevated relative to freshwater aquatic ecosystem (95% species protection) guideline throughout the Morwell and Latrobe catchments and are present in rainfall at concentrations of approx. 50 µg/L, likely due to burning of coal at power stations throughout the Latrobe Valley. It is expected that a reduction in the burning of coal in the Latrobe Valley will reduce the supply of copper and zinc to the system and thus reduce the modelled lake concentrations for these parameters. Similarly, the presence of lead in the pit walls and floor is likely associated with power stations in the Latrobe Valley. Over time, as the power stations are decommissioned, it is expected that the lead concentrations to the system will also decrease. The modelled results reflect the static nature of the source terms used in the model.,

8.8.3.2.5 Thermodynamic modelling

Further to the approach discussed above, considerations of the thermodynamic constraints (mineral solubility) and atmospheric equilibrium was undertaken using PHREEQC software on the mass balance results for Scenario 2 for Years 2029 to 2129.

For the YEF, the thermodynamic modelling showed that when allowed to precipitate, iron (oxy)hydroxides remove dissolved aluminium from the pit water significantly reducing dissolved aluminium concentration from ~0.3 mg/L to <0.005 mg/L (i.e. below guideline value). Similarly, sorption of copper and zinc ions on precipitating iron (oxy)hydroxides resulted in notable concentration decreases. Mass balance copper decreased to <0.0001 mg/L on thermodynamic modelling. Mass balance zinc decreased significantly but still exceeded the freshwater aquatic ecosystem (95% species protection) guideline.

For the YTF, the thermodynamic modelling had little influence on the mass balance results for aluminium, manganese, copper and zinc because of the low modelled pH conditions which increase metal solubility keeping metals in solution. However, as mentioned above, if the modelled acidic pH in YTF is due to overestimated iron concentration inputs in the WB/WQ model, then correction / update could result in neutral pH conditions and decreased solubility which would decrease modelled concentrations similar to the values modelled. A summary of the thermodynamic modelling results is shown in Table 8-27 below.

Table 8-27: Summary of model estimated water qualities for the YTF and YEF pits for Scenario 2 after application of solubility controls and atmospheric equilibrium.

Chemical Para-meter	Unit	YTF pit (Year 2079)			YEF pit (Year 2079)		
		Water balance (50th perc.)	Equilibrated with atmosphere	With mineral precipitation and sorption	Water balance (50th perc.)	Equilibrated with atmosphere	With mineral precipitation and sorption
pH	pH unit	5.09	6.62	4.50	5.50	7.61	7.51
Alkalinity	mg/L as CaCO3	25	5.33	<0	55	40.8	28.3
TDS	mg/L	584	540	522	471	720	690
Ca	mg/L	7.37	7.37	7.37	4.45	4.45	4.45
Mg	mg/L	35	35.5	35.5	28	28.2	28.1
Na	mg/L	102	102	102	229	229	229
K	mg/L	1.46	1.46	1.46	2.48	2.49	2.49
SO4	mg/L	214	214	214	58	58	58
Cl	mg/L	155	155	155	329	330	330
F	mg/L	0.114	0.114	0.114	0.055	0.0549	0.0549
Al	mg/L	0.173	0.173	0.173	0.301	0.301	0.00405
Fe	mg/L	19.9	19.94	5.98	11.7	11.7	0.00010
Mn	mg/L	0.58	0.582	0.582	0.166	0.166	0.166
As	mg/L	0.0030	0.0030	0.0030	0.0020	0.0020	<0.00001
Cd	mg/L	0.00003	0.00003	0.00003	0.00007	0.00007	<0.00001
Cr	mg/L	0.0004	0.0004	0.0004	0.0005	0.0005	<0.00001
Cu	mg/L	0.0023	0.0023	0.0023	0.0007	0.0007	<0.00001
Ni	mg/L	0.0079	0.0079	0.0079	0.0098	0.0098	0.00682
Pb	mg/L	0.0017	0.0017	0.0017	0.0002	0.0002	<0.00001
Zn	mg/L	0.103	0.103	0.103	0.282	0.282	0.112

8.8.3.3 Key Findings

- The modelling showed that the pit filled to RL +37 m AHD within 26.4 years with the mean being 24.4 for the preferred scenario
- The climate change sensitivity analysis showed that the pit fill timeframes were somewhat sensitive to climate (medium versus dry showed a +2.8-year (mean probability) increase in fill time).
- The requirement for the top-up occurs when the evaporation from the lake surface exceeds the lake inflow volumes. When that occurs, the annual top-up (for such year) varies between 1.8 – 3.9GL depending on climate approach
- The modelling indicates that YTF pH will be slightly acidic over the simulation period, however this could be influenced by an over estimation of iron inputs from the source terms
- The water qualities for each of the scenarios and sensitivities for all scenarios are dominated by the major ions (namely sulfate, chloride and sodium), with metal and metalloid concentrations relatively low in comparison.
- All modelled parameters are below the livestock drinking water guidelines (ANZG 2018) for all probabilities and scenarios.
- In YEF, aluminium, zinc & lead exceeded the freshwater aquatic ecosystem (95% species protection) using the mass balance approach, however when the thermodynamic constraints were considered, aluminium reduced below the guideline while zinc decreased significantly but it still exceeded

- In YTF, aluminium, zinc & copper all exceeded the freshwater aquatic ecosystem (95% species protection) guideline (ANZG 2018) under the mass balance approach and the thermodynamic modelling had little influence on the mass balance results due to low modelled pH conditions. However, as mentioned above, these results may be influenced by an over estimation of iron inputs.
- These metal exceedances are primarily driven by background water quality in the river system, not chemical reactions within the lake.
- Modelling showed manganese slightly exceeds the ADWG (NRMMC 2011) in the YTF lake after ~10 to 25 years; noting that there are no exceedances for manganese in the YEF lake.
- Some of the elevations likely reflect the static nature of the geochemical source terms used in the model. As some source term qualities may improve with time improving the modelled lake water qualities.
- Climate sensitivity and the impacts of climate change on the lake water quality is limited, due to the dominance of fill inputs, and the availability of Latrobe top-up water in the model

8.8.3.4 Key Knowledge Gaps

- Understand the appropriate estimation of iron inputs into the modelling and understanding its effects on the predicted water quality results (pH, metalloids) (KG33 in Table 17-1).
- Once further modelling is completed, likely guideline exceedances will be risk assessed to determine their impact and further controls (KG15 in Table 17-1).
- The requirement, availability and source of top up water for the lakes. i.e. further work will be required to optimise the lake operating level and peripheral catchment diversions (KG22 and KG32 in Table 17-1).
- Understand the most representative evaporation rate for the lake (Morton’s Lake Vs Corrected Class A Pan Evaporation (KG27 in Table 17-1).
- Hydrodynamic modelling to review temperature and total dissolved solids stratification is underway (KG03 in Table 17-1) and will include an additional stage for nutrient modelling (K04 Table 17-1). This will inform a review of the lake stratification and turnover (KG21 in Table 17-1) and provide guidance on whether the lake might promote algal growth (KG26 in Table 17-1).

8.9 Geotechnical Batter Stability

8.9.1 Introduction

Geotechnical studies are core components to Yallourn Mine rehabilitation. Without geotechnically stable conditions, the rehabilitation objectives to deliver safe, stable, and sustainable landform cannot be met. The geotechnical studies completed rely on the geological, groundwater, and surface water assessments, presented in prior sections of Chapter 8.

Yallourn Mine is a complex system with a number of mutually interacting components. It has evolved and become more complex over its long history of operations, as the pit voids have increased in size over more than a century of mining. Geotechnical stability of the mine and the immediate surrounding areas is contingent on this history. Significant stability incidents have previously occurred and whilst most involve multiple complex and interactive elements, they share many common factors, including:

- The critical role of water and water pressures
- Long gestation periods, where instability develops over the medium to longer term, rendering the system sensitive to an adverse water loading event that ultimately triggers instability
- Failure of water diversion structures, which provide a source for adverse water loading

The principal batter failure mechanism of large-scale failures and stability incidents within the Latrobe Valley coal mines is block-sliding of the coal along the underlying interseam clays. The mechanism is primarily driven by water loading in pre-existing sub-vertical joints in the coal. Therefore, the primary control to maintain long-term global stability is flooding of the pit to a high elevation. Yallourn Mine is unlike the other two Latrobe Valley mines because:

- There is substantial topographic relief around the mine, with large parts of the mine rising well above the final RL37 m lake level. Thus, both rising topography and surface catchments extend well outside the mine.
- There are more complex larger-scale geological structures present, which lie close to but outside the mine crests (e.g. the Yallourn Monocline).

The destabilising water load risks that are posed by the peripheral catchments will remain after lake full stage. This condition primarily exists to the west of side of Township Field, where the topography rises to the west. Such risks can be well managed by the implementation of surface drainage measures proposed for rehabilitation, discussed in Section 8.7. Therefore, controlling the risk of adverse water loading of the coal through passive management systems will remain critical to maintaining long-term batter stability beyond mine rehabilitation at Yallourn.

Ground instability risks will continue to require management post-cessation of mining, during the rehabilitation phase and post lake fill. During operations there are many active controls in place which reduce the risk of ground instability. One of the key aims of the rehabilitation design is to significantly reduce the number of active controls and move towards passive controls.

8.9.2 Methodology

8.9.2.1 Geotechnical and Surface Water Domains

Geotechnical domains are used to divide the site into sensible management portions by grouping spatial areas with similar characteristics. The geotechnical domains are defined by their mine batter alignments but also include physical conditions of the ground such as the geology, geotechnical characteristics, hydrogeology and surface water management, internal infrastructure such as the MRD, external receptors such as the railway, and future mining. A list of the Geotechnical Domains and abbreviations is shown below with a supporting map shown in Section 3.7.10 (Figure 3-7). The MRD domain is detailed in Section 8.12.

In addition to the geotechnical domains there are also surface water domains, which incorporate the surface water catchment area for each of the geotechnical domains. For some domains the surface water catchment is limited to the geotechnical domain itself. For some surface water domains, the peripheral catchments extend kilometres beyond the mine and geotechnical domain boundaries. These are also shown in Section 3.7.10 (Figure 3-8). The interdependence between geotechnical and surface water features and character are also discussed in Section 8.7.

Table 8-28: List of Geotechnical Domains and Abbreviations

Geotechnical Domain	Abbreviation	Geotechnical Domain	Abbreviation
Yallourn Township Field Fire Service Pond Batter	YTF FSP	Yallourn East Field Northern Batter West	YEF NB (West)
Yallourn Township Field Flocculation Pond Batter	YTF FPB	Yallourn East Field Northern Batter East	YEF NB (East)
Yallourn Township Field Southern Batter	YTF SB	Yallourn East Field Latrobe River Batter	YEF LRB
Yallourn Township Field South West Batter	YTF SWB	Yallourn East Field Extension Latrobe Road Batter North	YEFX LREB (North)
Yallourn Township Field Hernes Oak Batter South	YTF HOB (South)	Yallourn East Field Extension Latrobe Road Batter South	YEFX LREB (South)
Yallourn Township Field Hernes Oak Batter North	YTF HOB (North)	Yallourn East Field Extension Southern Batter	YEFX SB
Yallourn Township Field Western Batter	YTF WB	Yallourn Maryvale Field Eastern Batter	MVF EB
Yallourn Township Field Northern Batter	YTF NB	Yallourn Maryvale Field Southern Batter	MVF SB
Yallourn Township Field Raw Coal Bunker Batter	YTF RCB	Yallourn Maryvale Field Western Batter	MVF WB
Yallourn Township Field Latrobe South Batter	YTF LS		

8.9.2.2 Geotechnical Design Risk Assessment

A bespoke geotechnical design risk assessment framework has been developed for Yallourn Mine from first principles. The risk framework includes three separate systems for: geotechnical, surface water and consequence categories. The relative risk for each domain has been assessed considering surface water catchments, geology, groundwater responses, pin monitoring data, deformations observed and external infrastructure/receptors. The below sections provide a summary of the framework and assessment results. Detailed descriptions of the framework and the assessment is provided in PSM4487-200R (PSM 2025b).

A separate rehabilitation project risk assessment has been conducted to determine all risks associated with the Yallourn Mine rehabilitation project. This includes a broad range of areas, for which geotechnical risk is one aspect. The project risk assessment is detailed in Chapter 11.

8.9.2.2.1 Geotechnical Risk Assessment System

The geotechnical risk assessment system comprises two elements: base conditions and system responses. The base conditions are the underlying factors that result in a basic risk setting. The presence of surface water bodies and geological structure were both considered base conditions that are the major drivers of instability at Yallourn site. The important geological conditions in each of the Geotechnical Domains have been simplified and then classified into five typical geological settings and slope configurations. The classifications from most to least favourable for stability are:

- Bedding dipping into slope
- Flat bedding
- Bedding dipping out of slope
- Steep folded bedding with flat topography
- Steep folded bedding with rising topography

The system responses identify whether other factors, including exposure, time, environment, mining and mine geometry, have collectively or individually exacerbated the underlying risk setting. The groundwater responses in the domains, the movement monitoring and the mapped physical deformations are then combined to represent the responses of the system to these other factors that have occurred over time, that is the sensitivity factors. Because this risk approach is focussed on the sensitivity factors that could compromise the rehabilitation strategy it highlights the domains where additional consideration is required. The geotechnical risk ratings for each geotechnical domain are shown in Figure 8-76.

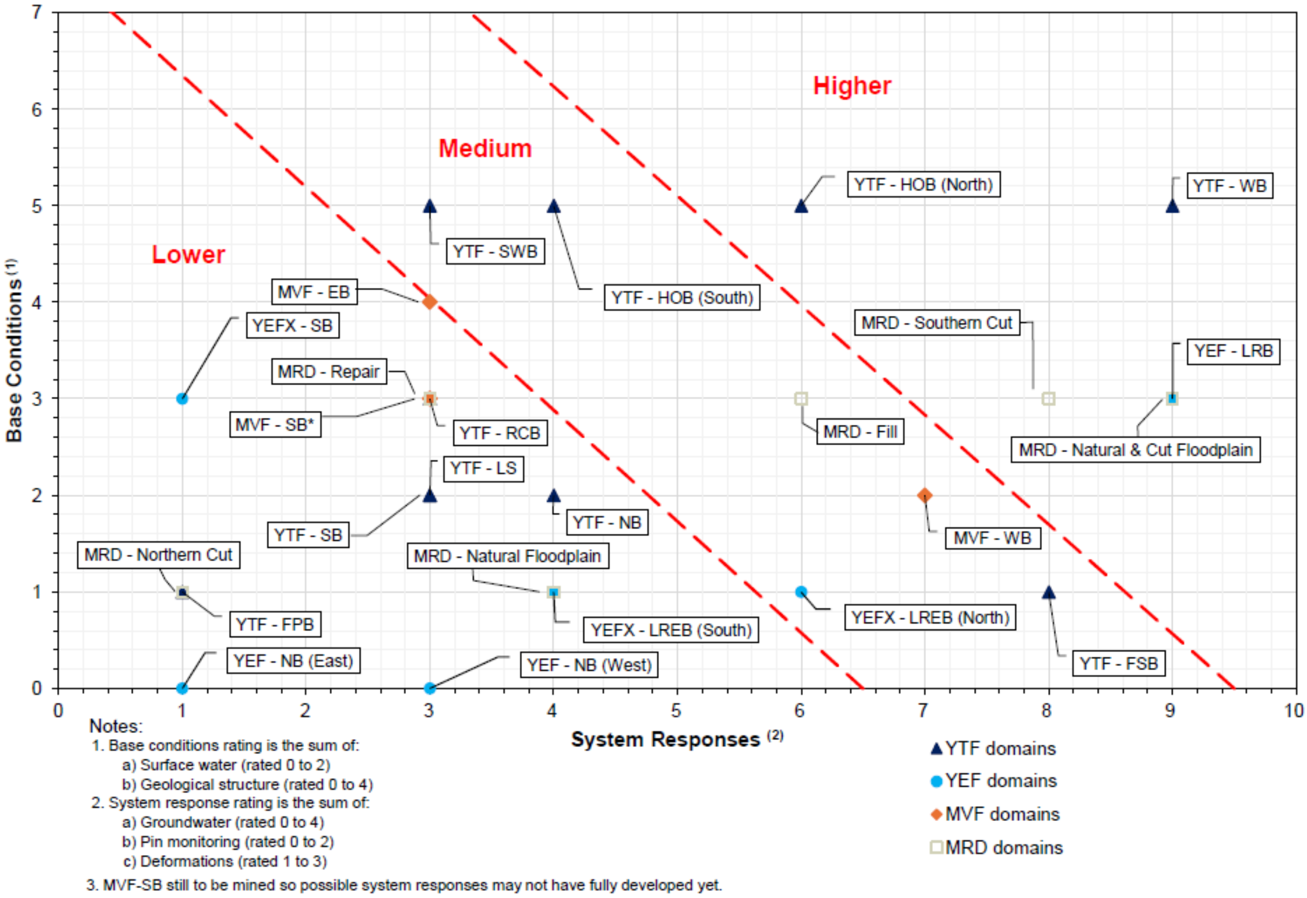


Figure 8-76: Geotechnical risk ratings (PSM 2025b)

8.9.2.2.2 Surface Water Risk Assessment System

The surface water risk assessment system also comprises two elements: base conditions and complicating factors. The base conditions are the inherent factors that categorise the domain and include catchment size and the nature of the peripheral catchment. These are illustrated by two end members:

- Low lying level terrain with small topographic relief which is considered to be a more easily controllable situation (low risk).
- An elevated catchment in steep terrain, which practically will present greater engineering and design difficulties (high risk).

The complicating factors are those elements that would increase the future design complexity and hence risk, and comprise:

- The complexity of the existing diversion infrastructure,
- The ability to guarantee future control, which could be compromised by factors such as the location of the mine lease boundary, adjacent important infrastructure and or private land ownership close to the mine crest; and
- The simplicity of the future surface water control systems required.

The surface water risk ratings for each peripheral catchment domain are shown in Figure 8-77.

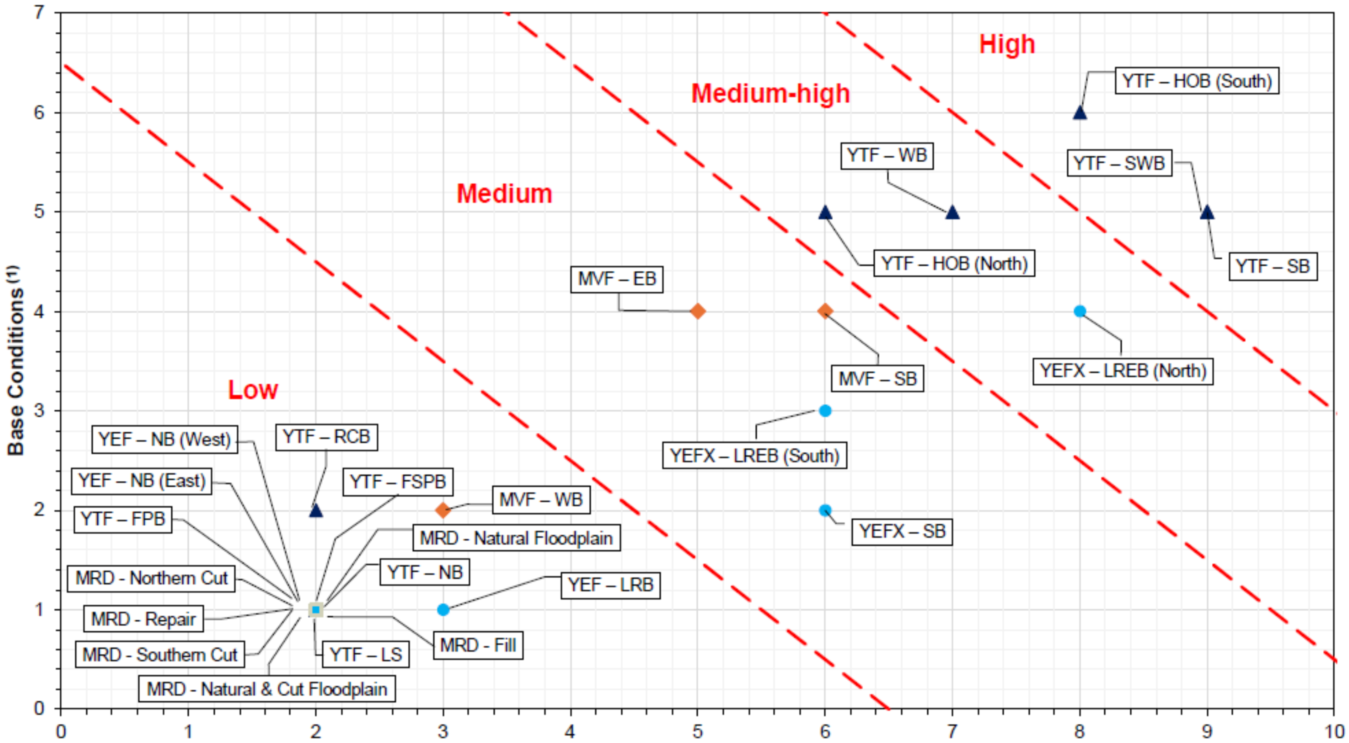


Figure 8-77: Domain surface water risk ratings (PSM 2025b)

8.9.2.2.3 Consequence Category Classification

Geotechnical domain consequence categories are also considered in the risk ranking. The rehabilitation design uses a risk-based approach to assess the potential rehabilitation design impacts to understand the potential consequence of failure and to guide assessments of risk, design, evaluation of Factors of Safety (FoS) and remediation. Five consequence categories have been developed for the Feasibility Rehabilitation Design studies based on current infrastructure and proposed / planned PMLU. The categories ranked from highest to lowest consequence, their equivalent expression, and general infrastructure descriptors are:

- Severity 5 – Critical: highways and railway lines,
- Severity 4 – Major: rivers,
- Severity 3 – Moderate: secondary public roads,
- Severity 2 – Minor: picnic spots or areas of temporary human occupation (for a few hours),
- Severity 1 – Insignificant: farmland or areas with no extended or permanent human occupation.

Each geotechnical stability section is also given a consequence rating, as these can sometimes vary within a domain. The geotechnical domain is then assigned the same rating as the highest consequence rating stability section within it. A plan showing the consequence categories for each geotechnical domain is shown in Figure 8-78. It is important to note that the planned PMLU are preliminary in nature and subject to further refinement based on outcomes of the future detailed design and stakeholder engagement.

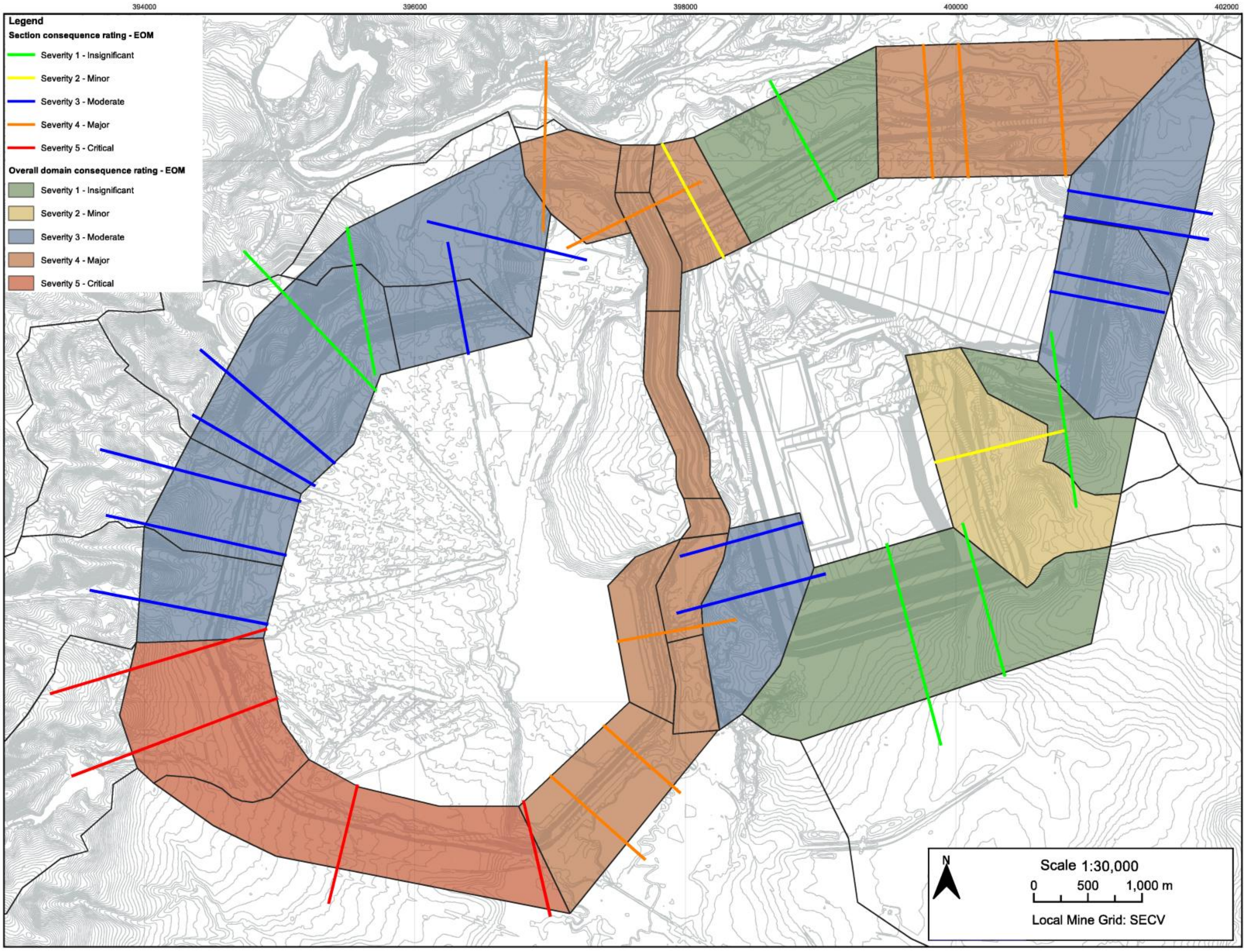


Figure 8-78: Geotechnical domain consequence category plan

8.9.2.2.4 Geotechnical Design Risk Assessment Outcomes

A summary of the risk rankings is provided in Table 8-29. The consequence categories are based on End of Mining (EOM). Scores are assigned to each parameter as shown in parenthesis and these are summed to create a total relative risk ranking score. The relative geotechnical design risk rankings are colour coded and split into: Low (3-6), Medium (7-8) and) High (9+).

Both the Geotechnical and Surface Water design risk ratings have educated the detailed rehabilitation designs as being appropriate. The aim is to then use the consequence category ratings in the medium and high-risk domains to define a targeted approach to selection of the design parameters. For example, with surface water, domains with lower risk as measured by the consequence category can adopt lower design Annual Exceedance Probabilities (AEP's) or Peak Design Flow Rates. Thus, the conventional risk classifications assist in defining what reliability is required and therefore how large a particular drainage structure is required.

Table 8-29: Geotechnical Domain Design Risk Rankings

Geotechnical Domain	Stability Section	Surface Water Risk Rating (score)	Geotechnical Risk Rating (score)	EOM Consequence Category*	Geotechnical Design Risk Ranking (score)
YTF – LS	31	Low (1)	Low (1)	4	Low (6)
YTF – RCB	30	Low (1)	Low (1)	3	Low (5)
YTF – NB	29, 28	Low (1)	Low (1)	3	Low (5)
YTF – WB	25, 26, 27	Med-High (3)	High (4)	3	High (10)
YTF – HOB North	24, 23	Med-High (3)	High (4)	3	High (10)
YTF – HOB South	22	High (4)	Medium (2)	3	High (9)
YTF – SWB	21, 20	High (4)	Medium (2)	5	High (11)
YTF – SB	19	High (4)	Low (1)	5	High (10)
YTF – FPB	17, 18	Low (1)	Low (1)	4	Low (6)
YTF – FSPB	16	Low (1)	Medium (2)	4	Medium (7)
YEF – NB (West)	1, 2	Low (1)	Low (1)	4	Low (6)
YEF – NB (East)	3	Low (1)	Low (1)	1	Low (3)
YEF – LRB	4, 5, 6	Low (1)	High (4)	4	High (9)
YEF – LREB (North)	7	Med-High (3)	Medium (2)	3	Medium (8)
YEF – LREB (South)	8, 9	Medium (2)	Low (1)	3	Low (6)
YEFX – SB	10	Medium (2)	Low (1)	1	Low (4)
MVF – EB	11	Medium (2)	Low (1)	2	Low (5)
MVF – SB	12, 13	Medium (2)	Low (1)	1	Low (4)
MVF – WB	14, 15	Low (1)	Medium (2)	3	Low (6)

*** Note:** The consequence categories are based on the End of Mining situation. Changes to Post-Mining Land Use and Geotechnical Risk Zones may change the consequence category of a domain during and post-rehabilitation. This will be examined in further detailed studies.

8.9.2.3 Stability Analysis

8.9.2.3.1 Groundwater Conditions

The Yallourn Mine groundwater situation is complex with the following main influence factors:

- Regional and mine site deep aquifer depressurisation, lowering pore water pressures from relatively deep below the Yallourn Seam
- Surface water bodies, the Latrobe and Morwell Rivers and their associated floodplains
- MRD low and high flow channels
- Peripheral Catchments
- HHF with an irregularly developed basal more granular layer (HHFA)
- The very thick Yallourn Seam comprising coal of very low permeability but with continuous sub-vertical joints of much higher hydraulic conductivity
- Horizontal drains drilled into the mine batters, some of which are now buried by in-pit dumps
- Historic tension cracks developed in the coal due to the mining, stress and incipient instability induced batter movements

In this situation monitoring points (piezometers and standpipes) distributed around a domain in various locations relative to all the above factors can make accurate interpretation difficult. This is exacerbated by sub-vertical piezometers in the Yallourn (coal) Seam, which has two radically different hydraulic conductivities related to intact coal or structure and where the structure is also sub-vertical. Consequently, three compilations of the data have been used, all of which provide guidance as to determining the groundwater profile in each geotechnical domain:

- The stability sections, which relate water observations spatially to many of the other factors
- The pore pressure profiles, which are focussed on the HFF and Yallourn Seam and their potential relationships with the geotechnical conditions and the influence factors listed above
- The hydrographs, which illustrate the connections with surface rainfall/runoff, surface water bodies and also the degree of hydraulic connection through the vertical profile

Piezometric observations from available piezometer tips or standpipes have been linked spatially to interpret piezometric levels, pore pressures and groundwater responses in each geological unit. Generally, two piezometric levels were defined, representing a perched groundwater table in the HHF and a separate groundwater table for the Yallourn Seam and underlying interseam. The piezometric level in the destressed zone of the mined Yallourn Seam batters is typically depressurised to the base of horizontal drains. The average pore pressure coefficient (Hu), as a percentage of the full hydrostatic pressure for the Yallourn Seam and interseam for end of mining (EOM) conditions is shown for each rehabilitation domain in Table 8-30.

Table 8-30: Interpreted Yallourn Coal and Interseam Pore Pressures

Pit Area	Geotechnical Domain	Coal & Interseam Pore Pressure Coefficient (Hu) (% of hydrostatic)
Yallourn East Field (YEF)	YEF – NB (west)	60
	YEF – NB (east)	60
	YEF – LRB	70
Yallourn East Field Extension (YEFX)	YEFX – LREB (north)	60
	YEFX – LREB (south)	50
	YEFX – SB	50
Yallourn Maryvale Field (MVF)	MVF – EB	50
	MVF – SB	60
	MVF – WB	60
Yallourn Township Field (YTF)	YTF – FSPB	50
	YTF – FPB	50
	YTF – SB	40
	YTF – SWB	70
	YTF – HOB (south)	50
	YTF – HOB (north)	60
	YTF – WB	60
	YTF – NB	60
	YTF – RCB	80
	YTF – LS	100

Two main groundwater cases are modelled for the lake filling period due to the uncertainty about how quickly the groundwater conditions behind the mine batters will equilibrate to the rising lake levels:

- EOM pore pressures continuing during lake filling.
- Hydrostatic pore pressures recover instantaneously during lake filling.

Piezometric levels during lake filling were modelled so that the batter is saturated to the respective elevation of the pit lake level being analysed, i.e., EOM piezometric levels are maintained above lake level (where applicable). Cross validation of the adopted hydraulic gradients has been conducted with the groundwater numerical modelling (refer Section 8.3). The Lake filling situations were modelled to the final pit lake level at RL +37 mAHD.

8.9.2.3.2 Geotechnical Material Parameters

Material properties adopted for the stability analyses are summarised in Table 8-31 for:

- Haunted Hills Formation (HHF) overburden
- Yallourn Seam (Coal)
- Disturbed Yallourn Seam, representing the zone of displaced coal within the Latrobe River Batters failure
- Interseam
- Fill material (buttress, MRD embankment or engineered fill, dumps)

Properties for the HHF and Yallourn Seam are based on laboratory testing and adopted parameters in other design reports. The collation and review of data from the various sources is detailed in PSM4487-001R (PSM 2021). For the geotechnical assessments, the parameters for the Haunted Hill Aquifer (HHFA) are assumed to be the same as HHF.

Disturbed Yallourn Seam parameters are based on measured shear wave velocities (Vs30) of intact Yallourn Coal and the Disturbed Yallourn Seam within the Latrobe River Batters failure. The strength parameters have been reduced by the same reduction between the measured shear wave velocity of intact coal and disturbed coal.

Selection of parameters for engineered fill material are based on construction (including lab) records for the MRD engineered fill. These records indicate that the material was compacted at 100% standard and close to Optimum Moisture Content with a bulk density of about 20 kN/m3. Other fill materials are based on typical conservative estimates for uncompacted fills.

Table 8-31: Stability model Mohr-Coulomb material parameters

Unit	Unit weight, γ (kN/m^3)	Cohesion, c' (kPa)	Friction angle, Φ' (°)
New Buttress Fill	15.0	2	32
MRD Engineered Fill (Design Parameters)	20.0	5	28
MRD Engineered Fill (Adverse Parameters)	20.0	2	25
Stabilising Fill	20.0	5	28
Existing Fill & In-Pit Dumps	18.0	2	32
Haunted Hills Formation (HHF) & Haunted Hills Aquifer (HHFA)	20.0	20	24
Yallourn Coal	11.2	150	40
Disturbed Yallourn Coal*	11.2	90	24
Interseam (residual) Lower Bound	19.6	0	11
Interseam (residual) Mean	19.6	0	18

***Note:** Zones of displaced coal, e.g. Latrobe River Batters failure area.

8.9.2.3.3 Interseam Shear Strength

Experience has shown the critical failure mechanisms for geotechnical stability of the mined batters at Yallourn always includes a component of sliding along low strength interseam clays at the base of the Yallourn Seam. This mechanism has been the dominant failure mode for all large-scale stability issues in the Latrobe Valley and at Yallourn and hence the interseam shear strength is a key parameter for stability and design. A complete review of all available shear strength testing data for the Yallourn Interseam unit has been conducted and this is presented in PSM4487-200R (PSM 2025b). A summary of the results is provided here.

Table 8-32 presents the statistical spread of the shear strength values and a plot of the direct shear failure envelopes is provided in Figure 8-79. Analysis of the validated database indicates:

- There are four material populations:
  - Type 1: >60% Clay
  - Type 2: 40-60% Clay with silt
  - Type 3: Silt with 20-40% clay
  - Type 4: Sand and silt with <20< clay
- There is a clear differentiation according to clay contents (population type), with higher friction angles for lower clay contents (Types 3 and 4) and lower friction angles for higher clay contents (Types 1 and 2).
- Samples with < 40% clay have higher residual secant friction angles, ranging between 13° and 25° with a median of 23°.

- Higher clay content samples with > 40% have lower residual secant friction angles ranging between 11° and 28° with a mean of median approximately 18°.
- Type 1 materials with clay contents greater than 60% define the lower boundary of the shear strength envelope.

Table 8-32: Statistical spread of laboratory interseam residual shear strength values

Parameter	Total population	Lower population (>40% Clay)	Higher population (<40% Clay)
Count	24	8	5
Mean	20.05	19.40	19.90
Std. Dev.	5.54	5.59	4.62
COV	0.28	0.29	0.23
Min.	11.00	11.12	13.25
25th %	16.06	16.05	15.51
50th %	20.50	18.68	22.73
75th %	24.71	23.23	23.07
Max.	29.58	28.14	24.94

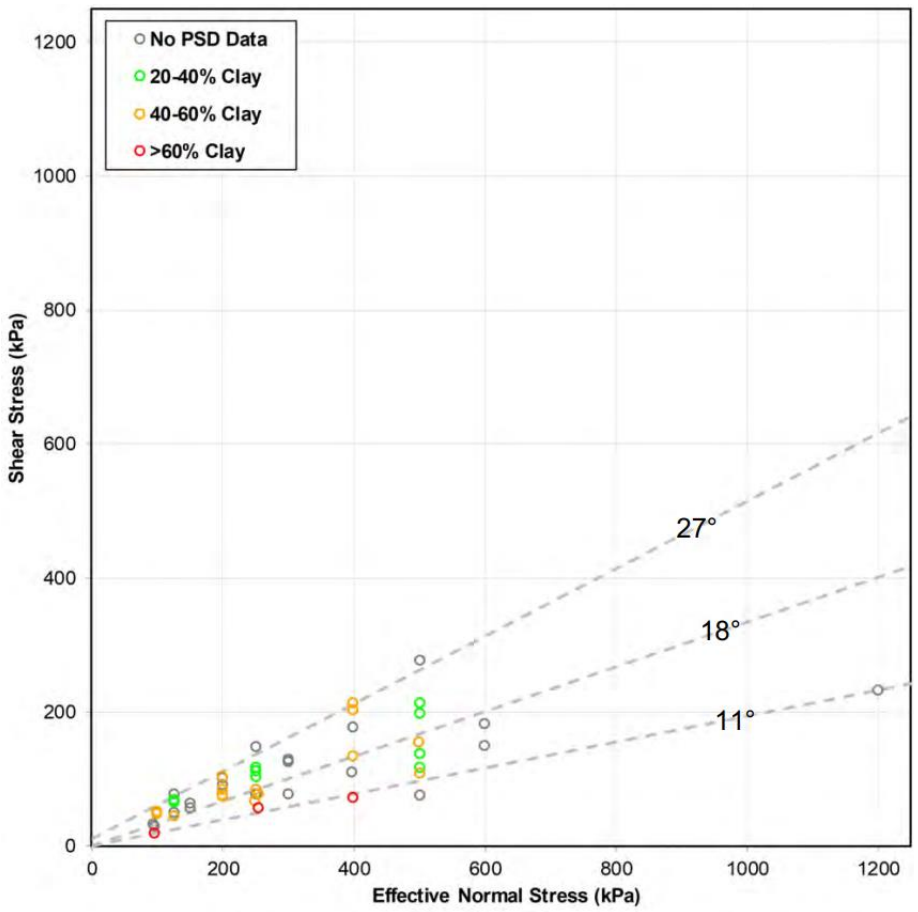


Figure 8-79: Validated direct shear failure envelope plots (residual shear strength) (PSM 2025b)

Figure 8-79 shows that the residual shear strengths have an upper bound of 27° and cohesion of 10kPa cohesion, and a lower bound friction angle of 11° and no cohesion. Mean residual shear strengths have no cohesion and a friction angle of 18°. Tests are categorised by their clay content where PSD results are available. Interseam materials with clay contents > 60% define the lower boundary of the shear strength envelope.

It is considered there is insufficient valid testing data to allow domaining of interseam shear strengths, let alone sub-domaining around the site. Therefore, a very conservative design approach has been adopted for all the static limit equilibrium analysis, entailing:

- The absolute lower bound,
- Residual strength = 11°, and
- Applied universally in all domains.

This lower bound value is chosen to assess geotechnical stability of individual slopes, with the assumption that a low-strength band of interseam materials (likely more fine-grained) can occur anywhere locally and impact on the stability of the batter.

Back analysis of the specific 2018 cracking and 2021 stability event on the MRD was undertaken as part of the investigation of the 2021 Stability Incident. Assuming a FoS of 1 during the event and with the highest water loading, a shear strength of between 11 and 12° was calculated for failure through the specific crack location. Back analysis using the same loading conditions of the 2021 stability event along the MRD indicates failure would occur in other locations unless the shear strength is much higher, above 16°. This demonstrates that variable interseam strengths can dictate the failure location and extent and that 11° is likely the lowest residual friction angle present.

Batter stability assessment of the 2007 Latrobe River incident reported by Geotechnical and Hydrogeological Engineering Research Group of Federation University (Baumgartl 2020) included additional shear strength testing and reported higher values (Minimum 14.9°, Mean 23.7°, Maximum 32°) of the interseam material.

For seismic analysis, a more realistic design value has been chosen, being the median (50th percentile) of the residual strength of the lower population (>40% clay) for the validated test results. This value is considered to represent the more realistic design condition because:

- During an earthquake, the entire region undergoes uniform disturbance, not just the mine or a singular batter.
- Failure would include a much larger area, which can be over 2km in length and 500-600m in width.
- This scale is large relative to the inferred area of deposition of very rich clay materials in the interseam, therefore isolated or localised area of low strength interseam would not govern stability for the full pit slope.
- Back analyses of previous seismic events and stability incidents have indicated higher shear strengths are present, more towards the median value of 18°, refer Section 8.10.2.3.
- It is justified to use the average shear strength value to assess this transient loading condition, as per the back analysis in Section 8.10.2.3.
- For conservatism:
    - Residual shear strength is used, not peak shear strength
    - Only the clay-rich (lower population) strength is used, not the full population

This is discussed further in Section 8.10.

8.9.2.3.4 Failure Mechanisms

Global stability checks have been undertaken on representative stability sections for each of the geotechnical domains for the current as-mined terminal batter profile (with the exception of MVF SB, which is the current operating face). Two primary stability mechanisms have therefore been analysed around the mine, and these are represented graphically in Figure 8-80:

1. Multilinear failure path with sliding along the base of the Yallourn Seam, and
2. Block sliding along the base of the Yallourn Seam with a tension crack from the base of coal to surface and filled with water.

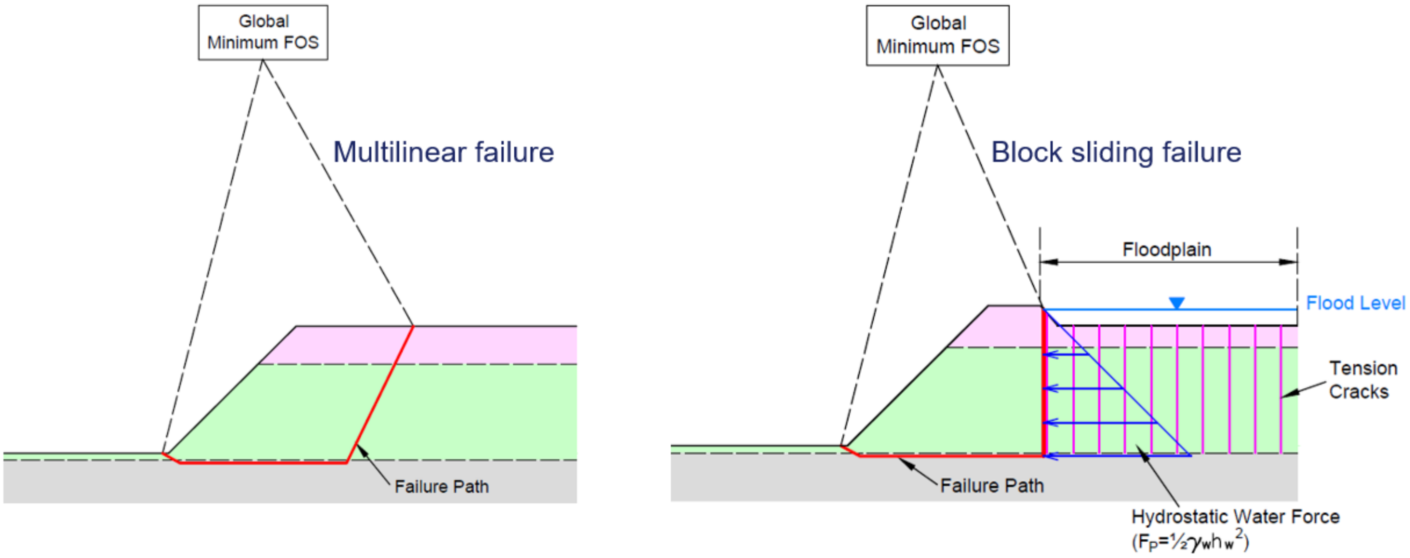


Figure 8-80 Multilinear and Block sliding failure mechanisms (PSM 2025b)

Generally, the critical failure mechanism at Yallourn is a block sliding mechanism, primarily driven by water loading within coal joints. This mechanism is feasible in domains prone to flooding from rivers and where there are major surface water drainage structures. However, the critical failure mechanism becomes a multilinear failure path where drainage control measures have been designed to eliminate the risk of water loading from peripheral catchments. Therefore, the design failure modes are prescribed and the basis for that are the domain characteristics, for which there are three types, refer Table 8-33 and Figure 32 (PSM 2025b). The Design Failure Modes for these different domain types are different and for some the failure mode changes between the end of mining (EOM) and lake full design periods, refer Table 8-33. EOM conditions and corresponding failure modes are assumed to extend though the lake fill period. The Morwell River Diversion has different failure mechanisms to the coal batters, and these are addressed separately in Section 8.12.

Table 8-33: Domain failure modes

Domain Type	Domain Characteristics	Design Failure Mode EOM (and during lake fill)	Design Failure Mode Lake Full
Type 1	A domain with relatively flat topography and no concentrated surface water flow paths, for example YEF NB.	Multilinear, because the topographic setting is such that concentrated water bodies or flows are not of sufficient magnitude to facilitate large scale block sliding.	Multilinear, as for EOM.
Type 2	Domains with permanent or semi-permanent water bodies such as floodplains or the MRD, for example YTF FPB.	Multilinear or Block Sliding, whichever generates the lowest FoS. It is not feasible to eliminate block sliding risk.	Multilinear or Block Sliding, whichever generates the lowest FoS. It is not feasible to eliminate the risk of block sliding.
Type 3	Domains with significant Peripheral Catchments and concentrated creek lines, for example YTF HOB.	Block Sliding because the Peripheral Catchment drainage structures have not yet been constructed.	Multilinear, because the Peripheral Catchment drains required to control adverse water loading events leading to block sliding have been constructed and are in operation, eliminating the risk of block sliding.

8.9.2.3.5 Scenarios

Four base case scenarios were conducted for the following conditions using the lower bound interseam shear strengths:

Table 8-34 Stability analysis base case scenarios

Base Case	Description
BC 1	EOM situation with current piezometric levels and pore pressure conditions (Hu values in Table 8-30)
BC 2	Lake filling situation using EOM pore pressures (Hu values in Table 8-30)
BC 3	Lake filling situation with pore pressures equilibrated to hydrostatic pore pressures (Hu = 1).
BC 4	Lake full situation with the final pit lake level at RL 37m and hydrostatic pore pressures (Hu = 1).

Base cases 2 and 3 are modelled for the lake filling period due to the uncertainty about how quickly the groundwater conditions behind the mine batters will equilibrate to the rising lake levels. For base case 4 (lake full) the pore pressures were assumed to be hydrostatic (Hu = 1).

Sensitivity checks were also undertaken as follows:

- Multilinear failure mechanism with mean residual interseam shear strength for Base Cases 1, 2, and 4.
- Buttressing assessment for Base Cases 1, 3 and 4 for stability sections with a factor of safety (FoS) less than 1.3.

The Morwell River Diversion stability analyses are included in Section 8.12.

Seismic analysis is detailed in Section 8.10.

Additional stability analyses were undertaken to determine the extent of drainage infrastructure required to eliminate the risk of a block slide event being triggered by peripheral catchment surface water flows and this is detailed in Section 8.7. The analysis includes:

- Assessing FoS of block sliding along the base of the Yallourn Seam with a tension crack from the base of coal to surface and filled with water to assess consequence of no drain or overtopped drain.
- Assessing changes in FoS with distance from mine crest to assess where individual drains should start / finish.

8.9.2.4 Design Acceptance Criteria

8.9.2.4.1 DEECA Draft Guideline

A draft Design Acceptance Criteria (DAC) guideline for Latrobe Valley mines was provided to EAY by DEECA in February 2025. The guidance outlines a risk-based approach for determining site specific DAC and highlights the requirement for geotechnical designs and DAC to address both data uncertainty and design reliability. The draft guideline lists four main objectives that closure designs must meet:

1. An appreciation of the control mechanisms is critical.
2. Data reliability and the level of understanding of underlying site-specific geotechnical information must be commensurate with the level of identified risk.
3. At relinquishment, final slope geometries must be in harmony with long-term material strengths and pore pressure conditions.
4. Long-term profiles adopted in the design should allow for flexibility to be upgraded in the future if performance is not meeting the design.

It is noted that while the rehabilitation design needs to be cognisant, Objective 4 can only be achieved with collaboration with and approvals from DEECA and other stakeholders, to agree on a progressive, observational design approach (PSM 2025b). The process for achieving Objective 4 imposes constraints on the range of corrective actions that can be implemented once rehabilitation enters its advanced stages or approaches the lake-full condition. Notably, the design accommodates the implementation of corrective measures in areas situated above the final lake level.

In order to address and reduce data uncertainty, the following 7 technical questions need to be addressed:

1. Is there sufficient data to capture natural variations in the rock mass?
2. Is the spread of the data sufficient to adequately define boundaries between different lithological units and identify critical structures or zones that could be problematic?
3. Is the data collection consistent using industry accepted practices?
4. How good is the quality of data collection and what quality assurance and quality control processes are used?
5. Is there a bias in the data such as direction of drilling, or sampling of stronger materials?

6. How good is the laboratory testing programme, both in quantity and quality of testing?
7. How is the data managed and interpreted?

The draft guideline notes that the impacts of climate change should be considered in the design, however, it is also acknowledged that there is a high level of uncertainty in the current science and potential impacts.

The draft guideline suggests incorporating Coefficient of Variation (CoV) and Probability of Failure (PoF) as a means of quantifying the data uncertainty and design reliability. Following the risk-based approach, consequence categories are assigned different values, with higher consequence slopes requiring higher confidence values. FoS are also suggested for each consequence category, with higher FoS required for higher consequence slopes. The DEECA DAC are shown below in Table 8-35. The EAY rehabilitation design approach adequately addresses and satisfies the DEECA DAC, objectives and technical questions. This is detailed in the following sections.

Table 8-35: DEECA design acceptance criteria (PSM 2025b)

DAC	Consequence Category				
	Insignificant	Minor	Moderate	Major	Critical
CoV	≤0.20 (low confidence)	≤0.15 (high confidence)		≤0.10 (very high confidence)	
PoF	≤30%	≤20%		≤10%	
FoS	≥1.3	≥1.4		≥1.6	

8.9.2.4.2 Design Objectives

The DEECA CDAC Objective 1 (appreciation of critical control mechanism) and Objective 2 (level of understanding commensurate with level of risk) are addressed via the design geotechnical model, Figure 8-81, that underpins the rehabilitation strategy:

- To achieve "Safe, Stable and Sustainable" the mine requires stable slopes.
- The key slope failure mechanism is identified at Yallourn (Section 8.9.2.3.4).
- Assessing historic large scale batter performance which show old batters are highly sensitive with large deformations and open joints/cracks, and these large-scale movements are primarily associated with water loading events (critical control mechanism).
- To control water loading events, it is not enough to rely on diversions around the pit crest for long term rehabilitation, instead, it is only possible with control of peripheral drainage where they are critical to stability, and with the filling of the pit lakes (level of understanding commensurate with level of risk).
- In assessing peripheral catchment drainage and mine geometry where many large peripheral catchments historically drained into the mine, it is determined that the successful rehab requires a drainage design that is in harmony with the natural landscape, and this requires moving the water effectively and efficiently into the pit void / lake.

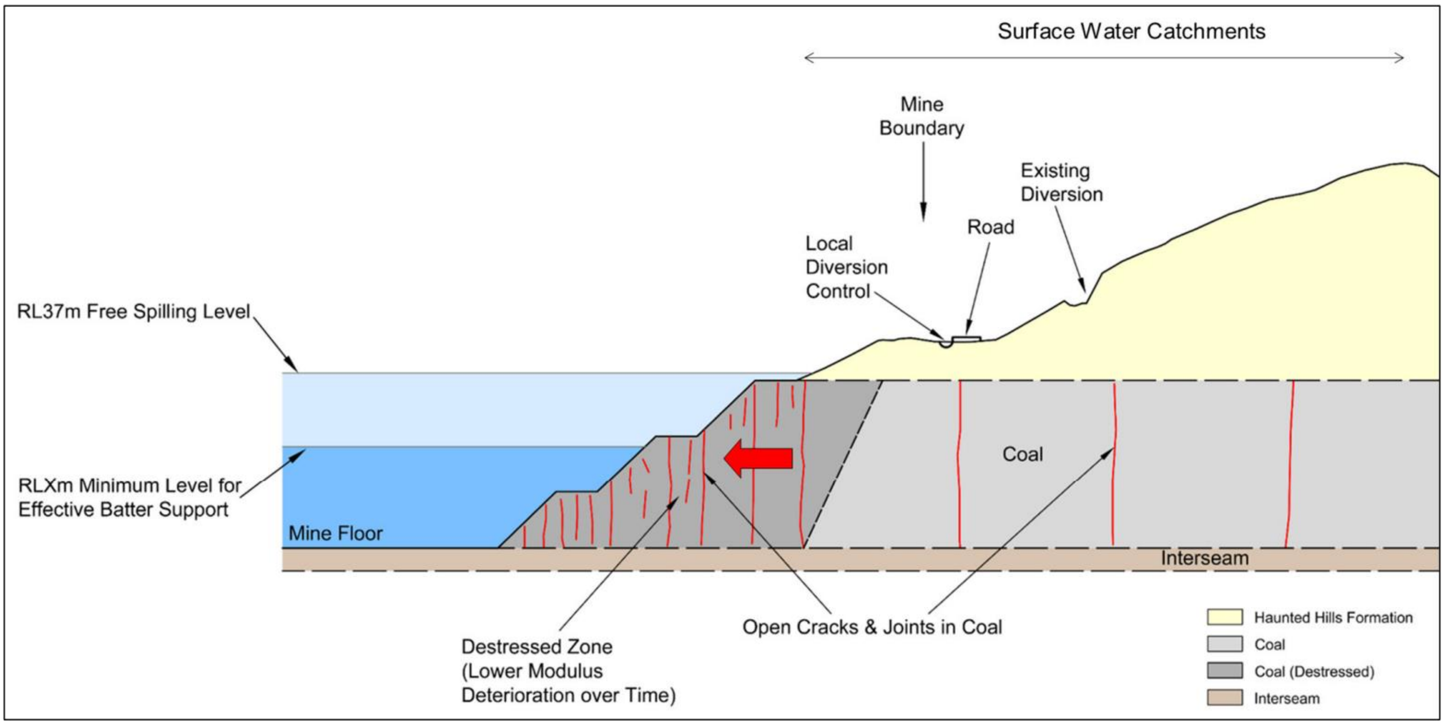


Figure 8-81: Summary model of principal factors and considerations for rehabilitation (PSM 2025b)

Objective 3 (final slope in harmony with long term strength and pore pressure conditions) is addressed via a sound understanding of the geomorphic process around the site in the environment, Section 8.13. The long-term strength is primarily dependent on the interseam layer, which is detailed in Section 8.9.2.3.3. Long-term groundwater conditions have been assessed utilising a groundwater numerical model, as detailed in Section 8.3. Geomorphology provides a framework for understanding the current and future behaviour of a physical system and at Yallourn the mine batters are subject to episodic progressive change where no recovery occurs. On that basis, the rehab strategy must deal with the batter, which it does in three areas: below lake, above lake, and outside crest:

- Below lake: no landform changes, lake level to control block sliding (refer Section 8.9).
- Above lake: rehabilitate upper slopes above lake level in accordance with geomorphology educated by local performance (refer Section 8.13).
- Outside crest in natural landform: Remove existing diversions and control water into mine quickly and efficiently, primarily driven by surface water requirements (refer Section 8.7).

As previously discussed, achieving the requirements of Objective 4 introduces constraints on the range of corrective actions available during the advanced stages of rehabilitation. For example, once the slope becomes submerged due to the rising lake level, constructing additional toe buttresses is no longer feasible. To address such potential limitations, it is essential to validate the rehabilitation design at an early stage, ensuring alignment with identified risks across all phases of rehabilitation and service the design intent period. Additionally, the monitoring and maintenance regime must be adaptive to evolving site conditions and capable of facilitating early detection and timely intervention.

8.9.2.4.3 Data uncertainty and reliability

8.9.2.4.3.1 Geological Model

The Geological Model is the basis for all stability analyses and is critical for mine rehabilitation design. Therefore, understanding the level of confidence in the geological model is also an essential input into the considerations for the DAC and Post Mining Land Use (PMLU) flexibility. The lower the confidence in the geological model, the more conservative the rehabilitation design and/or the greater limitations imposed on acceptable PMLU.

Section 8.2 presents the Yallourn geological model in detail. All available borehole data has been collated, assessed and tested to identify high confidence borehole and geophysical logging data that was then used to develop models, Section 8.2.2. A rigorous validation approach was followed on the model geometry and strength to ensure a very high reliability on all aspects of the geological and geotechnical model. This process has sufficiently addressed the questions on data quantity, coverage, collection, bias and interpretation.

8.9.2.4.3.2 Geotechnical Model

A reliable stability model has been developed using:

- A highly accurate geological model (previous section)
- Use of lower bound shear strength at the base of coal (critical for slope stability) (Section 8.9.2.3.3)
- Well defined failure mechanisms (Section 8.9.2.3.4)
- Software (Rocscience Slide2) to automatically search for minimum FoS
- Worst case loading conditions, with water filled tension crack to the surface for block slide mechanism
- Checking other failure mechanisms and for critical pool mechanism

This resulted in outputs for stability analyses are rigorous and highly reliable, i.e., assuming worst case conditions. Results are presented in Section 8.9.3.

8.9.2.4.3.3 CoV and PoF

Stability of all mines in the Latrobe Valley is controlled principally by the strength along the interseam at the base of the coal. Investigation and sampling programs for shear strength testing need to be cognisant that stability problems are three dimensional and controlled by geology. The majority of the Latrobe Valley coal measures were deposited in a coal swamp and the interseam sediments deposited as fine-grained silts and clays on top of the coal during flood phases. The main area of interest for stability at Yallourn are therefore these fine-grained low strength interseam layers underlying the main Yallourn coal seam that enables the block sliding mechanism.

The shear strength test database, testing, sampling and methodology has been carefully and fully reviewed and validated, Section 8.9.2.3.3. There is insufficient valid data to allow domaining of strengths, let alone sub-domaining. On that basis, the EAY rehabilitation design has adopted the lower bound residual strength (11°) in all domains, Section 8.9.2.3.3. The adoption of the lower bound residual strength for long term rehabilitation design means there is now a very high level of confidence in the geotechnical strength.

Despite the exhaustive rigor of the data validation process on the model and the interseam shear strength, the resulting CoV for interseam shear strength does not meet the criteria listed in the DEECA draft guideline (Table 8-35) in any consequence category. Martin (2020) (as referenced in (PSM 2025b)) provides some commentary on typical CoV as it exists in nature and suggests that the shear strength of soils can exhibit a natural CoV of up to 50%. In which case, the DEECA guideline CoV requirement would unlikely be ever met. Martin (2020) suggests that while in a manufactured material such as concrete or steel, the CoV may be less than 20%, in a natural material the variation can be very high and cannot be reduced by increased testing. For the Yallourn interseam shear strength, with 59 direct shear test results, the CoV is around 30% (Section 8.9.2.3.3).

Nonetheless, since the lower bound value is adopted, it is considered to have satisfied this requirement. Whilst CoV and PoF are significant when utilising mean shear strength values, the adoption of the lower bound residual shear strength means that CoV and PoF no longer have a meaningful impact on the rehabilitation design. The use of a lower bound friction angle ensures that the uncertainty associated with a relatively high CoV is already captured in the selected residual friction angle. This approach provides inherent robustness, reduces sensitivity to statistical variability, and effectively accounts for failure risk without the need for further probabilistic analysis. As a result, the design becomes independent of both CoV and PoF, offering a high level of certainty and reliability.

Therefore, the choice to use the lower bound value with a corresponding DAC satisfies the intent of the DEECA DAC guideline. In this way, it addresses Objective 1, 2, 3 and satisfies Technical Questions 1 to 7.

8.9.2.4.4 Yallourn Design Acceptance Criteria

The DEECA draft DAC guideline, Table 8-35, calls for a minimum mean FoS that is dependent on the risk-based consequence category. It assumes a probabilistic analysis approach, where CoV and PoF values, along with the corresponding mean FoS, are also specified for each risk-based consequence category. The EAY strategy is aligned to this, albeit with slightly different and deterministic FoS values, as listed in Table 8-36. Due to the conservatism in all the model inputs, lower FoS are used in the design and different FoS are assigned to different failure mechanisms. This conservative approach to the geotechnical stability model satisfies the intent of the DEECA DAC guideline, and results in slope designs more conservative than the guideline requires.

Table 8-36: EAY Geotechnical DAC

Mechanism	Consequence Category				
	1: Insignificant	2: Minor	3: Moderate	4: Major	5: Critical
Multilinear FoS:	≥1.30			≥1.50	
Block Slide FoS:	≥1.10				

8.9.3 Findings

8.9.3.1 Base Case Stability Analysis Results

The results from the base case stability analyses for all stability sections are provided in Table 8-37. A range of lake fill levels have been analysed as part of the rehabilitation studies (PSM4487-200R (PSM 2025b)), only the minimum (critical) lake level FoS is presented here.

Cells that are shown with **red text** are those that do not meet the DAC (Table 8-36). Cells that are shaded red do not meet the DAC for block slide; however, the multilinear mechanism meets the DAC and is applicable once the peripheral catchment drainage infrastructure is installed.

The sensitivity checks using higher interseam strengths and multilinear failure path show higher FoS, typically >+0.4. These results are detailed in PSM4487-200R (PSM 2025b).

At lake full:

The majority of stability sections meet the DAC, with following exceptions:

- Stability Section 21 (YTF SWB): While this is above the DAC for a normal slope, the presence of the railway gives the domain a high consequence level. When reviewing the applicable FoS at the railway, which is located 170m from the crest, it is over 1.5. Nonetheless, drainage structures in this area need to be specifically designed carefully and effectively to avoid further future loading of the batters. They also need to be permanent structures. Further geotechnical investigation and testing is planned for this domain, the results of which will inform the detailed design and has been noted in knowledge gap in Chapter 17.
- Stability Section 28 (YTF WB): Current geometry FoS is below 1.30 and buttressing is required to increase the FoS above the DAC, and this is discussed in Section 8.9.3.2 .
- Stability Section 32 (MRD): Marginally below DAC. Action/s to address this will be determined through the detailed design process.

The results for both multilinear and block slide mechanisms are shown for stability sections 9, 11, 15, 16, 19, 20, 22, 24 and 25. This highlights the criticality of controlling the surface water flows from the peripheral catchments, where the block slide scenario (with tension cracks filled to ground surface) results in FoS near or below 1.0.

EOM + Lake Filling

The majority of stability sections meet the DAC, with following exceptions:

- Stability Section 6 (YEF LRB): Block slide FoS of 1.29 (EOM) and 1.32 (critical lake level @ RL-20m). This is for the current geometry and does not include the planned backfilling of the North-East pond. Buttressing requirements are discussed in Section 8.9.3.2.
- Stability Section 16 (YTF FSPB): Block slide FoS of 1.21 (EOM) and 1.33 (critical lake level @ RL0m). There is potential that further buttressing will be required in this domain, and this is discussed in Section 8.9.3.2.

The results for both multilinear and block slide mechanisms are shown for stability sections 19, 20, 22, 24 and 25 (red shading). This highlights the criticality of controlling the surface water flows from the peripheral catchments, where the block slide scenario (worst case scenario, with tension cracks filled to ground surface) results in FoS near or below 1.0.

Further Works

The above stability analysis results are for the feasibility design. The results show that all stability sections can meet the DAC if the peripheral catchment flows are controlled, and buttressing is constructed in a select few locations. They also highlight the significant reduction in FoS which occurs, if the block slide mechanism (tension crack filled to ground surface) is allowed to manifest. Hence, peripheral catchment management is critical to the successful rehabilitation of the site.

Detailed design work is still required to determine the exact profile of the landform above the final lake level and the final buttressing requirements to ensure the DAC is met for all stability sections. Feasibility design buttressing analysis is presented in the following section.

Table 8-37: Stability analysis results

Domain	Land-form Type [10]	Stability Section #	End of Mining (2028)				Lake Filling (30 years)					Lake Full - Post Relinquishment (100 years)			
			Consequence Category [2]	Ground-water Condition (Hu) [7]	DAC / Target FoS [1]	Min FoS	Consequence Category [2,3]	Ground-water Condition (Hu) [4]	DAC / Target FoS [1]	Critical Lake Level (RL)	Min FoS	Consequence Category [2]	Ground-water Condition (Hu) [9]	DAC / Target FoS [1]	Min FoS
YEF NB	Type 1	1 [27]	4	0.6	1.5	3.27 [11]	4	0.6	1.5	20 m	3.24	4	1[8]	1.5	2.80
		2	2		1.3	1.90	2	0.6	1.3	-5 m	1.92	2	1[8]	1.3	1.72
		3	1		1.3	2.40	1		1.3	-10 m	2.36	1	1[8]	1.3	2.82
YEF LRB	Type 2	4 [27]	4	0.7[5]	1.5	2.24 [15]	4	0.7 [5][6]	1.5	-10 m	2.38 [15]	4	1[5]	1.5	3.01
		5 [27]	4		1.5	1.90	4		1.5	-20 m	1.84	4		1.5	3.88
		6 [27]	4		1.5	**1.29** [32]	4		1.5	-20 m	**1.32** [32]	4		1.5	3.15
YEF LREB	Type 3	7	3	0.6	1.3	1.80	3	0.6	1.3	-25 m	1.82	3	1[8]	1.3	2.18
		7b	3		1.1	1.56 [23]	3		1.1	-10 m	1.53	3		1.1	2.50 [28]
		8	3	0.5	1.3	2.08	3	0.5	1.3	-5 m	2.01	3		1.3	1.73
		9	3		1.3	2.33 [25]	3		1.3	-5 m	2.24 [25]	3		1.3	2.03 [25]
					1.1	1.26 [24]			1.1	-5 m	1.16 [24]			1.1	1.17 [26]
YEFX SB	Type 3	10	1	0.5	1.1	1.84 [23]	1	0.5	1.1	0 m	1.82	1	1[8]	1.3	2.22
MVF EB	Type 3	11	2	0.5	1.3	2.38 [25]	2	0.5	1.3	-5 m	2.32 [25]	2	1[8]	1.3	1.96 [25]
					1.1	1.30 [24]			1.1	-5 m	1.19 [24]			1.1	1.32 [28]
MVF SB	Type 3	12	1	0.6	1.1	1.40 [14] [23]	1	0.6	1.1	5 m	1.26 [14]	1	1[8]	1.3	2.23 [14]
		13 [13]	1		1.3	1.43	1		1.3	-40 m	1.43	1	1[8]	1.3	1.34
MVF WB	Type 1	14	3	0.6	1.3	1.71	3	0.6	1.3	-30 m	1.70	1 [18]	1[8]	1.3	1.78
		15	3		1.3	1.83 [25]	3		1.3	-25 m	1.90 [25]	1 [18]		1.3	1.94
					1.1	1.87 [24]			1.1	-25 m	1.92 [24]			1.1	19.1
YTF FSPB	Type 2	16 [27]	4	0.5[5]	1.5	2.01 [31]	4	0.5 [5]	1.5	0 m	2.17 [31]	4	1[5]	1.1	2.13 [12]
					1.5	**1.21** [30]			1.5	0 m	**1.33** [30]				
YTF FPB	Type 2	17 [27]	4	0.5	1.5	1.76	4	0.5	1.5	0 m	1.86	4	1 [8]	1.5	1.95
		18 [27]	4		1.5	1.75	4		1.5	5 m	1.77	4		1.5	2.05
YTF SB		18b [27]	5	0.5[5]	1.5	1.96	5	0.5[5]	1.5	10 m	1.94	5	1 [8]	1.5	2.30
	Type 3	19	5	0.4	1.5	1.92 [25]	5	0.4	1.5	33.4 m	1.92 [25]	5	1 [8]	1.5	1.54 [25]
					1.5	1.04 [24]			1.5	33 m	1.04 [24]			1.5	0.74 [26]
YTF SWB	Type 3	20	5	0.7	1.5	1.81 [25]	5	0.7	1.5	NA [16]	1.81 [25]	5	1 [8]	1.5	1.59 [25]
					1.5	1.20 [24]			1.5	NA [16]	1.20 [24]			1.5	1.06 [26]

Domain	Land-form Type [10]	Stability Section #	End of Mining (2028)				Lake Filling (30 years)					Lake Full - Post Relinquishment (100 years)			
			Consequence Category [2]	Ground-water Condition (Hu) [7]	DAC / Target FoS [1]	Min FoS	Consequence Category [2,3]	Ground-water Condition (Hu) [4]	DAC / Target FoS [1]	Critical Lake Level (RL)	Min FoS	Consequence Category [2]	Ground-water Condition (Hu) [9]	DAC / Target FoS [1]	Min FoS
		21	5		1.5	1.73	5		1.5	33 m	1.73	5		1.5	**1.39**
YTF HOB	Type 3	22	3	0.5	1.3	1.98 [25]	3	0.5	1.3	33.4 m	2.04 [25]	3 [19]	1 [8]	1.3	1.77 [25]
					1.1	1.13 [24]			1.1	33 m	1.04 [24]			1.1	0.86 [26]
		23	3	0.6	1.3	1.92	3	0.6	1.3	25 m	1.96	3 [19]		1.3	1.69
		24	3		1.3	1.79 [25]	3		1.3	20 m	1.83 [25]	3 [19]		1.3	1.65 [25]
					1.1	0.85 [24]			1.1	20 m	0.86 [24]			1.1	0.63 [26]
YTF WB	Type 3	25	3	0.6	1.3	1.47 [25]	3	0.6	1.3	5 m	1.47 [25]	3	1 [8]	1.3	1.36 [25]
					1.1	1.26 [24]			1.1	5 m	1.26 [24]			1.1	1.06 [26]
		26	3		1.1	1.75	3		1.1	10 m	1.75	3		1.3	1.56
		27	1		1.1	1.60	1		1.1	15 m	1.53	1 [20]		1.3	1.32
		28	1		1.3	1.40	1		1.3	15 m	1.35	1 [20]		1.3	**1.12**
														1.3	>1.30 [29]
YTF NB	Type 1	29	3	0.6	1.3	2.35	3	0.6	1.3	5 m	2.26	1 [21]	1 [8]	1.3	2.23
YTF RCB	Type 1	30	3	0.8	1.3	2.38	3	0.8	1.3	10 m	2.41	3 [22]	1 [8]	1.3	2.52
YTF LS	Type 1	31	4	1.0	1.5	1.70	4	1.0	1.5	10 m	1.64	4	1 [8]	1.5	2.31
MRD	Type 2	32 [27]	4	0.4	1.5	2.38	4	0.4	1.5	0 m	2.38	4	1 [8]	1.5	**1.48**
		33 [27]	4	0.5	1.5	2.12	4	0.5	1.5	-20 m	2.21	4	1 [8]	1.5	1.95
		34 [27]	4	0.5	1.5	2.10	4	0.5	1.5	-30 m	2.15	4	1 [8]	1.5	2.29
		35 [27]	4	0.6	1.5	2.09	4	0.6	1.5	-10 m	2.45	4	1 [8]	1.5	2.53

Notes:

(*) Cells that are shown with **red text** are those that do not meet the DAC.

(*) Cells that are shaded red do not meet the DAC for block slide, however, the multilinear mechanism meets the DAC and is applicable once the peripheral catchment drainage infrastructure is installed.

(1). DAC as listed in Section 8.9.2.4.4.

(2). Based on the EAY current mining and post relinquishment PMLU.

(3). There is obviously a transition period following EOM and leading through till the lake full situation is reached. Consequently, the PMLU in the transition period cannot be fully defined at this time. However, there are two periods that are reasonably well known or for which a plan exists, EOM and Post Lake filling. Although mining activities will cease at EOM, rehabilitation activities and lake filling will proceed, and the exact timing and order of all activities is currently unknown. Thus, in order to assess potential consequences, it is assumed the overall situation at EOM continues until lake filling is completed. These may need to be re-visited once EAY has developed their full rehabilitation schedule.

(4). Assumes regional dewatering is maintained until Lake Full (or approximately). Assumes surface drainage in Peripheral catchments is maintained until lake Full and longer as required. Assumes this is confirmed by monitoring during the 3-year rehabilitation program to the end of 2031. Assumes slow recovery over many years as lake level slowly rises.

(5). Assumes a full tension crack under hydrostatic conditions develops under flood plain during significant floods, but only to spillway level.

(6). Modifications to surface landform to exclude potential for flooding and or limit the intake area.

(7). This is the current situation without any rehabilitation, Peripheral Drainage and or some landform modifications. Along with the assumptions in Point 4 this means the current groundwater situation is unlikely to worsen and more likely to improve. This applies until at least a significant lake level has been achieved.

(8). Assume recovery of groundwater to a Hydrostatic level but to the current top of groundwater level and/or pit lake level.

(9). Assume this condition occurs instantaneously once lake level reaches 37 mRL ± 3m. In reality (based on modelling) the pore pressure recovery takes decades.

(10). Domain landform types as follows: Type 1 – A domain with relatively flat topography and no concentrated surface water flow paths, Type 2 – Domains with permanent or semi-permanent water bodies such as floodplains or the MRD, and Type 3 – Domains with significant Peripheral Catchments and concentrated creek lines.

(11). Some movement possible but failure is not feasible.

(12). FoS based on a block sliding mechanism connecting the MRD flood plain with a fully filled tension crack to the surface. The fully filled lake improves the stability of this mechanism.

(13). Assumes the final permanent coal batters are constructed steeper than as-planned and an in-pit dump is progressively backfilled against the batters at the EOM.

(14). The FoS is high with the in-pit dump in place. There is a large catchment and the FoS could be much lower without the dump, see Stability section 13 results.

(15). Multilinear FOS is less than the block slide FOS for this floodplain stability section.

(16). The pit lake level is below the toe of the batter, and therefore lake filling does not have an impact to the FoS.

(17). For the MRD stability sections, for the post relinquishment period, while the block sliding mechanism is viable, the analyses for multilinear result in lower FoS which are quoted here.

(18). Removal of coal conveyor system changes Consequence Category from 3 to 1 for Domain MVF WB (Stability sections 14, 15)

(19). There are plans to re-align Haunted Hills Road. Even if it is re-aligned the road is still behind the crest so Consequence Category remains 3 for YTF HOB domain (Stability sections 22, 23, 24).

(20). De Campo Drive in this area (Section 27, 28) lies outside of the geotechnical domain so Consequence Category is 1.

(21). YTF NB (Stability section 29) – Consequence Category is 3 during mining due to mine offices and infrastructure; changed to 1 assuming mine offices and infrastructure are removed.

(22). YTF RCB (Stability section 30) – PMLU shows private land which can be occupied at rehab. Consequence Category therefore remains at 3. Note the PMLU could change in future design stages

(23). FoS based on block slide mechanism with a fully filled tension crack. This stability section does not lie in a flood plain, i.e., the landform does not enable flood inundation, this analysis is only used to assess peripheral catchment drain requirements.

(24). FoS based on block slide mechanism with a fully filled tension crack. This stability section does not lie in a flood plain, i.e., the landform does not enable flood inundation, this analysis is done to assess peripheral catchment drain requirements. While there is no flood plain along this stability section, there is historic cracking indicating past batter movement (and the low FoS indicates this is a possible failure mode under some conditions, at least historically). The results indicate the criticality of effective peripheral catchment drainage.

(25). FoS based on a multilinear mechanism. This is the design FoS provided that there is effective peripheral catchment drains.

(26). FoS for post-relinquishment based on a block slide mechanism with a fully filled tension crack. This stability section does not lie in a flood plain, i.e., the landform does not enable flood inundation, this analysis is done to assess the failure of designed peripheral catchment drains. This indicates insufficient FoS and therefore the peripheral drains are required post relinquishment.

(27). These stability sections have a flood plain or river and therefore the block slide mechanism is analysed with a fully filled tension crack.

(28). FoS for post-relinquishment based on a block slide mechanism with a fully filled tension crack. This stability section does not lie in a flood plain, i.e., the landform does not enable flood inundation, this analysis is done to assess the failure of designed peripheral catchment drains. This indicates sufficient FoS and therefore the peripheral drains may be decommissioned at relinquishment.

(29). FoS with some buttressing at toe. This indicates that buttressing is effective in increasing the stability to acceptable level.

(30). FoS based on a block sliding mechanism connecting the MRD flood plain with a fully filled tension crack to the surface. This indicates the importance of both horizontal drains below the MRD flood plain, effective surface treatment to minimise formation of cracks and construction of buttressing.

(31). FoS based on a multilinear mechanism, provided effective horizontal drains and no cracks, minimising the block sliding mechanism.

(32). FoS based on a block sliding mechanism connecting the Latrobe River flood plain with a fully filled tension crack to the surface. This indicates the importance of effective surface treatment to minimise formation of cracks and reinforcement of the diversion bund by internal buttressing.

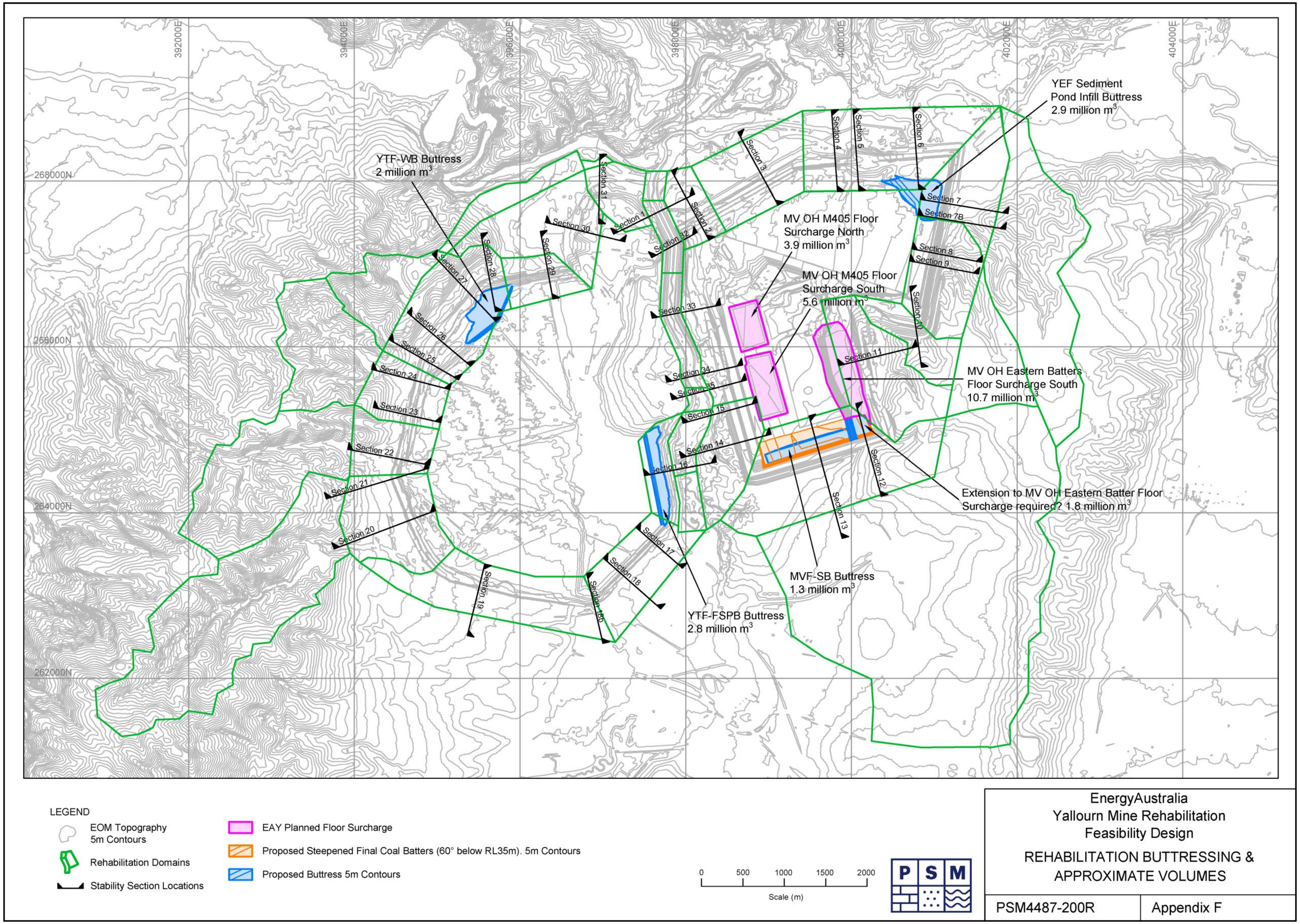


Figure 8-82: Feasibility buttressing design (PSM 2025b)

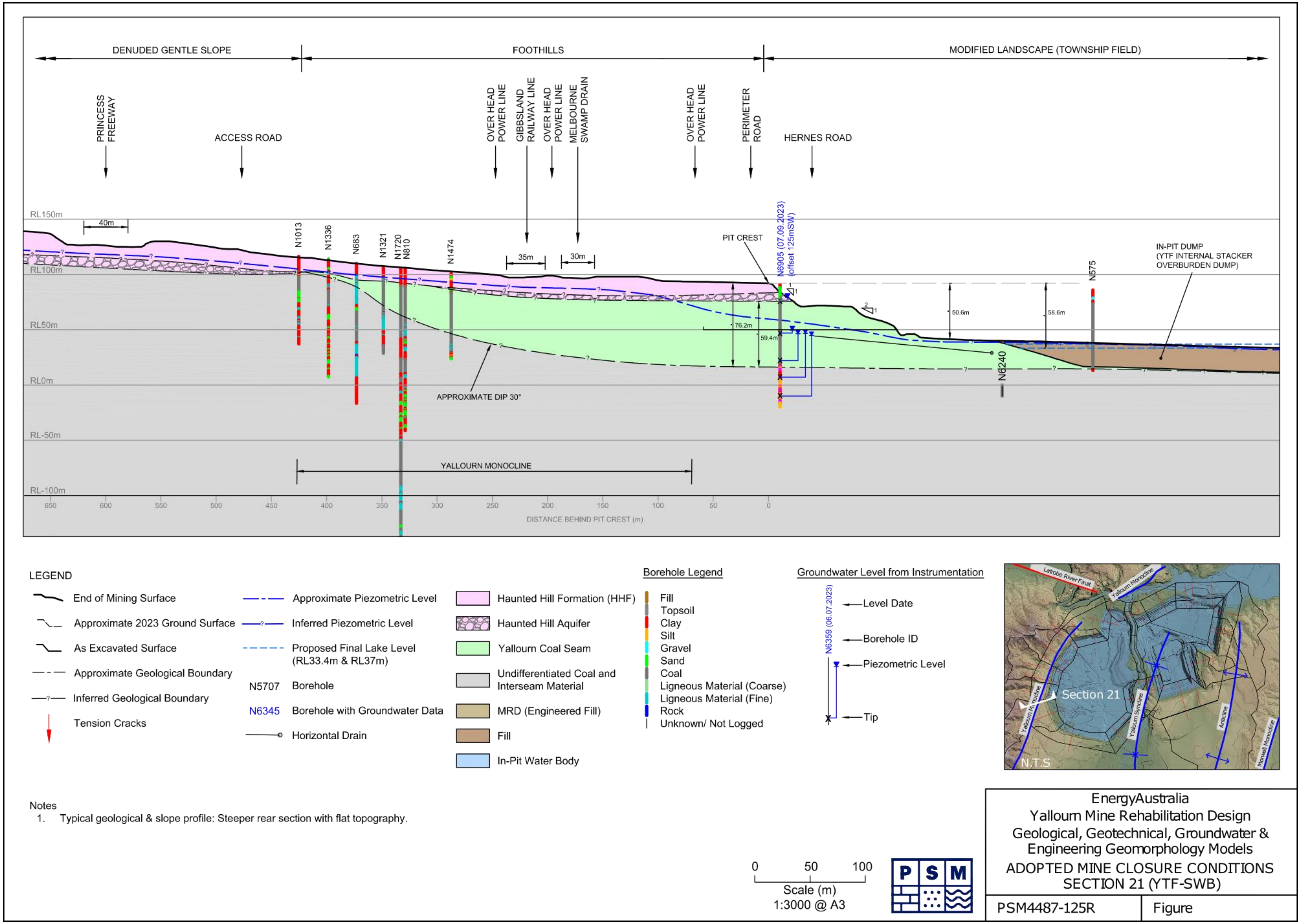


Figure 8-83: Section 21 (YTF SWB) geotechnical stability section

8.9.3.2 Buttressing Requirements

As discussed in 8.9.3.1, there are a few stability sections for which the current batter geometry does not meet the DAC, and these stability sections are also listed below. Feasibility stability analyses have been completed to determine approximate volumes of fill required to meet the DAC. The results are presented in Figure 8-82. Exact volumes will be determined during the detailed design phase (KG05 in Table 17-1). The following stability sections do not currently meet the DAC and feasibility design buttress volumes are listed where applicable:

- EOM / During Filling scenario:
    - Stability Section 6 (YEF LRB) – 2.9M m^3
    - Stability Section 16 (YTF FSPB) – 2.8M m^3
- Lake Full scenario:
    - Stability Section 21 (YTF SWB) – Buttressing requirement to be determined
    - Stability Section 28 (YTF WB) – 2.0M m^3
    - Stability Section 32 (MRD) – Buttressing requirement to be determined

Additional buttressing has not yet been proposed for stability sections 21 and 32. Further geotechnical investigation and testing is planned for the YTF SB/SWB, and this will inform the detailed design in this area (stability section 21). Stability section 32 (MRD) is marginally below the DAC, and this will also be investigated and addressed during the detailed design phase.

Stability section 13 is in on MVF Southern Batters, which are currently the operating face and therefore will not reach terminal profile until the end of mining in 2028. The current feasibility level stability analysis indicates that these batters will likely need buttressing. The exact volume required, and the terminal profile of the batters is yet to be determined. The coal operating face is excavated as two 3.5:1 slopes, with a 90m wide bench between the upper and lower slope. The terminal face geometry will be optimised in the detailed design phase to minimise the volume of buttressing required to meet the DAC, which will likely mean steepening of the coal batter.

8.9.3.3 Geotechnical Design Summary

Detailed stability models have been created for each of the stability sections around the mine (Figure 3-7). Each model considers all available information, including geotechnical, hydrogeological, hydrological, stability analyses, risk assessments, sensitive receptors and the PMLU. The full geotechnical design is covered in detail in PSM4487-200R (PSM 2025b). An example geotechnical design summary for high-risk domains, the YTF Southern and YTF Southwestern Batters (stability sections 19, 20 and 21), is provided below.

Geotechnical Model

An example stability section (21) located on the YTF South Western Batters is shown in Figure 8-83. Major external infrastructure is located within proximity to the mine crest in these domains, with the Gippsland railway line and the M1 Princes Freeway both running adjacent to the batters. At their closest points the railway is less than 100m from the mine crest and the Freeway is approximately 300m. This places the domains in the highest consequence category.

The geology in the area is not favourable. The coal-interseam bedding is dipping into the mine and towards the Yallourn Monocline there is a steep rear section. The batters of the mine rise well above RL37m lake level, with the pit crest located at approximately RL70m to RL90m. However, the YTF OB Dump buttresses the batters, with the dump height rising above the final lake level of RL37m at the toe of the batters.

The batters above the final lake level are, for the most part, in their as-mined terminal profile, which was completed by the SECV circa 1970. These will need to be reprofiled to a flatter gradient and treated, as per Section 8.13, during the rehabilitation works.

There has been no significant tension cracking observed in this domain.

Due to the extensive buttressing by the YTF OB Dump there is minimal horizontal drain coverage, or (operational) requirement, with just two horizontal drains located in the eastern end of the YTF Southern Batters where the OB dump grades down towards the floc pond. The available groundwater data shows that the pore pressures are between 40-70% of hydrostatic (Hu = 0.4-0.7). Groundwater observation bore coverage in the area is relatively low and additional observational bores are being drilled as part of rehabilitation works. These will also provide additional interseam shear strength test results as discussed in Section 8.9.2.3.3.

Surface Water Catchment

The surface water catchment for the YTF Southwestern Batters is large, extending behind the mine into the hills behind Witts Gully and is rated as high risk.

The surface water catchment for the YTF Southern Batters itself is small and localised. However, a major surface water diversion drain, the Melbourne Swamp Drain, runs along the top of the domain, between the railway and the freeway. This drain carries both the YTF Southwest Batters and the YTF Hernes Oak Batters (South) catchment flows, and the Rifle Range Gully pumped flows, around the mine and into the Morwell River wetlands to the southeast. This presents a significant risk, should the drain fail, of creating a major surface water recharge event.

Refer to Section 8.7 for a detailed summary of the surface water catchment.

Stability Analysis Results

The stability analysis results are presented in Section 8.9.3.1 and seismic analysis results presented in Section 8.10.3. The results for the base case scenarios are summarised in Table 8-38:

Table 8-38: YTF SB and YTF SWB stability analysis results

Stability Section (Mechanism)	EOM FoS	Lake Filling FoS	Lake Full FoS
19 (Multilinear)	1.92	1.92	1.54
19 (Blockslide)	1.04	1.04	0.74
20 (Multilinear)	1.81	1.81	1.59
20 (Blockslide)	1.20	1.20	1.06
21 (Multilinear)	1.73	1.73	1.39

It is evident that the FoS at Lake Full is lower than that for EOM and lake filling. This is because the Lake Full scenario assumes hydrostatic pressures (Hu=1), whilst both the other scenarios use domain specific values of Hu (refer Section 8.9.2.3.1). Due to the high elevation of the batters and the existing buttressing of the YTF Overburden Dump, which are both above the final lake level, the lake does not provide a stabilising effect in this area of the mine.

The FoS for all blockslide analyses are below the initial DAC, and near and even below 1.0 for several scenarios. These results highlight the importance of preventing the blockslide mechanism from manifesting, through the control of peripheral catchment surface water flows. This process could involve adding a sensible maximum Hu value to the DAC in this specific domain where full saturation of a tension crack may not be possible.

The feasibility limit equilibrium seismic analysis (refer Section 8.10) results for these domains report a FoS less than 1.0. This indicates that some movement could occur if the design seismic event were to manifest. It should be noted that these results are preliminary and will be refined during the detailed design phase. Due to the high consequence category of these domains, additional geotechnical investigation and testing are to be conducted to further refine the design, including targeted testing of the interseam materials.

8.10 Seismic Stability Analysis

8.10.1 Introduction

A risk-based approach has been adopted to assess the effects of earthquake loading on batter stability. The aim of this risk-based approach is to understand the potential consequence of deformations in each domain to guide the assessments of risk and impacts on rehabilitation batter slope design. This approach can then also be used as required to:

- Potentially modify the intended PMLU in a particular domain such that the potential consequential risk is lowered, and/or
- Undertake additional investigations to better define the geotechnical model, and/or
- Undertake more rigorous seismic investigations.

8.10.2 Methodology

8.10.2.1 Seismic Hazard Assessment

Seismic hazard assessments aim to forecast earthquake occurrence and the resultant ground shaking. A site specific probabilistic seismic hazard assessment (PSHA) aims to consider all possible earthquake events and resulting ground motions, as well as their associated probabilities of occurrence, to find the level of ground motion intensity exceeded with some tolerable low rate

A site specific probabilistic seismic hazard assessment (PSHA) has been conducted for Yallourn Mine and a summary of the study is presented here. The full assessment is detailed in PSM4487-200R (PSM 2025b). The aim was to consider all possible earthquake events and resulting ground motions, as well as their associated probabilities of occurrence, to find the level of ground motion intensity exceeded with some tolerable low rate. The assessment methodology included:

1. Selection of domain risk rating, based on risk to life or risk to infrastructure damage, with comparison to industry standards.
2. Geological siting and soil profile (mostly common to the entire site)
    a. Review of seismotectonic setting
    b. Evaluation of past seismic activities:
        i. 2012 (M5.0) earthquake
        ii. 2021 (M5.9) earthquake
3. Estimate of seismic hazard
    a. Seismic source models
    b. Ground motion models
    c. Peak ground acceleration
    d. Response spectra
4. Earthquake Design Parameters for pseudo static analyses

8.10.2.2 Seismic Design Parameters

The rehabilitation design requires the selection of design PGA's based on the following factors:

- The Design Intent Period and
- Current and Post Mining land Use (i.e. consequence category).

Hence the approach is risk based.

Table 8-39 summarises the approach for the selection of PGAs and shows:

- Assigned PGA probability of exceedance for each of the land consequence categories
- Equivalent PGA return periods corresponding to the assigned PGA probability of exceedance over the 30 year and 100-year design intent periods
- Corresponding PGA values estimated considering the 30-year and 100-year design intent period.

These parameters are used for pseudo-static stability analyses, discussed in Section 8.10.2.4.

Table 8-39: PGAs for design.

Consequence Category	Probability of Exceedance during Design Intent Period	Design intent period 30 years		Design intent period 100 Years	
		Equivalent return period over the design intent period (Years) [AEP in bracket]	Design PGA (g)	Equivalent return period over the design intent period (Years) [AEP in bracket]	Design PGA (g)
1	50%	43 [2.33%]	0.015	144 [0.69%]	0.05
2	30%	84 [1.19%]	0.025	280 [0.36%]	0.09
3	10%	285 [0.35%]	0.09	949 [0.11%]	0.26
4	5%	585 [0.17%]	0.15	1950 [0.05%]	0.41
5	2%	1485 [0.07%]	0.32	4950 [0.02%]	0.7

8.10.2.3 Back Analysis of Historical Events

Over more than a hundred years of mining at Yallourn, the 2012 and 2021 are the largest events, with the following estimated PGAs:

- 0.16g for the magnitude Mw 5.0 on 19 June 2012 located approximately 5 km southwest of the mine, and
- 0.05g for the magnitude Mw 5.9 on 22 September 2021 located approximately 75 km north of Yallourn.

No significant displacements nor global instability of the mine batters were reported or recorded for these events, and they provide important clues for seismic slope design for rehabilitation. The 2012 earthquake event has the highest site PGA of 0.16g, which has been used in the back-analysis to understand the impact of shear strength.

The back-analysis of the 2012 event used the June 2012 batter geometries and groundwater conditions. Sensitivity checks were undertaken to understand the impact of interseam shear strengths (11° and 18° residual friction angles were used). Results indicate:

- 18°: No stability section has a FoS of under 1.0, minimum calculated FoS of 1.28.
- 11°: Three stability sections (all in YTF WB) have FoS of under 1.0 (0.90, 0.94, 0.99), some stability sections are quasi-stable (FoS 1.0 to 1.1, in YTF SWB, YTF RCB, YEF LRB).

As there was observed good performance around the mine after the earthquake, the results of the back analysis support the logic that on a domain wide scale, the strength on the interseam layer is closer to the mean (18°) than the lower bound (11°) (refer Section 8.9.2.3.3).

This back analysis indicates that:

- All batters around the mine have performed satisfactorily during moderate seismic events, equivalent to an AEP of 1:600.
- Higher mine-scale shear strength, of around 18°, is appropriate for assessment of stability under seismic loading.

8.10.2.4 Pseudo-static Analysis

The pseudo-static method applies a horizontal inertial force to the slope to represent a seismic load, calculated as a proportion of weight. It provides a FoS and indicates if the slope is at risk of yielding during an earthquake. Pseudo static back-analysis are also used to provide the critical seismic coefficient which is the horizontal seismic load required to achieve a FoS of 1 for a given model. The method is commonly used as an initial tool for seismic assessments.

Both the Design Intent Period and the land use influence the risks from earthquakes, firstly because the probability of a site experiencing larger earthquakes increases with the time and secondly because whether or not a particular sized earthquake results in a significant risk depends on the sensitivity of man-made or natural infrastructure within the domain. The land use affects the potential consequence of failure and for a high consequence domain, a lower probability of exceedance, resulting in a higher design earthquake magnitude, is adopted.

Domains with the following consequence categories were checked for seismic loading:

- MRD
- Categories 4 and 5 for the 30-year design intent period, and
- Categories 3, 4, and 5 for the 100-year design intent period.

Domains with lower consequence categories were not assessed at this stage because (1) the pseudo-static PGAs are relatively low and moderate events such as the 2012 earthquake have already demonstrated adequate performance of the batters, and (2) the consequence of failure is low and do not typically involve risk to life.

The following failure mechanisms were modelled:

1. Domain-specific critical failure mechanisms at EOM for the 30-year design intent period, Section 8.9.2.3.4.
2. Multilinear failure mechanism for the lake full 100-year design intent period.
3. Circular failure mechanism within the engineered fill in the MRD embankment, for stability section 32 only.

Analysis for the 30-year Design Intent Period adopted the EOM situation, groundwater conditions and pore pressures. The final pit lake level situation and hydrostatic pore pressures were modelled for the 100-year Design Intent Period.

The use of mean interseam shear strength is considered to be the representative condition for these seismic stability assessments, as per discussion in Section 8.10.2.3.

The analyses are for a seismic loading coefficient of 50% of the consequence-specific PGA as a horizontal seismic load. This reduction is consistent with AS4678 and has been previously used in different studies (Hynes–Griffin and Franklin (1984) *Rationalizing the seismic coefficient method* as referenced in (PSM 2025b)).

8.10.2.5 Empirical Assessment of Displacement

Empirical assessment of displacements has been undertaken as a feasibility level assessment of the dynamic response. Two empirical methods have been used to estimate co-seismic displacement for models where the FoS in the pseudostatic analysis is less than 1 (refer PSM4487-200R (PSM 2025b) for detailed methodology). Displacement is estimated using the critical seismic coefficient, which is the earthquake acceleration to achieve a FoS = 1.0 stated as a fraction of the acceleration due to gravity. These empirical estimates are intended to provide displacement estimates for the geotechnical domains, however, these estimates do not consider distance behind the crest, size of slope, or spatial distribution of the calculated displacements.

8.10.3 Findings

8.10.3.1 Pseudostatic Analysis Results

The results, including plans and model outputs, are presented in detail in PSM4487-200R (PSM 2025b). A summary is provided here. Results indicate:

- For domains analysed for the 30-year rehabilitation period: FoS are above or near 1.0. The lowest FoS is at YTF-SWB with FoS of 0.98 and 0.99. This is considered acceptable for this feasibility stage.
- For domains analysed for the 100-year period: Due to the higher PMLU category and the longer design duration attracting a much higher design PGA, many stability sections, especially those with a PMLU category of 4 or 5, report a FoS of lower than 1.0, indicating further seismic assessments will need to be considered in the detailed design stage.

8.10.3.2 Empirical Deformation Results

A summary of the displacement outputs for the deformation analysis is provided in Table 8-40.

The calculated displacements are in the range from 40 to 750 mm. Comparing the calculated critical seismic coefficient for each stability section to the PGA of 0.16g of the historic event, which showed minimal amount of damage and no permanent displacements across the mine, and estimated displacements for a similar PGA in the below table, suggests this calculation method yields conservative results. In addition, these estimated displacements need to be compared against the other displacements that occur and have occurred in the past around Yallourn Mine:

- Long term movements due to the general mining operations at Yallourn and aquifer pumping in the region
- Movements associated with pre-failure and pre-cracking movements for the 2007 YEF Latrobe River Batter Failure, which were up to 1800 mm.

Table 8-40: Empirical co-seismic displacement estimates for stability sections with a FoS <1 for the 100-year design intent period

Domain	Stability Section	Lake Full pseudo-static FoS	Empirical Co-Seismic Displacement Estimate			
			Critical Seismic Coefficient (g)	Length of Failure (m)	Displacement (mm)	Strain (%)
YEF-NB W	1	0.69	0.13	575	121	0.02%
YEF-LRB	4	0.68	0.13	622	121	0.02%
	5	0.45	0.09	627	273	0.04%
	6	0.36	0.08	551	335	0.06%
YEFX-LREB N	7	0.66	0.07	945	150	0.02%
MVF-EB	11	0.68	0.08	611	113	0.02%
MVF-WB	14	0.94	0.11	416	50	0.01%
	15	0.98	0.12	414	39	0.01%
YTF-FSPB	16	0.48	0.09	393	273	0.07%
YTF-FPB	17	0.45	0.09	359	273	0.08%
	18	0.56	0.11	304	181	0.06%
YTF-SB	19	0.48	0.12	354	600	0.17%
YTF-SWB	20	0.45	0.11	620	674	0.11%
	21	0.47	0.11	500	757	0.15%
YTF-NB	29	0.60	0.11	1879	181	0.01%
YTF-RCB	30	0.62	0.11	939	181	0.02%
YTF-LS	31	0.76	0.15	666	82	0.01%
MRD	32 (left to right)	0.56	0.08	717	335	0.05%
	32 (right to left)	0.78	0.15	836	82	0.01%
	32 (circular)	0.78	0.13	127	121	0.10%
	33 (left to right)	0.55	0.09	1037	273	0.03%
	33 (left to right)	0.96	0.19	648	39	0.01%
	34 (left to right)	0.36	0.07	1300	411	0.03%
	35 (left to right)	0.40	0.08	1226	335	0.03%

It is considered that the results of the stability analyses and estimated displacements indicate that adverse outcomes for the infrastructure at risk, rehabilitated slopes and the peripheral catchment drainage structures are not likely, recognising the following uncertainties and limitations:

- Design PGAs for pseudo-static analyses are conservative,
- Stability and deformation results are used for sensitivity checks,
- Geotechnical model is to be updated with additional investigation and test data (currently progressing), and
- EAY PMLU and Consequence Ratings are subject to future refinement.

The design for seismic hazard for mine rehab will increase in rigor in the detailed design stage. Further planned works include the following and will form part of the detailed design works:

- More targeted testing of the interseam materials to refine the geotechnical model, focused on the higher consequence domains.
- Further dynamic analyses, based on a refined risk matrix.

8.11 Mine Weight Balance

8.11.1 Introduction

During the earlier years of mining at the site up until the late 1980s, aquifer depressurisation was not required due to the shallow mining depth. The historical record however revealed artesian flow occurred from two bores drilled in 1934 in the original YOC area (part of the current Yallourn Township Field). The bores were subsequently covered by internal overburden dump.

SECV investigations prior to development of East Field from the mid to late 1980s concluded that depressurisation of the Yallourn Interseam and M1A aquifers was required ahead of mining to reduce the risk of mine floor heave. These studies adopted a Factor of Safety of 1.2 consistent with the approach adopted by the SEC elsewhere in the Latrobe Valley. Depressurisation of the M2/TFAS was not required at Yallourn site due to the relatively shallow mine depth and pumping at Hazelwood Mine had lowered aquifer pressures regionally, below the future M2/TFAS target levels estimated at RL-30 m. Investigations concluded the Yallourn Interseam, which was characterised by a very fine grained and silty sand, was not sufficiently permeable for groundwater pumping and occurs only as isolated channel deposits in the East Field area.

Depressurisation of the M1A aquifer was observed prior to the commissioning of the East Field pump bores in 1994. This was attributed to seepage though the coal seam joints particularly to the south suggesting drainage from M1 dewatering at Hazelwood open cut. A series of M1A aquifer pump bores and free flow artesian bores were commissioned in East Field from 1994 to reduce aquifer pressures below the required target levels for mine development. From September 2004 M1A aquifer depressurisation was implemented via flow from five artesian bores (passive depressurisation), with no active pumping. M1A aquifer pumping was reinstated in June 2008 at N5056 at around 14 L/s (Litre/Second) and the artesian bores progressively sealed with the final flowing bore sealed in 2011. In June 2015 bore N6899 was commissioned at 26 L/s to provide depressurisation ahead of the Maryvale Field mining development to supplement pump N5056 which has been operational since 1998. In April 2024, pump bore M4203 was commissioned along western side Maryvale Field (MVF) with a targeted average flow of about 17 L/s. This pump acts as increased redundancy in the system for mining operational life and into rehabilitation of the site. Figure 8-14 shows the location of M1A aquifer monitoring bores and Figure 8-86 shows the active pump bores.

Purpose of Depressurisation

Groundwater in the Latrobe Valley flows through layers of surficial sediments and interseams, which are separated by thick sequences of brown coal. The in-situ (undisturbed) coal layers are characterised by low bulk hydraulic conductivity and generally act as aquitards, limiting groundwater flow and hydraulically separating the intervening interseam layers, which function as aquifers. Because the interseams are confined by the thick coal layers, groundwater within the interseams at depth is pressurised, resulting in sub-artesian to artesian conditions. When coal is excavated during mining, floor heave and unstable mining conditions can occur if the upward force from the high pore pressure within the underlying interseams exceeds the weight of the overlying strata. This state is known as being above Weight Balance. Therefore, depressurization of the interseams is necessary to reduce the pore pressure and prevent uncontrolled floor heave. Figure 8-84 shows a conceptual representation of floor heave mechanism.

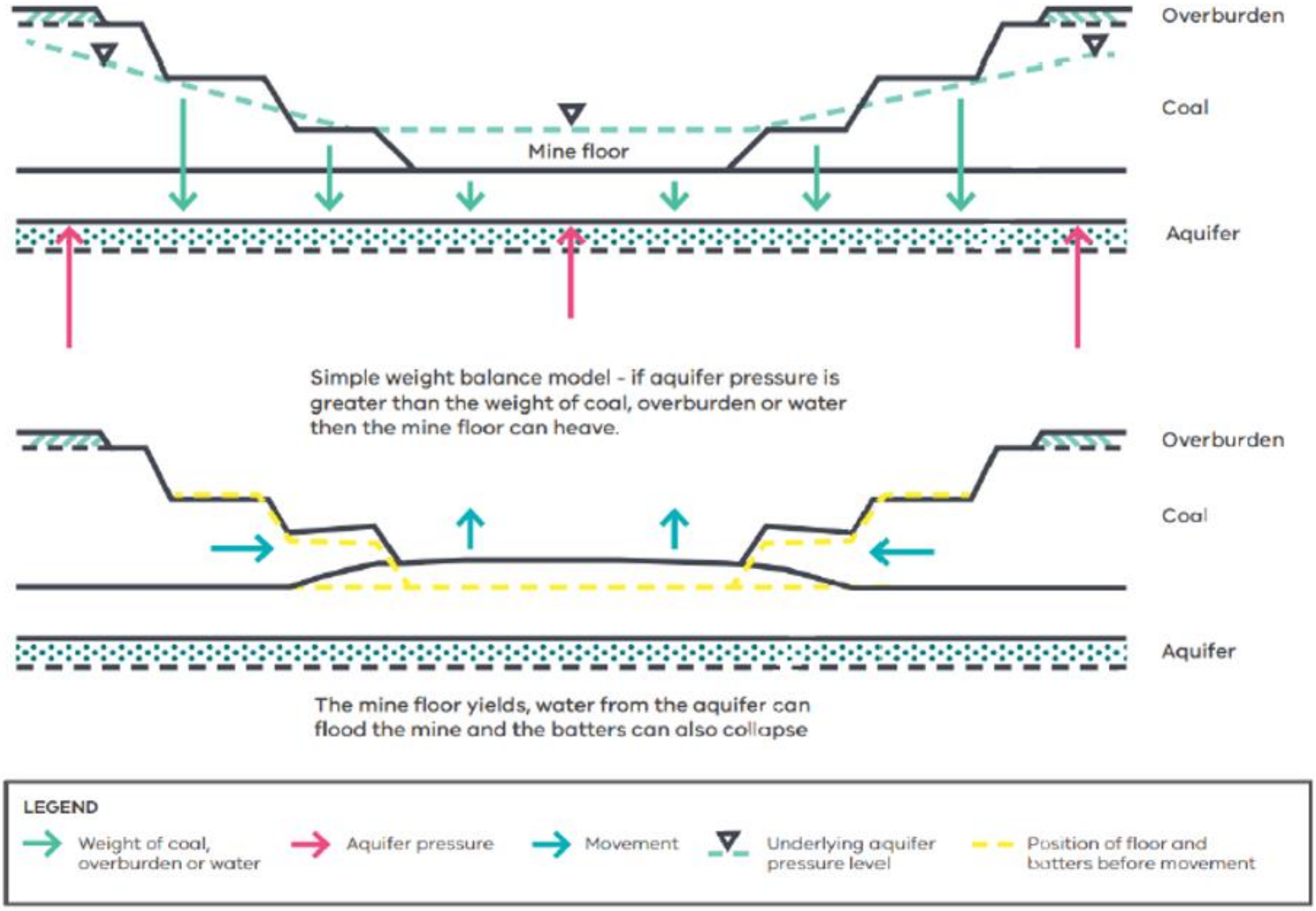


Figure 8-84: Conceptual Representation of Floor Heave Mechanism (DJPR and DELWP 2000)

In addition to lowering aquifer pressures through pumping (either active or passive), the weight balance can be managed by reintroducing material into the pit void to counteract the imbalance created by mining. An example of such supplementation is the construction of in-pit overburden dumps on the mined-out areas of the pit. The planned pit lake for mine rehabilitation can further improve the weight balance requirements on site, providing a passive weight balance solution that is considered most sustainable for the long term.

8.11.2 Methodology

The M1A aquifer system at Yallourn, which is being pumped, consists of four modelled sub-layers. These layers are part of the M1A Interseam and are detailed in Section 5.4.2 (Table 5-6). The hydrogeological concepts of aquifer interconnections at the mine scale level are discussed in Section 8.2.4. Monitoring the responses to these interconnections among the aquifer layers is a key aspect of weight balance management. This is achieved by installing groundwater monitoring bores in these Hydrostratigraphic Units (HSUs). A network of such bores is presented in Figure 8-14.

A computed weight balance model is generated in Datamine Minescape software. This model is used to calculate the weight all stratigraphic units above the M1A aquifer inconsideration of the density and thickness of each material. The density inputs for each material type for the weight balance model are as follows:

- Overburden/Haunted Hills Formation (HHF) – 2 g/cm^3
- Coal – 1.12 g/cm^3
- Interseam (combination of clays, sands, silts, gravels) – 1.8 g/cm^3

Utilizing the thickness of hydrogeological layers modelled in the Geological model (Section 8.2) and the aforementioned material densities, a weight balance surface is generated. This generated surface is then compared to the excavated surface of the mine void to identify areas that are above weight balance. Targeted management plans can then be developed for these identified areas to mitigate the associated stability risk factors.

The data obtained from groundwater monitoring bores is used as a monitoring tool. These assist to understand the progressive changes in groundwater levels and to assist in developing an aquifer surface for the site. This generated aquifer surface serves as an input for ongoing monitoring of areas above weight balance, which can then inform the mitigation and management measures required.

The assessment presented for the rehabilitation planning consider two key stages:

1. Weight balance from the End Of Life (EOL) pit void
2. Weight balance for a Lake level of RL+17m

The End-of-Life (EOL) weight balance assessment aimed to identify key areas that will remain above weight balance upon the completion of mining. This information can then inform the requirements for mitigation measures, such as groundwater pumping or using fill material to counterbalance the areas above weight balance. A static lake level of RL+17m was evaluated to determine a lake level where the weight balance can be passively managed, eliminating the need for further groundwater pumping. Notably, these findings need to be further tested as part of future detailed design works.

Results – Weight Balance Model

The EOL pit void is shown in Figure 8-85. This includes the final mine batters planned for 2028, excluding any reshaping of the batters above the lake level that may be required for rehabilitation. It encompasses all in-pit features such internal overburden dumps, water bodies, constructed Fill structures such as conveyor embankments, MRD etc.

The generated results in Figure 8-86 shows areas above weight balance for EOL pit void. These are represented by the negative values in the plot (i.e. areas < 0m), implying that these areas would require mitigation measures to manage potential floor heave. This suggests that ongoing groundwater pumping will be required post 2028 and for a period through mine rehabilitation.

The effects of lake filling to RL+17m are illustrated in Figure 8-87. These outputs demonstrate that the weight of the water from lake filling can help counterbalance the areas above weight balance, acting as passive management measure against instability that may result from floor heave.

There are three aquifer pump bores currently active in the mine, namely N5056, N6899 and M4203, shown in Figure 8-86.

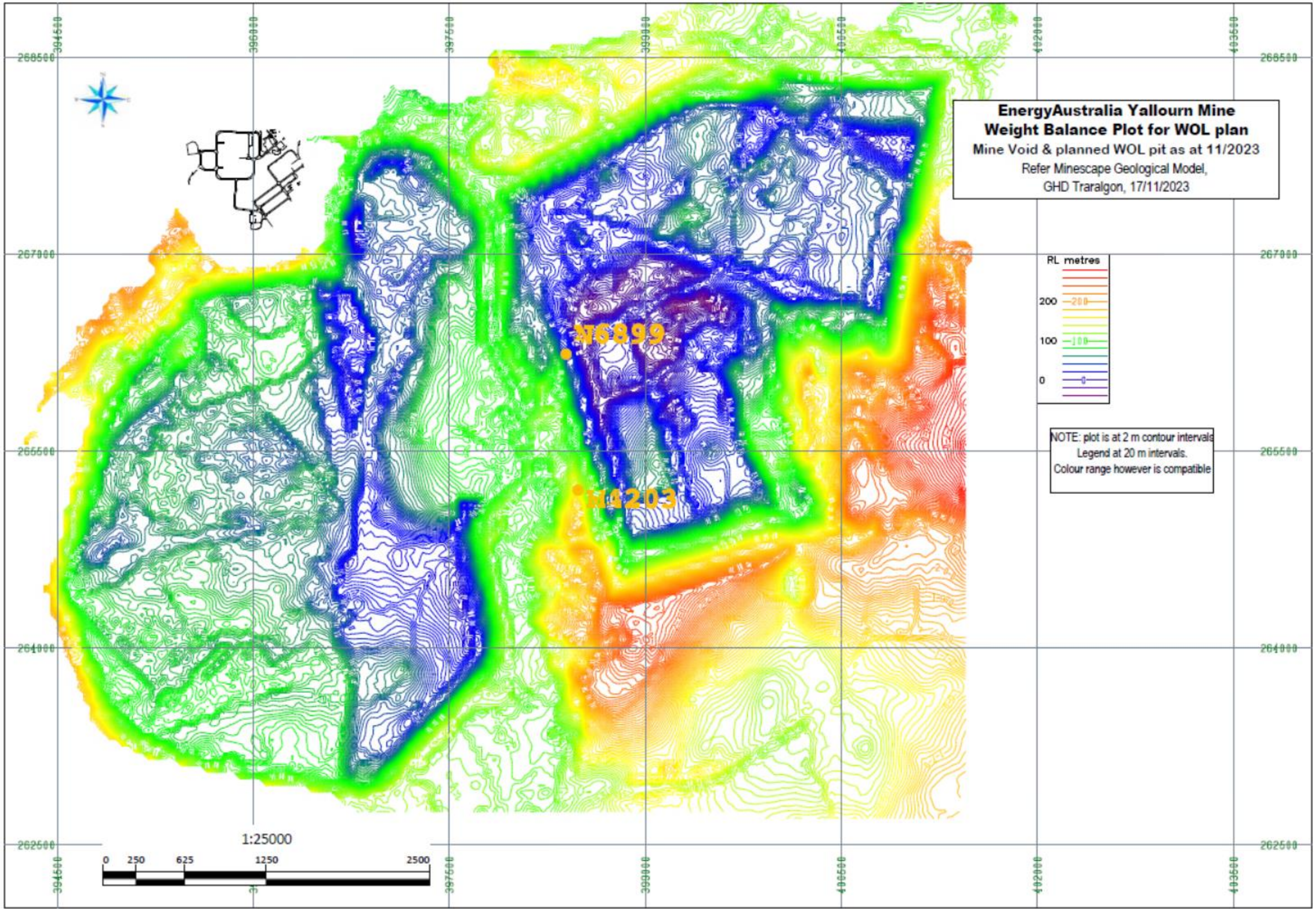


Figure 8-85: Yallourn Mine EOL pit void topographic surface (Yallourn Minescape Model, 2025)

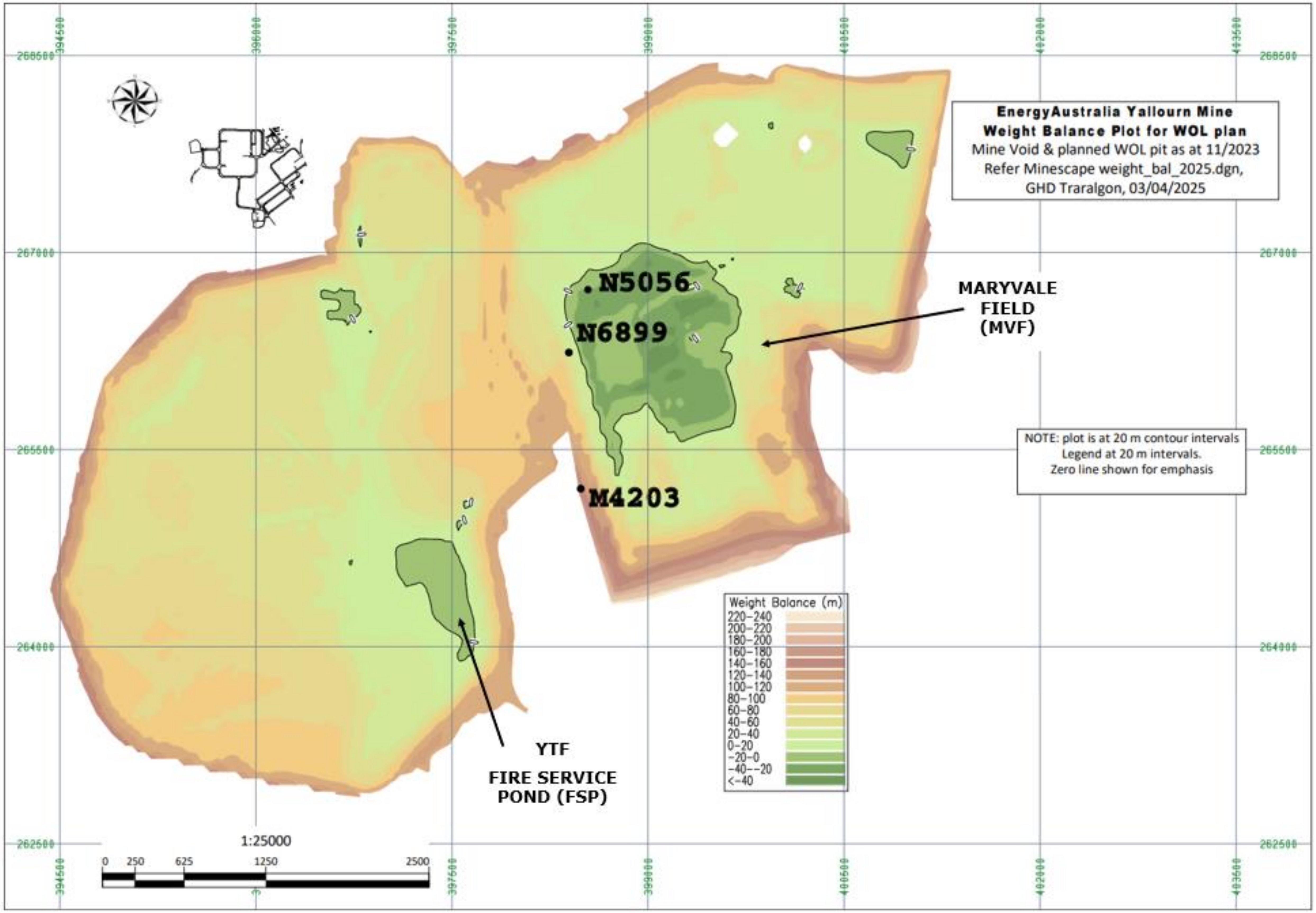


Figure 8-86: Yallourn Mine weight balance plot for EOL Pit Void (Yallourn Minescape Model, 2025)

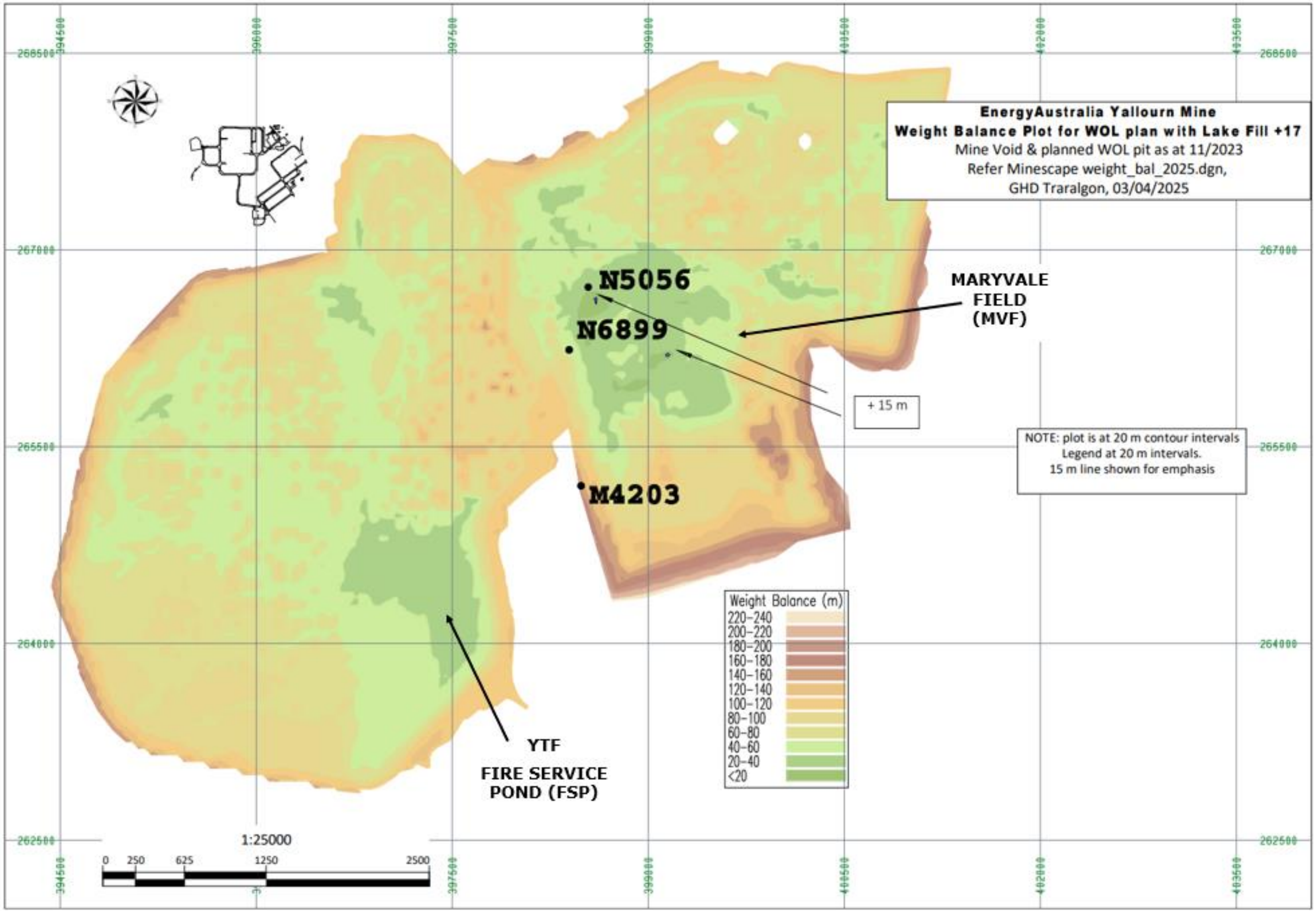


Figure 8-87: Yallourn Mine weight balance plot for lake fill to RL+17m (Yallourn Minescape Model, 2025)

8.11.3 Findings

The following are key findings of the weight balance assessment considering the rehabilitation design for the site:

1. At the End-of-Life (EOL), the northern area of Maryvale Field (MVF) shows regions that remain above weight balance. Additionally, a small area in the northern section of the Fire Service Pond also remains above weight balance.

2. Groundwater pumping from the M1A aquifer will be required beyond the operational life of the mine and will need to continue through a period of rehabilitation lake filling, until stable weight balance conditions are achieved.

3. A static lake level of RL+17m suggests that weight balance conditions are met once the rehabilitation lake reaches this level. This indicates that the lake water body acts as a passive management tool for weight balance, potentially eliminating the need for further groundwater pumping.

The passive measures for weight balance management will be further explored during the future detailed design works for rehabilitation (KG12 in Table 17-1). This will include progressive lake filling stages and the subsequent weight balance requirements. This will need to consider that pump bore N5056 is located on the mine floor and is subject to being inundated at the early stage of lake filling. Pump bore N6899 is located on the mid-seam coal bench (~ RL0m) and is subject to being inundated during the rehabilitation lake filling. These bores will require decommissioning prior to being inundated and so further assessment will be required to confirm redundancy in the system and verify if additional pumps will be required until passive management conditions are met. Pump bore M4203 is located on the grass level (RL +61.23m) which is above the final lake level of RL +37m. This pump bore will continue to service the required rehabilitation phase.

8.12 Morwell River Diversion Assessment

8.12.1 Introduction

The performance of the MRD, as an engineered structure, forms a critical part of the site's rehabilitation plan and outcomes. This section presents the key considerations that informs the landform design for Post Mine Land Use. In addition, the key features of the structure that form inputs to the stability assessments of MRD are discussed. A detailed assessment of the MRD is presented in *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b), (Appendix C – Technical Studies).

Herein, the stability outcomes are considered to be a factor of all geotechnical elements linked to:

- Geological and hydrogeological factors
- Stream flow hydrology and hydraulics (Morwell and Latrobe Rivers)
- Hydromechanical factors linked to mining activities, loading events (rainfall, floods, pit-lake filling etc.) and aquifer depressurisation

Further, the historical performance of the engineered structure, ongoing progressive deterioration and the potential stabilising of deterioration form critical considerations to the performance analysis of the MRD.

8.12.1.1 MRD Overview & Sub-Domains

The MRD (current alignment), constructed in 2005, was designed to pass the Mowell River flows in an open channel through the middle of Yallourn Mine to facilitate mining operations in Yallourn Eastfield and Maryvale Field. The diverted flows report to Latrobe River which flows along the northern boundary of Yallourn Mine. The Morwell River has had several diversions during the history of operations at Yallourn. Owing to the recent history of the current alignment of MRD, there are two major events that have influenced the MRD stability assessment for rehabilitation design:

- 2012 (July) MRD Failure – occurred in northern end of engineered structure (MRD Repair sub-domain, Figure 8-89) where the Morwell River piped through the earth fill embankment discharging the flooded river flows into the pit, causing a large-scale failure of the two conveyor tunnels (E110 and E210) and overlaying river channel and associated floodplain.
- 2021 (June) Mine Incident – occurred in the southern end of the engineered structure and its interface with the Natural & Cut sub-domain. The Morwell River in a flooded state hydraulically connected with the underlaying foundation and lower stratigraphic units, causing extensive cracking along the river floodplain, low flow channel and along the adjacent mine benches and operating face.

The 2012 failed area of MRD was repaired with a multi-liner system with river flows commissioned in 2014. The 2021 incident area involved reconstructed a 200m of section the low flow channel. In addition, resealing, recompacting and regrading 600m section of the floodplain in the southern end of MRD ((PSM 2025b)). The river flows were recommissioned in 2022. Whilst the 2012 repair area is no longer considered to be influenced by mining related stress changes, the 2021 incident area has continued to display dynamic responses linked to stress changes induced by mining activities in Maryvale Field. These dynamic responses are expected to continue until end of mining operations (2028) and for a significant period into mine rehabilitation. This is deliberated in detail in *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b), (Appendix C – Technical Studies).

Limiting factors of MRD, in its current state and following the 2021 Mine Incident:

- Progressive deterioration of the structure due to ongoing mining induced deformation
- Uniform or differential settlement of earthen structure linked to ongoing settlement and predicted collapse settlement during rehabilitation
- Sodic, highly reactive soils linked to widespread cracking of the near surface clay layers along the floodplain and internal embankments. This is also linked to surface and tunnel erosion mechanisms
- Maximum flood carrying capacity of up to RL 43m

Notably, these limiting factors are foreseen to evolve, contributing to the progressive deterioration of the structure. The rehabilitation assessment of MRD has therefore aimed at quantifying these factors which has then informed the remedial measures than can be incorporated into the rehabilitation design of MRD. The derived rehabilitation design of MRD is presented in Section 12.3

The risk profile of the MRD in its current state and the target residual risk rating is a key consideration to the rehabilitation design of MRD. The risk profile of the structure through various stages of mine rehabilitation is discussed in Chapter 11.

The key features and terminology for the MRD are presented in Figure 8-88 represented by a typical cross-section across the conveyor tunnels. It also shows the design lake level of RL 37m on east and west of the MRD.

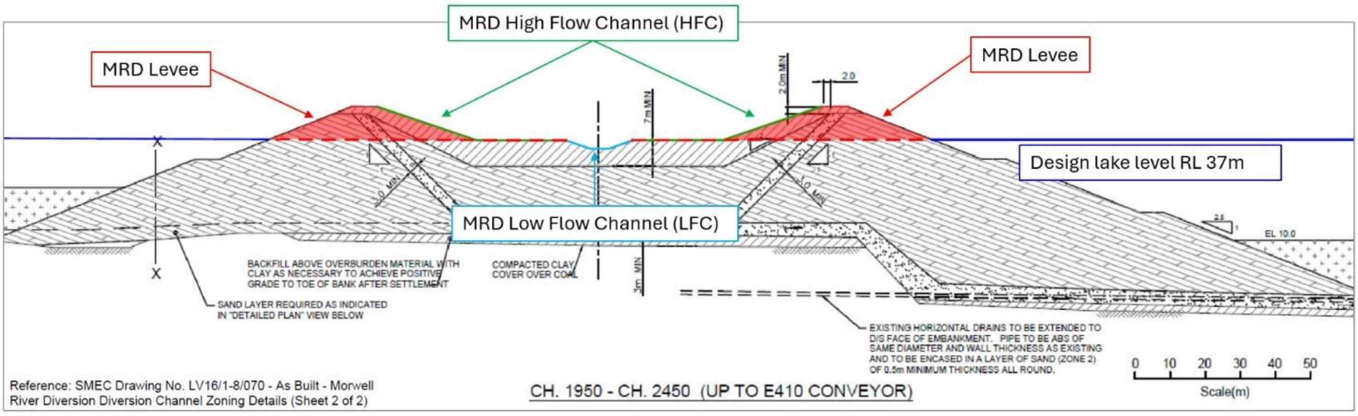


Figure 8-88: MRD Terminology and Key Features

The MRD is constructed on variable foundations, being dumped overburden, in-situ coal and mined out floor. The performance of MRD is also interdependent on the upstream and downstream reach of the Morwell River system. Linked to this variability and other geotechnical factors discussed above, the structure is segmented into sub-domains (Figure 8-89). This has enabled the stability analysis to be targeted by accounting for localised features that influence the stability outcomes and performance of the structure. These local features within each sub-domain will further assist in developing a targeted ground management system through various phases of rehabilitation. The monitoring, maintenance and management regime is presented in Chapter 15.

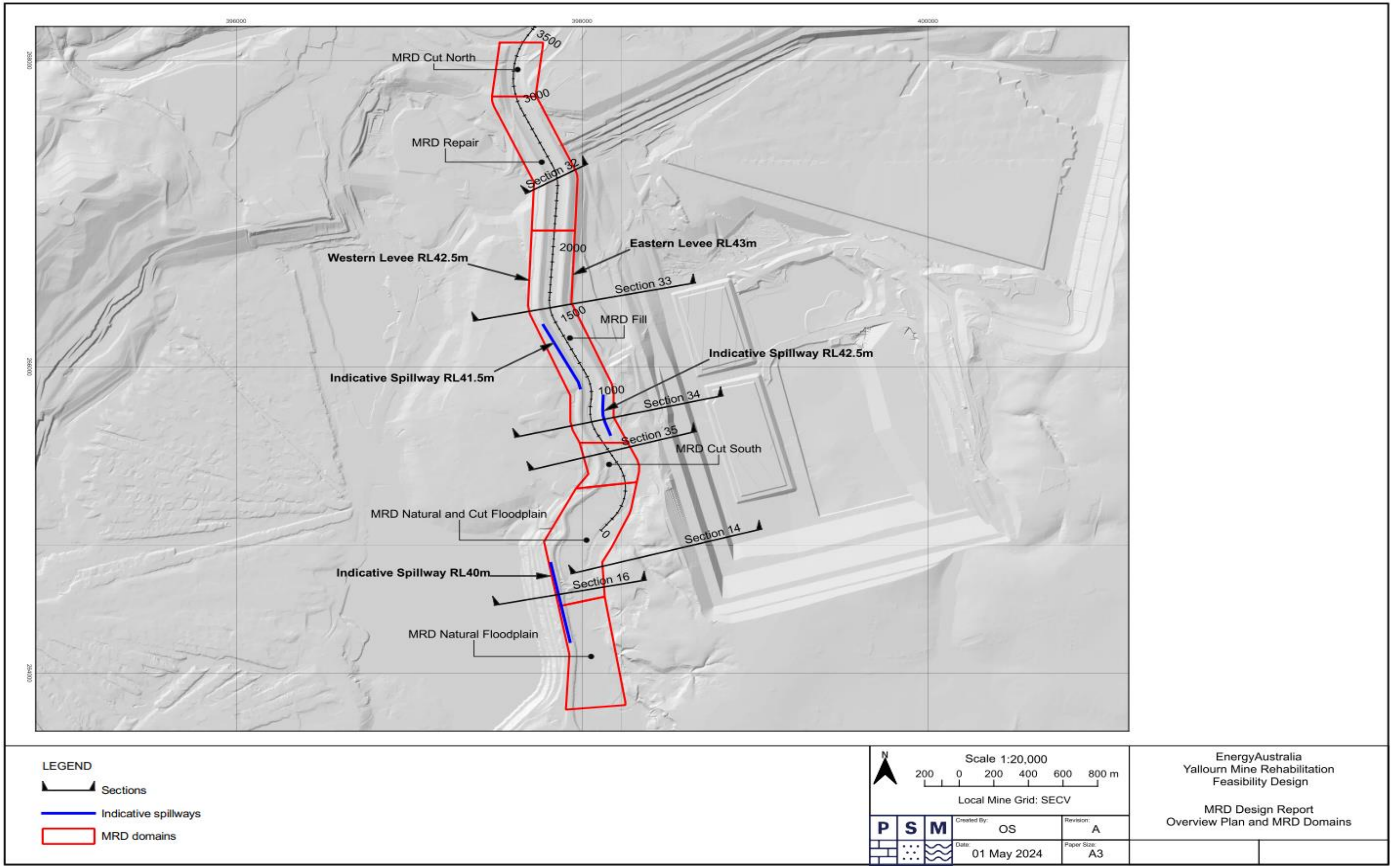


Figure 8-89: MRD Sub-Domains, Cross-Section Lines & Indicative Spillway locations for Rehabilitation Design (PSM 2025b)

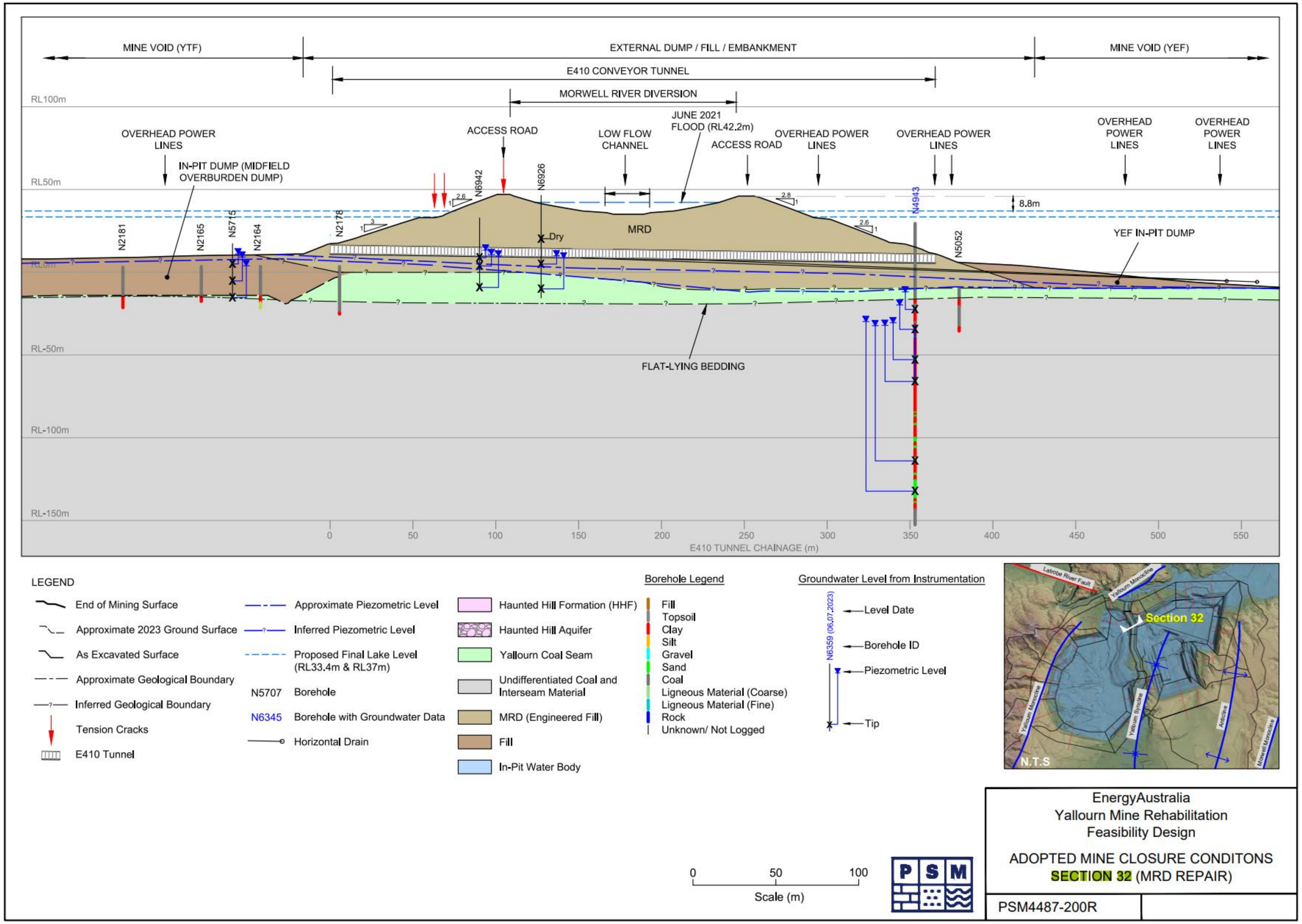


Figure 8-90: MRD Geotechnical Cross-Section (Section 32) (PSM 2025b)

8.12.2 Methodology

8.12.2.1 Geotechnical Model

For illustration purposes, Figure 8-90 shows a representative geotechnical cross-section 32, plotted across the conveyor tunnels in the northern section of the MRD. The detailed assessments are discussed in *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report* (PSM 2025b), (Appendix C – Technical Studies).

The analysis in general considers three principal elements.

- Stability of overall structure (global stability), as shown in 8.12.2.4.
- The Levee embankments/slopes.
- The Low Flow Channel (LFC), including the channel slopes.

The geotechnical models for the analysed cross-sections along MRD are variable, owing to the variability in the foundation and adjacent domain features. The key aspects of the geotechnical model are as follows:

Foundation and underlying geology

- The northern and southern ends of the MRD are founded in natural cut (Haunted Hills Formation), sub-domains MRD Cut North, MRD Cut South and MRD Natural and Cut Floodplain. The embankment structure is founded on variable foundations comprising of natural overburden, dumped overburden, coal and excavated mine floor. Underlying the abovementioned foundations is the Yallourn Interseam which overlies the Morwell formation.
- The Yallourn Township Midfield Overburden Dump (MOD) lies on the western side of the MRD embankment. On the eastern side of the engineered embankment is the YEF mine void with constructed conveyor embankment fill. South of MRD CH1000 (approx.) is the MVF Western Batters and MVF mine void.

Hydraulic gradients

- The hydraulics gradients with the earthen structure are managed by the subsurface filter drainage systems and chimney filters. These are present to the north of MRD CH1000 and predominantly along the eastern embankment and along the high earthen fill western embankment (covering Fill and Repair sub-domains). In addition, where Yallourn Coal is the underlying the MRD, there are drilled horizontal bores to manage the coal water table, influencing the pore pressures in the underlying Yallourn Interseam.
- Deeper M1A Interseam aquifers are depressurised via pump bores which results in lowering the upthrust from aquifer pressures and obliquely lower the Yallourn Interseam pressures where hydrologically connected (discussed in Section 8.12.2.2).
- The hydrostatic conditions (Hu) for each geological unit in the geotechnical model factors in the abovementioned features and the groundwater data from observation bores.

Material Properties

- The material properties are as per Table 8-31.

8.12.2.2 River Hydrology & Hydraulics

The river flows passing through the MRD are a function of Mowell River and Latrobe River catchments (Alluvium, 2025). The hydrology of the Latrobe and Morwell River systems including its upper catchments have been considered for the rehabilitation of MRD with reference to the Design Intent Period. This has been supported by a hydrological model for these catchments to estimate peak flows and generate hydrographs which form inputs to the design (presented in Section 8.6).

In understanding the hydrology and hydraulics of these two river systems, the ecological value of this cultural asset has been considered. In general, these consider the impact to ecological value in a scenario of catastrophic failure of MRD and the resulting downstream losses. With this, the key focus of the hydrologic and hydraulic assessment has been to enable a rehabilitation design for MRD that services the hydrologic, geomorphic and ecological functions of the catchments.

Hydrologic Assessment

The surface hydrology for the regional catchment is presented in Section 8.6 in more detail. The key aspects of the hydrologic assessments relevant to MRD are presented here. The Latrobe River catchment size of 1940 Km^2 is over three times that of Morwell River catchment (612 Km^2). A calibrated RORB catchment model was developed to generate peak flows for various AEPs for each catchment (Alluvium 2025). These primary peak flows were considered for the overall MRD assessment considering the current and future limitation of MRD (as discussed in 8.12.3).

Table 8-41: Morwell & Latrobe River Catchment Peak Flows (m^3/s) (Alluvium 2025)

AEP	50%	5%	2%	1%	1 in 200	1 in 500	1 in 2000
Latrobe River @ Yallourn	60	480	770	1000	1180	1680	2600
Morwell River @ Yallourn	40	240	370	480	560	740	1090

Peak flow estimates based on Climate change scenarios

- The impact of climate change on the design events was modelled for the near, medium, and long-term projections up to 2100. These scenarios were based on the very high Shared Socioeconomic Pathways (SSP5-8.5).
- The peak flow rates under the very high Shared Socioeconomic Pathways (SSP5-8.5) scenario are shown in the figure below.

River Hydraulics

The river hydraulics assessment presented here are for the following conditions and considerations:

- MRD in its current state with a flood of RL 42m and RL 43m passing through, measured at the Southern Crossing of MRD.
- Probability of the above two flood events occurring during the course of lake filling period (range of periods in Table 8-42) and the corresponding AEPs.

The assessment outputs generated also inform the exposure to risk for MRD and contributes to development of an integrated rehabilitation design for MRD.

The results generated from the hydraulic modelling:

- A flow of about 81,000 ML/d (937 cumecs) passing through the MRD Southern Crossing is likely to reach RL 42m. This equates to a 1.7% AEP (60 Year ARI) at the Thoms Bridge on Latrobe River (immediately downstream of Yallourn site).
- A flow of about 118,000 ML/d (1365 cumecs) passing through the MRD Southern Crossing is likely to reach RL43m. This equates to a 0.6% AEP (170 Year ARI) at the Thoms Bridge on Latrobe River.

The probability of these events occurring over various lake fill time periods are presented in Table 8-42.

Table 8-42: Probability of occurrence for design floods at the MRD (Alluvium 2025)

Probability of Occurrence (%)		
Lake Fill Periods (Yrs)	**RL42m***	**RL43m****
10	16%	6%
15	23%	9%
20	29%	11%
25	35%	14%
* Measured at MRD Southern Crossing, AEP of 1.7% for Latrobe River (Thoms Bridge) ** Measured at MRD Southern Crossing, AEP of 0.6% for Latrobe River (Thoms Bridge)		

The potential risk outcomes associated with the above probabilities is assessed in a risk assessment and is discussed in Chapter 11. The measured risks inform the controls required to mitigate against such risks have then informed the rehabilitation design of MRD.

8.12.2.3 Surface Water Catchment – MRD Peripheral

The mine peripheral surface water catchment is presented in Section 8.7. The local catchment of the MRD is significantly smaller the mine peripheral and is insignificant when comparing to the size of regional catchments. The local catchment of MRD covers the surface runoff generated along the levee embankments, the internal embankments and runoff generated along the external embankments and lower berms. All runoff generated on the levees and internal embankments report to the MRD LFC. All runoff generated along external embankments and berms report to the mine void on the west (YTF) and east (YEF) of MRD.

The key implications of surface water along MRD peripheral are:

- Erosion of the surface capping and vegetation
- Water ingress and recharge into the underlying foundation(s)
- Development of erosion pathway to LFC (Sunny day) and/or under flooded conditions

These have been factored in the performance assessment of MRD in its current state so the associated risk outcomes can be measured/assessed and subsequent rehabilitation design for MRD can appropriately mitigate the risk to an ALARP level.

8.12.2.4 Stability Analysis

Failure Mechanisms

Potential failure mechanisms for the MRD are considered below. In addition to these, the performance of MRD under seismic loading has been analysed.

Table 8-43: MRD Failure Mechanisms

FAILURE MECHANISM	CONSEQUENCE
Overtopping of MRD Levees	Partial loss of MRD Levee Total loss of MRD Levee Loss of MRD LFC
Global slope failure due to block sliding along the base of the Yallourn Seam	Loss of MRD LFC Loss of MRD Levees
Local slope failure of MRD Levees	Internal slope failure leading to: • Partial loss of MRD Levee • Total loss of MRD Levee External slope failure leading to: • Partial loss of MRD Levee • Total loss of MRD Levee • Loss of MRD LFC
Piping leading to failure	Sunny day event leading to: • Loss of Levees • Loss of MRD LFC Flood event leading to: • Partial loss of MRD Levee • Total loss of MRD Levee • Loss of MRD LFC

Other considerations include Wave Action and Overtopping. These are factors to consider as part of the derived rehabilitation design of MRD. These are discussed in the chapter for Landform Design.

Target Performance Requirements of MRD for Mine Rehabilitation

1. Protect the LFC against failure to transmit Morwell River flows uninterrupted over the Design Intent Period (Section 0) and meeting all environmental flow requirements.
2. Protect the High Flow Channel (HFC) in combination with LFC to pass environmental flows and design flood flows (below RL 43m), with minimal to no adverse downstream impacts.
3. Maintain the MRD levee banks to protect the HFC and LFC.
4. MRD tunnels stability is maintained to deliver the interconnection between the West and East Pit Lakes (future lakes).

An outcome of meeting these performance targets will be to deliver a rehabilitation design for MRD that will meet the Victorian Rural Levee criteria with a low hazard classification, servicing the Design Intent Period (KG07 in Table 17-1).

Global Stability Results – MRD

There are four critical stability mechanisms detailed in Table 8-43 with the analysis results at various sections presented in Table 8-44.

Table 8-44: Results of Global Stability for MRD (PSM 2025b)

Section	Stability Mechanism	Failure Direction	Factor of Safety and Condition		
			End of mining (EOM)	Lake Full	Lake Filling Minimum
32	Multi-linear	YEF	~ 1.7	~ 1.5	~ 1.3
		YTF	~ 2.2	~ 2.15	~ 1.8
33		YEF	~ 1.9	~ 1.95	~ 1.5
		YTF	> 3.0	> 3.0	> 3.0
34		YEF	~ 2.1	~ 2.4	~ 1.5
		YTF	~ 2.4	~ 2.5	~ 2.1
32	Block Slide	YEF	~ 2.4	> 3.0	~ 1.8
		YTF	~ 3.0	> 3.0	~ 2.3
33		YEF	~ 2.1	> 3.0	~ 1.6
		YTF	> 3.0	> 3.0	~ 3.0
34		YEF	~ 2.1	> 3.0	~ 1.6
		YTF	~ 2.1	> 3.0	~ 1.9
32	Circular	YEF	~ 1.8	~ 1.7	~ 1.6
32	Block Slide w' Flood Loading (RL42.5m)	YEF	2.2	NA	NA
33		YEF	2.03	NA	NA
34		YEF	1.89	NA	NA

Levee Embankment/Slopes

A representative section at MRD CH2000 was analysed, considered to be an adverse case where embankment slopes are locally steep. The geometry at this location comprises:

- Total slope height of 35 m,
- Batter slope of 4H:1V above RL 37m, and
- Batter slopes of 2.5H:1V below RL 37m with intermediate berms for an overall slope angle of 3H:1V.

The analyses have been undertaken for the following lake levels:

- EOM (no lake), and
- Lake levels of RL 10, 20, 30 and 37 m.

The analyses have assumed a worst-case scenario and used the current profile of MRD slopes. The results of the analysis are presented in Table 8-45.

Table 8-45: MRD Levee Slopes – Stability Analysis Results (FoS) at MRD CH2000 (PSM 2025b)

Condition	EOM	Lake, RL 10m	Lake RL20m	Lake, RL 30m	Lake, RL 37m
Design	1.7	1.7	1.8	2.4	2.9
Adverse*	1.4	1.4	1.5	1.9	2.3

Note: *Adverse conditions present sensitivity case where strength parameters are reduced to account for deterioration of MRD over time.

Stability of LFC

Stability analyses of the LFC have been undertaken for the typical geometry, adopted from MRD As-Built profile and discussed in PSM (2025b). These comprise of:

- Slope heights of up to 3 m,
- Batter slopes of 2H:1V along straight sections of the channel and
- Batter slopes of up to 1.5H:1V along the outside of channel bends, and where steeper slopes are present stabilisation with rock fill was specified in the design.

The analysis considers two variations to groundwater conditions:

1. LFC partially full and groundwater gently decreasing away from the LFC.
2. LFC close to empty and a rapid drawdown groundwater condition.

The results of the analysis are presented in

Table 8-46: MRD LFC Stability Analysis Results

Material Properties	Batter Slope	Groundwater Condition	FoS
Design	2H:1V	No rapid drawdown	2.2
	1.5H:1V		1.8
	2H:1V	Rapid drawdown	1.7
	1.5H:1V		1.4
Adverse*	2H:1V	No rapid drawdown	1.5
	1.5H:1V		1.2
	2H:1V	Rapid drawdown	1.1
	1.5H:1V		0.9**

Note: *Adverse conditions present sensitivity case where strength parameters are reduced to account for deterioration of MRD over time.

** FoS of <1 here is for adverse parameters, denoting localised failure and short-term event. This could be repaired following the event passing and will be part of routine management.

Piping – MRD

A tangible failure mechanism for the MRD is piping failure (internal erosion of the MRD embankments eventually creating channels that lead to structural instability), as noted in 8.12.1 along with the potential consequences. The analysis of this failure mechanism considers the adverse nature soil properties (based on lab test results), being clay dominant, reactive in nature to varying climate conditions, of sodic character making it highly alkaline and dispersive.

Two piping failure conditions have been analysed. These conditions have been assessed against a scenario of dry pit (no lake), lake at RL 33.4m (near full) and full lake of RL 37m.

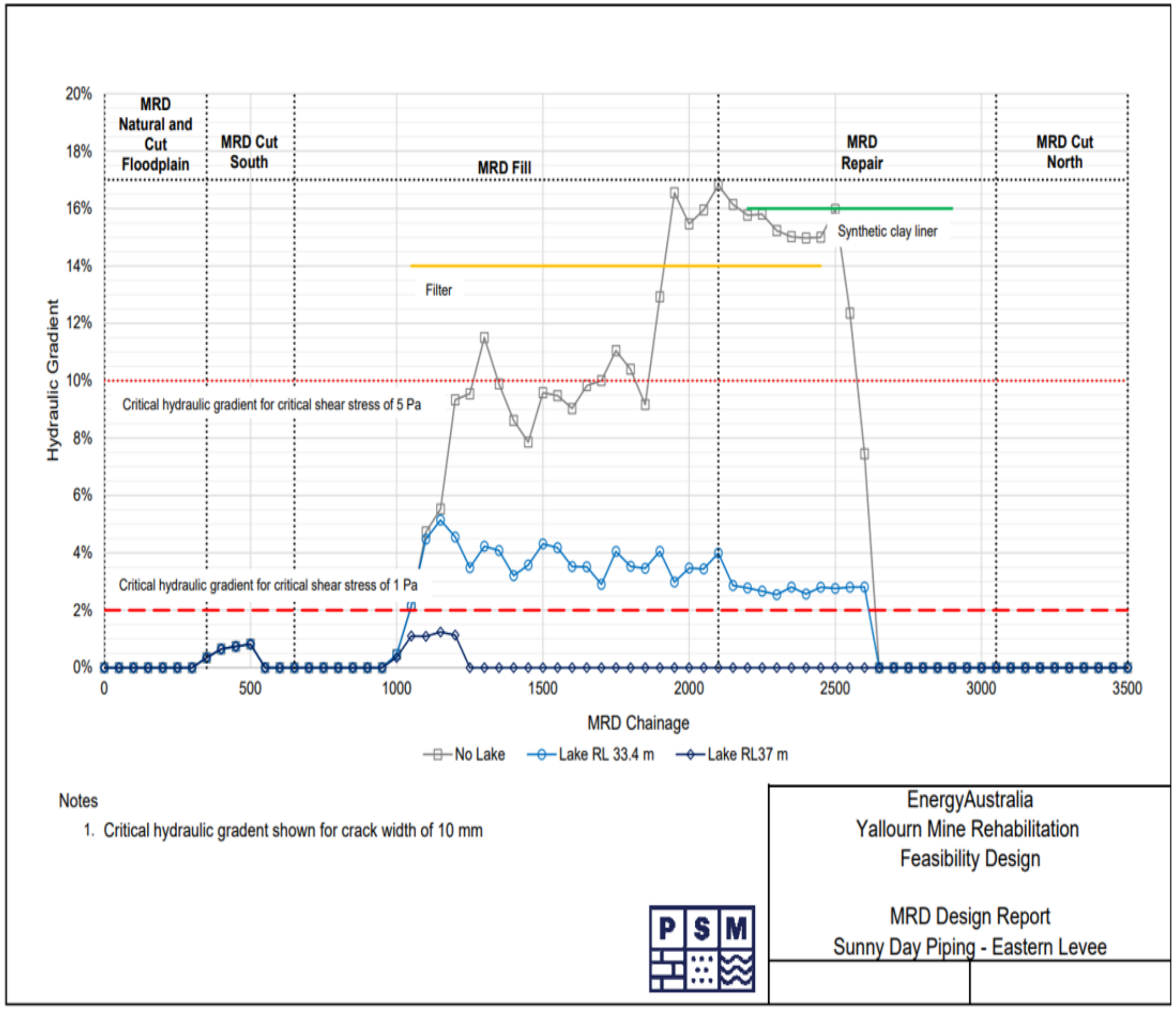
1. Piping though LFC, sunny day condition (base flow condition)
2. Piping through Levee, in a flooded condition (up to RL 42m)

The analysis outlines that risk of piping failure is greatest without a lake body (No Lake) linked to the critical hydraulic gradient being exceeded, for sunny day condition. This is most unfavourable for MRD Fill sub-domain (and downstream) along the west and east levee and has the highest potential of a piping failure to occur. Here the hydraulic gradient of up to 17% is expected along the west and up to 22% along the east levee where MRD is thicker and is elevated well above the mine floor to the east. The high gradient can be somewhat counter balanced (managed) in areas with filter drainage system but reliability of that system to service the Design Intent Period is very low. The risk levels increase by a factor for piping under a flooded condition.

With a lake level of RL33.4m, these adverse hydraulic gradients are significantly lower, therefore reducing the risk of piping failure leading to a catastrophic outcome. However, the piping risk is further reduced with a lake level of RL

37m. The higher lake level being higher than the nominal invert level of the LFC (at RL 36m in the southern end, RL 34m in northern end) effectively eliminates a catastrophic outcome for a sunny day condition and significantly lowered for a flooded condition.

The results for piping conditions analysed are presented in Figure 8-91 (Sunny Day Condition) and Figure 8-92 (Flooded Condition).



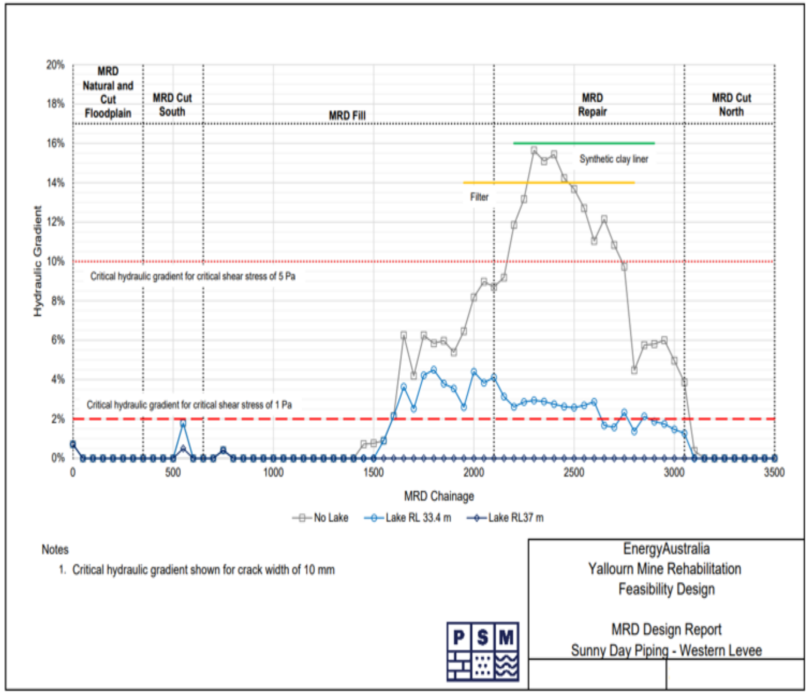
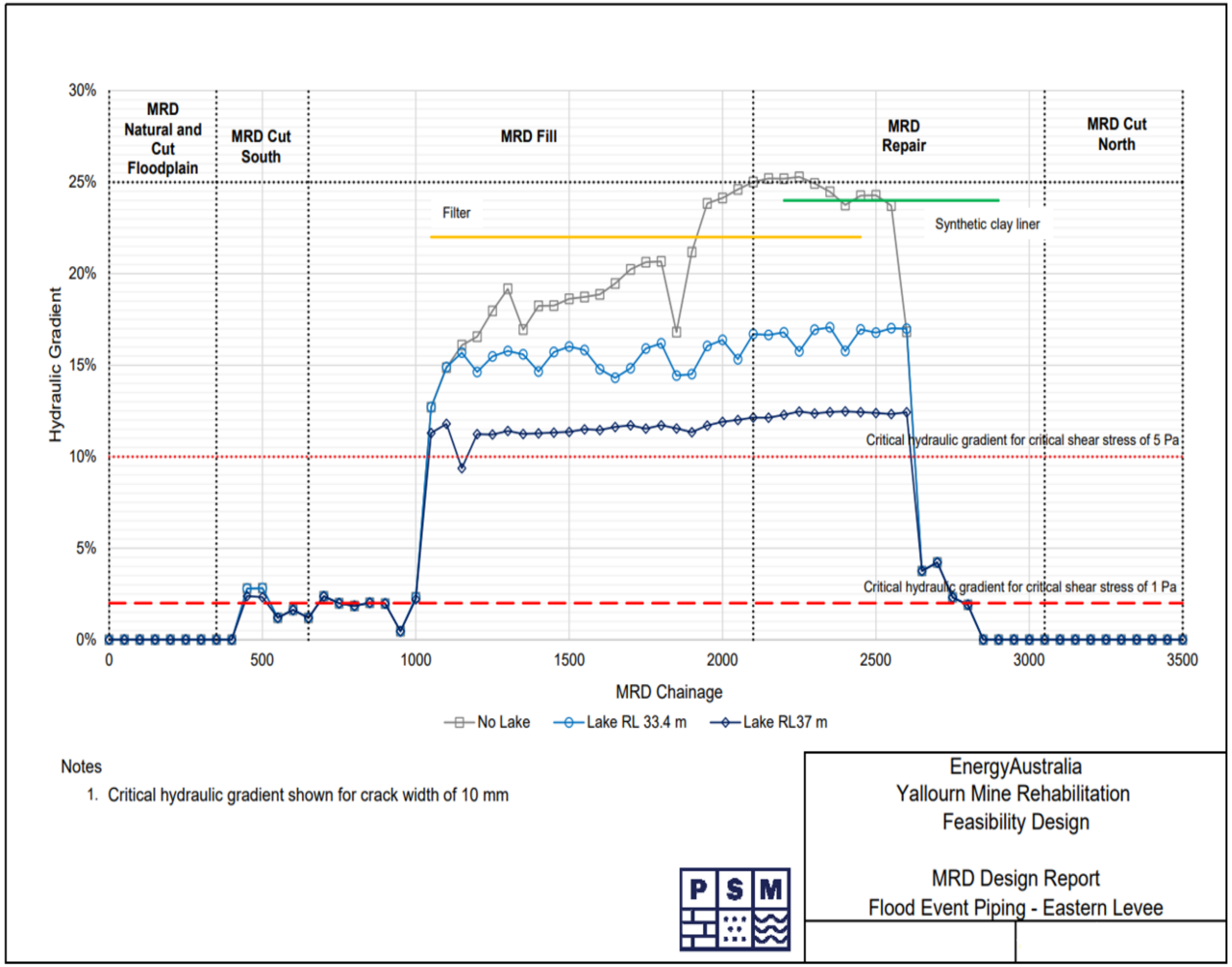


Figure 8-91: Piping Analysis Results – Sunny Day Condition (East & West Levee) (PSM 2025b)



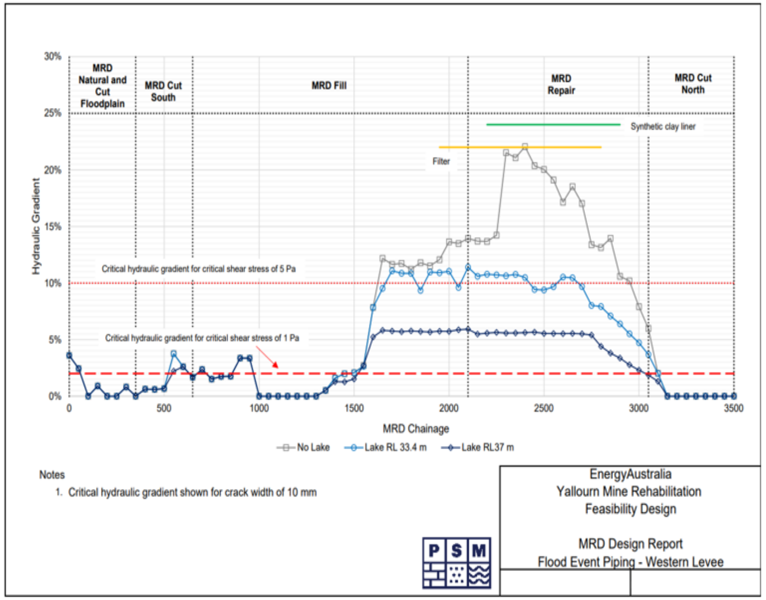


Figure 8-92: Piping Analysis Results – Flooded Condition (East & West Levee) (PSM 2025b)

Conveyor Tunnels

During and post lake filling, the conveyor tunnels will form the hydraulic connection between YTF and YEF/MVF. In order to ensure the tunnels, continue to function in that capacity for the Design Intent Period pipes will be installed within the tunnels and the annulus grouted. The size and number of pipes required in each tunnel are discussed in Section 12.3.1.

Settlement – MRD

Since construction in 2005, the MRD embankments have been showing settlement. The sub-domains where the MRD is thicker (north end), the settlement has been greater resulting in non-uniform settlement profile. In the northern end of MRD these settlement profiles were somewhat reset following the remediation of the MRD following the 2012 MRD Failure. Post that, the settlement has continued with several contributing factors.

Measured settlements of MRD is associated with a range of mechanisms including:

1. Internal settlement of fill materials. This includes:
   a. Primary Consolidation and elastic settlements due to the weight of the fill
   b. Creep settlement
   c. Collapse or hydroconsolidation settlements
2. Settlement associated with mining including:
   a. Unloading, both vertical and lateral
   b. Instabilities
3. Mine scale settlements associated with changes in groundwater levels including:
   a. Settlement due to groundwater drawdown and resultant increases in effective stress
   b. Rebound following groundwater recharge.

When assessing the settlement of MRD and its contribution to the rehabilitation design, the following key aspects have been identified:

- **Regional Dewatering Settlement**
  - Total of up to 1m settlement has been measured at the regional level monitoring pins with a relatively higher rate of settlement during 1962 to 1980 (period of increase pumping at Hazelwood Mine). This can be clearly linked to regional dewatering.
  - Creep Settlement of MRD
  - The key factors linked to creep settlement:
    a. Consolidation of the Fill materials including the foundation layers such as the Mid-Field Overburden Dump, engineered Fill
    b. Hydroconsolidation of MRD, its founding layers and underlying stratigraphic units
    c. Settlement linked to mining induced strains and developing stress fields
    d. Settlement linked to aquifer depressurisation (regional and mine scale)
  - Based on these factors an estimation of settlement has been calculated considering the historical settlement recorded for the Mid-Field Overburden Dump (foundation layer along the western section of MRD) and the measured settlement of the engineered fill. These have assisted in predicting the potential creep settlement for the remainder of mine operating life and the Design Intent Period to be approximately 0.6m.

- **Collapse Settlement**

Most poorly compacted, partially saturated fills undergo a reduction in volume when inundated or submerged for the first time. Case studies from the published literature and experience is that such settlements are typically between 2% and 6% of the inundated fill thickness.

For the Mid-Field Overburden Dump, 3% of the inundated thickness is estimated for collapse settlement with an upper bound of 6%.

For the MRD engineered fill, collapse settlement of 2% of the inundated thickness is estimated with an upper bound of 3%.

In consideration of the above, the potential for collapse settlement is a pivotal consideration to the rehabilitation design for MRD. Drawing from this an estimation of the upper and lower estimate of potential settlement is presented in Figure 8-93: Potential Collapse Settlement along MRD (PSM 2025b). Collapse settlement is expected to continue through the period of lake filling, non-uniform along the MRD as the saturation of the soils increases with rise in lake level. Collapse settlement of up to 0.9m (East embankment) and 0.8m (West embankment) are expected as a lower bound estimate. On the upper bound estimate this could be up to 1.5m along the East and West embankments. The upper estimates of settlement are expected in the MRD Repair sub-domain where MRD is the thickest, followed by the MRD Fill sub-domain.

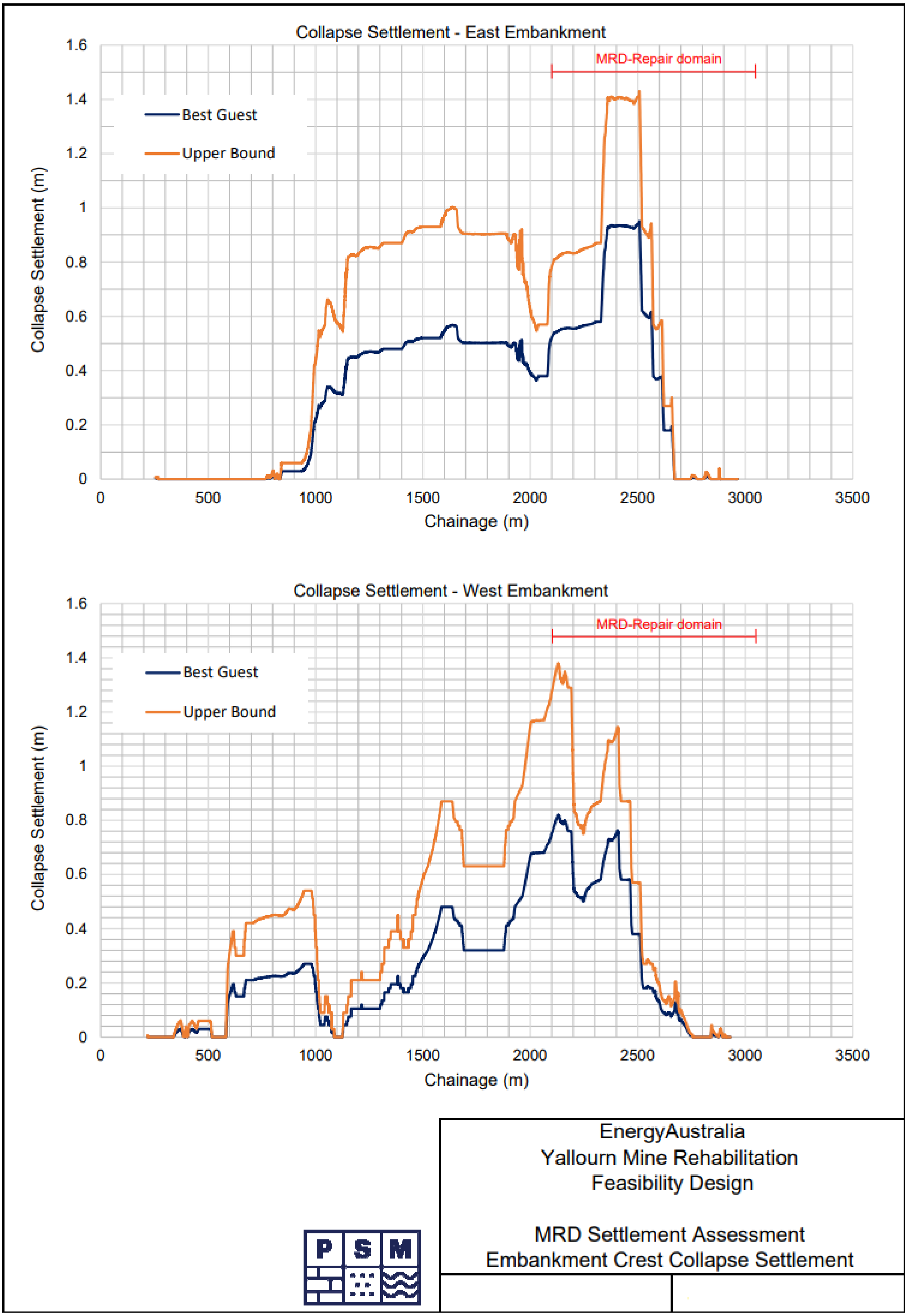


Figure 8-93: Potential Collapse Settlement along MRD (PSM 2025b)

8.12.3 Findings - MRD Stability

- The stability of MRD for Block Slide and Multilinear assessment achieve a high FoS with lower bound parameters for End Of Mining (EOM). The full pit lake provides buttressing support to the MRD once full with a progressively increasing stability outcome (FoS) as the lake level rises from empty to full.
- The stability of the levee slopes progressively increases with the lake level rising to full pit lake. For the current MRD, the high embankments induce vertical loading which are considered adverse for performance of the MRD during rehabilitation and the Design Intent Period. This has been addressed by the proposed remediation design for MRD.
- The LFC stability is favourable. Notably, the stability outcome for steeper (1.5H:1V) LFC slopes is slightly lower than the flatter banks (2H:1V). In addition, these are slightly reduced (but satisfactory) for rapid drawdown which is considered for a higher flow event (a short-term event).
- Risk of piping failure through the LFC for the sunny day condition is considered negligible for a pit of RL37m. This is due to no hydraulic gradient being developed between the LFC and lake body for the majority of MRD due to the geometry. This risk is slightly increased for a flooded condition. These are considered to be short-term event(s) and any eroded areas that develop during these event(s) can be repaired as part of the maintenance program, discussed in Chapter 15.
- Risk of piping failure eventuating to a catastrophic outcome progressively increases for a reducing lake level. This is demonstrated by analysis of lake level of RL 33.4m and compared to a dry pit (no lake) where piping risk is the highest under both sunny day and flood conditions.
- Conveyor tunnels will provide the hydraulic connection between the west and east lake bodies. The stability of the tunnels is pivotal to stability of the overlaying embankments and reliability to pit water balance.
- Settlement is expected to continue, linked to ongoing deformation due to mining activities during mine operational phase. Collapse settlement is expected to continue through and up to the later stages of lake filling, resulting in loss of freeboard.
- Surface water infiltration and runoff contribute to progressive deterioration of the structure. The rehabilitation design for MRD will aim to address these adverse factors to minimise intensity of contribution to progressive deterioration. These will require ongoing careful management through all phases of rehabilitation.
- The Morwell River levels are greatly influenced by the Latrobe River flows. The height of flood flows in Latrobe River forms a choke point for Morwell River outflows leading to a higher flood height in the MRD.
- A Latrobe River dominant flood can result in Latrobe River backflowing into MRD. For a modelled 1:2000 (AEP) coincidental with a 1:100 AEP in Morwell River results in a potential height of flood level in MRD exceeding RL42m. An analysed probability of such an event being around 16% over 20 years post mine closure.
- A pit lake level (RL 37m) higher than the LFC of MRD can mitigate against majority of the risk elements considered as part of the MRD analysis. Achieving this lake level and maintaining it post filling is an important consideration to the rehabilitation design for MRD.

This DMRP considers all MRD factors presented above to derive a remediated design that can service the Design Intent Period and standards. The proposed rehabilitation design for MRD is presented in section 12.3. Effective management measures are a key to the performance of MRD through various stages of rehabilitation and are discussed in Chapter 15.

8.13 Landform and Erosion Modelling

8.13.1 Introduction

Erosion is a key risk to mine rehabilitation success as it enables soil loss and water pollution which then prevent vegetation growth, ecosystem restoration, or other beneficial land uses from being realised.

Mine rehabilitation erosion experts Landloch were engaged in 2022 to investigate topsoil stockpiles, overburden materials and progressive rehabilitation for erosion control suitability (Landloch 2022). Site inspections and testing results would then be modelled using the Revised Universal Soil Loss Equation (RUSLE) to understand long term risk and success.

8.13.2 Methodology

8.13.2.1 Topsoil Stockpiles

Chemical fertility for nitrogen and phosphorus was assessed as moderate to high in the topsoil and rehabilitated areas. Organic carbon levels, an important aspect for CEC and maintenance of fertility, were very high. The chemical fertility of the stockpiled soils is comparable to that of rehabilitated site soils. Therefore, the soils at the stockpile sites are considered suitable for the establishment of vegetation.

The main limitation for the use of the topsoil from the stockpiles for plant growth is the elevated levels of exchangeable sodium (ESP >6%). A combination of low EC/chloride levels and high ESP can result in the dispersion of clay within the soils, resulting in reduced infiltration capacity, high rates of runoff and elevated erosion risk, and soil hard setting when dry. Areas rehabilitated to grasslands will need to monitor this risk, whilst woodland and habitat areas are less susceptible due to increased root penetration, shading, nutrient cycling, and water dispersion processes.

8.13.2.2 Revised Universal Soil Loss Erosion Modelling

Topsoil Stockpiles for which the RUSLE modelling was carried out had moderate to high chemical fertility and would be suitable for the establishment of vegetation.

Whilst the ESP was greater than 6% in half of the soil sites assessed, the model predicted that potential soil loss for these soils was still acceptable at gradients and slope lengths shown below. No constraints in terms of gradient or slope length up to 120 m were found for any stockpile soils assessed using RUSLE when vegetation cover is greater than 95%. Achieving a reliable and sustainable cover greater than 95% may be considered a challenging benchmark, but the majority of rehabilitated sites observed by Landlock did meet this criteria.

Where areas such as batters with steeper gradients and longer slope lengths are essential, the use of more stable soils from stockpiles B2_2 and D4 could be considered in order to achieve >95% cover and reduce erosion risk.

Table 8-47: Summary of Erosion Modelling Results Highlighting Vegetation Importance (Landloch 2022)

Site	Site material	Gradient	Slope length (m)	Annual soil loss (t/ha/y) with 60% cover	Annual soil loss (t/ha/y) with 80% cover	Annual soil loss (t/ha/y) with >95% cover
Site 3	Clay loam	3.3:1 (30%)	120	21.79	6.75	1.56
		3:1 (33%)	120	19.56	6.05	1.40
		2.5:1 (40%)	120	26.77	8.29	1.91
Site 13b	Loam	3.3:1 (30%)	80 120	13.40 16.34	3.60 5.06	0.83 1.17
		3:1 (33%)	80 120	14.86 18.21	4.60 5.64	1.06 1.30
		2.5:1 (40%)	80 120	18.18 22.37	5.63 6.92	1.30 1.60
Site 16	Loam	3.3:1 (30%)	80 120	9.57 11.73	2.96 3.63	0.68 0.84
		3:1 (33%)	80 120	8.63 10.53	2.67 3.26	0.62 0.75
		2.5:1 (40%)	80 120	11.71 14.41	3.62 4.56	0.84 1.03
Site 19	Sandy loam	3.3:1 (30%)	60	10.61	3.28	0.76
		3:1 (33%)	60	9.58	2.97	0.68
		2.5:1 (40%)	60	12.85	3.98	0.92

Observations made on topsoils at rehabilitated sites align with the RUSLE modelling predictions for the length of slope, percentage slope and groundcover. These predictions also show that if groundcover was reduced to 60%, then erosion may become an issue if soils have not had gypsum incorporated.

8.13.3 Findings

Vegetation is key to success in erosion prevention. Without vegetation, soils at Yallourn will experience significant erosion. This can be seen at disturbed mining areas which have not been treated with any progressive rehabilitation.

For rehabilitation slope design, it is modelled that slopes of 120m length and gradients of 40% are erosion resistant at 95% vegetation cover. These will be treated as limits for rehabilitation slope design.

8.14 Wave Impact Assessment

8.14.1 Introduction

A wave impact assessment was conducted by the Water Research Laboratory at the University of New South Wales (UNSW) as a desktop study (Gilbert et al. 2025). The aim was to understand the magnitude of waves that would form in a pit lake scenario and identify which parts of the lake shoreline would be impacted. The study estimated the heights of waves generated in these areas and proposed options for shoreline protection for further investigation.

The wind-induced waves generated by the planned pit lake have the potential to erode the external embankments of the Morwell River Diversion (MRD) (PSM 2025b). As an earthen fill structure, the MRD is particularly susceptible to erosion from these waves. Therefore, it was necessary to map wind fetch directions, speed and duration, and identify high-impact zones. The rehabilitation design for the MRD takes these wave impact zones into account, considering the assessed risk factors for the geotechnical domains. Further details on these risk factors are provided in Chapter 11.

8.14.2 Methodology

The assessment methodology involved determining the wind wave climate and conducting a desktop evaluation of shoreline protection options along the mined-out batters.

A focused assessment of wind wave impacts on the MRD considered the specific characteristics of the engineered structure. The analytical approach is similar to that used for the mine batters.

Key Assumptions

- Wind blowing across open water generates waves, causing shoreline erosion.
- Assessment assumes Township Field and Maryvale Field pits filled to final lake level of RL +37m.
- Pits assumed to have uniform slopes at 1V:3H above final lake level.
- Final pit slopes above lake level and water level variations will be determined at a later stage. So, a static lake level is assumed.
- Foreshore slope angle is crucial for determining crest elevation for shoreline protection.
- Site topography influences the toe detail of protection works.
- 100-year ARI (Average Recurrence Interval) design wind speeds used, as per Australian Standard *AS/NZS 1170.2 Structural Design Actions Part 2: Wind Actions* (2021).
- Wind-induced wave conditions estimated using the US Army Corps of Engineers (USACE) (2006) *Coastal Engineering Manual*.
- Significant wave height (Hm0) and peak period (Tp) used for designing shoreline protection options.

Design Wind Speeds

The following factors are considered to calculating site wind speeds:

- Design event ARI – assumed to be 100 years.
- Terrain category – assumed to be Category 1, described as "all water surfaces" in *AS/NZS 1170.2 Structural Design Actions Part 2: Wind Actions* (2021).
- Topography – this factor is only applied for sites located on top of hills, ridges or escarpments. This was not applied given the surface of the pit lakes will be essentially flat.
- Shielding – assumed to be no shielding from upwind buildings or other structures (does not include trees or vegetation).
- Wind direction and adopted wind velocities are presented in Table 8-48 below.

Table 8-48 Adopted design wind velocities - wind wave impact assessment

Average Recurrence Interval (years)	Directional site wind velocities, 0.2 second duration (m/s)							
	N	NE	E	SE	S	SW	W	NW
100	42.1	35.4	35.4	35.4	35.4	42.1	44.3	42.1

These adopted wind velocities currently do not consider the climate change multipliers and will be considered for the detailed design stage.

Design Wind Waves

Wind waves are influenced by both wind speeds and the fetch, which is the distance over which the wind acts to form waves. The fetch distance and wind speed direction vary around the lakes' perimeters, affecting wave climate and exposure levels. At this feasibility design stage, indicative high and low wave conditions were adopted for the study.

Twelve locations (Figure 8-94) along the foreshore of the proposed pit lakes were selected for wind wave analysis. These points were chosen to maximise fetch lengths and wind waves, though wave climate may be lower between points, especially in sheltered areas. The generated results are presented in Table 8-49.

Fetch length was determined by projecting nine radials at 3-degree intervals centred on the direction of interest, as per the US Army Corps of Engineers (USACE) (2006) *Coastal Engineering Manual*. Multiple directions were considered to account for varying wind speeds. The fetch length for each direction was calculated as the mean of the nine radials. An example of this method is provided for the proposed Yallourn pit lakes.

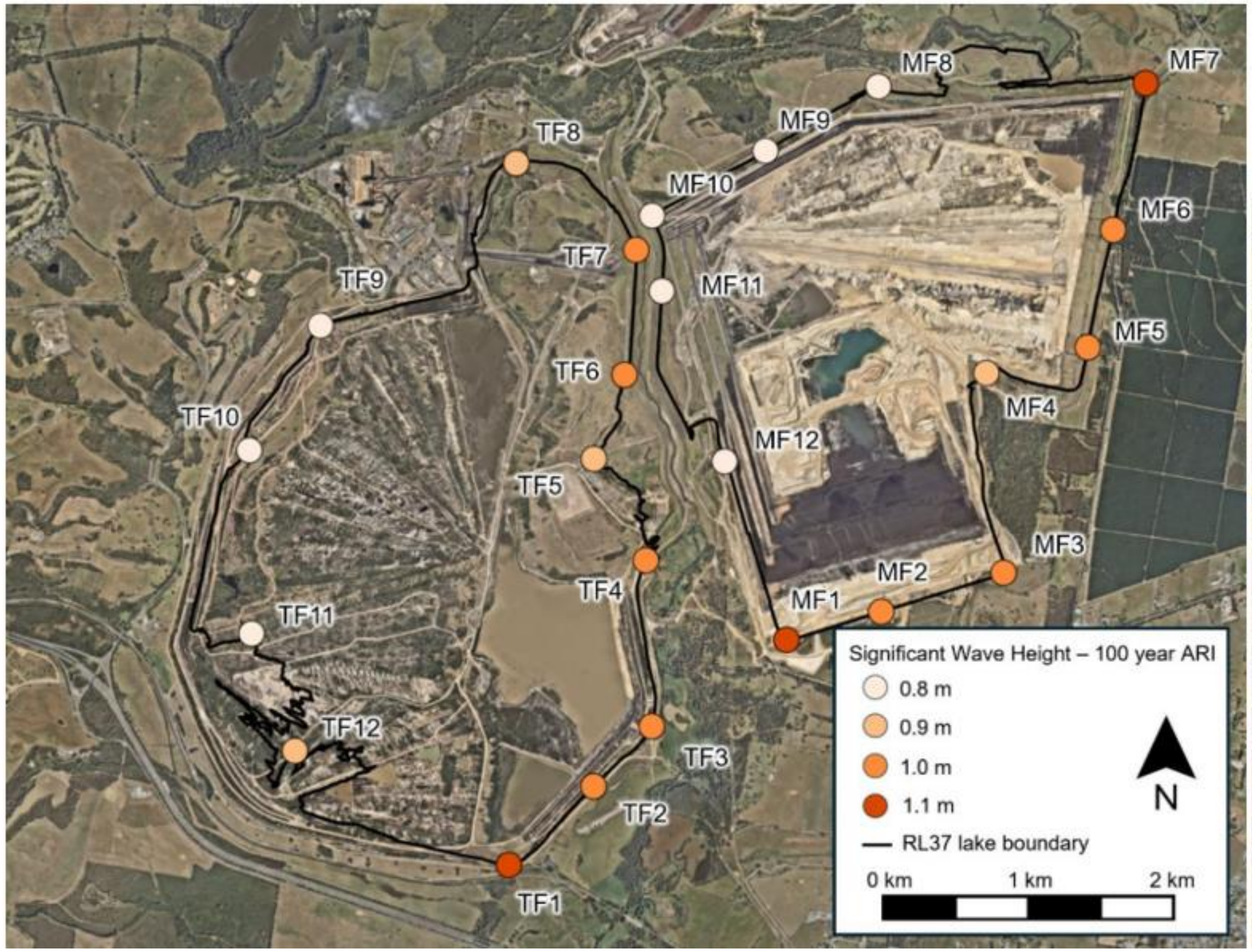
Desktop Assessment of Shoreline Protection Options

Based on the wind wave analysis shoreline protection options ranging from soft nature-based solutions through to hard, engineered structures were considered. The following options were considered:

- Vegetated Shoreline
- Rock Rubble Structure
- Exposed Rock (Brown Coal)
- Geotextile Layer
- Sand-filled Geotextile Containers/Rock Bags
- Concrete Mattress
- Floating Breakwaters

8.14.3 Findings

The wave heights and duration of the wave event occurrence is shown in Figure 8-94. The high and low wave conditions in Township and Maryvale Fields are presented in Table 8-49, for a 100-year ARI.



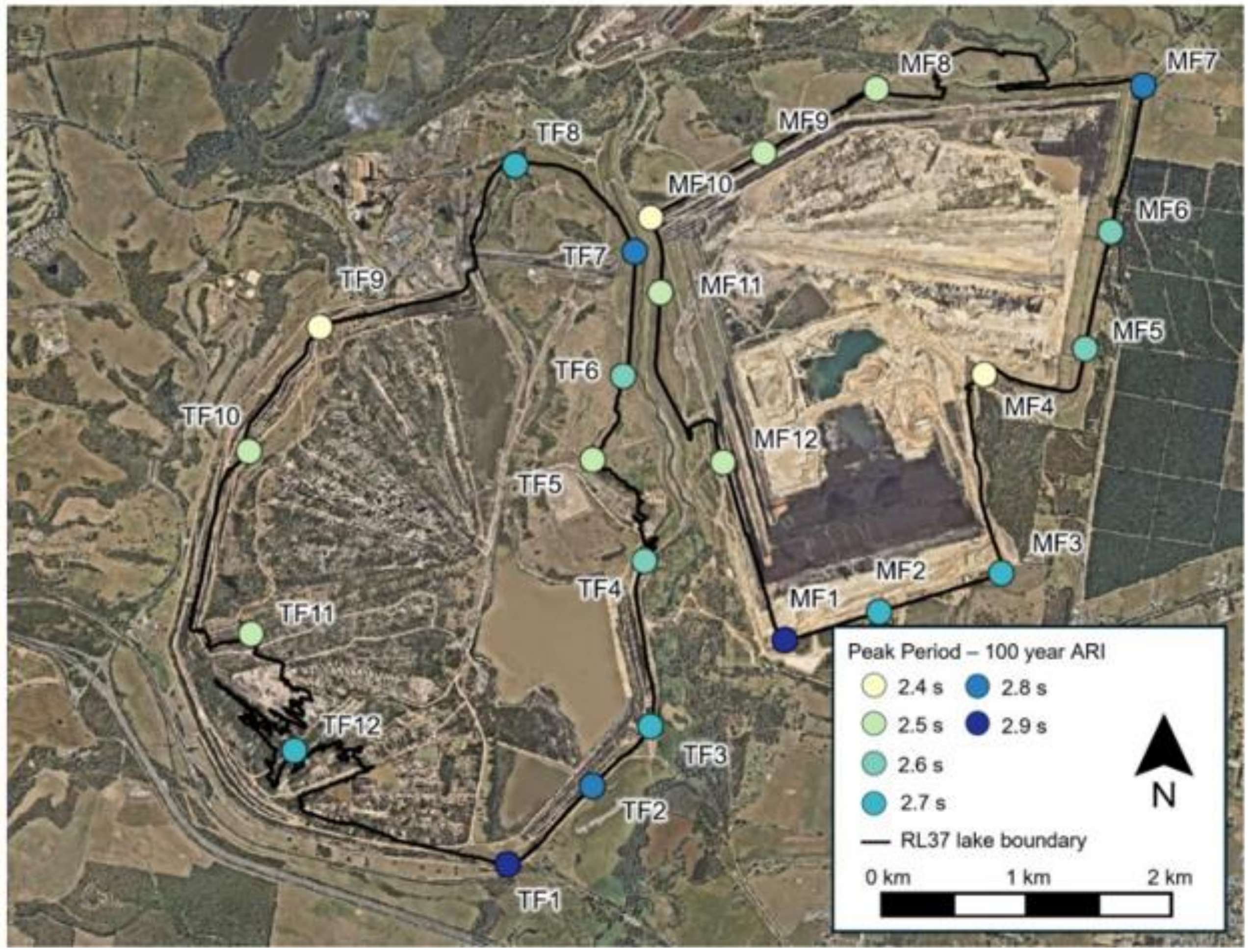


Figure 8-94 Wave Assessment Locations, Generated Wave Heights & Durations for 100-Year ARI (Gilbert et al. 2025)

Table 8-49 High and low wave conditions in Township and Maryvale Fields for 100-year ARI (Gilbert et al. 2025)

Location	Condition	Significant wave height, H_{m0} (m)	Peak period, T_P (sec)
Township Field	Low (TF9)	0.77	2.4
	High (TF1)	1.08	2.9
Maryvale Field	Low (MF10)	0.76	2.4
	High (MF1)	1.06	2.9
Adopted values	**Low**	**0.77**	**2.4**
	High	**1.08**	**2.9**

The wind wave action assessment of options to protect the pit lakes shoreline from erosion during a 100-year ARI event yielded the following key findings. These can be further considered for the detailed design phase of the rehabilitation project (KG20 and KG30 in Table 17-1):

1. **Vegetated Shoreline**: Not feasible for all areas but could be used in areas with shallow slopes and mild wave conditions or integrated into conventional structures.
2. **Rock Rubble Structure**: A two-layer rock rubble design can be a robust proposition, specifically for high impact areas, providing adequate protection and long design life.
3. **Exposed Brown Coal**: A shallow exposure of coal along the waterline can be considered for wave erosion due to low erodibility of coal but requires further investigation.
4. **Geotextile Layer**: Not suitable as a standalone option for protecting overburden material.
5. **Sand-Filled Geotextile Containers/Rock Bags**: Cost-effective but have a shorter lifespan (5-20 years) compared to rock rubble structures.
6. **Concrete Mattresses**: More expensive but viable due to anchoring capabilities, despite differing in appearance from rock rubble.
7. **Floating Breakwaters**: Effective but costly, potentially useful for creating recreational spaces.

Wave Impacts - Morwell River Diversion (MRD)

The MRD consists of compacted earthfill embankments with slopes up to 2.5H:1V and top elevations between RL +46.8m (west embankment) and RL +48.3m (east embankment). Wind over the pit lakes can generate waves that may erode the MRD's external batters if left unprotected. An assessment considered wind speed, fetch, and duration to determine design wave heights for shore protection. For a 100-year ARI design period, slope protection may be needed from -1.0m below to +0.7m above the final lake level. Flat slopes with grass and ongoing maintenance might suffice for repurposing the MRD as a rural levee (being the proposed remediation for MRD rehabilitation design). Based on the wind fetches and velocities, the external western embankment will require wind wave protection.

The technical assessment of MRD is discussed in Section 8.12, with the rehabilitation design considerations presented in Section 12.3. The trade-off between slope protection costs and maintenance will be evaluated in ongoing studies for detailed rehabilitation design (KG20 and KG30 in Table 17-1). Regular maintenance of the external slopes will be necessary throughout the structure's life, typically during dry periods when lake levels are likely to drop below the design levels.

The project will continue to evolve, optimizing shoreline protection based on ongoing studies and local conditions (KG20 and KG30 in Table 17-1).

8.15 Yallourn Landfills - Hydrogeological Assessment

8.15.1 Introduction

The Hydrogeological Assessment (HA) was commissioned by EAY and prepared by Jacobs to meet EPA Victoria's regulatory requirements for landfill sites (Jacobs 2020b). The primary objectives were to:

- Describe the development and hydrogeological setting of the Yallourn Landfills, including Ash, Hard Waste, and Asbestos Landfills.
- Assess the potential groundwater and surface water impacts from landfill operations.
- Review historical and current monitoring networks and data trends.
- Identify potential sources of contamination, pathways, and receptors.
- Recommend updates to monitoring and management strategies, including trigger levels and risk mitigation measures.

This HA builds on previous investigations and provides an updated Conceptual Site Model (CSM) for groundwater flow and leachate impacts.

8.15.2 Methodology

Site Characterisation

The study area includes the former Yallourn North Open Cut (YNOC), now used for landfill operations and ash disposal.

The local geological profile includes:

- Shallow Aquifer System (SAS): alluvium and Haunted Hills Formation
- Deep Aquifer System (DAS): Morwell Formation, Latrobe Coal, Traralgon Formation
- Bedrock: Strzelecki Group (Mesozoic)

Data Sources and Fieldwork

- Long-term groundwater, surface water, and leachate monitoring data
- Lithology logs, climate data, water levels, and water quality indicators
- 74 groundwater bores (34 actively monitored for quality); 33 pump bores
- 8 surface water sites on Latrobe River, Morwell River, and Anderson's Creek

Analytical Focus

- Field parameters: pH, EC, DO, Redox, temperature
- Laboratory tests: TDS, sulphate, major ions, metals, ammonia, nitrate, TRH
- Biannual sampling in March/April and October
- Assessment of relevant beneficial uses under State Environment Protection Policy (SEPP) Waters

Hydrogeological Modelling

- Mapping of groundwater flow direction (horizontal and vertical)
- Identification of potential contaminant pathways from landfill to the Latrobe River
- Mass flux and leachate plume modelling

8.15.3 Findings

Groundwater and Surface Water Impact

- Ash Landfill: Evidence of leachate impact in shallow groundwater bores near Brown Coal Mine (BCM) Bridge, suggesting limited seepage towards the Latrobe River.
- Other landfills (Hard Waste, Asbestos): Minimal impact due to inert nature of waste and engineered containment.

Key Indicators

- Elevated TDS and sulphate levels near the Ash Landfill indicate localised contamination but low risk to Latrobe River.
- Groundwater in surrounding bores generally meets relevant SEPP trigger levels for most analytes.
- Metals, ammonia, nitrate, and pH exceedances are observed in both impacted and background bores, likely due to natural conditions.

Beneficial Uses and Receptors

- Primary receptors: Latrobe River ecosystems, potential stock watering and recreational use.
- DAS aquifer: No active users within 5 km; protection focus remains on ecological values.

Hydrogeological Behaviour

- Groundwater flow in SAS generally directed eastwards to Eastern Basin (hydraulic sink).
- BCM Bridge area remains a minor migration pathway but is managed through drainage control.
- No influence detected on Anderson’s Creek, due to westward groundwater gradients.

8.16 Spontaneous Combustion Technical Report

8.16.1 Introduction

The primary purpose of the technical report is to assess the spontaneous combustion hazard associated with lignite samples extracted from the Yallourn Mine (Beamish and Theiler 2022). This evaluation is particularly significant due to the importance of understanding long-term fire risks related to self-heating coal after the mine's closure. The report establishes a detailed understanding of the spontaneous combustion propensity of the lignite and identifies conditions that could potentially lead to self-heating incidents. By conducting thorough testing and analyses, the study provides stakeholders with essential insights into how to manage these risks effectively, thereby ensuring safety and operational efficiency in the vicinity of the mine.

8.16.2 Methodology

To achieve the objectives outlined in the report, a structured methodology was employed, focusing on comprehensive testing and analysis. The key components of the methodology include:

- Sample Collection: Lignite samples were collected from various locations within the Yallourn Mine site. To maintain their integrity and minimise pre-oxidation during transit, the samples were carefully preserved in protective materials.
- R70 Testing: Each sample underwent the R70 testing procedure, which quantifies the self-heating rate of the lignite. This testing is crucial for establishing an intrinsic spontaneous combustion propensity rating, which helps to categorise the risk levels associated with each sample.
- Incubation Testing: Further incubation tests were conducted to determine the minimum incubation period for the samples. This involved simulating conditions to establish whether thermal runaway could occur under ambient mine conditions. If no thermal runaway was observed, step-heating incubation tests were performed to assess the impact of external heat sources.
- Coal Quality Analysis: A thorough analysis of coal quality, including proximate analysis, total sulfur content, and calorific value, was performed. This data supports the interpretation of the spontaneous combustion testing results.
- Hazard Likelihood Chart Development: To summarise the findings and facilitate risk assessments, a spontaneous combustion hazard likelihood chart was developed based on the combined results of moisture content and self-heating rate values.

8.16.3 Findings

The findings of the report present several positive insights related to the self-heating characteristics of Yallourn lignite:

Self-Heating Rate Values: The fresh Yallourn lignite samples exhibited R70 self-heating rate values ranging from 22.17 °C/h to 52.63 °C/h. These values are indicative of a high spontaneous combustion propensity, classified as Ultra-High to Extremely High. This information provides a critical baseline for understanding the potential fire risks associated with fresh lignite.

Moisture Content Impact: The report highlights that although fresh lignite has a high propensity for self-heating, its significant moisture content acts as an internal heat loss mechanism. Consequently, this factor prevents the fresh lignite from reaching thermal runaway and only allows it to simmer within a temperature range of 85-95 °C. This positive finding underscores the effectiveness of moisture in mitigating the likelihood of spontaneous combustion in fresh lignite.

Weathered Lignite Characteristics: The findings reveal that weathered lignite samples exhibited considerably lower R70 values and were unable to sustain self-heating due to the degradation of reactive sites over time. This serves as a reassuring factor, conveying that the weathering process further reduces the risk of spontaneous combustion.

Ageing Window: The report identifies a limited ageing window (approximately 1-6 months) during which the moisture/reactivity balance may allow for incubation to thermal runaway. However, this window is unlikely to reflect actual site conditions, where in-situ moisture levels remain above 25%, making thermal runaway without external heat sources improbable.

In summary, the report provides a comprehensive understanding of the spontaneous combustion risks associated with lignite at the Yallourn Mine, highlighting factors that effectively mitigate these risks. The integration of testing methodologies and analytical findings equips stakeholders with the knowledge necessary for informed decision-making regarding mine safety and management, ultimately contributing to the overall operational efficiency and risk management strategies in the area.

In addition to this work on spontaneous combustion, EAY are also investigating how water moves through the coal via capillary rise. This work will assist in designing the capping cover and vegetation selection above the water line by providing information on the moisture levels that may arise. Refer to knowledge gap KG11 in Table 17-1.

8.17 Lake Triggered Seismicity

8.17.1 Introduction

Flooding Yallourn Mine to RL37m will require approximately 665GL of water, to a maximum depth of around 80m, and is projected to take around 20 years. Seismicity triggered by lake filling has been identified as a potential risk during mine rehabilitation work. A study of potential lake induced seismicity specific to Yallourn Mine has been conducted (PSM4487-219R (PSM 2025a)) and comprises:

1. Review of existing technical literature to assess potential mechanisms and controlling parameters for cases of seismicity triggered by lake impoundment, including:
    a. A focus on parameters and factors that may trigger seismicity
    b. Review the influence of lake filling rates
2. Assessment of the lake characteristics, including volume, water height, fill timing and tectonic setting, with:
    a. Focus on seismic events and performance of areas and sites similar to the Yallourn lakes, that is, a large waterbody and the influence of this on the local geological structures that could trigger tectonic movements.
    b. Where possible, a semi quantitative assessment of likelihood, and likely magnitude of any triggered seismicity.
3. The implications for Yallourn.

8.17.2 Methodology

8.17.2.1 Existing Literature Review

There have been two previous seismic studies for Yallourn Mine rehabilitation:

- *Mine Pit Lake Triggered Seismicity Preliminary Assessment* (GHD 2024b)
- Site Specific Seismic Hazard Assessment and Selection of Earthquake Parameters within PSM Report PSM4487-200R (PSM 2025b)

The outcomes of Site Specific Seismic Hazard Assessment report within PSM4487-200R (PSM 2025b) is summarised in Section 8.10. It was conducted to determine appropriate Peak Ground Acceleration (PGA) for a variety of annual exceedance probabilities to apply at Yallourn Mine.

The *Mine Pit Lake Triggered Seismicity Preliminary Assessment* (GHD 2024b) presents a discussion of:

1. Mechanisms of natural (tectonic) seismicity and background on the seismicity in Australia and Yallourn.
2. Description and discussion on triggered and induced earthquakes and reservoir impoundment lakes and triggering mechanisms and characteristics.
3. Examples of reservoir impoundment triggered seismicity from Australia.
4. Results from poroelastic simulations using a semi 3D physics-based approach to assess the impact of the mine lakes at Yallourn on two known faults, the Haunted Hills Fault and Yallourn Fault.

GHD concluded that the stresses from pit lake filling on these faults could trigger seismicity, provided that the faults are loaded to critical stress state. However, the model to assess triggered seismicity inevitably relies on assumptions, simplifications and uncertainties related to the input parameters. More importantly, any triggered seismicity is dependent on the current loaded stress state of the faults, which is unknown. Currently there is no method to measure how close to failure a fault is and consequently the application of the results from any model of triggered seismicity relies on unknowns for the stress state of the faults and rock mass.

There are numerous reported cases of seismicity triggered by water reservoir impounding. A global review of human-induced earthquakes from 1868 to 2017 reported in the HiQuake database reported 231 confirmed and/or inferred earthquakes triggered by:

- Water reservoir impounding (227),
- Mine flooding (1),
- Abandonment of a mine (1) and
- Abandonment and flooding of a mine (2).

Only three records in the database are reported in flooded mines, which is assumed to represent a similar process to the infilling of the pit lakes at Yallourn. The magnitude of the earthquakes reported as triggered by mine flooding are magnitude 3 or lower. As a result, this Yallourn assessment focusses on all reported cases of seismicity triggered by water impoundment. The main conclusions from the literature review are:

- Most of the reported cases of triggered seismicity resulting from water reservoir impoundment are associated with impounding of reservoirs behind dams.
- There are very limited cases of seismicity triggered by mine flooding (a process similar to the water infilling of the pits at Yallourn), water impoundment in mine pits or similar process in mine settings. Only three cases in the database are reported as associated with underground mine flooding, none are reported as associated with pit lakes.
- Most of the reported seismicity triggered by water reservoir impoundment has small magnitudes, with 58% of earthquakes with magnitude 4 or less and 83% of earthquakes are reported with magnitude lower than 5.
- Most of the cases (64%) of earthquake triggered by water reservoir impounding in the database are reported to occur in intraplate areas such as Australia.
- Seismicity triggered by water reservoir impoundment in Australia is not uncommon and has been reported in association with Talbingo, Thomson, and Pindari, Eucumbene, Warragamba, Gordon, and Argyle reservoirs.
- The reported cases have occurred in the southeast Australia and Tasmania, which are regions that have similar tectonic regime to Yallourn.
- The Thomson reservoir case is relevant for Yallourn as it is located 35 km north of the mine and the fault understood to be associated with the main event (magnitude 5.0) in 1996 is the Yallourn Monoclinal Fault which runs close to Yallourn. The Thomson Reservoir is located on the hanging wall of the Yallourn Monoclinal Fault, whilst Yallourn is located on the footwall.
- The location of the reservoir with respect to the fault is important. A reservoir existing on the footwall of a reverse or normal fault, or over one block of a strike-slip fault would generally have a stabilizing effect, while a reservoir existing on the hanging wall of a reverse or normal fault, or directly over a vertical strike-slip fault, would have a destabilizing effect.
- The faults must be critically stressed for triggered seismicity to occur. However, it is not possible to measure the current stress state.
- The rock must be porous enough to be able to accept fluids, but the permeability must be low enough to allow pore pressure build-up. The penetration of fluids into the rocks must be at such rates and pressures that the formation pore pressures are significantly increased over a large area.
- The other factors that may play a role in triggering seismicity, include:
    a. Height of the water column in the reservoir,

b. Reservoir volume,

c. Rate of increase in water levels and

d. Duration of retention of highwater level.

8.17.2.2 Assessment of Lake Characteristics

The distinction between tectonic (natural), triggered, and induced seismicity is relevant for this assessment. Tectonic (natural) seismicity is, in the simplest terms, the result of natural processes, mainly tectonic, where the progressive accumulation of tectonic strain surpasses the strength of the rock and is released by sudden dislocation along geological faults. Tectonic seismicity relevant to Yallourn and its site-specific seismic hazard is included in the PSM report (PSM4487-200R (PSM 2025b)).

Triggered or induced earthquakes, also known as anthropogenic earthquakes, are associated with human activity, including filling of large water reservoirs, mining activity and hydraulic fracturing. This report focuses on triggered earthquakes associated with water reservoir impounding.

The terms triggered or induced are often used interchangeably. In this report the following definitions are used:

1. **Triggered** earthquakes are earthquakes where only a small fraction of the stress changes or the energy released by the earthquake is accounted for by the causative anthropogenic activity. In case of triggered seismicity, tectonic loading is the major contributor to the energy released in the earthquake.
2. **Induced** seismicity alternatively occurs when the causative anthropogenic activity is responsible for most of the energy released by the earthquake.

Due to the small (relative to geological processes) stress changes caused by lake filling, earthquakes occurring in the vicinity of water reservoirs during and or after their filling fall under the category of triggered earthquakes.

Geological faults slip when the shear stress acting parallel to the fault surface exceeds the natural resistance of the shear strength of the fault. A fault must be subjected to substantial shear stress to slip and generate an earthquake, that is the fault must be critically stressed. A slip on the fault may be triggered by either increasing the shear stress or reducing the fault’s strength. The strength depends on the effective normal stress confining the fault, which decreases with increasing pore pressure, thereby weakening the fault. The loss or gain of overlying mass, introduction of fluid into a fault zone, or the imposition of vertical and/or horizontal stress by other means, for example stress transfer from nearby earthquakes, can bring a fault closer to failure.

Water / lake impoundment may trigger seismicity by two main mechanisms:

1. The weight of the water changes the stress field under the reservoir (increased shear stresses). These induced-stresses at depth, where earthquakes occur are very small, of the order of 0.1 MPa, which is much smaller than the 1–10 MPa stress change typical in earthquakes.
2. The increased porewater pressures within existing faults may decrease the stress required to cause an earthquake due to:
    a. Increases in pore pressure in the underlying rock (due to decrease in pore volume as a consequence of compaction under the weight of the water load). This occurs almost immediately after filling.
    b. Diffusion of reservoir water through porous rocks under the reservoir. This is not an instantaneous effect as it depends on the permeability of the rock, but it increases with time. It may take years for the pore pressure to increase at depths of kilometres.

As a result, triggered seismicity may occur immediately after filling or may be delayed for years depending on the controlling mechanism, that is changes in stress or pore pressure. For seismicity to be triggered from either mechanism, the faults must already be critically stressed and close to failure, as the changes in stress caused by the lake are relatively small compared to those occurring via natural processes.

8.17.3 Findings

The two main factors for lake triggered seismicity to occur are (PSM 2025b):

- The rock mass and faults must be critically stressed and close to failure and
- The location of the site with respect to the fault plays a role, where sites on the hanging wall are more likely to promote triggered seismicity.

Consequently, the location of Yallourn Mine with respect to local faults and their current stress state are very relevant for this study. The three known major faults closest to Yallourn are:

- Haunted Hills Fault
- Yallourn Monoclinal Fault
- Morwell Fault

The characteristics of the faults from the national fault source model indicate:

- The current stress state of the faults is unknown and cannot be accurately assessed.
- Yallourn is located in the footwall of two of the most relevant faults the Haunted Hills and Yallourn Monoclinal Faults. As a result, the site lies on the structurally more stable side of these two geological structures.
- The dip direction of the Morwell Monoclinal Fault is uncertain and therefore whether Yallourn Mine is in the hanging wall or footwall is not known.

The conclusions relative to the Yallourn Mine Lakes are:

- The probability of triggering earthquakes as a result of filling of the pit lakes is considered to be low, as many of the factors reported to play a role in triggering seismicity are not applicable to Yallourn.
- However, considering the unknowns, uncertainties in the knowledge of processes related to triggered seismicity, the unknown current stress state of the faults and uncertainties around mass hydrogeological conditions; the risk of triggering some seismicity cannot be quantified.
- Notwithstanding this the literature shows that:
    - It is not possible to accurately determine the number or frequency of any earthquakes that may be potentially triggered.

- However, if seismicity is triggered, this seismicity is most likely to be of small magnitude (magnitude ≤ 4).
- There is a possibility that larger magnitudes (magnitude ~ 5) may occur, but for these magnitudes to occur the prevailing stress state must be critical and fault orientations with respect to lakes must be favourable.

Despite the relatively higher seismic hazard of the region where Yallourn is located, compared with other regions in Australia, anecdotal evidence indicates that Yallourn has not experienced significant damage and/or any slope failure as a consequence of the recorded earthquake activity to date. This provides context for any potential damage at Yallourn and the surrounding area from triggered seismicity. Any potential lake triggered seismicity is anticipated to be limited to small magnitude earthquakes which pose a minor threat in terms of physical damage. The potential impact associated with an event of larger magnitude (~5) can be inferred from impact of similar tectonic earthquake magnitudes at Yallourn (refer Section 8.10).

8.18 Summary of Modelling and Technical Studies

Since initial EES approval of the lake rehabilitation concept in 2000 and then 2002 through the Supplementary EES, it was recognised that further technical research was needed to gain a greater understanding of geotechnical, water quantity, water quality, other environmental issues, and risk.

This position was echoed by the HMFI which also recommended further research into the preferred lake concept.

This section summarises the additional technical studies completed since EES approval, and the major follow up considerations for rehabilitation design and implementation:

- Large flood events that exceed design levels are likely to occur in the future and the rehabilitation design needs to account for these by incorporating appropriate flood resilience measures such as spillways.
- There is a large peripheral catchment around the Yallourn Mine which creates a geotechnical hazard if not managed appropriately. Directing this water into the mine as quickly as possible limits geotechnical risk.
- Groundwater levels, flows, and flux are critical geotechnical stability inputs. Understanding these groundwater processes allows us to accurately calculate geotechnical stability for block slide and floor heave failures. Limiting groundwater extraction will limit regional subsidence.
- Geotechnical conditions are stable in a pit lake setting with appropriate buttressing volumes quantified. In comparison, the dry void geotechnical buttressing requirements analysed by the LVRRS (2020) require more material than Victoria’s total quarrying capability for a three-year period and added active management.
- Earthquakes will cause mine batters to move, however these displacements are within historical tolerances.
- The MRD requires additional work to ensure long-term capability, these works include surface stabilisation, flood spillways, and levee reshaping. Similar to the geotechnical setting, water provides stabilisation better than the dry void scenario.
- Without pumping and intervention, the mine will fill with water. Top up water to maintain a stable lake level may be required in the future, depending on climate conditions.
- It is expected that water quality will be suitable for many beneficial uses including recreation and ecology. Future monitoring will be analysed against the modelled results. Additional water quality modelling is also proposed.
- Any pit lake interaction with groundwater systems will not change the beneficial uses of that groundwater.
- Through landform modelling, most landforms are capable of 120m slope lengths and 2.5:1 gradients at 80% vegetation cover. Otherwise, erosion will begin and limit the proposed beneficial land use. Progressive rehabilitation completed to date confirms these predictions.
- Maximum wave heights from the lake of up to 1.08m are forecast based on design wind speeds and lake fetch distance. Shoreline landform design will allow for this, but where constrained, erosion protection from rock, geotextile, or other materials, will be required.
- Coal is a combustible material with coal fire being a major operational risk. Coal fire is not a risk under water level and cannot reach thermal runaway conditions with appropriate rehabilitation controls.

Chapter 9 Post Mining Landform and Land Use

9.1 Introduction

As introduced in section 3.7 and expanded thereafter, the nominated post-mining landform is a pit lake bisected by the MRD, surrounded by sloping mine batters and levees that integrate into the surrounding, unmined landscape. This includes rivers, floodplains, and low elevation hills and plateaus. Figure 9-1 shows the post mining landform across the site.

This landform has been the focus of mining operations since the site's privatisation, aligning with the principle of *"starting with the end in mind"* as outlined in the ICMM's Integrated Mine Closure: Good Practice Guide (2025). Multiple public and EAY-led options analyses have consistently confirmed that a full pit lake is the most feasible landform that meets the criteria of being safe, stable, and sustainable.

Technical studies presented in Chapter 8 have reinforced the suitability of the pit lake and informed its conceptual design. This landform also supports a range of post-mining land uses, including environmental, recreational, conservation, agricultural, commercial, and/or industrial purposes, as shown in Figure 9-2.

Outside the operational boundary, public infrastructure easements (e.g., freeway, railway, and roads) are proposed to remain in their current alignments and continue to be managed by the relevant authorities. On EAY-owned land within the Mining Licences but outside the operational mine area, existing uses such as agriculture and recreation are proposed to continue.

The nominated land uses are designed to enable future or ongoing non-mining activities within the Mining Licence boundaries. Under the Mineral Resources (Sustainable Development) Act (MRSDA), EAY is required to deliver a landform which supports these proposed land uses. It is not required to deliver that the land use, however, it is committed to facilitating them and is actively engaging with local and state government agencies to explore implementation pathways.

To achieve relinquishment of the Mining Licences, EAY must demonstrate that the closure criteria for each land parcel and its nominated post-mining use have been met. For areas that have never hosted mining activities, EAY aims to pursue early and progressive relinquishment while working to rehabilitate other parts of the mine. This approach supports a faster transition of low-risk areas to new economic uses.

Should alternative land uses be proposed after relinquishment, they will need to be assessed under the Victoria Planning Scheme, a process that falls outside the scope of this DMRP.

Historically first adopted by the SECV, EAY has mined specifically to achieve this outcome since the site's privatisation. As outlined in *Integrated Mine Closure: Good Practice Guide* (ICMM 2025), mining should always 'start with the end in mind'. The selection of this landform has been further confirmed by the multiple public and EAY driven options analyses that have consistently determined that the only feasible landform that maximises the principles of safe, stable and sustainable, is a full pit lake.

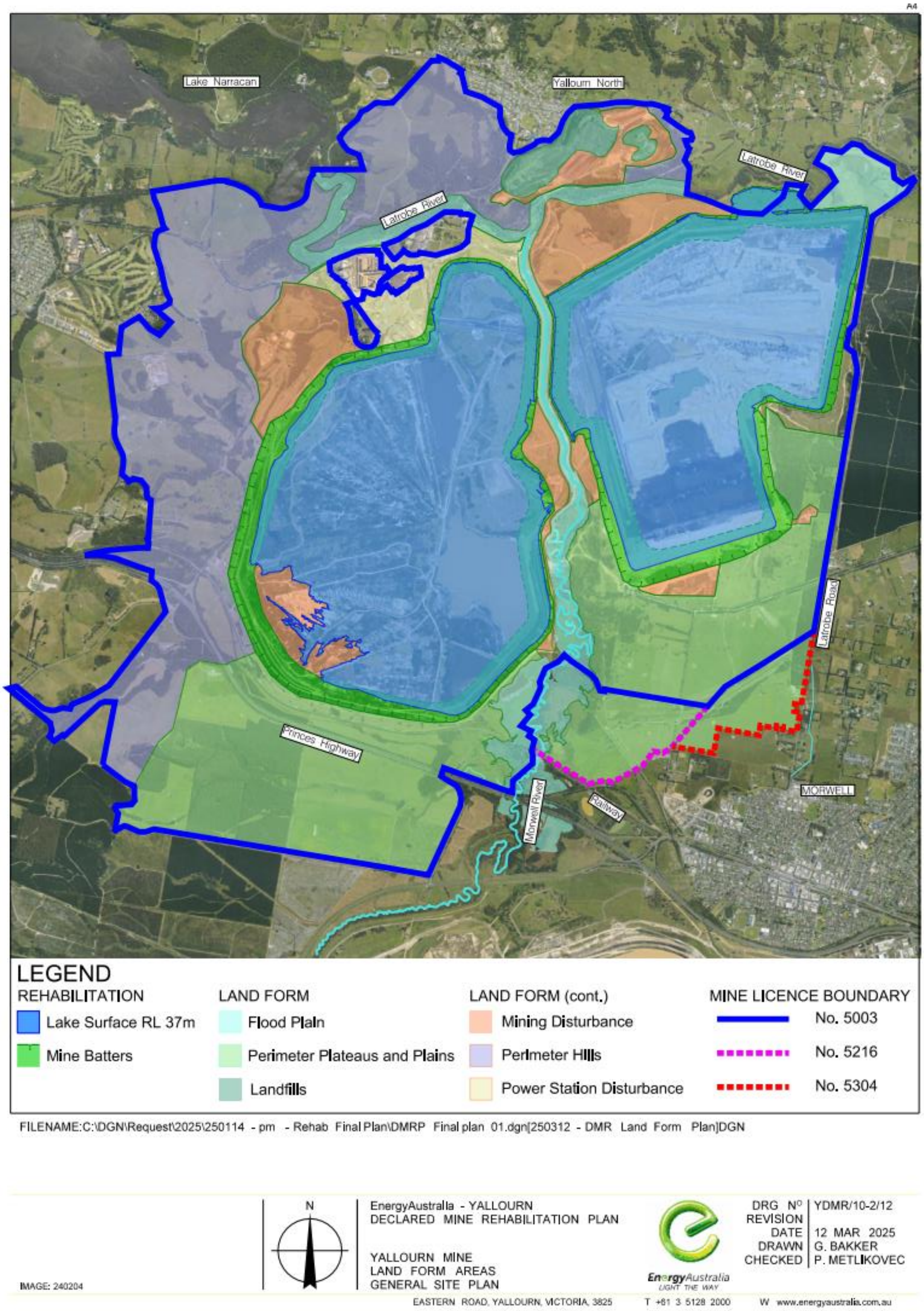


Figure 9-1: Post-mining Landform of the Mining Licence Area

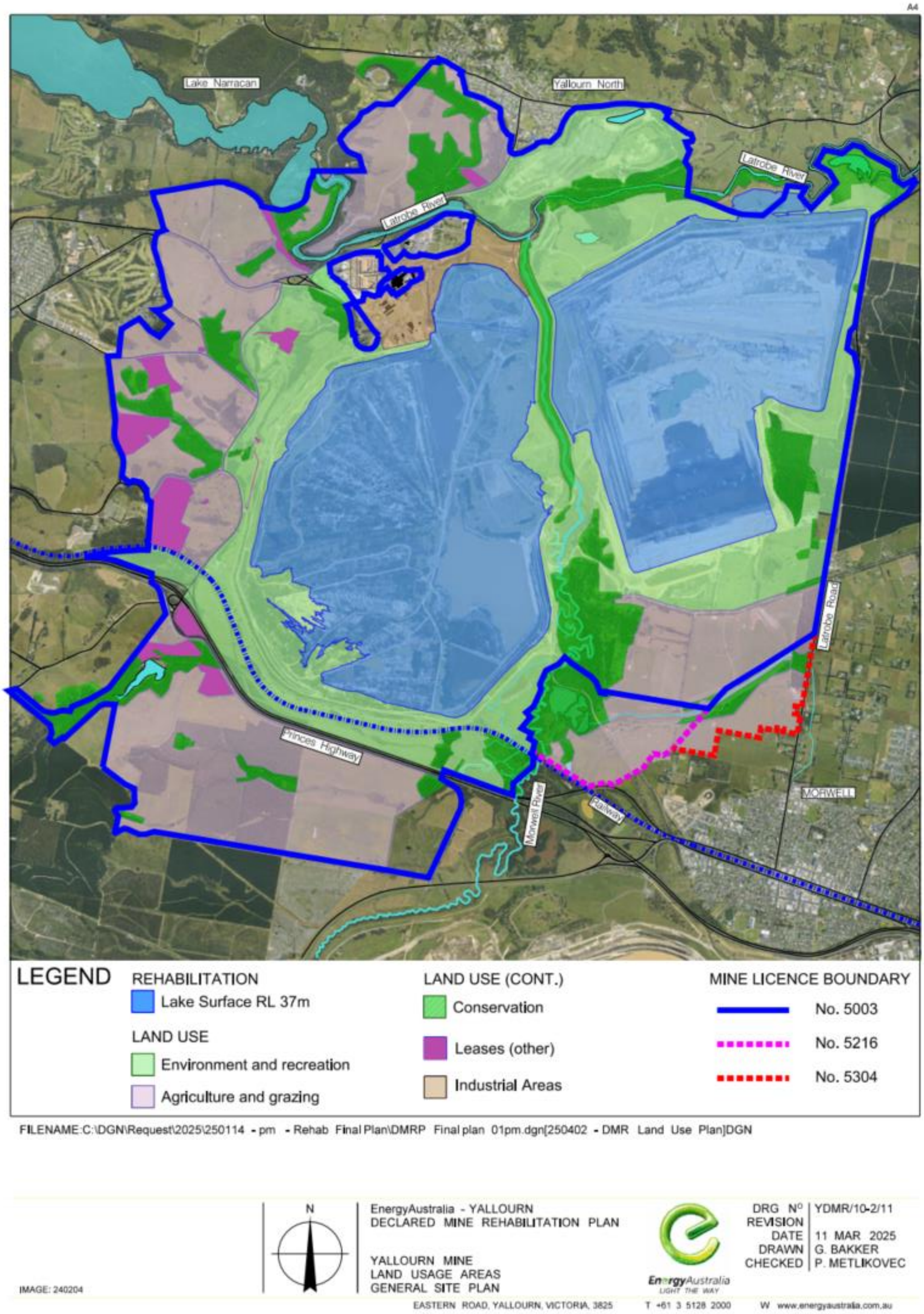


Figure 9-2: Post Mining Land Uses for Mining Licence Area

9.2 Post Mining Landform

9.2.1 Lake Yallourn

The key feature of the rehabilitated landform is the 665 GL Lake Yallourn. The lake will operate at a level of approximately RL +37m with fluctuations based on local climate and flood conditions. The selected level integrates with the surrounding Morwell and Latrobe Rivers which ensures the best geotechnical and hydrogeological stability conditions. Lake Yallourn will be split into western and eastern portions, bisected by the MRD which runs along a north-south alignment, and hydraulically connected via the conveyor tunnels. Key statistics associated with the lakes are shown in the table below.

Table 9-1: Lake Yallourn Key Statistics

Parameter	Lake Yallourn West	Lake Yallourn East
Volume (GL)	250	415
Area (ha)	1,062	899
Perimeter (km)	22.5	15.1
Average Depth (m)	23.5	46.2
Max Depth (m)	57	92

9.2.2 Mine Batters and Levees

Mine Batters are typically defined as the section that connects the mine floor to the mine crest. However, in this rehabilitation context Mine Batters are defined as the section of land from Lake Yallourn to the mine crest.

Due to mining practices and the pre mining landform elevation, mine batters range from less than 10m in elevation in the northeast of the site to 70m in the southwest of the site. Final mine batter slopes are designed at no steeper than a 2.5 horizontal to 1 vertical gradient. This allows vegetation to manage erosion risk whilst providing adequate access for maintenance.

Where engineered levees have been constructed to keep flood waters out of the operating mine, these are included within this description.

9.2.3 Other Mining and Power Station Disturbance

Some small parcels of land above final lake level, but not part of a batter or levee system are captured here. These areas are typical overburden dumping locations which are shaped to tie into the surrounding environment, or hardstand areas associated with Power Station development. These areas are relatively flat which allows future land use opportunities.

9.2.4 Landfills

Three EPA Licenced Landfills are situated within the YNOC. The designations include an Ash Landfill, Hard Waste Landfill, and Asbestos Landfill. The Ash Landfill is designed to replicate the pre-mining contours of the land and allow for a free draining landform whilst the Hard Waste and Asbestos Landfills are domed with relatively flat tops and steeper side slopes. The Hard Waste and Asbestos Landfills are placed on top of a previous overburden dump completed in the 1950s. Each of these sites is subject to EPA approval for capping and rehabilitation (BlueSphere 2021), which will provide end land uses capable and consistent with the land uses identified further in this chapter.

9.2.5 Perimeter Low Elevation Hills

Beyond the Lake Yallourn, Mine Batters and Levees, the Yallourn Mining Licence area returns to natural landforms such as Low Elevation Hills. These areas are typically situated on the west and southwestern perimeter situated between Newborough, Yallourn, and Driffield. The Haunted Hills and Hernes Oak localities are within this landform.

9.2.6 Perimeter Plateaus and Terraces

Perimeter plateaus and terraces are defined as flat areas between the low elevation hills, floodplains, and mining disturbance. Soil types are mixed with sandy material largely dominant in the east and southeast of the site, whilst clay and sandy clay materials are present within the western portions.

9.2.7 Rivers and Floodplains

The Morwell River and Latrobe River systems flow through the Mining Licence area and are integral to this DMRP. Adjacent to the river systems are flat alluvial floodplains typically containing well drained soils.

9.3 Land Uses

Based on the landforms identified above, post mining land uses for the site include:

- Potential beneficial uses for the lake
- Environment and recreation
- Existing sporting and recreational associations
- Conservation
- Agriculture
- Commercial and Industrial
- Other uses including supporting cultural heritage and further development

9.3.1 Beneficial Uses for Lake Yallourn

For Lake Yallourn, preliminary water quality modelling indicates that the lake water will be capable of supporting aquatic ecosystems, industrial and agricultural uses, and primary and secondary contact recreation (per section 8.8), however studies are ongoing (refer to water based studies in Chapter 17 Knowledge Gaps). Any post relinquishment use of water requiring extraction from the Lake will need to ensure the lake level remains within its designated operating level for maintaining mine batter and MRD stability. Further risks regarding safe access and egress, wave action, and environmental events such as major river floods and algal blooms are the subject of ongoing studies (KG29, KG20, KG15, KG17, KG26 in Table 17-1). These will be used to inform discussions with key government authorities on future access and management of the lake. As such, while EAY aspire to deliver a pit lake which is capable of supporting recreational use, the realisation of this use will be an outcome of discussions with government authorities and other key stakeholders. The table below outlines the potential suitability of the lake for different beneficial uses based on water quality and other risks by comparing modelled water quality outcomes against Victoria's Environmental Reference Standard (EPA 2022).

Table 9-2: Lake Yallourn Potential Beneficial Use Summary

Environmental Value	Water quality modelling results	Further comments
Water dependent ecosystems and species	Water quality will likely be suitable to protect the integrity and biodiversity of water dependant ecosystems. Including the integrity of riparian vegetation and maintenance of fish passage.	Current licenced discharges from the Yallourn Mine support water dependent ecosystems. It is modelled that lake water quality will be equivalent or better than the existing EPA Licenced discharge.
Potable water supply	Would likely be suitable with additional treatment.	Any extraction would need to ensure water level in the lake didn't fall below the operating range for maintaining mine batter and MRD stability.
Agriculture and Irrigation	Water quality will likely be suitable for agriculture and irrigation use.	Any extraction would need to ensure water level in the lake didn't fall below the operating range for maintaining mine batter and MRD stability.
Human consumption of Aquatic Foods (Aquiculture)	Water quality will likely be suitable for Aquiculture.	
Industrial and Commercial Use	Suitability would depend on each industrial or commercial purpose.	Any extraction would need to ensure water level in the lake didn't fall below the operating range for maintaining mine batter and MRD stability.
Water-based Recreation	Water will likely be suitable for primary (e.g. swimming) and secondary (e.g. boating and fishing) contact recreation.	Would require commitment from Government to facilitate access and manage the lake long-term for this purpose. Landform is being designed so that future access infrastructure can be installed (potential locations on Figure 9-2).

EAY also notes the possibility of Lake Yallourn having a Cultural beneficial use for Traditional Owners. Ultimately EAY is unable to comment on the suitability of the lake for this purpose, but notes that it is engaging in conversations with GLaWAC on cultural and economic aspirations for Traditional Owners and how the site's rehabilitation project and outcomes could contribute.

9.3.2 Environment and Recreation (Open Space)

Majority of the land adjacent to the lake footprint is assigned as environment and recreation. Within this designation there will be opportunities for open space, plus environmental improvements such as habitat enhancement and biodiversity areas. Whilst previous Yallourn Mine rehabilitation plans have prescribed exact areas of Open Woodland, Closed Woodland, Wetland, and Grassland areas, this DMRP will use consultation and engagement as a method of deciding on the size, density, and location of revegetation projects.

Providing opportunities for recreational use and public access has been a pillar of the Yallourn Mine Rehabilitation Plan since 1995. Lands with a primary designated open space recreational post-mining land use are presented in Figure 9-2. These lands will be of suitable quality and capacity to host shared user (i.e. walking, cycling, horse riding) paths.

It is noted that the scope of the DMRP is to provide land capable of hosting recreational activities, including tracks and trails, but their installation and public access is outside the scope of the DMRP. EAY has, however, commenced discussions with the Latrobe City Council on their regional tracks and trails strategy and how the nominated recreational land within the Mining Licence can facilitate improved connectivity and recreational outcomes for the region.

An existing mine viewing location on DeCampo Drive will be maintained during rehabilitation for the community to view progress. Additional viewing locations are being considered and EAY welcomes community input.

9.3.2.1 External Lease Areas

EAY supports a wide variety of not-for-profit community run leases across the external lands surrounding the Mine. These leases will not be impacted through the rehabilitation project and will likely continue into the future.

9.3.2.2 Grasslands

Grasslands are being developed in areas close to mining as they provide open space recreation opportunities, provide erosion control, and mitigate fire risk whilst creating acceptable aesthetics for mine rehabilitation standards. A Yallourn Mine pasture grass mix has been developed during decades of previous progressive rehabilitation and this mix is acceptable for stabilization and also agricultural use. Successful germination of a grassland should result in at least 90% cover of a rehabilitated area. Grasslands can be managed by grazing or a slashing program after relinquishment, as is the current practice, with opportunities for modified seed mixes, improved cropping, and soil carbon sequestration also possible.

9.3.2.3 Revegetation

Creating a diversity of habitats based on the landform and pre disturbance ecological vegetation class will maximise opportunities for native species and human enjoyment in the future. Furthermore, creating more habitat and biodiversity areas aligns with Strzelecki-Alpine Bio-link as incorporated into the *Latrobe City Council Rural Land Use Strategy* (LCC 2019), the Victorian State Government's *Biodiversity 2037 Plan* (DELWP 2017), and the Federal *Nature Repair Market* (DCCEEW 2025) launched in 2024.

The environmental land use designation allows for the concepts of Open Woodland, Closed Woodland, Wetland, and Grassland to be implemented in the most practical locations. Revegetation targets for each designation are based on Victoria’s EVC Revegetation targets and are shown in the table below (DSE 2004).

Exact positions of environmental land use are not yet defined, but a sensible split between open space and environmental outcomes will be sought through further community consultation (KG28 in Table 17-1).

Table 9-3: Range of Revegetation Targets for Environmental Land Uses

Lifeform	Open Woodland Number of Plants per Hectare	Closed Woodland Number of Plants per Hectare	Wetland Number of Plants per Hectare
Overstory / Canopy	50	50	50
Understory tree or Large Shrub	50	150	300
Medium Shrub	400	800	800
Small Shrub	0	500	0
Large Tufted Graminoid	0	500	1500

9.3.2.4 Open Woodland

Open Woodland areas will be characterised by a woodland EVC from the Gippsland Plains Bioregion. At Yallourn, the only woodland present on site is Plains Grassy Woodland (PGW), therefore PGW is to form the basis of revegetation requirements. A summary of the revegetation requirements for PGW (Open Woodland) is given in Table 9-3.

9.3.2.5 Closed Woodland

With PGW EVC being the only woodland EVC found at Yallourn, closed woodland can be defined as a hybrid between PGW and a denser understory, shrub and graminoid community characterised by Lowland Forest (LF) and Plains Grassy Forest (PGF) which are also present at the Yallourn site. Hybrid revegetation targets for these designations are shown in Table 9-3.

9.3.2.6 Wetlands

Wetland areas at Yallourn are to be revegetated in accordance with Swampy Riparian Complex standards. Until a Eucalyptus canopy is established areas are likely to resemble Swamp Scrub (SS), another EVC found locally. Additional challenges will be met with some understory, shrub and graminoid species preferring poorly drained areas. This will represent the landform at completion of the project; however, the sandy soils and incomplete final lake level will not allow some species to prosper. Wetland revegetation targets are shown in Table 9-3.

9.3.3 Conservation

Conservation areas are existing commitments made through previous mining and development approvals (*Figure 5-16: Existing Conservation Zones at Yallourn Mine*). The conservation areas cover 623 hectares of the site and contain a variety of EVC including Plains Grassy, Woodland, Plains Grassy Forest, Swampy Riparian Complex, Swamp Scrub, and Lowland Forest. The quality within these sites is higher than background due to current management practices and resources, with many areas progressing towards self-sustainability.

These conservation areas are largely remnant patches of vegetation which have been improved through fencing, security, pest control, weed control, and supplementary planting. In contrast to remnant native vegetation patches, some revegetation efforts adjacent the Morwell River, Latrobe River and Morwell West Drain Diversion are also committed as conservation zones, providing additional habitat and aesthetic value to the local area. The environment and recreation revegetation strategy for mine rehabilitation complements existing conservation commitments, with opportunities to create vegetation corridors between conservation patches and enhance the size of conservation zones with abutting vegetation of the correct EVC.

9.3.4 Agriculture

Where areas have historically been utilised for the purpose of Agriculture, and where these are not currently planned to be revegetated, these practices are proposed to continue. Most of the agricultural lands have favourable farming conditions such as low slopes, good drainage and good access. The agricultural areas are currently split into 6 precincts due to the method in which stock can be rotated from paddock to paddock. These are:

- Morwell
- Driffield
- Newborough
- Yallourn North
- Hernes Oak
- Mine

Some of the paddocks within the Mine disturbance footprint will either be submerged by the full pit lake level or require some rework when stabilizing the Mine batters. These areas are typically of a low pasture quality and are only grazed to support the reduction of fuel loads during the operational phases of the Mine.

Some areas classified as Grassland in 9.3.2.2 will also be capable of achieving an agricultural beneficial use.

Almost one quarter of the Mining Licence area is currently used for agricultural purposes with 1,450 Ha currently leased to a local agricultural company. The current lease has been setup to focus on improving the condition on the agricultural lands. Various activities currently undertaken annually are:

- Fencing repair and construction
- Rubbish removal
- Culvert construction and access road improvements for all season access
- Ongoing fertiliser program
- Pasture renovation
- Weed and pest control

With the creation of this new lease in 2021, six permanent stockyards were built to improve stock handling facilities to ensure farm workers are safe and animal husbandry is kept to the highest of standards.

As these agricultural lands surround the Mine, a high priority is on the reduction of fuel loads, especially during the fire danger period. Grazing can often keep the fuel loads down however slashing is often undertaken in parallel to control higher risk areas. Mineral disturbances are created where fire breaks are required and green cropping of boundaries which crops such as chicory form part of the agricultural practice across the lease. Agriculture remains as a beneficial land use for the DMRP.

9.3.5 Commercial / Industrial

The current mine offices, workshops, and support buildings have great repurposing potential for industry. An example of this occurred during the SECV privatisation when former SEC workshops were sold to private businesses and remain utilised as private engineering workshops today.

Commercial and industrial reuse of these areas is planned, with development opportunities to be explored.

9.3.6 Existing Land Use

9.3.6.1 Public Infrastructure

Public Infrastructure such as the Gippsland Railway, Princes Freeway, regional roads, bridge crossings, Telstra and Optus Fibre Optic Cable, Ausnet Electricity and Transmission Lines, freshwater pipelines and storages, sewerage systems, and Yallourn Weir are located within the Mining Licence boundary.

Perimeter assets will retain their existing intended beneficial use with Yallourn Mine rehabilitation designed to retain these uses for the community. However, assets located within the lake footprint and mine batters will need to be decommissioned and removed or rerouted.

9.3.6.2 Supporting Cultural Heritage

There are a range of indigenous and European cultural heritage sites located around Maryvale Field that were identified during the EES investigations in the early 2000s. Most of these sites are located in protected conservation areas and some are individually protected. Additionally, there are various other identified protected sites that would require a Cultural Heritage Investigation Plan in order to disturb lands within a 50m buffer zone as per the Aboriginal Heritage Act 2006 and the Heritage Act 2017 (2023 Amendment). None of these sites are proposed to be disturbed through the rehabilitation project and will remain protected now and into the future.

9.3.6.3 Capability for Additional Land Use

Whilst this section has detailed the land uses for each parcel of the Mining Licence as required by the MRSDA and MRSDMIR, alternative options are possible in the perimeter areas. These areas will have minimal restrictions from mining and mine rehabilitation activities. Commercial and industrial opportunities within the perimeter areas can be developed depending on each project's business case. EAY will support value add options that benefit the Latrobe Valley community.

Chapter 10 Community and Stakeholder Consultation

10.1 Introduction

As a declared mine licensee, EAY have a duty to consult with the community during mine closure and rehabilitation under the MRSDA and MRSDMIR. This duty to consult includes specific requirements for the DMRP including a 60-day public exhibition period, evidence of consultations, and copies of any submissions received.

A Community and Stakeholder Engagement Plan (CSEP) has been developed to provide the strategic framework and guidelines for community and stakeholder engagement activities for the 60-day public exhibition period of the DMRP.

Undertaking community and stakeholder engagement activities as described in CSEP builds on the strong foundation of engagement that EAY has undertaken during its operation of the Yallourn Mine, including ongoing discussions regarding rehabilitation. The CSEP seeks to formalise and document community and stakeholder engagement on the DMRP to meet the regulatory obligations and ensure EAY meet the requirements of the 60-day public consultation and exhibition period required for the DMRP. The CSEP is founded on the principle that timely provision of information, complete transparency, strong relationships with stakeholders and regular engagement with communities is critical to the successful delivery of the rehabilitation of the mine and minimising potential impacts on the community and stakeholders.

The following engagement objectives demonstrate our commitment to engaging with the community and stakeholders:

- Compliance with applicable regulation.
- Being proactive and seeking a broad range of feedback and perspectives.
- Building on our existing relationships and forging new ones.
- Detailed analysis of issues to be managed during the Project and strategies to mitigate these issues.
- Maintaining effective communication with community and key stakeholders.
- Applying the principles of the IAP2 Public Participation Spectrum (IAP2 2023).
- Providing the community and stakeholders with timely, accurate, and appropriate information on project activities and potential impacts.
- Ensuring EnergyAustralia management are available to meet community and stakeholders as required.
- Record and monitor stakeholder engagement in the Project's Consultation Management System (CMS)

The prepared CSEP is attached as an appendix to this DMRP (Appendix D – Community and Stakeholder Engagement Plan). It provides further details on the community and stakeholder engagement approach including:

- Identification of key stakeholders including those prescribed in the MRSDA and MRSDMIR
- Prior community engagement with these stakeholders
- Current/ongoing engagement and
- Planned engagement activities going forward.

10.2 Broad Engagement

EA has undertaken a significant amount of genuine and informed prior engagement and consultation with the community and stakeholders. As a major employer and industry participant in the region, EA has provided a multitude of opportunities for meaningful engagement throughout the operation of the site.

There is a long history of engagement prior to the announcement of Yallourn's closure which presented the final landform as a lake. This includes but is not limited to:

- The Maryvale Environmental Effects Statement (EES) 1999 included a comprehensive rehabilitation plan, which was open for public display and comment.
- The Supplementary EES 2001 followed the same process. A condition of approval from these EES processes was the development of a Rehabilitation Master Plan (RMP).
- The Yallourn Open Day in 2016 featured a dedicated mine rehabilitation shopfront, attracting over 1500 attendees.
- Subsequent years saw the establishment of dedicated mine rehabilitation shopfronts in Moe, with notable events from 2017-2019.
- Significant consultation on the Yallourn Mine Rehabilitation and Closure Plan (RCP) that was approved in June 2019.

The Covid-19 pandemic (2020-2023) significantly disrupted our community engagement efforts for mine rehabilitation. The imposition of lockdowns, social distancing measures, and travel restrictions hindered our ability to conduct in-person meetings, workshops, and site visits, which are crucial for effective community involvement. Despite these challenges, online engagement continued, allowing us to maintain some level of communication and collaboration.

Engagement regarding the closure of the Yallourn Mine and Power Station forms part of the Yallourn Transition Program which commenced in late 2022 (following the closure announcement in 2021). Consultation and engagement with the community and stakeholders has been ongoing since that time. In August 2024, EA opened the Morwell Community Hub, which exemplifies a community-centred approach to actively inform, involve, and benefit the local community. The EA Morwell Community Hub has set the benchmark for community engagement in the Latrobe Valley.

In 2024 alone, EA hosted over 20 site tours and attended a broad range of community events, reaching over 2300 community members and stakeholders, allowing for genuine and informed prior engagement and consultation regarding the Yallourn Mine closure and its rehabilitation.

In 2025, and prior to formal DMRP engagement, EA dutifully undertook informal DMRP engagement with stakeholders and the community. These engagements ranged from site tours, visits and meetings with key stakeholders, and community events. Of particular note, EA consulted with community at the Warragul Show (February 2025), Thorpdale Potato Festival (March 2025), and Farm World at Lardner Park (March 2025).

Updates on the progressive rehabilitation of the site were included in the April 2025 Community Update (EnergyAustralia 2025) which was advertised in the Latrobe Valley Express newspaper, with hardcopies available at the Morwell Community Hub. These Community Updates provide an effective method of communicating the progress of the rehabilitation project.

EA continues to engage in-person at the Morwell Community Hub every Tuesday, Wednesday, and by appointment.

10.3 Targeted Engagement

In addition to the engagement already undertaken by EAY, targeted engagement initiatives have been implemented and will continue throughout the entire rehabilitation project.

10.3.1 Internal Engagement

Whilst stakeholder engagement generally focuses on those external to the business, EAY is committed to engaging with the internal workforce at Yallourn, and across other EA sites such as the nearby Jeeralang gas fired power station. Ways that EAY have engaged with the internal workforce on rehabilitation include:

- Closure and Rehabilitation Visioning workshops (refer to section 6.2)
- Rehabilitation project updates at site briefings
- Communication via onsite newsletter (Yabba) and company-wide platform (Viva Engage)

EAY also mapped internal engagement to understand the preferred communication methods for the people working onsite at Yallourn.

10.3.2 Environment Review Committee (ERC)

Commencing in 2002 and replacing the Environmental Community Consultation Group which began in 1996, the ERC is comprised of stakeholders and community members that review Yallourn's environmental performance and enhance communication between industry, government agencies and the community. EAY value the ERC highly for their honest feedback and insights into the operation and rehabilitation of the site. The ERC aims to meet 4 times per year which often includes an annual mine site tour. Updates on rehabilitation are provided at every ERC meeting and the committee are aware of the rehabilitation plans and regulatory requirements for a DMRP.

The ERC comprises of the following stakeholders, noting that not all stakeholders can attend all meetings:

- Advance Morwell Inc
- Community Representatives
- Department of Energy, Environment and Climate Action
- Earth Resources Regulator Victoria
- Environment Protection Authority
- Gunaikurnai Land and Waters Aboriginal Corporation
- Independent Chair
- Latrobe Catchment Landcare Network
- Latrobe City Council
- Latrobe Valley Field Naturalists
- Mine Land Rehabilitation Authority
- Southern Rural Water
- West Gippsland Catchment Management Authority

EAY also involved the ERC in the visioning workshops (refer to section 6.2) and has commenced holding meetings at the Morwell Community Hub.

10.3.3 Mine Land Rehabilitation Authority (MLRA)

The MLRA are an "*independent authority working with community, industry and government. We facilitate the rehabilitation of declared mine sites to ensure they are safe, stable and sustainable for the beneficial use of future* *generations*" (MLRA 2023). Functions of the MLRA are outlined in Part 7A of the MRSDA and include the objective to promote efficient and consistent rehabilitation of coal mine land (s 84AE). Under the MRSDA the MLRA are a referral agency for the assessment of the DMRP.

EAY and MLRA have regular meetings to discuss the progression of mine rehabilitation and the development of the DMRP.

10.3.4 GLaWAC

The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) is the Registered Aboriginal Party that represents the Gunaikurnai Traditional Owners (GLaWAC 2015). There are five clans within the Gunaikurnai nation, with the Yallourn mine site being on the traditional lands of the Brayakaulung people.

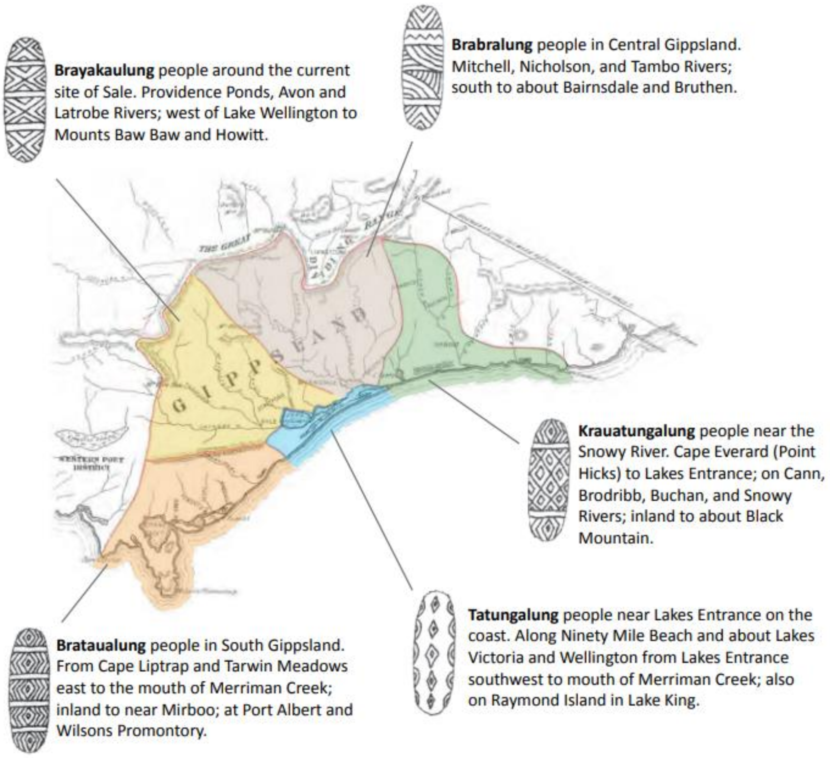


Figure 10-1: Five clans of the Gunaikurnai nation (GLaWAC 2015)

Continued engagement with GLaWAC is essential to ensure EAY delivers a rehabilitation solution that benefits Traditional Owners and the wider community. EAY will continue to share our rehabilitation plans with GLaWAC and seek feedback for consideration. Outside of dedicated rehabilitation-based meetings, GLaWAC are also members of the Yallourn ERC which provides another forum for providing advice and feedback (*Section 10.3.2*).

Whilst there are regulatory requirements for engagement with GLaWAC, EAY is committed to building genuine and long-term connections with Traditional owners that go beyond those legal obligations. EAY will continue to engage with GLaWAC to understand the aspirations of Traditional Owners and provide opportunities for meaningful collaboration that supports those aspirations.

10.3.5 CRC TiME

EAY is a partner in the Cooperative Research Centre for Transformations in Mining Economies (CRC TiME) which is dedicated to researching what happens after mining ends to promote better outcomes. Annual funding and in-kind hours are allocated to various projects including the *Collaborative planning for post-mining development in Latrobe Valley* (Project 1.7) which has a community engagement element. This project aims to create a shared vision for the future land use of mine land in Latrobe Valley by promoting collaboration between industry, state and local government, indigenous, and community organisation.

Stage 1 of the project has been completed and included the development of "a robust framework to support deliberation for future land use planning" and preliminary post-mining land use scenarios to take into Stage 2 (Foran et al. 2024). A further report was published to focus on the regional aspirations and community values, along with exploring the relevant planning documents for the region (Haque et al. 2024). This stage of the project included workshops with various stakeholders and explored the rehabilitation plans of the three Latrobe Valley coal mines.

Stage 2 of the project is underway and will present the land use options to the public via three forums: community panel, Indigenous reference group and a youth panel. These forums have been held with reporting underway. Of note for stakeholder engagement are the two sets of tours conducted at Yallourn during this project. The first set was for the community panel, the other set was specific to those who identify as Gunaikurnai, or as an Indigenous person who has connection with the Latrobe Valley.

EAY also hosted a site tour as part of the CRC TiME Annual Forum in November 2023. The tour was attended by 72 delegates and included commentary on the history, current operations and rehabilitation plans for the site.

10.3.6 Government, Authorities, and other groups

EAY have undertaken preliminary discussions regarding our rehabilitation plans via meetings and/or site visits with various stakeholders including:

- Mine Land Rehabilitation Authority (refer section 10.3.3)
- Latrobe City Council
- Department of Transport and Planning
- Department of Energy, Environment and Climate Action
    - Earth Resources Regulator (ERR)
    - Latrobe Valley Regional Rehabilitation Strategy (LVRRS)
    - Resources Victoria Approvals Coordination (RVAC)
- West Gippsland Catchment Management Authority (WGCMA)
- Independent Expert Scientific Committee (IESC)
- Office of Water Science
- Gippsland Water
- AusNet
- Aboriginal Education Centre
- Baw Baw Latrobe Local Learning Network
- Latrobe Catchment Landcare Network
- Latrobe Valley Field Naturalists
- Great Latrobe Park
- Friends of Latrobe Water (FLoW)

EAY also aims to engage with younger adults through secondary school programs such as the New Energy Technology program, or hosting tours with schools such as Chairo Christian College, Trafalgar Secondary College and Lavalla Catholic College Traralgon. The MLRA also provides an education service to the community with a dedicated Education Officer who often assists EAY with school visits.

Engagement has also occurred with various universities including Federation University and RMIT Melbourne. RMIT Melbourne Landscape Architecture students undertook a site tour of Yallourn and then designed look-out areas that incorporated the changing landscape during transition of the site from a coal mine to a lake. Tours with Federation University

10.4 DMRP Exhibition Period

An engagement program will be carried out during the 60-day exhibition period for the DMRP. Outcomes from this consultation will be presented in the updated DMRP, along with information on how EAY considered feedback in the DMRP.

EAY already uses a "centralised stakeholder relationship manager platform" called Consultation Manager (Consultation Manager 2024). This platform allows EAY to keep a register of all stakeholders and record any interactions (e.g. meetings, public events, email correspondence). EAY intends to continue to use Consultation Manager during the rehabilitation period to ensure accurate records of engagement are maintained.

10.5 Ongoing consultation

Consultation with stakeholders and community will be conducted throughout the rehabilitation project. Examples of engagement methods can be found in the CSEP and will be a continuation of the engagement that EAY already conducts. Details of engagement will be captured in Consultation Manager and considered in future updates to the DMRP.

The specific strategy that EAY will implement for ongoing engagement will be determined at a later date based on the level of interest in the DMRP, and learnings from the DMRP public exhibition period.

EAY will also continue to report on the progress of rehabilitation to the ERC (section 10.3.2) or similar committee.

10.6 Summary

With respect to engagement regarding the closure and rehabilitation of the Yallourn Mine, EAY has dutifully conducted ongoing engagement during mining operations at the site. EAY will continue to engage with stakeholders noting that all stakeholders, including the public, will have the ability to review and provide comment on the DMRP during the public exhibition period. Details of the engagement to be conducted for this DMRP are outlined in the CSEP.

Chapter 11 Risk Identification and Management

11.1 Introduction

The rehabilitation of the Yallourn Mine is a complex project which carries risk. This is recognised in the updated MRSDMIR which specifically acknowledge risk. This DMRP is required to outline the measures that Yallourn Mine will take to rehabilitate land to mitigate risk, as far as reasonably practicable. There are several key legislative requirements that have been identified to develop the scope of the risk assessment undertaken for the DMRP at the Yallourn Mine. Specific considerations to this risk assessment include:

- MRSDMIR, 64C Closure Criteria
  - (a) The measures the licensee must take to address the risks to public health and safety, the environment and infrastructure posed by the geotechnical, hydrogeological, water quality or hydrological status of declared mine land covered by the licence.
  - (e) The measures the licensee must implement to assess and manage fire risks.
- MRSDMIR, 64D Post-closure plan.
  - (a) A risk management plan for the mitigation of risks that may continue post-closure.
- MRSDMIR, 64F Matters required in a declared mine rehabilitation plan
  - (2)(a) Any use of passive controls to maximise the rehabilitation outcome that any landforms are to be safe, stable and sustainable.
  - (2)(d) An identification and assessment of:
    - (i) risks that may lead to an early or sudden cessation of operations and closure of the mine.
    - (ii) rehabilitation risks and hazards; and
    - (iii) risks that may affect the rehabilitation outcomes, objectives and milestones that apply to the rehabilitation of the declared mine land.
  - (2)(e) a risk management plan that specifies the actions the licensee will take to mitigate, as far as reasonably practicable, the risks referred to in paragraph (d) including:
    - (i) the performance standards to be achieved by either individual measures or a combination of measures; and
    - (ii) the management systems, practices and procedures the licensee will apply to monitor and manage risks and to comply with performance standards.
- MRSDMIR 57A Requirements for annual report for declared mine rehabilitation plans
  - (b) an identification and assessment of any risks to the rehabilitation and post-closure management of the declared mine

The effective management of risk is central to EnergyAustralia achieving its purpose of leading and accelerating the clean energy transformation for all and it is the policy and commitment of the company to develop effective and robust risk management practices and processes in line with industry best practice, namely *Risk Management – Guidelines (ISO 31000:2018)* (ISO 2018b).

Operational risk management is achieved via mandated and approved regulatory processes including Risk Assessment and Management Plan (RAMP) which is reviewed, updated and approved in accordance with Mine Licence requirements and Major Mining Hazards Safety Assessments reviewed and updated in accordance with OHS Regulatory Requirements. These processes are thoroughly documented with nominated controls effectiveness reviewed via internal, regulatory, and ISO accreditation audits.

This chapter of the DMRP describes the processes that have been implemented to effectively identify, assess and nominate management measures to control risks associated with the rehabilitation of the Yallourn Mine in accordance with regulatory requirements and company policy for risk management.

11.2 Objectives

The overall objective of the Yallourn Mine rehabilitation is to meet the conditions and commitments for a safe, stable, and sustainable landform to achieve successful relinquishment of the Mining Licence.

The objectives of risk identification, assessment and management for the rehabilitation of the Yallourn Mine are to:

- Develop an appropriate process for the assessment of the identified risks accounting for the anticipated timeframe during which rehabilitation activities will be undertaken.
- Identify existing and potential key closure related risks and opportunities and confirm and/or propose risk control measures / actions and responsible parties to achieve a safe, stable, sustainable and non-polluting landform for the duration of rehabilitation activities and upon relinquishment of the land.
- Provide validation for the current rehabilitation provisions for the site and identify improvements as required.
- Identify additional potential opportunities to expedite rehabilitation activities and reduce the timeframe for rehabilitation and subsequent relinquishment.
- Develop a series of recommendations, controls or actions to reduce all risks and hazards to an acceptable level and / or realise the identified opportunity/s.
- Regularly and periodically monitor progress and review the risks, opportunities and actions to determine validity of all risk reduction measures and allow for improvements to be implemented based on updates in knowledge and learnings.

11.3 Risk Assessment Scope

The scope of the risk assessment process accounts for all land, landforms and infrastructure associated with Mining Licences MIN5003, MIN5126 and MIN5304 in accordance with the objectives for rehabilitation and relinquishment and with consideration of associated risks that have the potential to impact these objectives.

The process considers risks and opportunities associated with pre-closure, closure, decommissioning, rehabilitation and relinquishment activities, including potential post-closure and rehabilitation legacy items that may not be able to be rehabilitated and / or remediated. The key risk areas considered related to consequences of identified scenarios are:

- Safety & Health (consideration of potential health and safety impacts to any and all people)
- Environment (impacts with potential to result in harm to the environment)
- Land, property and infrastructure (potential impacts to public land, property or infrastructure)
- Cultural Heritage (assessment of potential impacts to areas of cultural significance)
- Community (includes potential financial or societal impacts or impacts to community assets resulting from rehabilitation and closure activities).
- Regulatory & Governance (potential for regulatory breach resulting from the identified risk event / scenario)

11.4 Risk Assessment Process

11.4.1 Risk Identification

To meet the objectives of the risk assessment process, the intent of the primary objective to achieve a safe, stable, sustainable and non-polluting landform upon relinquishment of the Yallourn Mine is the basis of the assessment. The considerations that cumulatively informed risk identification process were:

- Risk Factors
- Current Risk
- Studies and Knowledge
- Rehabilitation Objectives

11.4.2 Risk Factors

The risk factors which have the potential to impact the objective are the factors which are assessed, and which are documented in Table 11-1.

Table 11-1: Summary of factors risk assessed and associated identifiers

Risk Factor	Potential to Impact	Identifier
Geotechnical	Loss of Ground Control	G
Hydrogeology	Loss of control of ground-based water conditions	GW
Surface Hydrology	Loss of control of surface water conditions	SW
Fire	Loss of control of fire ignition and propagation	F
Environment	Loss of control of environmental conditions	E
Water Access and Delivery	Loss of control of water supply, distribution and movement	WA
Site Security	Loss of control of site security	SS

Each of these factors is reviewed independently with appropriately qualified and knowledgeable people contributing to the assessment. Information to inform the assessment is based on previous and current studies, investigations, known operational parameters, historical review, published papers and expert knowledge.

11.4.3 Current risk

Known operational risks that are anticipated to remain upon cessation of operations and throughout the rehabilitation phases. For the purposes of this risk assessment process, the current known operational risks were considered as the base case for the assessment and treated as the inherent risk, inclusive of accounting for current control measures that are in place and are documented in the operational Risk Assessment and Management Plan.

This inherent risk is indicative of the risks that would be present if the scenario of early or sudden closure occurs.

11.4.4 Studies and Knowledge Base

Past and current studies provide information about potential risks associated with planned rehabilitation activities and provide opportunity for consideration to implement activities and remediation measures to maintain risk to as low as is reasonably practicable.

11.4.5 Rehabilitation Objectives

The overall objective of safe, stable, sustainable, and non-polluting, to enable approval for the site to be relinquished for post-mining land uses.

11.5 Risk Assessment Scenarios

11.5.1 Background Information

Risk scenarios were pre-populated by subject matter experts from EAY and other specialists during three facilitated workshops in February 2024. These workshops utilised the knowledge of the workshop participants to inform scenarios that have potential for unintended and unwanted outcomes with consideration for each of the identified risk factors Table 11-1.

An assessment of the risks associated with development of the DMRP for the Yallourn Mine was conducted during a series of facilitated workshops which were facilitated by GHD (GHD 2025a) with subsequent report and risk register developed to document the information that was discussed and obtained during the workshops. Risk scenarios were pre-populated into the risk register using the information that was obtained during the February workshops. Information to summarise the objectives, methodology, risk criteria and agenda to be used in the workshops was distributed to intended participants to provide context prior to their attendance. The workshops included the participants in reviewing, updating and validating the draft inputs, and identifying any new risks, consequences or controls with all scenarios prosecuted to completion.

Ten full-day risk assessment workshops were facilitated over the course of five weeks from July to August 2024, with the process involving subject matter experts both in-person and on-line, an additional two workshops were held in October 2024 to review any outstanding risk scenarios and a further workshop was held in February 2025 to assess the risks associated with rehabilitation of the Yallourn North Open Cut and complete the review of the risk register (Table 11-2).

Table 11-2: Workshop dates and information

Day	Date & Time	Location	Technical Risk Factor Category Reviewed
1	Monday 15 July 2024 8:30am – 4:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Geotechnical
2	Tuesday 16 July 2024 8:30am – 3:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Geotechnical
3	Monday 22 July 2024 8:30am – 4:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Geotechnical (including MRD)
4	Tuesday 23 July 2024 8:30am – 3:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Groundwater
5	Monday 29 July 2024 8:30am – 4:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Surface Hydrology (Rivers & Pit)
6	Tuesday 30 July 2024 8:30am – 3:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Fire Management
7	Monday 5 August 2024 8:30am – 4:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Environment
8	Tuesday 6 August 2024 8:30am – 3:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Environment
9	Monday 12 August 2024 8:30am – 4:30pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Water Access & Delivery
10	Tuesday 13 August 2024 8:30am – 3:30pm	Maryvale Meeting Room Remotely via MS Teams	Site Security
11	Tuesday 22 October 2024 9:00am – 3:30pm	Maryvale Meeting Room	Geotechnical, Hydrogeology, Environment
12	Wednesday 23 October 2024 9:00am – 3:30pm	Maryvale Meeting Room	Geotechnical, Groundwater, Water Access & Delivery
13	Thursday 27 February 2025 9:00am – 2:00pm	Yallourn Strzelecki Meeting Room Remotely via MS Teams	Yallourn North Open Cut

The workshop groups comprised sufficient knowledge, backgrounds and experience to provide confidence that the workshop results are soundly based. The workshop team included representatives from EnergyAustralia and industry experts including: PSM, RGS Environmental (RGS), Environmental Resources Management (ERM), University of NSW, Alluvium, and GHD.

11.5.2 Geotechnical

The geotechnical scenarios that were assessed as risk events are:

- Surface Water Recharge
- Elevated Groundwater Levels
- Overtopping of Rivers
- Seismic Event
- Floor Heave

A total of 117 Geotechnical Risk Event Scenarios were assessed.

11.5.2.1 Geotechnical Assessment – Mine Batters

The Yallourn Mine shares similar characteristics to the other Latrobe Vally Open Cut Coal Mines in that they are unique in a geotechnical mining context due to the following factors:

- The seams of coal that are mined are very thick.
- The coal that is mined has a density only slightly greater than the density of water
- The coal that is mined is of very low strength similar to the strength of soil
- The coal seams that are mined are separated by interburden soil units that also contain groundwater aquifers containing groundwater of elevated temperatures
- The groundwater aquifers can be at high pressure and require depressurization to maintain batter stability
- The mines are quite deep (the excavated pits at Yallourn are ~80 metres deep) considering the geotechnical nature of the coal and interseam materials

The above listed factors combine to provide conditions that if not appropriately controlled, can result if large ground movements in areas within and surrounding the mine and render the batters of the open cut pits sensitive to both ground and surface water.

Given this, the predominant factor influencing planning for the rehabilitation of the Yallourn Mine is the geotechnical stability of the excavated pit and requirement to stabilise the batters to achieve the objective of a safe, stable and sustainable landform post relinquishment. The experience and documented history of the site from 100+ years of open cut brown coal mining and the undertaking of multiple geotechnical investigations and studies has provided information that the pit void will require stabilisation in the form of weight against the exposed batters and the mine floor to prevent ground failure events from occurring into the future.

Current controls for managing stability of the pit void including pumping of water, drainage management, groundwater extraction and monitoring, inspection and implementation of TARPS are reliant on the intervention of people and continued maintenance of infrastructure which is not practically or financially viable post operation and rehabilitation of the Mine. The location of the Mine in relation to infrastructure including public roads, rail lines and conservation areas means that ground movement and failure in certain areas will have potential to impact this infrastructure and result in damage and risks to public health and safety.

The geotechnical risk assessment was conducted by separating the Mine into various domains shown in Table 8-28. Each domain was assessed separately with factors including geotechnical risks, proximity to public infrastructure, proximity to rivers and conservation areas, current operational controls and required implementation of actions and further implementation of controls to maintain ground stability considered for each area for each of the identified phases of rehabilitation until weight balance, batter and ground stabilisation and relinquishment is achieved through full pit lakes.

11.5.2.2 Geotechnical Assessment – Morwell River Diversion

A unique feature of the Yallourn Mine is a river that flows between the historical Township Field and East and Maryvale Fields in the form of the Morwell River Diversion – a man-made diversion that was constructed in 2005 to allow for continued mining at the Yallourn site following the completion of activities in Township Field.

The MRD was designed to carry the Morwell River through the Yallourn Mine at its original elevation, while mining continued at depth in the Yallourn Eastfield and Maryvale Fields (YEF and MVF). The structure comprises of a very large fill embankment with foundation of the MRD partially on the Midfield Overburden Dump (MOBD) and partially on an in-situ coal dyke. In 2012 a section at the northern end of the MRD failed leading to the flooding of the Yallourn Mine and loss of flows in the river until repairs were completed which included the installation of a synthetic liner in the repair prior to river flows in the MRD being reinstated. In 2021 a stability incident occurred at the southern end of the MRD including ground movement and cracking that required extensive remedial works including installation and operation of pumped and piped diversions, surface treatment of the MRD low and high flow channels and ongoing monitoring and maintenance.

The MRD was assessed as a domain in and of itself for the risk assessment due to the current and proposed controls required to be implemented to maintain stability of the structure.

11.5.3 Hydrogeology

Similar to the geotechnical assessment, the risk scenarios for groundwater were assessed according to the geotechnical domains as applicable and accounted for the potential risk associated with loss of control for each of these areas.

The hydrogeological scenarios that were assessed as risk events are:

- Increase in groundwater levels in M1A aquifer
- Increase in groundwater levels in shallow aquifer
- Decrease in groundwater levels (phase 3a onwards)

A total of 50 Hydrogeological Risk Event Scenarios were assessed.

11.5.4 Surface Hydrology

As per the geotechnical and hydrogeology assessments, the risk scenarios for surface water were assessed according to the geotechnical domains as applicable and accounted for the potential risk associated with loss of control for each of these areas.

The Surface Hydrology scenarios that were assessed as risk events are:

- River meandering / meander development
- Flood flow from Latrobe River to the pit
- Failure of Inlet / outlet structures
- Loss of containment of water from surface drainage channels
- Loss of containment of water from Morwell River channel
- Wind / wave action

A total of 30 Surface Hydrology Risk Event Scenarios were assessed.

11.5.5 Fire

Fire risks were informed by current operational knowledge, assessments and management plans. Risk events were defined by identifying potential sources of ignition, these being:

- Ignition of coal in Maryvale Field
- Ignition of coal in Eastfield and Eastfield Extension
- Ignition of coal in Township Field
- Ignition of coal in Yallourn North Open Cut
- Ignition of vegetation in Maryvale Field
- Ignition of fuels
- Building fire

A total of 7 risk scenarios were assessed related to risk events for fire.

11.5.6 Environmental

The environmental assessment accounted for risks to air, land and water resulting from activities on site and the scenarios were informed by current operational conditions including current risk assessments and management plans.

The risk scenarios that were assessed are:

- Dust generation and transport off-site
- Smoke & particulates transport off-site
- Generation of unacceptable odour
- Gaseous emissions generating air pollution
- Unacceptable noise emissions
- Unacceptable vibration
- Introduction and/or spread of weeds, invasive species and plant disease
- Presence of pest animals and vermin degrading habitats
- Habitat fragmentation and disruption for both terrestrial and aquatic fauna
- Damage to habitats and native vegetation
- Contamination of pit-lake water
- Poor pit-lake water quality pollutes groundwater and creates offsite groundwater plume

- Poor pit-lake water quality pollutes Morwell River and Latrobe River
- Lack of suitable topsoil
- Lack of suitable bulk fill material
- Failure of batter capping
- Unsuitable earthen materials left in pit
- Erosion of batters and/or shoreline from wave action
- Spill / release of hazardous materials
- Damage to Cultural Heritage sites
- Increase in vector
- Lake Fill impacting fauna habitat
- Chemical risk from water quality in pit lake
- Pathogen risk from water quality in pit lake via primary or secondary recreational contact
- Physical risk from water quality in pit lake
- Flood water from spillways impacting water quality in the pit lake
- Flood event resulting in fish capture in existing pits or future pit lakes
- Reduced / changed water use and associated impacts on downstream environments

A total of 29 environmental risk scenarios were assessed.

11.5.7 Water access / delivery

The risks associated with the plan to access water to fill the mine pit voids with water were assessed with the identified scenarios being:

- Lake fill is impacted by unavailability of required water from the local river system resulting in slower fill of lakes
- Pumping system unable to facilitate pit lake fill
- Operational bulk water entitlement revoked upon cessation of operation
- Restricted seasonal use for revised BWE for rehabilitation
- Drought conditions (5+ years) impact water access during lake fill

A total of 5 scenarios were assessed related to water access and delivery.

11.5.8 Site Security

Security of the site was identified as a risk during rehabilitation activities with risk scenarios assessed being:

- Unauthorised public access to site prior to relinquishment threatens public
- Unauthorised public access to site prior to relinquishment threatens business interests
- Unauthorised water extraction from lake
- Data and information threat

A total of 4 site security risk scenarios were assessed.

11.5.9 Yallourn North Open Cut (YNOC)

The YNOC contains the Twin Ash Ponds, Ash Landfills and an Industrial Waste Landfill which are managed under EPA licences and as such, this area was subject to a separate assessment and is treated as a separate domain for the purposes of rehabilitation.

The risk scenarios assessed for this area are:

- Contamination or degradation of water quality in the Latrobe River resulting from poor quality ground water flowing from YNOC to the river
- Contamination or degradation of water quality in the Latrobe River resulting from poor quality surface water flowing from YNOC to the river
- Contamination or degradation of water quality in the Latrobe River resulting from generation and release of gasses
- Contamination or degradation of air quality resulting from generation and release of gasses and odour into the atmosphere
- Contamination or degradation of air quality resulting from generation and release of dust into the atmosphere
- Generation of noise and vibration
- Fugitive lighting
- Uncontrolled release or spill of contaminants
- Surface water recharge
- Elevated groundwater levels
- Seismic
- Surface water recharge
- Elevated groundwater levels
- Ignition of coal in YNOC

A total of 27 risk scenarios were assessed for YNOC.

11.6 Methodology

The risk assessment uses a cause – consequence approach to risk scenario identification and the cause – consequence model outlined in *IEC 31010 Risk Management – Risk Assessment Techniques* (IEC and ISO 2019) was adopted. This allows credible linkages to be identified, representing systems and processes that may lead to an unfavourable consequence. The cause – consequence model captures potential factors that may reasonably impact the meeting of the final closure objectives.

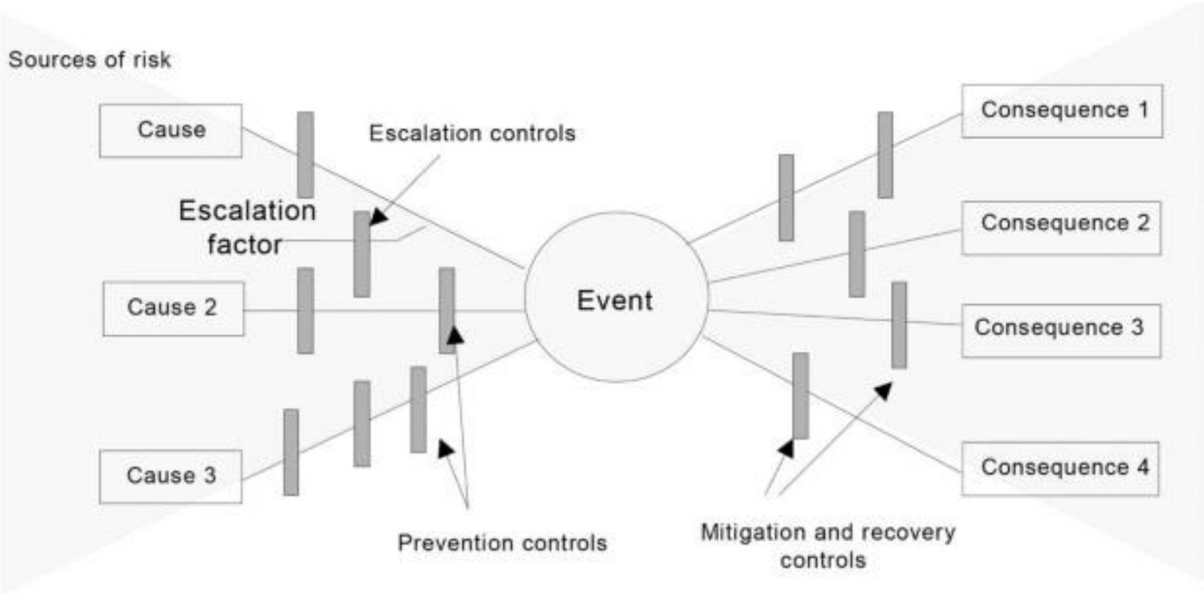


Figure 11-1: Risk Assessment Techniques (IEC and ISO 2019)

For the risk identification process, the cause – consequence approach allows for the identification and assessment of scenarios impacting the risk factors. Each risk is then assessed against developed milestone phases described below to replace the typical risk assessment process where 'inherent', 'current' and 'residual' language is used. The assessment considered scenarios for each risk factor across the nominated phases of closure, rehabilitation and relinquishment periods with notional timeframes identified for each phase. It is recognised that these notional timeframes will be subject to change and are adopted for the duration of the risk assessment process to provide scope for the assessment.

Table 11-3: Phases of closure for risk assessment

Rehabilitation Phase	Description
1. Pre-closure (Operations) (Notionally 2024 – 2028)	Includes developing and finalising the closure vision and objectives, progressive rehabilitation, stakeholder engagement, ongoing demonstration studies, gap analysis, closure options analysis. Includes progressive rehabilitation, which encompasses ongoing efforts throughout the mine operations that seek to advance rehabilitation and closure activities during operation. Examples of progressive rehabilitation activities include disturbed land reshaping and revegetation, decommissioning and demolition of unused infrastructure.
2. Closure and decommissioning (Notionally 2029 – 2030)	This is the process of taking infrastructure out of active service, which begins at the end of its utility for site activities and ends with the removal of all unwanted infrastructure and services. Includes demolition which is the process of physically taking apart infrastructure and may involve disassembly of some or all of the structures, or destruction of infrastructure with heavy equipment or explosives. This does not include risk assessment of the demolition itself, only the planning of demolition works.
3a. Rehabilitation & Active Management (Notionally 2031 – 2039)	Rehabilitation is the return of the land to a stable, productive and self-sustaining condition. Works are conducted during this time to achieve rehabilitation requirements and to manage landforms and infrastructure while these works are conducted.
3b. Monitoring and Measurement (Notionally 2040 – 2049)	This is the period of time when monitoring and measurement of the areas that have been rehabilitated is undertaken to determine effectiveness of the works to achieve a safe, stable, sustainable and non-polluting landform.
4. Relinquishment (Notionally 2049 – 2061)	The period after the completion of all works needed to implement the closure of the site, meet the closure criteria and account for potential legacy issues after the Mining Licences are relinquished. Includes a period of monitoring and maintenance leading up to relinquishment and may include a period in which ongoing activity is needed to meet the closure criteria and address identified legacy issues. This period also extends beyond the license relinquishment period.

Identified risks were assessed using the EAY Rehabilitation Risk Assessment Criteria in section 11.6.1 and control options were considered using the control identification decision tree described in the *Integrated Mine Closure Good: Practice Guide* (ICMM 2025).

The assessment process considered the following for each identified scenario to form the basis of assessment:

- Causes/Drivers (Contributing factors that may cause the identified risk scenario to occur).
- Potential Consequences (Impact(s) to the business or project as a result of risk event occurring).
- Maximum Reasonable Consequence (Determination of the consequence which has the potential to have the greatest impact on the primary objective).
- Identification of current operational controls relevant to the identified risk scenario.
- Current Risk Ranking - Risk Ranking considers of potential outcome of Maximum Reasonable Consequence by identifying the level of consequence (with reference to the Risk Consequence Materiality Table) and the probability of realising this outcome (with reference to the Risk Likelihood Table) considering the effectiveness of controls in place.

For the purposes of this assessment and in relation to rehabilitation activities, current risk ranking with operational controls is considered Inherent Risk (current risk level given the existing set of controls rather than the hypothetical notion of an absence of any controls). Potential changes to the identified consequence are assessed across the four phases with consideration given to the changes resulting from works undertaken. Controls, treatments and actions required to be implemented or undertaken across the four identified phases are then determined for each phase individually by assessing the controls and treatments required to be continued or implemented in each phase as well as any actions required to maintain risk as low as reasonably practicable (ALARP) during each phase.

A risk ranking is determined for each phase by identifying the level of consequence and probability considering the perceived effectiveness of the identified controls, treatments and actions.

11.6.1 Risk Assessment Criteria

Identified risks were assessed using the risk assessment criteria to determine the risk rankings for each of the identified risk scenarios.

The risk assessment criteria provides information about consequence severity (Table 11-4) and likelihood ratings (Table 11-5) to inform the risk ratings (Table 11-6 and Table 11-7) for each scenario across the rehabilitation phases.

Table 11-4: Consequence Criteria

No.	Ranking	Safety & Health	Environment	Plant and Property	Heritage	Public Infrastructure	Regulatory
5	Critical	Loss of life to members of the public.	• Very serious effect on the natural and/or built environment and/or environment suffers long term harm (20+ years). • Environmental recovery on a very large scale and/or over a long period (20+ years). • Impacts on the state or multiple regional directorates. • Environmental contamination event (of air, soil-land and/or water of a magnitude that a State-level incident response is required. • Environmental damage leading to bioregional, State or national extinction of listed threatened species of native flora or fauna or vegetation community. • Irreversible or long-term (years) damage or environment harm to 10 ha of native vegetation (not listed threatened vegetation community) or to ≥1 ha listed threatened native vegetation community. • Deaths of hundreds (or more) of listed native flora or fauna species or native mammals. • Contamination or other environmental damage leading to deaths of native fauna well beyond (>1 km) the boundaries of the operation. • Contamination of surface water/ groundwater aquifer leading to disruption of beneficial uses as defined by Environmental Reference Standard for more than year. • Unplanned connections to Morwell River flood plain and Latrobe River. • Loss of the MRD low flow channel.	• Significant damage to land/property with permanent loss of amenity. • Permanent loss of conservation areas. • Permanent asset reduced value.	Permanent loss of heritage or cultural assets.	• Damage to critical infrastructure or services (for example railway lines, public roads, communications or power) which impacts multiple municipalities. • Extended disruption of business, services or transportation resulting in social dislocation and / or impacting employment. • Permanent loss of community assets.	• Breach of a material licence or authorisation resulting in the loss of the Mine Licence and/or the cessation of mining operations that threaten the viability of the core business. • Significant contractual or legal exposure. • Director or Officer liability realising resultant prosecution.
4	Major	Life altering and / or permanent injury or impact to health to members of the public.	• Major effect on the natural and/or built environment and/or environment suffers harm for 10-20 years. • Environmental recovery on a large scale and/or over a period of 10-20 years. • Impacts on a region or multiple municipalities. • Environmental contamination event (of air, soil-land and/or water) of a magnitude that would necessitate a regional emergency management incident response. • Environmental damage leading to local extinction of listed threatened species of native flora or fauna or vegetation community. • Deaths of up to ~100 listed threatened flora or fauna species or native mammals. • Major damage or environment harm to 1-10 ha of native vegetation (not listed threatened vegetation community) or to <1 ha listed threatened native vegetation community. • Impact to conservation areas. • Contamination of surface water/ groundwater aquifer leading to disruption of beneficial uses as defined by Environmental Reference Standard for up to one year. • Significant damage of the MRD low flow channel or Latrobe River or Morwell River flood control levees.	• Significant damage to land/property resulting in temporary loss of amenity. • Significant damage to conservation areas. • Reduced value of the asset.	Significant damage or impact to heritage or cultural assets.	• Damage to critical infrastructure or services (for example railway lines, public roads, communications or power) impacting the local community. • Some disruption of business, services, or transportation resulting in social dislocation and / or impacting employment. • Significant damage to community assets.	• Breach of a material licence or authorisation resulting in the suspension of the Mine Licence and/or undertakings to regulators. • Increased contractual or legal exposure. • Business liability realising resultant prosecution and / or fines.
3	Moderate	Recoverable injury or impact to health	• Moderate effect on the natural and/or built environment and/or environment suffers harm for 5-10 years.	• Moderate damage to land/property	Limited impact to	• Easily recoverable damage to critical	• Breach of a regulatory obligation resulting in

No.	Ranking	Safety & Health	Environment	Plant and Property	Heritage	Public Infrastructure	Regulatory
		to members of the public.	• Environmental recovery on a small scale and/or over a period 5-10 years. • Impacts on a municipality. • Environmental contamination event (of air, soil-land and/ or water) with clean-up and rehabilitation expected to run for weeks. • Environmental damage leading to deaths of a small number of listed threatened flora or fauna species or native mammals. • Reversible damage or environmental harm to <10 ha of non-listed native vegetation community or <1 ha of listed native vegetation community. • Localised contamination of surface water/groundwater aquifer leading to disruption of beneficial uses as defined by Environmental Reference Standard for weeks to months. • Localised short-term damage of the MRD low flow channel or Latrobe River or Morwell River flood control levees.	for a short period of time. • Moderate and easily recoverable damage to conservation areas. • Short-term and recoverable impact to value of the asset.	heritage or cultural assets.	infrastructure or services (for example railway lines, public roads, communications or power) impacting a small number of people locally. • No significant disruption to business, services or transportation resulting in short term social dislocation and / or impacting employment for small number of people. • Recoverable damage to community assets.	regulatory action including issuance of a warning, non-court fines or penalties or infringement notice. • No significant contractual or legal exposure.
2	Minor	Negligible impact to public health and safety.	• Limited effect on the natural and/or built environment and/or the environment suffers harm for 1-5 years. • Environmental recovery on a minor scale up to 5 years. • Restricted to single township or locality. • Minor environmental contamination event (of air, soil-land and/or water). Clean-up and rehabilitation may be required but can be completed within days. • Minor damage or environment harm to <1 ha of native vegetation (not listed threatened vegetation community) that can be recovered in weeks to months. • Environmental damage that affects native fauna populations but does not kill individuals or disrupt breeding or other important ecological processes. • Minor contamination of natural waterway or wetland occurs, but water quality remains within applicable EPA or ANZECC guideline for existing beneficial uses. • Water extraction or diversion reduces surface water flows or groundwater available for environmental uses, but with no detectable effect on dependent species or ecosystems and carried out within terms of water licence.	• Minor damage land/property. • Minor impact to conservation areas. • Minor impact to asset value.	Negligible impact to heritage or cultural assets.	• Minor impact to critical infrastructure or services (for example railway lines, public roads, communications or power) with no discernible impact. • Negligible disruption to business, services or transportation resulting in short term social dislocation and / or impacting employment for small number of people. • Negligible impact to community assets.	• Non-systemic breach or complaint with no statutory requirement for reporting to regulator with no penalty or regulatory action. • No contractual or legal exposure.
1	Insignificant	No impact to public health and safety.	• Hazard event with minimal environmental impact. • No noticeable effect beyond the immediate occurrence or expression of the hazard.	• No discernible damage to land/property. • No impact to conservation areas.	No impact to heritage or cultural assets.	• No impact to critical infrastructure or services (for example railway lines, public roads, communications or power).	• No requirement to report to the regulator or for regulatory intervention.

No.	Ranking	Safety & Health	Environment	Plant and Property	Heritage	Public Infrastructure	Regulatory
				• No impact to value of asset.		• No disruption to business, services or transportation resulting in short term social dislocation and / or impacting employment for small number of people. • No impact to community assets.	

Table 11-5: Likelihood Criteria

#	Level	Qualitative Measure	Probability
E	Almost Certain	Already happened or is expected to occur in most circumstances.	90% or greater chance of occurrence
D	Likely	May probably occur in most circumstances.	66% up to 90% chance of occurrence
C	Possible	Not unusual and might occur in the foreseeable future.	33% up to 66% chance of occurrence
B	Unlikely	Could occur at some time but unlikely in the foreseeable future.	10% up to 33% chance of occurrence
A	Rare	Is expected to occur only in exceptional or extreme circumstances.	Less than 10% chance of occurrence

Table 11-6: Risk Matrix

			Likelihood				
			Rare	**Unlikely**	**Possible**	**Likely**	**Almost Certain**
			A	**B**	**C**	**D**	**E**
Consequence	**Critical**	**5**	Medium (15)	High (19)	High (22)	Extreme (24)	Extreme (25)
	Major	**4**	Medium (11)	Medium (14)	High (18)	High (21)	Extreme (23)
	Moderate	**3**	Low (6)	Medium (10)	Medium (13)	High (17)	High (20)
	Unlikely	**2**	Low (3)	Low (5)	Low (8)	Medium (12)	Medium (16)
	Rare	**1**	Low (1)	Low (2)	Low (4)	Low (7)	Low (9)

Table 11-7: Risk Classification

Risk Classification	Descriptor
Extreme	Immediate further assessment of the task and control measures and treatments required.
High	Additional control measures and treatments are required to be nominated and reviewed for effectiveness for risk reduction.
Medium	Review control measures and monitor for changes.
Low	Maintain existing control measures and monitor for changes.
Unranked	Risk scenario is either not existent or is yet to be realised.

11.6.2 Control Measures

Identification of control measures and subsequent implementation and management of the identified control measures is important in managing the identified risks for each scenario. There are many current operational control measures that are in place for mining operations and many of these control measures will continue into rehabilitation. Additionally, future nominated control measures have been identified and nominated for implementation at different times during rehabilitation for continued risk management and reduction. All control measures are considered using the control identification decision tree described in the *Integrated Mine Closure: Good Practice Guide* (ICMM 2025), as per Figure 11-2. Current operational control measures and nominated future control measures that were utilised for the risk assessment process were tracked.

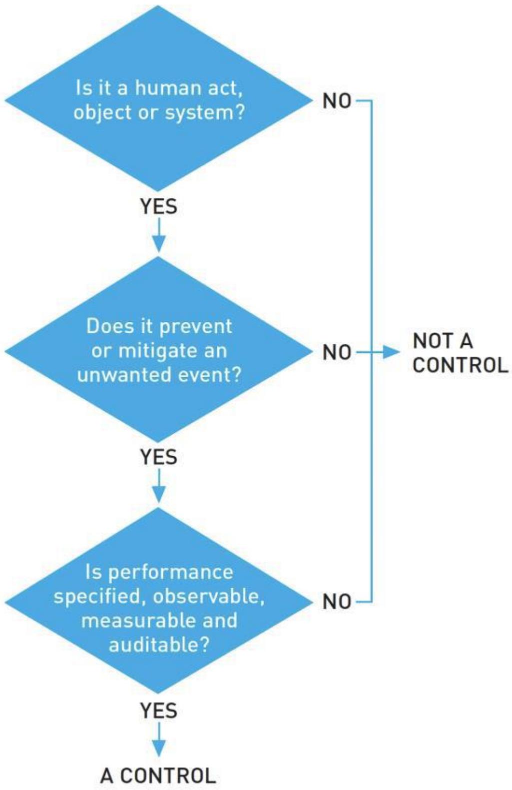


Figure 11-2: Control Identification decision tree (ICMM 2025)

11.7 Summary of Results

The workshops identified a total of 269 risks that were considered across all six phases (including current). Figure 11-3 provides an overall summary of the findings from the risk assessment process. Many of the ranked risks were either rated as low or medium, represented by the green and yellow columns in the plot respectively. Risks that were not present or no longer applicable within a particular phase were assigned as unranked in this risk assessment. There were a total of 1,687 risks ranked throughout the assessment across all six phases. As rehabilitation activities are progressed towards completion, the risk assessment demonstrates that many of the risks transition from medium to low and become negligible (classified as unranked). Other risks may emerge as rehabilitation progresses (e.g. site security risks). The plot also illustrates that no extreme risks were identified in this assessment. High risks assessed across all phases are further described in Table 11-9 .

Table 11-8: Count of risk ratings across all phases

Rating	Current	Phase 1	Phase 2	Phase 3a	Phase 3b	Phase 4
Extreme	0	0	0	0	0	0
High	7	2	4	10	3	2
Medium	114	117	115	102	89	65
Low	96	97	96	124	148	162
Total Ranked	217	216	215	236	240	229
Unranked	52	53	54	33	29	40
Total Risks	269	269	269	269	269	269

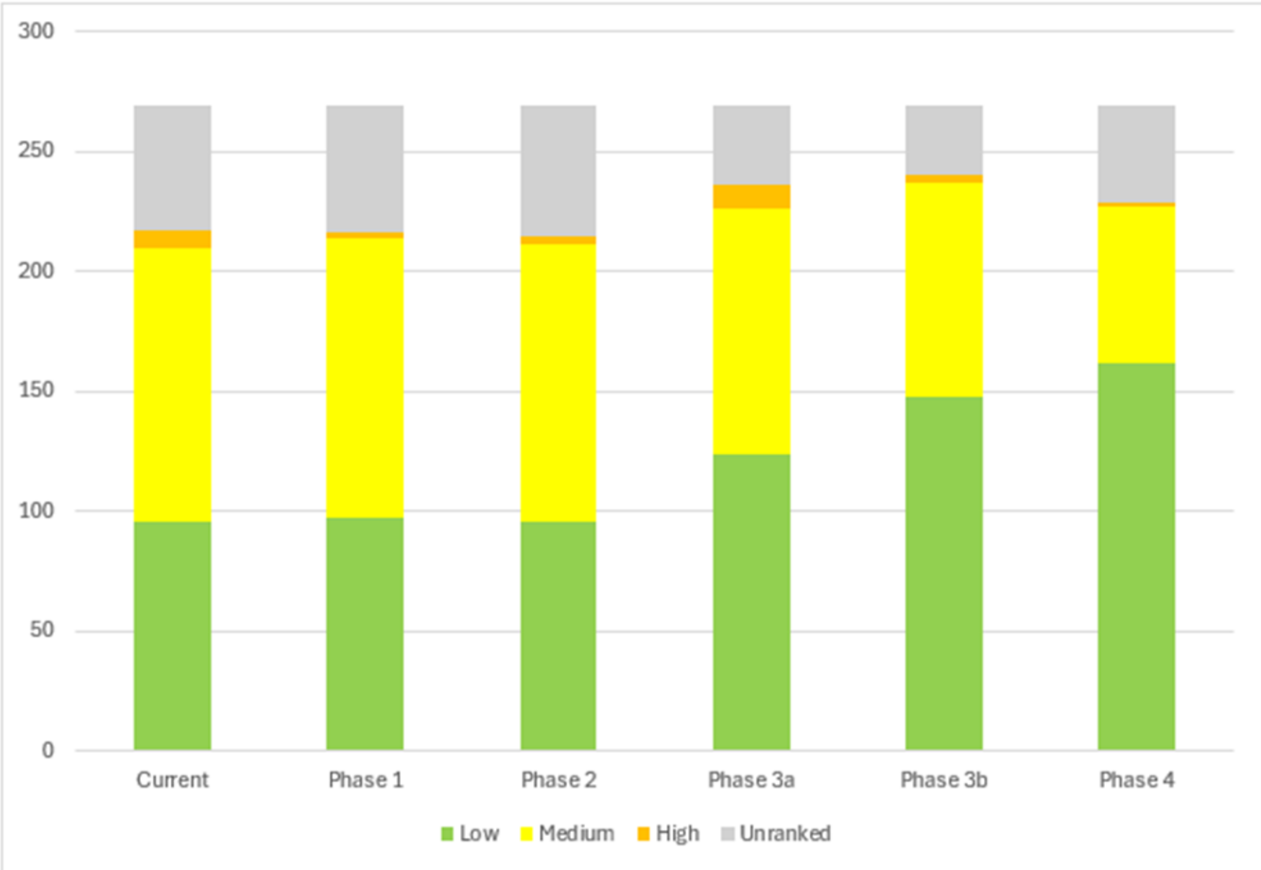


Figure 11-3: Overview of risk ratings across all phases

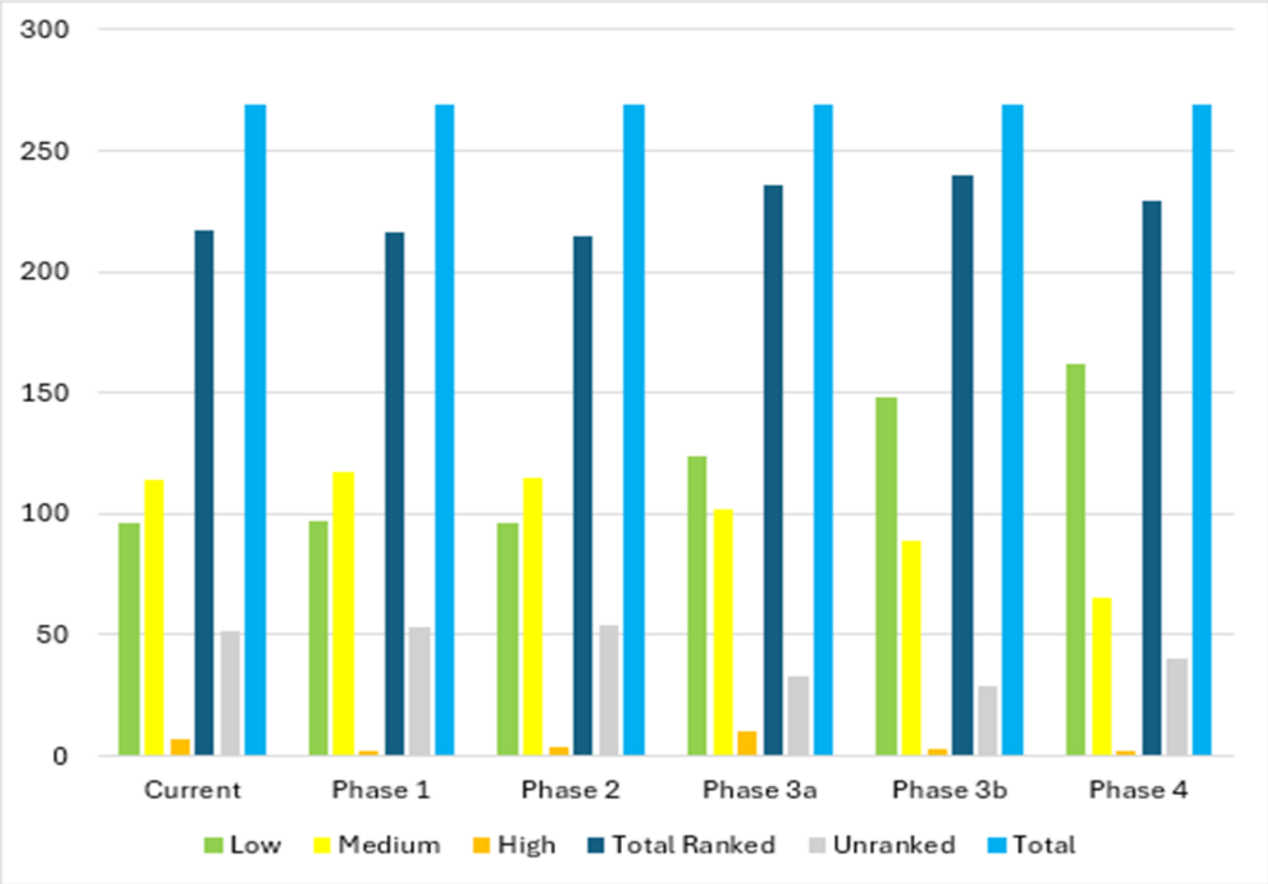


Figure 11-4: Overview of risks assessed across all phases

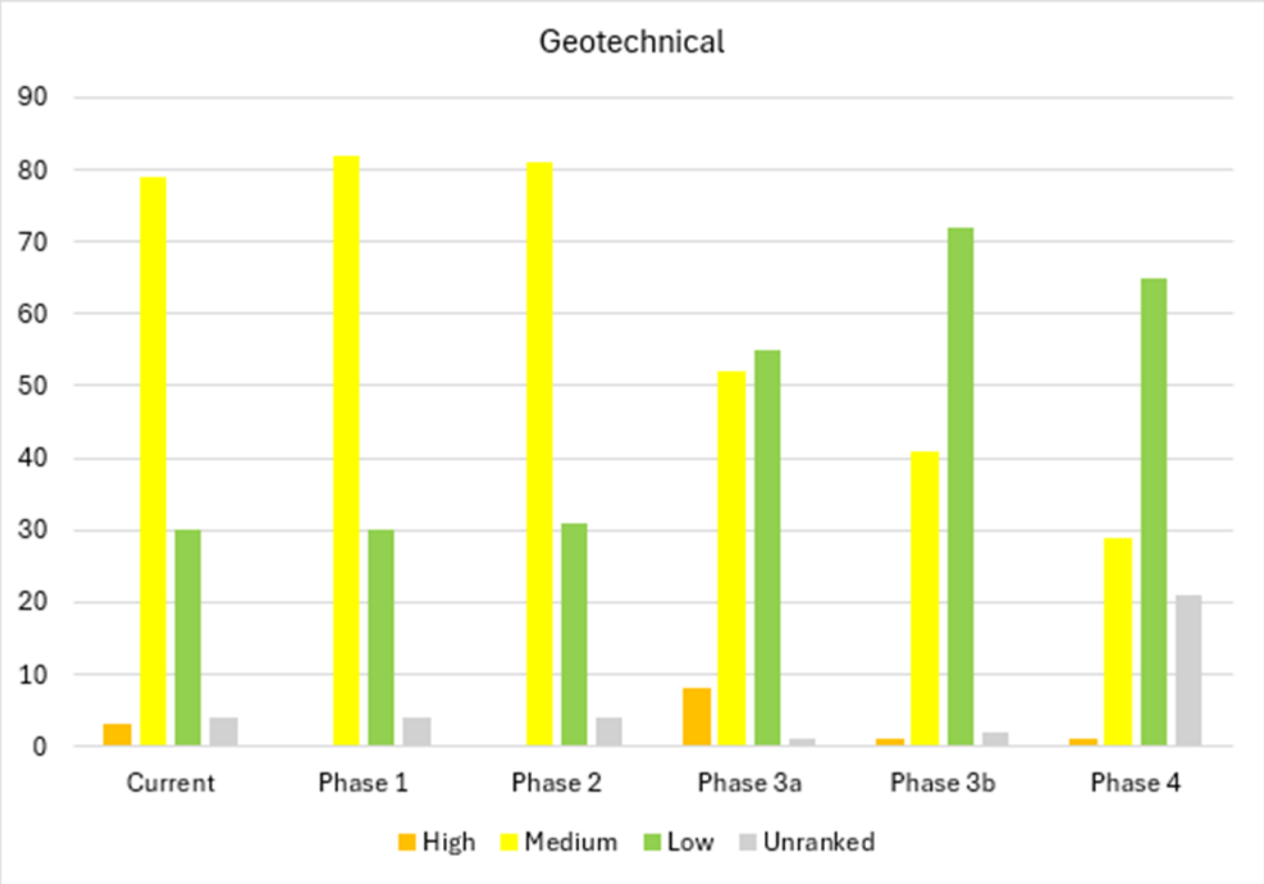


Figure 11-5: Geotechnical risks assessed across all phases

The Geotechnical risk profile changes over time with a number of medium ranked risks in earlier phases becoming low risks in later phases due to the implementation of future nominated controls to reduce potential for ground movement including filling of the pits with water and conducting surface treatment works on the MRD structure.

Phase 3a is the period where the risk profile sees the greatest number of high risks and a reasonably equal number of medium and low risks. This is due to the proposed decommissioning of two of the three pump bores during this phase altering reliability of dewatering and increasing the potential for floor heave. This risk is reduced as the pits fill with water and the potential for floor heave is reduced in Phase 4b to the point where weight balance is achieved and floor heave is not possible, thus the floor heave risk is unranked in the assessment at this point.

Unranked scenarios in earlier phases are related to differential levels in the pit lakes resulting in unbalanced loading. This scenario is not realised until the pits are filling with water with the risk of this event assessed as low from Phase 3a.

A base case scenario for maintaining the MRD with no proposed controls implemented was assessed with the risk profile increasing from medium to high in Phase 3a with this high risk enduring to Phase 4.

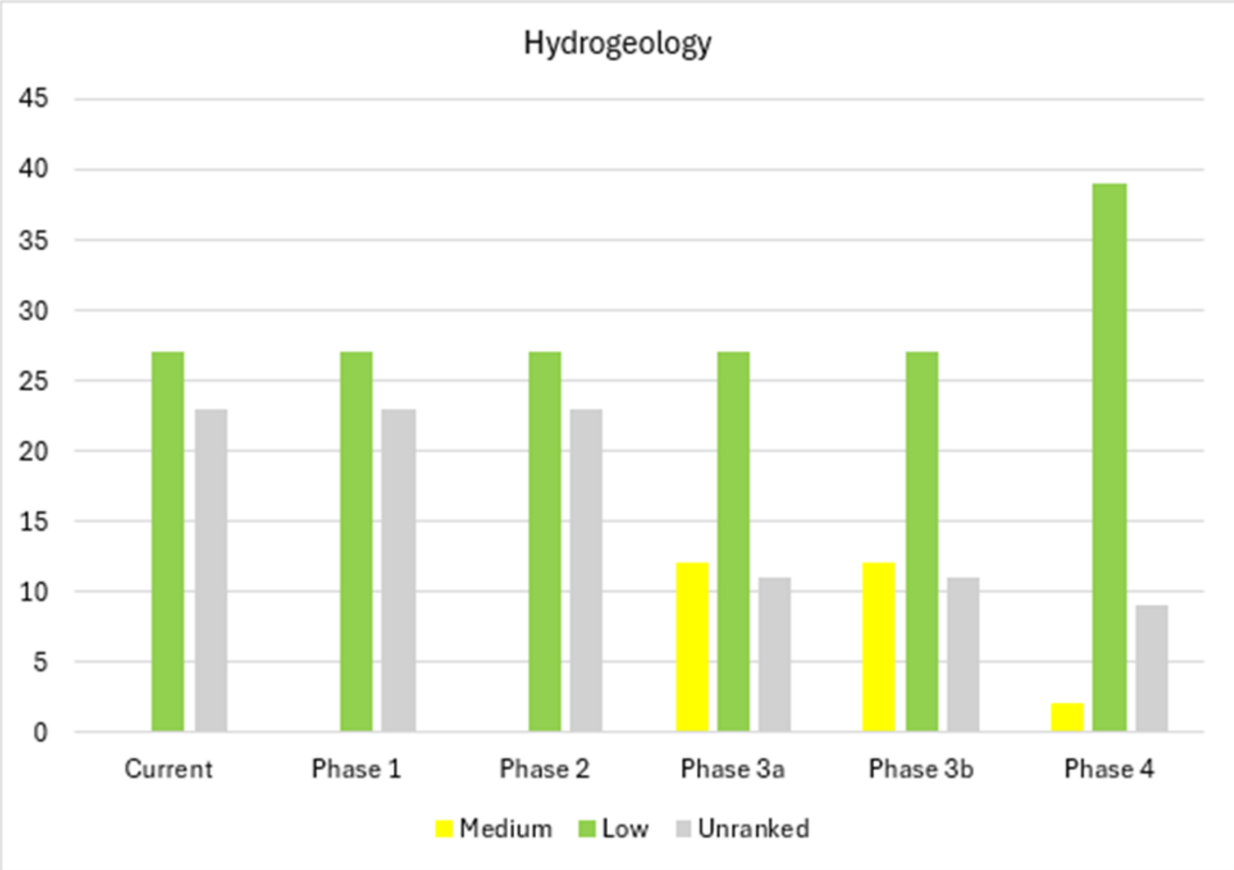


Figure 11-6: Hydrogeology risks assessed across all phases

There are a large number of hydrogeology risks that are unranked in earlier phases which are related to decrease in the groundwater levels. This risk isn't realised until Phase 3a where it becomes a moderate risk which reduces to a low risk once lake filling activities are completed in Phase 4.

There is no realisation of risk related to increase in groundwater levels in shallow aquifer in the context of this assessment thus the risk scenarios for this event remain unranked throughout the assessment.

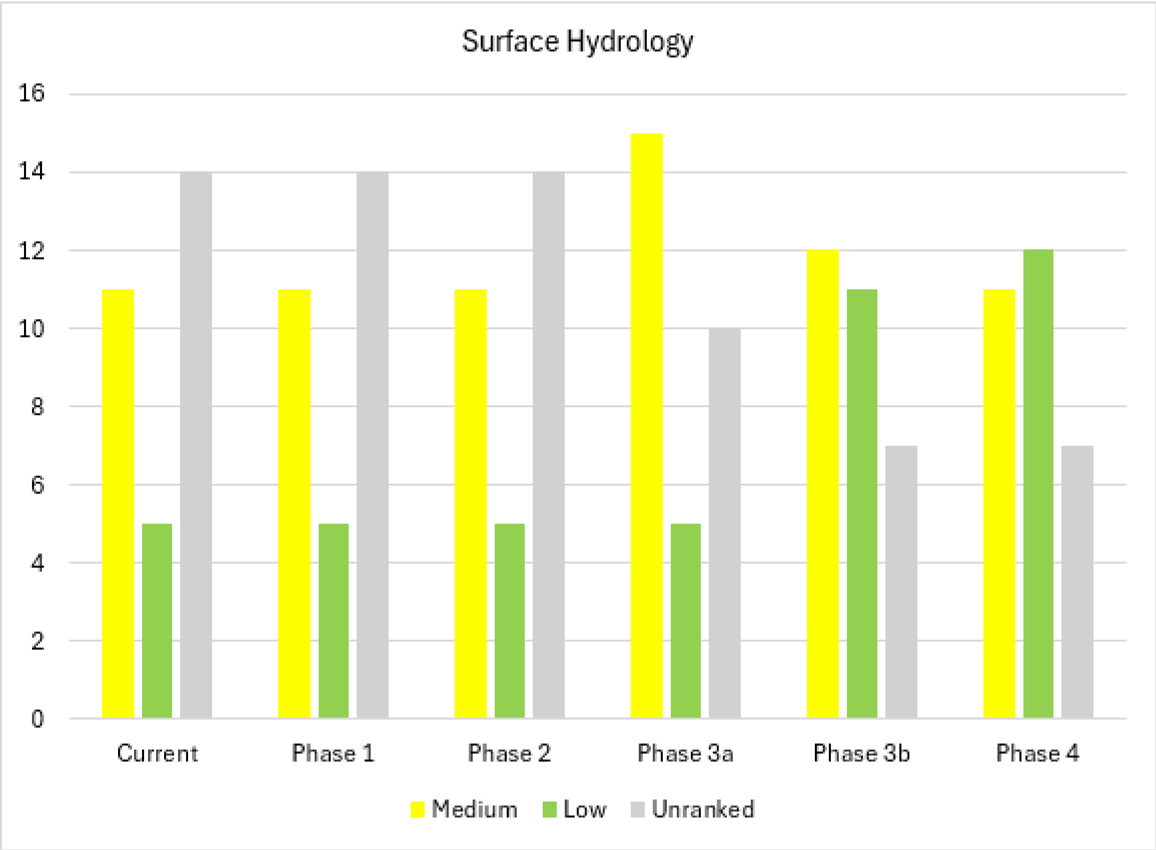


Figure 11-7: Surface hydrology risks assessed across all phases

There are a number of different scenarios that are unranked in earlier phases, these being:

- Failure of inlet / outlet structures. These are not constructed until Phase 3a at which time the risk is ranked as medium before becoming a low risk upon completion of lake filling activities at Phase 3b.
- A number of domains have surface drainage channels for which the risk scenario of loss of containment of water from these channels is assessed. The risk is unranked in a number of domains for the context due to realisation of the risk having no impact in the context of the assessment.
- Wind / wave action is unranked until pit lake levels will see the introduction of this risk at Phase 3b at which time the risk is assessed as low due to implementation of control measures including shoreline protection and land erosion controls.

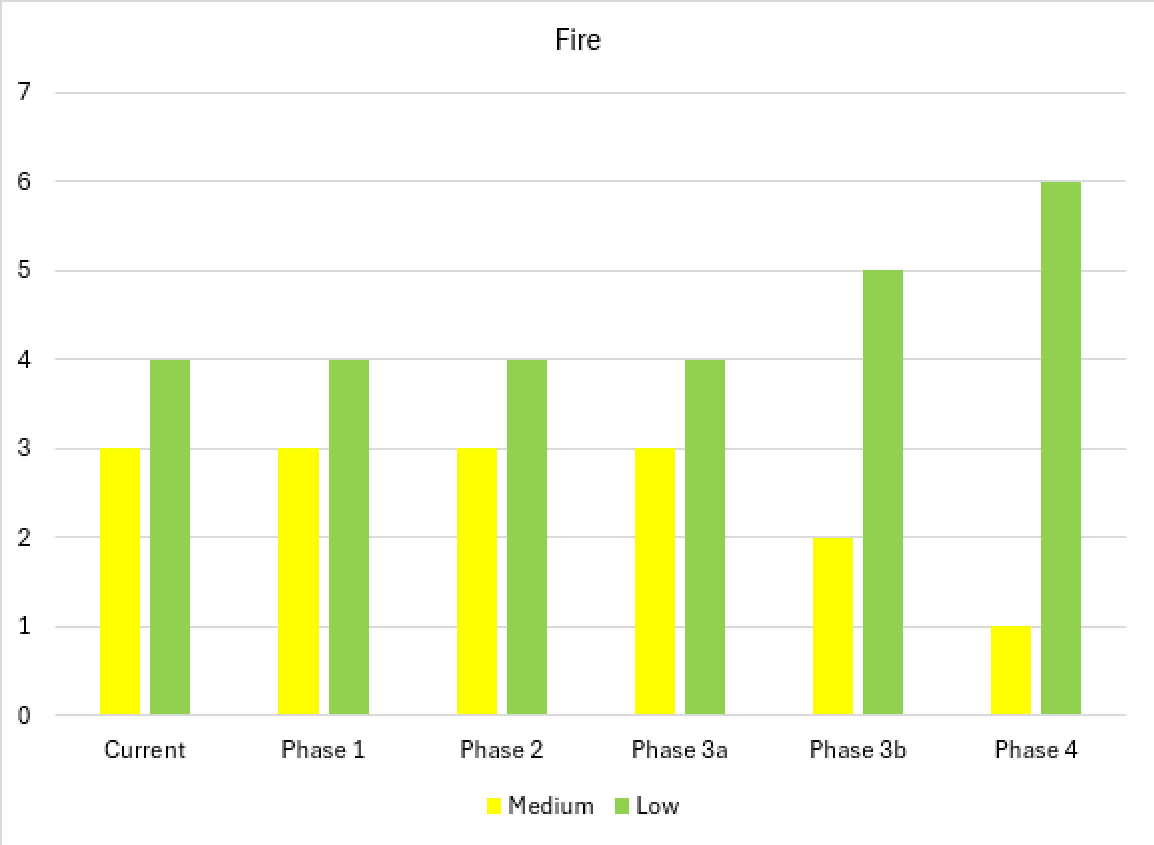


Figure 11-8: Fire risks assessed across all phases

The medium risks that are assessed in the earlier phases become low risks as the pits fill with water and cover any remaining exposed coal. A medium risk endures across all phases for ignition of vegetation in Maryvale Field.

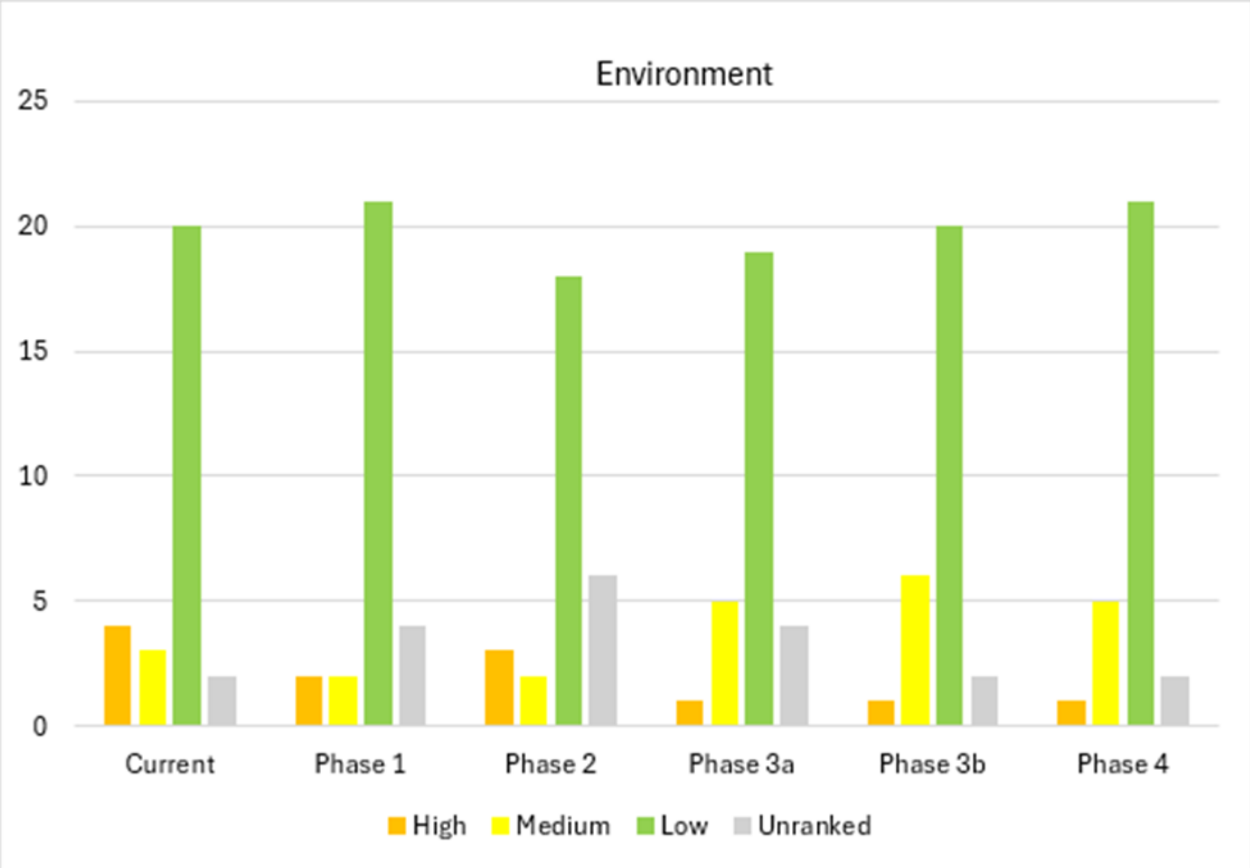


Figure 11-9: Environment risks assessed across all phases

There is one scenario related to reduced / changed water use and associated impacts on downstream environments that retains a high risk ranking throughout the phases with the risk rated as per *Type of conditions that could apply to water access for Latrobe Valley mine rehabilitation and associated risks and benefits* (Alluvium and HARC 2023). It is noted that EA Risk Assessment scopes don't align with Alluvium assessing the river system in its entirety with cumulative impacts and EAs take being about 2-3% of actual passing flows. Whilst Alluvium rate risk to the environment as high, Yallourn's isolated impact could be considered as low. Furthermore – whilst shifting from the existing Bulk Water Entitlement to the Rehab Bulk Water Entitlement gives improved conditions in the Latrobe River, the risk remains high and unchanged.

Other high risks in earlier phases are habitat fragmentation and disruption for both terrestrial and aquatic fauna related to fish passage in the MRD. Work proposed to be conducted to remove sheet pile during operations see this risk unranked from Phase 1 to Phase 3b when spillways are implemented in the MRD with potential to again impact fish passage. Control measures proposed include access track along Spillway with set of dark culverts to dissuade fish from entering and implementation of MRD riparian zone. The risk at Phase 4 remains medium during flooding events and low during baseflows in the river.

Smoke and particulates transport off site is maintained as a high-risk scenario until Phase 3a when sufficient coal is capped or covered to reduce the risk to a medium score which endures up to Phase 4.

Scenarios related to pit lake including fauna habitat fragmentation and impacts to water quality are unranked until Phase 3a when a low risk is realised and potential for poor pit lake water quality impacting the river systems is unranked until Phase 4 when a medium risk is realised.

Operational risks related to generation of noise and vibration are initially ranked low and become unranked in later phases as the use of machinery is phased out.

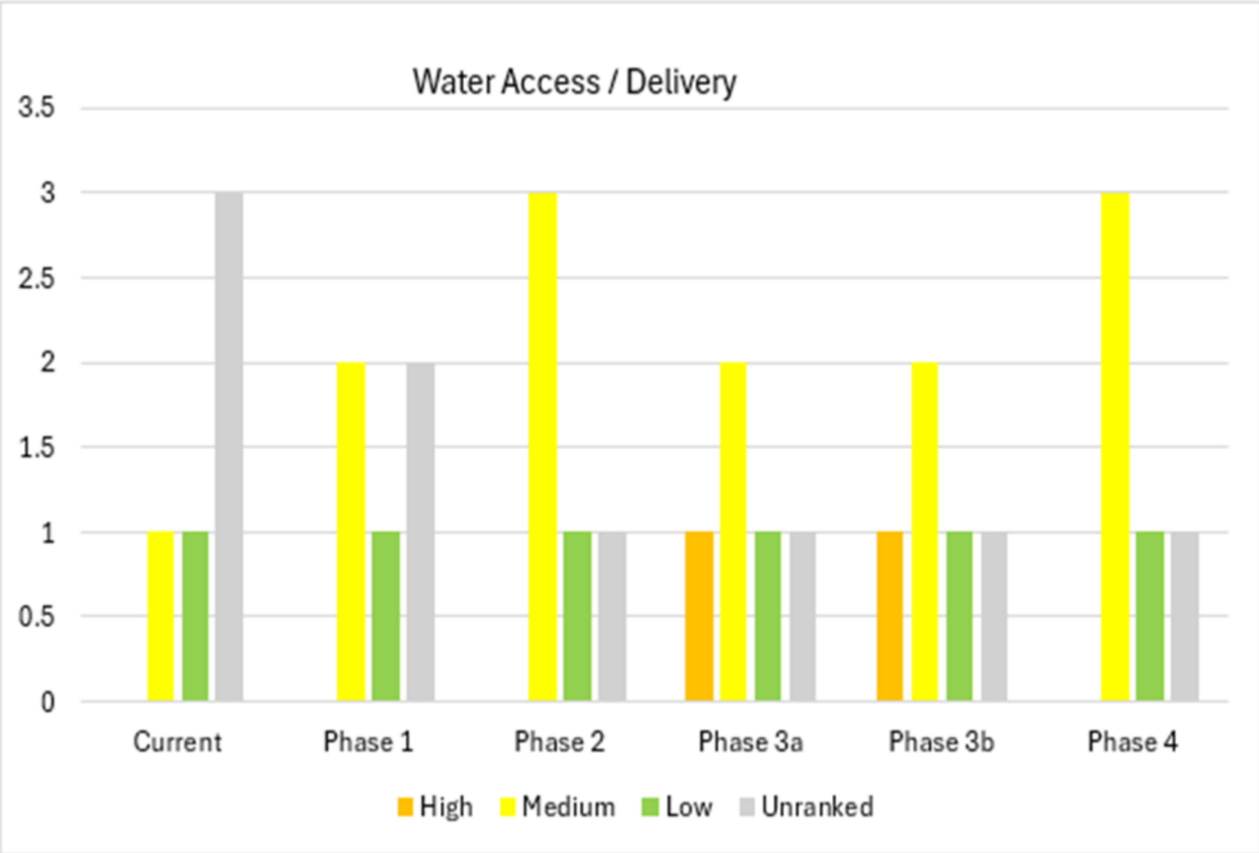


Figure 11-8: Water access / delivery risks assessed across all phases

The risk scenarios all consider impacts to the planned lake fill due to potential restrictions to access water resulting from:

- Lake fill is impacted by unavailability of required water from the local river system resulting in slower fill of lakes.
- Pumping system unable to facilitate pit lake fill.
- Operational bulk water entitlement revoked upon cessation of operation.
- Restricted seasonal use for revised BWE for rehabilitation.
- Drought conditions (5+ years) impact water access during lake fill

The risk ranking fluctuates for each scenario across the phases dependent on the scenario and the impact to the planned lake fill.

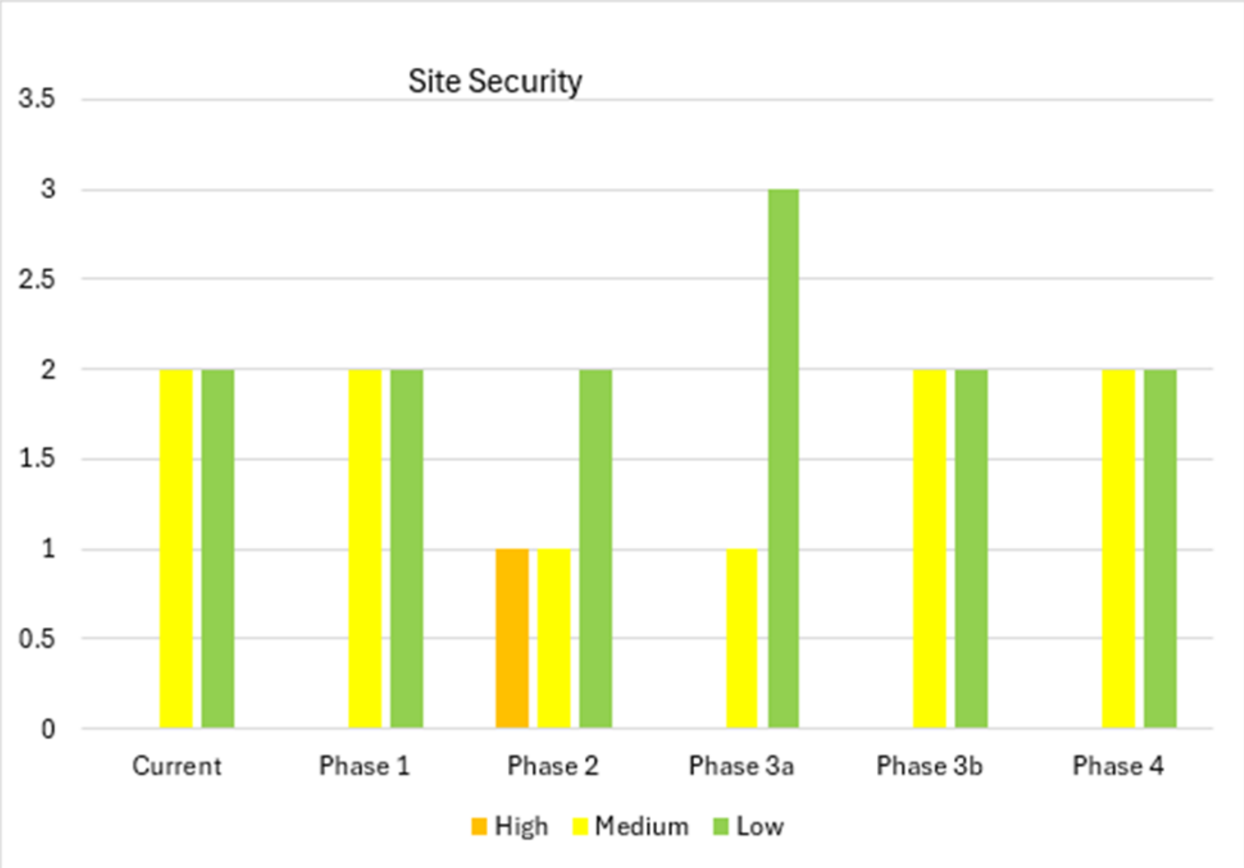


Figure 11-9 Site security risks assessed across all phases

All risk scenarios are ranked as low or medium throughout the assessment apart from the scenario related to unauthorised public access to site prior to relinquishment threatens public which increases to a high risk in Phase 2 when there are less personnel on site and perception is that public interest in the activities will increase.

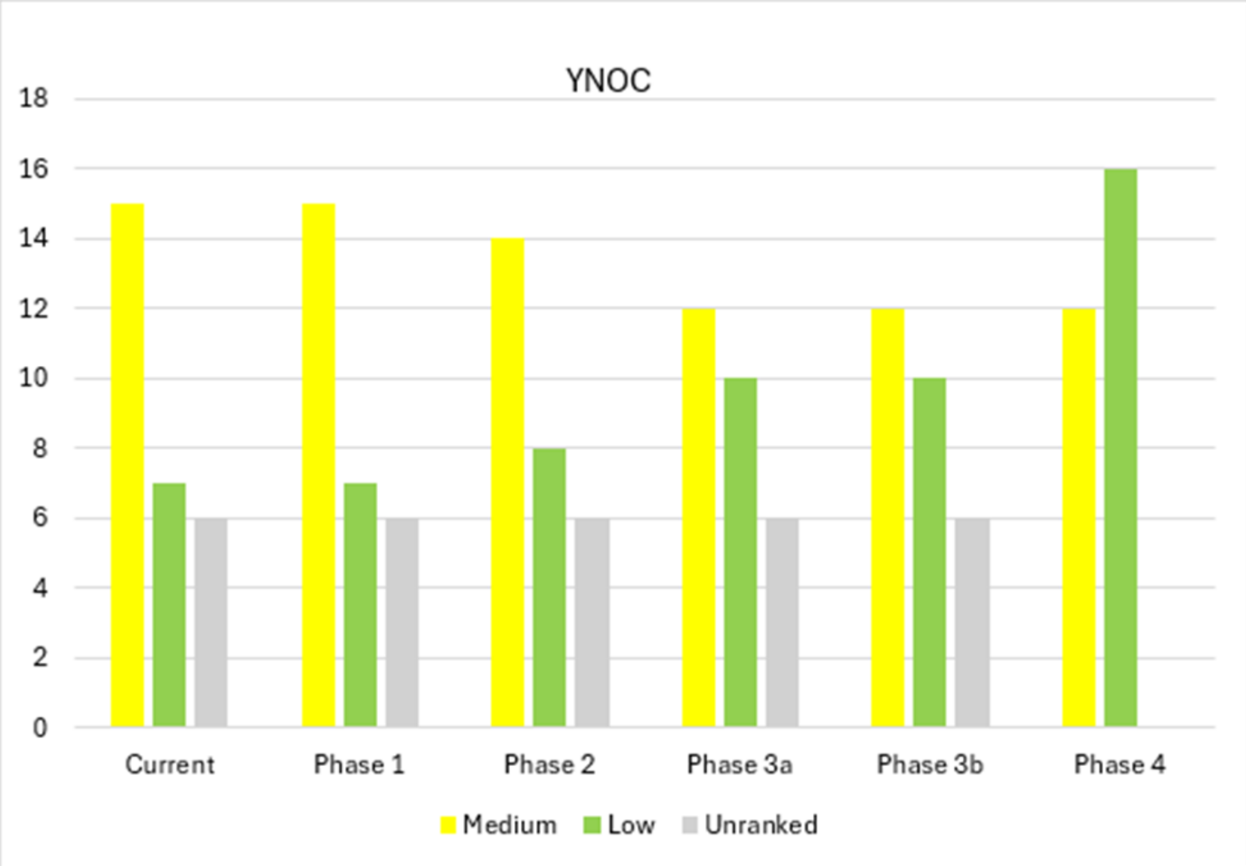


Figure 11-10 YNOC risks assessed across all phases

There are six scenarios that remain unranked in the context of this assessment until Phase 4 when the intention is that the YNOC area will be a public space at which time the risks are ranked as low.

Medium risks endure throughout all phases for risk scenarios related to surface water recharge, elevated groundwater levels and seismic in the following areas:

- Brown Coal Mine Road Batters
- North Western Batters
- Central Ash Landfill
- Western Ash Landfill

11.8 High Risk Events

There were several scenarios that realised high risk ratings across various phases during the assessment process. A majority of these ratings are revised to medium or low ratings as proposed works and control implementation occurs in later phases. A full list of high rated scenarios is summarised in Table 11-9 below:

Table 11-9: Summary of High Risks Identified in DMRP Risk Assessment

Relevant Domain and Risk Scenario	Description of High-Risk Scenario and Control Strategy
Surface water recharge at the following domains: • Eastfield Latrobe River Batters • Eastfield Northern Batters (East) • Eastfield Northern Batters (West)	These domains are adjacent to the Latrobe River. The current risk is rated as being High (19) (Critical consequence and Unlikely occurrence). Implementation of engineering controls (e.g. more buttressing) is nominated to be implemented during Phase 1 which reduces the risk rating to Medium (15) (Critical and Rare). This rating is maintained until Phase 3b when the risk rating is revised to Medium (11) (Major and Rare) and then again in Phase 4 when the risk is revised to Low (3) (Minor and Rare).
Floor Heave at the following locations: • Township Field Fire Service Pond Batters • Maryvale Field Western Batters • Maryvale Field Southern Batters • Eastfield Extension Latrobe Road Eastern Batters (South) • Eastfield Latrobe River Batters • Eastfield Northern Batters (East) • Eastfield Northern Batters (West)	Risk rating increases from Medium (15) (Critical and Rare) in Phase 2 to High (19) (Critical and Unlikely) in Phase 3a due to decommissioning of pump bores (N5056 and N6899). Risk rating is revised to Low (1) (Insignificant and Rare) in Phase 3b as weight balance is achieved through lake fill.

Relevant Domain and Risk Scenario	Description of High-Risk Scenario and Control Strategy
Maintain MRD with no long-term remediation, diversion or structural modifications	This scenario demonstrates that the risk of MRD failure will increase over time if no works are conducted on the structure to maintain stability. The risk rating at Phase 2 is Medium (14) (Major and Unlikely) with the rating increasing to High (22) (Critical and Possible) at Phase 3a due to the following: Lake fill commencing. Recovery from a MRD failure in this phase would be very difficult. Structure has aged, and the progressive nature of the deterioration means that the past 17 years is not necessarily reflective of the next 16 years. Thus, the likelihood of an incident may increase. Assuming that staffing levels will be further reduced (including engineers and operators). Progressive loss of knowledge and subject matter expertise. This High (22) risk rating is maintained at Phase 3b for the same reasons listed above with the risk reducing slightly to High (21) (Major and Unlikely) at Phase 4 due to lake filling activities being completed and reaching equilibrium. The intent of this risk scenario is to show the benefit in conducting proposed works on the MRD structure. The proposed works avoid realisation of this risk scenario and further detail about the history of the MRD including potential failure mechanisms and proposed remediations is documented in Chapter 8 Technical Studies (8.26 Morwell River Diversion Geotechnical Analysis) and Chapter 12 Key Activities and Design Considerations (12.3 Morwell River Diversion).
Smoke & particulates transport off-site PM 2.5	A High (19) (Critical and Unlikely) was assessed as being relevant as a current risk rating due to the amount of exposed coal in operational areas and the proximity of the operational Mine to local residences. This risk rating is maintained throughout Phases 1 and 2 with the risk rating reducing to Medium (15) (Critical and Rare) in Phase 3a as coal is covered and lakes commence to fill with this rating maintained for Phases 3b and 4.
Habitat fragmentation and disruption for both terrestrial and aquatic fauna - (baseflows)	A risk rating of High (20) (Moderate and Almost Certain) is realised in Phase 1 due to known impediments to fish passage in the Morwell River including sheet piling which was installed by SECV and current pumping and diversion infrastructure installed upstream of the MRD.

Relevant Domain and Risk Scenario	Description of High-Risk Scenario and Control Strategy
	Plans to construct fish passage sees this risk unranked for Phases 1, 2 and 3a with planned continuation of upstream pumping and diversion infrastructure including Cofferdam until Phase 3b when removal of the Cofferdam is considered, and risk rating reduces to Medium (10) (Moderate and Unlikely). Implementation of riparian zones in Phase 3b sees the risk rating reduced to Low (3) (Minor and Rare) at Phase 4.
Habitat fragmentation and disruption for both terrestrial and aquatic fauna - (during flooding events)	A risk rating of High (20) (Moderate and Almost Certain) is realised in Phase 1 due to known impediments to fish passage in the Morwell River including sheet piling which was installed by SECV and current pumping and diversion infrastructure installed upstream of the MRD. Plans to construct fish passage sees this risk unranked for Phases 1, 2 and 3a with planned continuation of upstream pumping and diversion infrastructure including Cofferdam until Phase 3b when removal of the Cofferdam is considered and risk rating reduces to Medium(10) (Moderate and Unlikely) with this risk rating maintained in Phase 4 due to proposed implementation of spillways and river connection to pit-lake under certain flood flow conditions.
Contamination of pit-lake water	The risk rating increases from Low (7) (Insignificant and Likely) in Phases Current and Phase 1 to High (17) (Moderate and Likely) in Phase 2 as a result of degradation of water quality due to: Variations in bulk water supply could result in changes to pit lake salinity & acidity Decommissioned equipment could result in contaminant spills such as hydrocarbon spills Any interruption in water input (e.g. discontinuity of bulk water entitlements [current to future] resulting in period with no entitlement access) to the lakes. Controls nominated for implementation during Phase 3a include: Secure proceeding bulk water entitlement

Relevant Domain and Risk Scenario	Description of High-Risk Scenario and Control Strategy
	Adopt lime dosing or some equivalent treatment train to meet water quality requirements and/or guidelines (e.g. above pH 6) The risk rating is reduced to Medium (12) (Minor and Likely) in Phase 3a as a result. The risk rating reduces further to Low (6) (Moderate and Rare) in Phase 3b due to implementation of further nominated controls: Identify suitable (if any) preventative and mitigation controls to manage inflows from Latrobe River to manage pit lake water quality Appropriate land use in watershed of pit lake to prevent/reduce fertiliser reaching pit lake The risk rating increases to Medium (15) (Critical and Rare) at Phase 4 due to proposed public access to the pit-lake and potential for contamination resulting from activities in and around the lake.
Reduced / changed water use and associated impacts on downstream environments	Risk rating is based on *Type of conditions that could apply to water access for Latrobe Valley mine rehabilitation and associated risks and benefits* (Alluvium and HARC 2023). EA Risk Assessment scopes don't align with Alluvium assessing the river system in its entirety with cumulative impacts and EAs take being about 2-3% of actual passing flows. So, whilst Alluvium rate risk to the environment as high, Yallourn's isolated impact could be considered as low. Furthermore, whilst shifting from the existing Bulk Water Entitlement to the Rehab Bulk Water Entitlement gives improved conditions in the Latrobe River, the risk remains High (21) (Major and Likely) and unchanged.
Rights and permissions less than adequate allowing for spillways into the pit	This scenario considers unavailability of water resulting from inability to install spillways in nominated locations. This scenario is ranked at Phase 2 only as this is the timing determined for which implementation of the plan will be required to commence following approval of the plan. The risk is rated High (22) (Critical and Possible).

Relevant Domain and Risk Scenario	Description of High-Risk Scenario and Control Strategy
Lake fill is impacted by unavailability of required water from the local river system resulting in slower fill of lakes.	This risk is unranked as a Current Risk and is rated Medium (15) (Critical and Rare) for Phases 1 and 2 when the application for water is anticipated to progress. The risk rating increases to High (19) (Critical and Unlikely) in Phases 3a and 3b based on the impact to pit stability and requirement to maintain operational controls in the event that unavailability of water leads to slower filling of the pit. The risk is rated as Medium (15) (Critical and Rare) at Phase 4 as this is the point in time when pit filling is achieved to realise a safe, stable, sustainable and non-polluting site.
Unauthorised public access to site prior to relinquishment threatens public	A High (19) (Critical and Unlikely) risk rating is realised in Phase 2 when it is anticipated that staff numbers and hours of work decrease and public interest in the activities on site increases with higher potential for unauthorised site entry. The risk rating for Current and Phase 1 in Medium (15) (Critical and Rare) and this rating has again been adopted in Phases 3a, 3b and 4.

11.9 Risk Assessment Actions

The extensive risk assessments completed highlighted many actions which are shown below. The actions are tracked through operational risk management programs with completed actions forming part of future DMRP updates and site management plans.

Table 11-10: Actions from Risk Assessment

#	Risk Factor	Risk Event	Domain	Action Required
Phase 1 - Pre-closure (Operations) (Notionally 2024 – 2028)				
1	Geotechnical	Surface water recharge	Global	Existing technical studies to support conceptual design.
2		Elevated Groundwater levels		Comparative trial of drainage concepts.
3				Conduct continued monitoring of groundwater levels and performance
4		Overtopping (global for all domains where there is a river)		Review the sitewide flood levy design criteria
5				Develop flood levy monitoring and maintenance regime suitable for rehabilitation phase (as part of GCMP review).
6				Determine the timing and costing of phased spillway construction for each domain.
7		Seismic Event		Develop seismic models based on outcomes of geotechnical investigations.
8				Investigate Seiche (Seismic induced landslide creating waves).
9		Floor Heave		Develop a weight balance management plan and determine the increase in Factor of Safety (e.g. pumps, internal buttress construction, lake fill, regional aquifer impacts).
10				Assess the cost and benefits of faster lake fill.
11		Seismic Event	Yallourn Eastfield Extension - Latrobe Road Batters (North) (YEFX-LRB (North))	Consider earlier implementation of North east sump decommissioning and back filled allowing more stabilisation and reducing block movement.
12		Surface water recharge		Surface drainage design to provide for low care long term rehabilitation.

#	Risk Factor	Risk Event	Domain	Action Required
13			Yallourn Eastfield Extension - Latrobe Road Eastern Batters (South) (YEFX-LREB (South))	Engage with HVP regarding communication about surface water runoff.
14				Engage with VicRoads regarding communication about surface water run off via side and under road drains.
15			Yallourn Township Field - Southwest Batters (YTF-SWB)	Specify to Telstra the requirements for installation of their infrastructure Specify to Telstra the requirements for installation of their infrastructure.
16				Conduct additional geotechnical investigations to better define geotechnical and ground water models.
17			River Adjacent Domains	Verify the appropriateness of the levy height for all domains where there is adjacent river.
18			Morwell River Diversion (MRD) Repair Domain CH2100 - CH3000	Consider lowering and reshaping embankments to lower rural levels (to blend into the South fill domain)
19		Tunnel instability		Install additional monitoring equipment along the tunnel to survey the differential separation of the tunnel segments.
20	Surface Hydrology	Loss of containment of water from surface drainage channels	Maryvale Field - Southern Batters MVF-SB Maryvale Field - Eastern Batters MVF-EB Yallourn Eastfield Extension - Southern Batters YEFX-SB	Implement surface water drainage measures from rehabilitation study.

#	Risk Factor	Risk Event	Domain	Action Required
			Yallourn Eastfield Extension - Latrobe Road Eastern Batters (South) YEFX-LREB (South)	
21		Loss of containment of water from surface drainage channels Loss of containment of water from Morwell River channel	Yallourn Township Field - Floc Pond Batters YTF-FPB Yallourn Township Field - Fire Service Pond Batters YTF-FSPB Maryvale Field - Western Batters MVF-WB	Conduct investigation to determine requirements for revegetation of the flood plain.
22	Hydrogeology	Increase in groundwater levels in M1A Aquifer	Global	Application in accordance with the standard required to secure the M1A extraction aquifer renewal.
23				Confirm pumping requirements for rehabilitation.
24				Confirm adequacy of the regional monitoring bores based on the groundwater modelling to assess the reliability of the modelling undertaken.
25				Reassess Yallourn monitoring network as part of groundwater modelling reliability review.
26				Decommissioning of pumping bores as per license conditions to ensure bores are adequately sealed as per minimum bore construction requirements.
27		Increase in groundwater levels in shallow aquifer		Reconfiguring existing drainage systems.

#	Risk Factor	Risk Event	Domain	Action Required
28				Review the potential impact to groundwater dependent ecosystems.
29				Monitoring the alternative capping trials.
30	Fire	Various	N/A	Planning reconfiguration of fire services infrastructure for lake fill period and determine the fire management requirements for beyond phase 4 based on coal property studies.
31				Investigate the existence of a standard for Victorian rural landform e.g. Council land classification (global)
32		Ignition of fuels (diesel, oils, chemicals, non-coal) (e.g. 2 x 40,000 litres diesel, oil store)		Review the storage requirements for bulk fuel and oil storage.
33	Environmental	Smoke & particulates and transport off-site (PM2.5), etc.) - particulates Generation of unacceptable odour	N/A	Identify future controls required for odour management (both prevention & mitigation).
34		Gaseous emissions generating air pollution (includes operation of machinery, carbon dioxide, diesel, fugitive emissions), engine exhausts/pollutants, methane (exposed coal, plant), release of SF6 gas from switchgear during decommissioning)		Develop decommissioning plan for plant, to include controls for environmental releases (fuel; gases; liquids) and associated monitoring.
35		Unacceptable vibration		Develop decommissioning plan (explicitly involves community engagement) for plant and associated monitoring. Ensure interface agreements are followed (e.g. V-line awareness of demolition days).
36		Poor pit-lake water quality pollutes groundwater and creates offsite groundwater plume		Investigate whether concentration of specific contaminants of concern in background water quality in receiving aquifers exceed values adopted in industry guidelines. Note that: (1) guideline value depends on salinity of aquifer.

#	Risk Factor	Risk Event	Domain	Action Required
				(2) no specific guideline referenced in discussion. Guideline to be dependent on nominated beneficial uses at the time.
37		Unsuitable earthen materials left in pit (in-pit dumps and surcharges)		Monitoring soils and overburden geochemistry.
38		Pathogen risk (e.g., algae, E. coli) from water quality in pit lake via primary or secondary recreational contact		Design pathogen monitoring process for post operation, specifically for stagnant water conditions and weather conditions.
39		Chemical risk (e.g., salt, pH, heavy metals, herbicides) from water quality in pit lake		Discharge is in accordance with license conditions.
40		Physical risk (e.g., turbidity, nutrient) from water quality in pit lake		Optimise design to minimise wave action and surface water erosion during filling.
41		Flood water from spillways impacting water quality in the pit lake		Complete detailed design of spillways.
42		Flood event resulting in fish capture in existing pits or future pit lakes (Ref Alluvium Assessment)		Determine if fish passage is required based on the fish passage study and ongoing aquatic monitoring.
43	Water Access - Delivery	Rights and permissions less than adequate for allowing surface water into the pit Rights and permissions less than adequate allowing for spillways into the pit	N/A	Consult governing bodies, rail and road organisations and community during development of water source plan
44		Pumping system unable to facilitate pit lake fill		Review asset management transition from power station operations to mine rehabilitation team
45				Investigate pumping system reliability and redundancy
46		Operational bulk water entitlement revoked upon cessation of operation Restricted seasonal use for revised BWE for rehabilitation Drought conditions (5+ years) impact water access during lake fill		Determine design scope for fire service system (including alternative water sources to ensure continuous water supply as required)

#	Risk Factor	Risk Event	Domain	Action Required
47	Site Security	Unauthorised public access to site prior to relinquishment threatens public	N/A	Investigate long-term site security requirements (for all phases of rehabilitation).
48		Unauthorised public access to site prior to relinquishment threatens business interests		Consider incorporation of security aspects in community engagement plan.
49		Unauthorised water extraction from lake		Monitor council developments that may impact site accessibility (e.g. paths, establishment of picnic areas etc.).
50				Assess which parts of mining lease may be designated for public access & use, and which may not.
51		Data and information threat		Investigate benchmark for verification & validation of recorded data versus actual field device performance (e.g. automated samplers for water quality versus field measurements) for devices that may be introduced in later phases.
52				Establish progressive reporting and data transfer to external agencies (e.g. provides additional back-ups to secure record management required for successful relinquishment).
Phase 2 Closure and Decommissioning (Notionally 2029 – 2030)				
53	Geotechnical	Various	Global	Decommissioning of Ash Lines.
54				Removal / relocation of Overhead Powerlines.
55				Surface drainage implementation as per design.
56				Following the assessment and approval of lake fill cost and benefit, implement the fill plan.
57				Implement construction of shoreline protection.
58				Implement the findings from the geotechnical investigations and Seiche.
59				Implementation of weight balance management plan.
60				Develop a Construction Management Plan to cover the risks associated with surface water recharge.

#	Risk Factor	Risk Event	Domain	Action Required
61				Develop a Construction Management Plan (CMP) to cover the risks associated with elevated groundwater levels.
62				Consider the results of regional hydraulic modelling and review the GCMP including all related controls.
63		Tunnel Instability	Morwell River Diversion (MRD) Repair Domain CH2100 - CH3000	Develop monitoring program for tunnel, linking back to existing GCC05.
64		Elevated Groundwater levels	Morwell River Diversion (MRD) Fill Domain CH650 - CH2100	Assess whether additional subsurface drainage is required to combat elevated groundwater due to extension of Western batter buttress.
65	Surface Hydrology	Loss of containment of water from surface drainage channels Loss of containment of water from Morwell River channel	Yallourn Township Field - Floc Pond Batters YTF-FPB Yallourn Township Field - Fire Service Pond Batters YTF-FSPB Maryvale Field - Western Batters MVF-WB	Implement findings of the revegetation of the flood plain.
66		Wind wave action	Global	Implement the results of the wave study from UNSW WRL.
67		Loss of containment of water from surface drainage channels/ River erosion/River meandering/ Meander development		Lake Narracan and Yallourn weir will influence the geomorphic processes (Erosion, sedimentation) in the Latrobe River. Changes to these structures will influence the processes.

#	Risk Factor	Risk Event	Domain	Action Required
				Assess the risk if Lake Narracan and / or Yallourn Weir are removed.
68	Hydrogeology	Increase in groundwater levels in M1A Aquifer		As per plan, two of three pump bores (N5056 and N6899) will be decommissioned during this phase.
69				Confirm adequacy of the regional monitoring bores in light of rehabilitation of Hazelwood based on the groundwater modelling to assess the reliability of the modelling undertaken.
70				Reassess Yallourn monitoring network as part of groundwater modelling reliability review.
71		Increase in groundwater levels in shallow aquifer		Implement the preferred capping options (timing of this is domain specific)
72	Fire	Various	N/A	Implement the results of reconfiguration of fire services infrastructure for lake fill period
73	Environmental	Gaseous emissions generating air pollution (includes operation of machinery, carbon dioxide, diesel, fugitive emissions), engine exhausts/pollutants, methane (exposed coal, plant), release of SF6 gas from switchgear during decommissioning)	N/A	Implement decommissioning plan to control environmental releases.
74		Unacceptable vibration		Implement controls from demolition plan.
75		Contamination of pit-lake water		Secure proceeding bulk water entitlement.
76				Adopt lime dosing or some equivalent treatment train to meet water quality requirements and/or guidelines (e.g. above pH 6).
77		Poor pit-lake water quality pollutes groundwater and creates offsite groundwater plume		Investigate suitability of monitoring locations as proxies for groundwater management.
78				Nominate groundwater quality testing based on aquifer conditions to inform pit lake water quality minimum standards.

#	Risk Factor	Risk Event	Domain	Action Required
79				Continuous monitoring of pit lake water quality and implications for groundwater system (given low risk of transport to underlying aquifer).
80		Unsuitable earthen materials left in pit (in-pit dumps and surcharges)		Monitoring as water is added into the pit.
81		Pathogen risk (e.g., algae, E. coli) from water quality in pit lake via primary or secondary recreational contact		Implement pathogen monitoring process designed in Phase 1.
82		Flood water from spillways impacting water quality in the pit lake		Implementation of detailed design of spillways and actions from water quality studies
83	Water Access - Delivery	Operational bulk water entitlement revoked upon cessation of operation Restricted seasonal use for revised BWE for rehabilitation Drought conditions (5+ years) impact water access during lake fill		Assuming the commencement of the rehabilitation bulk water entitlement occurs in 2030, implement fire service system design to accommodate reconfiguration for revised BWE.
84		Drought conditions (5+ years) impact water access during lake fill		Determine preventative controls to protect MRD through prolonged drought.
85	Site Security	Unauthorised public access to site prior to relinquishment threatens public Unauthorised public access to site prior to relinquishment threatens business interests Unauthorised water extraction from lake	N/A	Review controls identified for both security and community consultation in Phase 1 action and update controls if required.
Phase 3a Rehabilitation & Active Management (Notionally 2031 – 2039)				
86	Geotechnical	Various	Global	Review and update GCMP including review of monitoring requirements.
87		Floor Heave		Consider pump and/or bore redundancy options as part of weight balance management plan.

#	Risk Factor	Risk Event	Domain	Action Required
88		Various		Create a site-specific traffic management plan that changes to accommodate domain specific changes
89				Develop an implementation framework (includes overall staffing/skills complement, project management, construction management, QA/QC, resource prioritisation) for all rehabilitation activities (global).
90		Surface water management		Determine optimum timing to introduce spillways (e.g., number, location, height, length, width).
91		Various		Complete regional hydraulic modelling and mine lake water balance.
92		Elevated Groundwater levels	Morwell River Diversion (MRD) Fill Domain CH650 - CH2100	Based on the outcomes of the assessment in phase 2, install and extend subsurface drainage as required.
93	Hydrogeology	Increase in groundwater levels in shallow aquifer	Global	Review groundwater dependent ecosystems for changes with lake fill against the predictions forecasted in phase 1 (global)
94		Decrease in the groundwater levels		Water balance and groundwater modelling will estimate potential changes to groundwater quality (July 2024). Review modelling updates and validate the model; compare with pit lake water monitoring data to determine the quality of the monitoring results.
95	Fire	Various	N/A	Continue reconfiguration of fire services infrastructure for lake fill period.
96				Assess the options for maintaining a standard for access along the perimeter road.
97				Review Fire Management Plan for response with the lake fill bodies.
98				Assess the risk and controls for transferring building to future uses.

#	Risk Factor	Risk Event	Domain	Action Required
99	Environmental	Presence of Vermin and Pest animals degrading habitats	N/A	Consider controls for vermin or pests (such as carp; for which - electrofishing & fish screens).
100		Habitat fragmentation and disruption for both terrestrial and aquatic fauna - (baseflows) Habitat fragmentation and disruption for both terrestrial and aquatic fauna - (during flooding events)		Consider removal of Coffer Dam (at Phase 3b).
101		Contamination of pit-lake water		Identify suitable (if any) preventative and mitigation controls to manage inflows from Latrobe River to manage pit lake water quality.
102		Physical risk (e.g., turbidity, nutrient) from water quality in pit lake		Implement findings from the wave action and erosion studies for the final shoreline.
103	Site Security	Unauthorised public access to site prior to relinquishment threatens public	N/A	Implement site accessibility actions related to council developments (e.g. paths, establishment of picnic areas etc.).
104		Unauthorised public access to site prior to relinquishment threatens business interests Unauthorised water extraction from lake		Implement results of assessment regarding which parts of mining lease may be designated for public access & use, and which may not.
105		Data and information threat		Investigate additional methods for data and records security (e.g. backup, assurance).
Phase 3b Monitoring and Measurement (Notionally 2040 – 2049)				
106	Geotechnical	Various	Global	Develop and implement post closure plan.
107				Implement relinquishment maintenance and monitoring plan.
108				Review and update GCMP (and specify the measuring and monitoring requirements for phase 3).
109				Define an overtopping risk scenario for all domains that have river.

#	Risk Factor	Risk Event	Domain	Action Required
110				Track Loy Yang's phase changes over time and their decommissioning of the pipeline supplying their cooling water.
111	Surface Hydrology	Failure of Inlet/outlet structures	Global	Implementation of spillway at the end of 3b i.e. 2049 when lake is full and therefore hydraulic equilibrium has been reached.
112				Consider spillway to be designed bidirectional (i.e. to accommodate flow from river to lake and vice versa).
113	Hydrogeology	Increase in groundwater levels in M1A Aquifer	Global	Confirm M1A aquifer weight balance is achieved through the model updates and respond with appropriate pumping strategy.
114	Environmental	Pathogen risk (e.g., algae, E. coli) from water quality in pit lake via primary or secondary recreational contact.	N/A	Need to clarify if public access is restricted to recreational areas around water bodies, and if this includes access to the water body.
115				Design emergency response plan with respect to pathogen risk.

11.10 Risk Conclusion

As shown within the chapter, a rigorous risk assessment process was completed for this DMRP. This process utilised site knowledge and experience, plus existing frameworks which meet international standards and have prior regulatory approval in the operational context. Site based personnel and 3rd party experts were engaged in a series of workshops which identified hazards, inherent risks, event likelihoods, event consequences, additional controls, and future risks. These sessions were systematically divided into geotechnical, hydrogeological, water access, environmental, fire, and security sessions to engage and make best use of expert input.

This risk assessment shows that most risks progressively reduce as rehabilitation is completed. High risks identified all have future control strategies which result in acceptable risk reduction. Ultimately, implementation of mine rehabilitation reduces existing mining risks to ALARP, allowing future beneficial uses to be achieved.

Chapter 12 Key Activities and Design Considerations

The key activities and design considerations for rehabilitation implementation are informed by the environmental setting, vision and objectives, progressive rehabilitation learnings, technical studies, and risk control strategies. An outline of the key activities enabling the nominated post mining landform and land uses are shown below. Knowledge gaps relating to each of these activities are tracked in Chapter 17.

12.1 Decommissioning and Removal

Prior to filling the mine void with water, operational infrastructure with the potential to contaminate the lake, or that is no longer needed, must be removed. This includes large mining equipment, mobile plant, conveyor systems, electrical lines and poles, substations, pump stations, and litter. Demolition of larger items such as the dredgers, stacker and bunker may utilise explosives. In addition, some infrastructure used today such as Fire Service Pipelines and Electrical Lines will be rerouted around the lake to maintain functionality for monitoring or risk control purposes. Infrastructure situated outside of the lake footprint and without future beneficial use will also be removed at later stages of the project.

Preliminary planning for decommissioning, demolition and removal has begun with a detailed plan to be developed and is listed as a knowledge gap (KG23 and KG19 in Table 17-1).

12.2 Water Delivery System

12.2.1 Pit Filling

A water delivery system is needed to fill the mine void with water. The existing pump station and hydraulic network used for Power Station operations is proposed to deliver this function, however opportunities to optimise the system will be investigated (KG13 in Table 17-1).

12.2.2 Reticulated System

An extensive reticulation network including sprays and tanker fill outlets and a water supply system which includes water bodies and pumps will be maintained to provide sufficient water to mitigate fire and dust risks while rehabilitation of the mine is conducted. This system will be reconfigured as rehabilitation progresses accounting for relocation of pump stations, requirements for removal and re-routing of piped network and removal of water bodies as sources of water for the network.

There are four primary sources of water supply for the reticulated system at Yallourn Mine, these being:

- The Witt’s Gully Dam is the water supply for the reticulated system and provides a gravity supply to the network. Witts Gully has a storage capacity of 306 ML’s and has the capability to supply water at the rate of approximately 2,000 l/s.
- The Fire Service Pond has a total storage capacity of 9,420ML’s with 2,181ML’s of the total capacity able to be accessed to supply the reticulated network utilising 4x electrically driven pumps that are located on floating pontoons anchored to the land on the west side of the pond. The 4 pumps have a combined operating capacity to supply water at a rate of 2,000 l/s.
- The Latrobe River Pumps comprise of 2x land based electrically driven pumps with combined capability to supply water to the reticulated network at a rate of 500l/s.
- The Township Lake is utilised to provide contingency supply to the network with 2x land-based diesel-powered pumps providing a combined capacity of 340l/s.

12.3 Morwell River Diversion

The MRD is integral to the rehabilitation design and success. The flood study of the Latrobe River system (Section 8.6), assessment of MRD (Section 8.12), and risk categorisation (Chapter 11) highlight the stability challenges and adverse outcomes if the structure is left untreated. To enable successful rehabilitation of the site following modifications to the MRD are proposed. It is acknowledged that detailed design of these works is still required (KG07 in Table 17-1).

The key design objectives for a rehabilitated MRD are:

- Remediate the MRD so that it can carry all environmental flows and design flood flows, throughout all phases of rehabilitation and the design intent period.
- Transform the MRD from a river diversion to a Rural Levee to support the above objective.
- Short-term disruptions are considered acceptable where the defect(s) can be repaired readily (approximately one month, i.e. moderate consequence level).
- Ensure MRD is fit for purpose by end of Lake filling as a Rural Levee and can be maintained under the Victorian *Levee Maintenance Guidelines* (DELWP 2015).

12.3.1 Tunnel Modifications

The MRD Tunnels are currently used as a conduit for coal conveyors, pipelines, and communications purposes. Once mining operations cease, this infrastructure will be removed, and the tunnels will be used to transfer water between the West (Township Field) and East (East Field & Maryvale Field) Lakes. Repurposing the tunnels into water conduits includes placing three 1.6m diameter HDPE pipes within each of the three tunnels and grouting around the pipes to ensure the tunnels and transfer pipes integrity is maintained. This forms part of the feasibility design proposed here and would need to be further explored in detailed design phase.

A conceptual sketch of the pipe layout through the tunnels is shown in Figure 12-1 below, sketched over the 2005 MRD design drawing. Detailed design phase will further explore the optimum layout and backfill around the pipes (KG06 in Table 17-1).

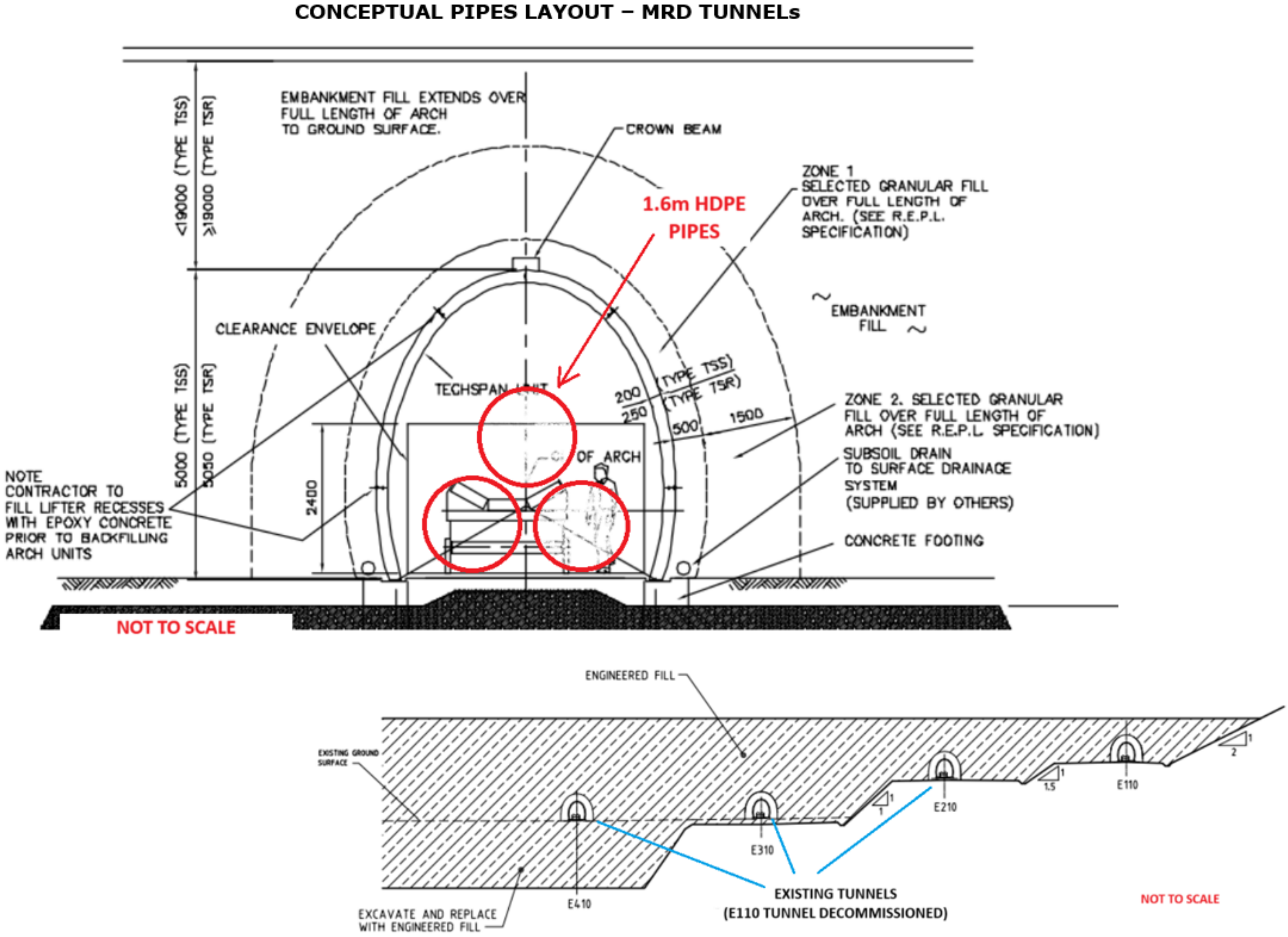


Figure 12-1 Conceptual Pipes Layout – MRD Tunnels (PSM 2025b)

12.3.2 Surface Stabilisation

The technical studies and risk assessments highlight the ongoing deterioration of the MRD. Enhancing the ground surface of the MRD will help mitigate future deterioration risks and offer better protection against flood events. Design proposed includes lime stabilization of the upper 1m layer, a technique commonly used in civil engineering and road construction. This will be applied to the internal embankment and floodplain (High Flow Channel, HFC). This treatment is proposed for area upstream (south) of MRD CH2200.

The external embankments will be covered with topsoil and grass. Both internal and external embankments will be regraded to a slope of 1V:4H to help reduce sheet flow erosion. The HFC will be regraded at 3% (~1V:20H) to drain towards the Low Flow Channel (LFC). Typical cross-sections illustrating this treatment are shown in Figure 12-2.

The requirements and treatment details for the area north of Ch2200 will be further determined, taking into account the existing synthetic liner, which has been deemed reliable for the design period (KG08 in Table 17-1).

12.3.3 Levee Reshaping

The existing MRD Levees are steep and narrow. Considering the current deteriorating conditions and capability of MRD (discussed in Section 8.12), they are required to be modified to service the design objectives. This entails, reducing the height of the levees, re-grading the top of the levee to drain externally at a 3% (~ 1V:20H) grade and finished with appropriate capping suited to minimise erosion. Typical cross-sections illustrating this treatment are shown in Figure 12-2, with detail design to be completed in the later phase.

Figure 12-3 shows a longitudinal profile of the Low Flow Channel (LFC) which is planned to remain relatively unchanged.

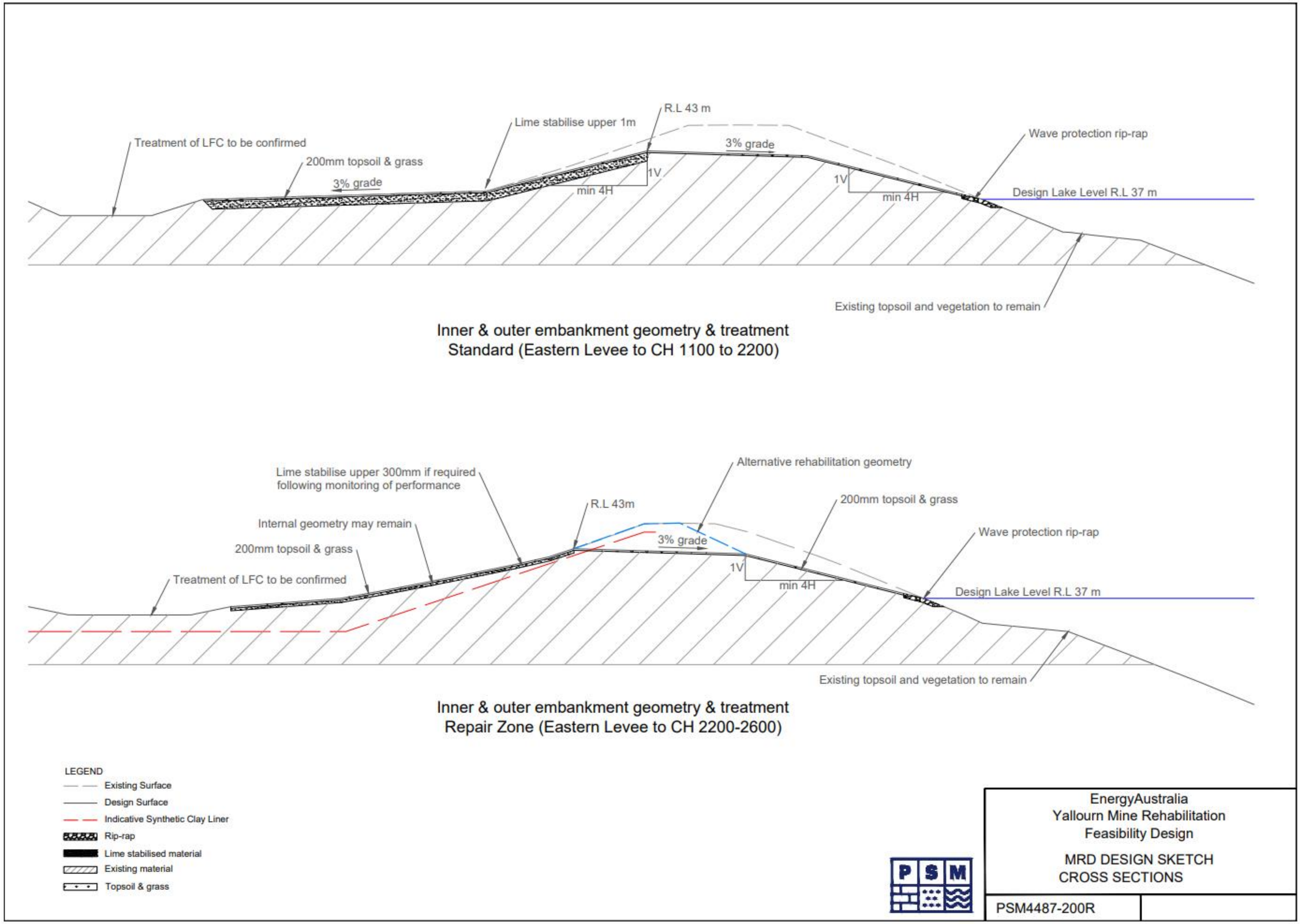


Figure 12-2 MRD rehabilitation design sketch – typical cross-sections (PSM 2025b)

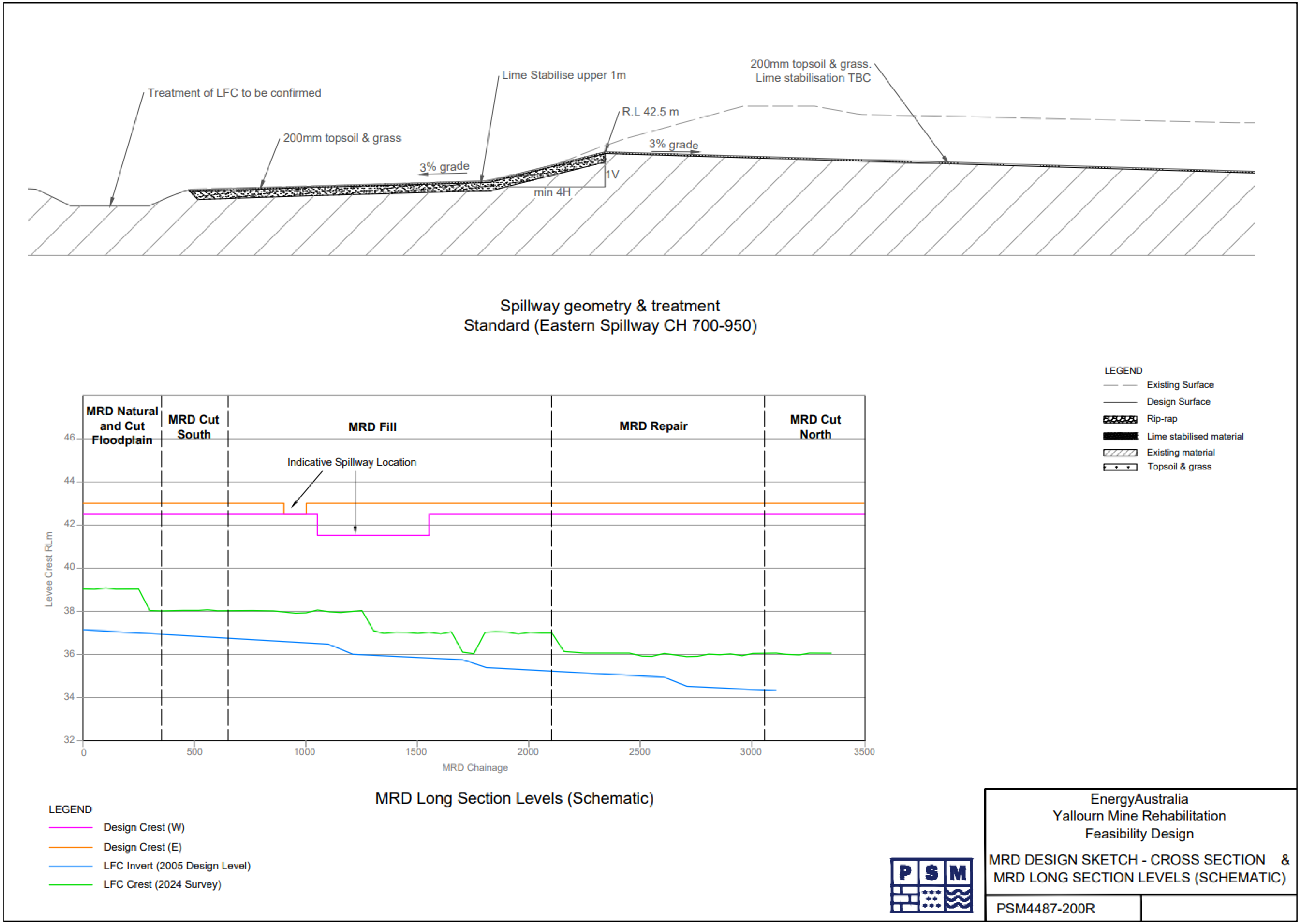


Figure 12-3 MRD rehabilitation design sketch – spillway and long section (PSM 2025b)

12.3.4 Erosion Protection

The MRD outer embankments are grassed which prevents surface erosion from rainfall, runoff, and other environmental forces today. When lake levels rise to the final operating level, there is potential for excess erosion from wave action which could lead to large scale erosion along the shoreline against these embankments. This could impact on the MRD overall stability if left untreated. Erosion protection is proposed for the MRD outer embankment to withstand wave action forces into the future, however detailed wave impact assessments will be completed to optimise the treatment required. The spatial extent to be considered for detailed design of wave action protection is shown in Figure 12-4 MRD

The surface capping and treatment proposed for areas above the lake level, the internal embankments and High Flow Channel are presented in Figure 12-2.

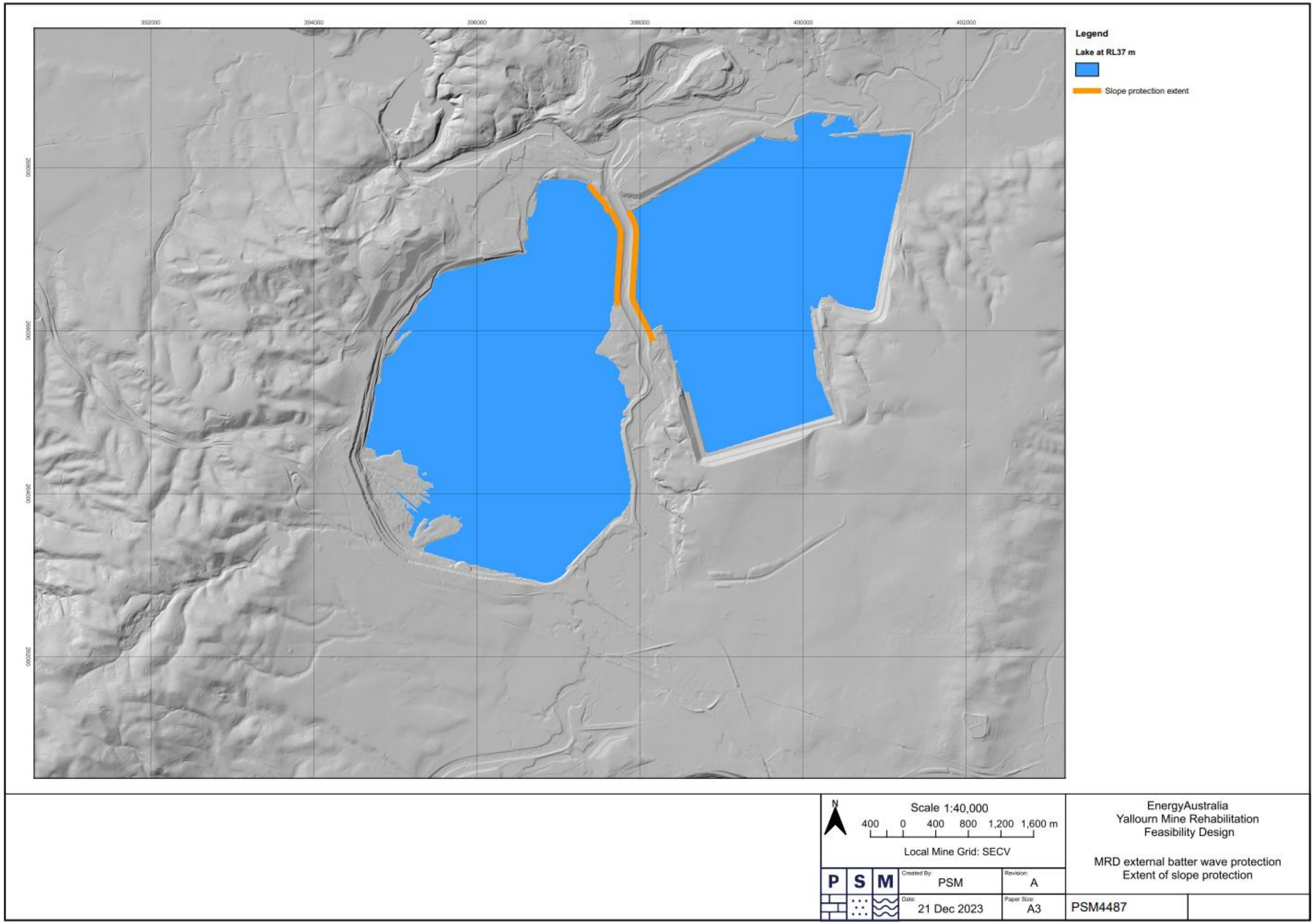


Figure 12-4 MRD external embankments – shoreline erosion protection

12.4 Geotechnical Stabilisation

Geotechnical stability is critical to delivering rehabilitation objectives for the site and to meet the mining license conditions. Without geotechnical stability, only limited beneficial land uses are possible and may require exclusion zones, limiting future land use. Geotechnical studies (Section 8.9) show that majority of the mine batters are stable with the proposed lake levels of RL +37m within the mine, including during the lake filling stage. However, some areas require further treatment to create more stable conditions to meet the Design Acceptance Criteria (DAC) for ground stability.

These areas will require targeted treatment to meet the stability requirements for all stages of rehabilitation and deliver longer-term post rehabilitation objectives, in line with the design intent period (discussed in Section 0).

12.4.1 Design Acceptance Criteria

The DAC is an outcome of the geotechnical analysis with consideration to the consequence for the relevant geotechnical domain (KG04 in Table 17-1). The technical study and derived DAC are discussed in Section 8.9.2.4.

12.4.2 Slope Stabilisation & Buttressing

The following geotechnical domains have been identified where stabilisation and buttressing will be required for meeting stability requirements. The stabilisation works can involve unloading of a slope by excavating material at the top or toe of a slope. Buttressing here is referred to as the introduction of a load along the toe of a slope to increase the resistance force against potential movement, increasing the reliability of a slope to meet the relevant stability design criteria.

- YEF Latrobe River Batters (East) – requires earth fill buttress to be constructed along the eastern section of this domain.
- MVF Southern Batters (current operating face) – stabilising measures include coal slope to be excavated to a steeper gradient and earth fill buttress to be constructed along the length of the slope.
- YTF Fire Service Batters – construct earth fill buttress along the length of these batters.
- YTF Western Batters – requires earth fill buttress in the northern section of this domain.

The feasibility design volumes for buttressing are presented in Figure 8-82. Notably, these will be further reviewed for optimisation as part of detailed design works (KG05 in Table 17-1).

12.5 Landform Reshaping and Preparation

12.5.1 Typical Mine Slope

Progressive rehabilitation and technical studies show relationships between slope gradient, slope length, soil type, vegetation cover, and erosion potential. Changing one of these variables alone can change the erosion potential, however at 95% vegetation cover the mine slopes are shown (discussed in Section 8.13) to limit erosion at 120m slope lengths and gradients of 2.5H:1V. These parameters are treated as design limits for rehabilitated mine slopes above the shoreline. Any slopes exceeding this criterion will require additional erosion prevention controls or further technical assessment. There is no reshaping required for slopes below the shoreline as the lake waterbody will submerge these slopes and provide adequate protection against environmental and geotechnical hazards (refer to risks in Chapter 11).

12.5.2 Shoreline

Where space is available, a shoreline will be shaped into the mine slope to protect the landform against wave action erosion. The shoreline slope is an 8H:1V grade from RL 36.2m to RL 38.14m which accounts for evaporation losses during dry periods, and the 1 in 100 wave height.

Elsewhere there will be additional erosion protection requirements designed and implemented. These will be further explored in detailed design. Figure 12-5 shows the conceptual layout of a typical cross-section with shoreline. This is an example cross-section along the geotechnical domain YTF Hernes Oak Batters (domains shown in Figure 3-7).

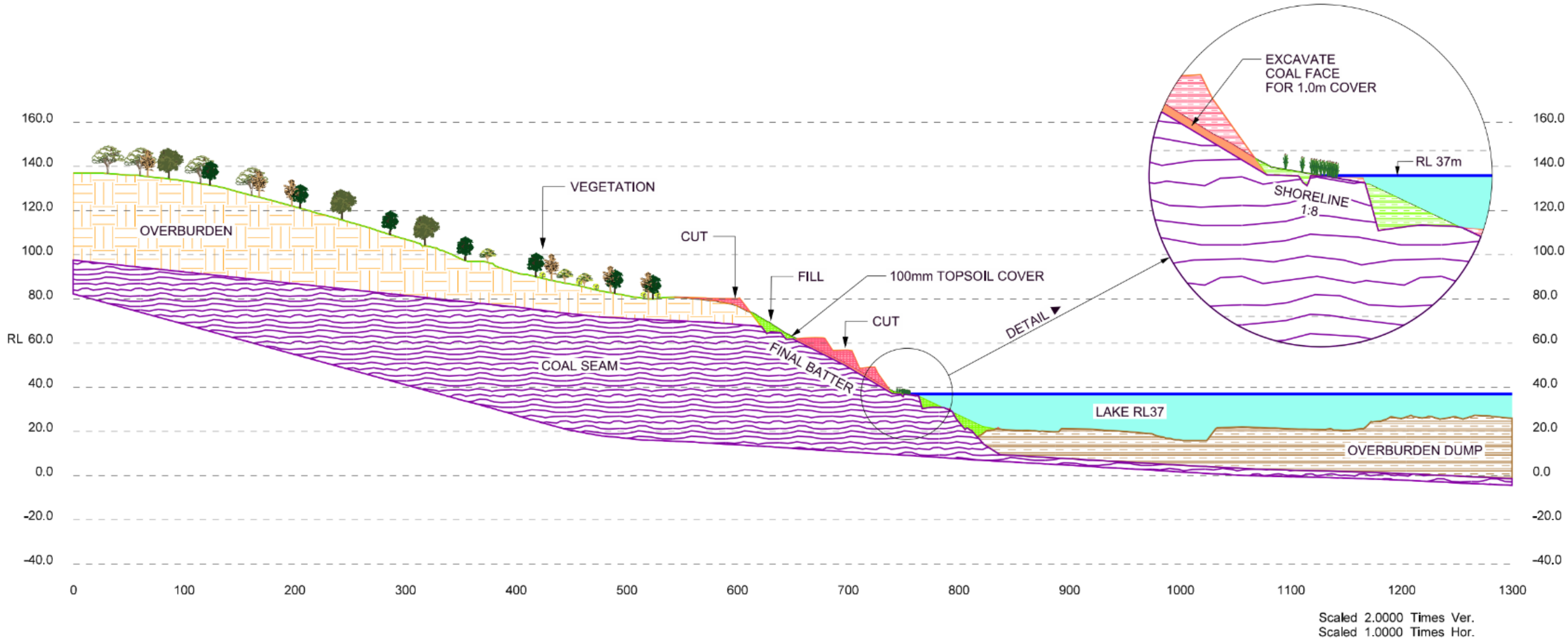


Figure 12-5 Conceptual Rehabilitated Landform Cross-Section (YTF Hernes Oak Batters shown here)

12.6 Revegetation

Years of progressive rehabilitation and conservation works have demonstrated successful revegetation programs. On flat areas, direct seeding to native species can be achieved without a topsoil medium. On steeper terrain, topsoil is required to enable fast vegetation establishment. This is normally achieved through seeding by tractor to a pasture grass with supplementary revegetation done after establishment to suit the nominated land use. Seed suitable for native revegetation has historically been collected at site and used successfully for nursery establishment to tube stock, or for directed seeding by tractor.

Revegetation planning will incorporate the *Yallourn Conservation Strategy* (IDEM 2020) and the plans for the Strzelecki-Alpine Bio-link (LCC 2019) where applicable.

Key objectives of revegetation design are as below. The associated risks are discussed in Chapter 11:

- **Minimise sheet flow erosion** along the slopes.
- **Reduce surface infiltration** to the underlying strata (overburden and/or underlying coal).
- **Facilitate the creation** of a geomorphic landform.
- **Support the management** of environmental factors such as water quality, wind, fire, and storm events.

Figure 12-5 shows a conceptual vegetated landform above the lake level.

12.7 Surface Drainage Structures

Technical studies of the surface drainage systems have highlighted the risks to geotechnical stability due to underperformance of surface water drainage systems. These drainage systems include the mine peripheral catchments which are on grass level and extend well beyond the mine crest. The technical studies presented in Section 8.7 show the extent and influence of these catchments. The outcome of these studies and the risk factors presented in Chapter 11 demonstrate the requirements of drainage improvements and/or controlled redirection of drains into the pit void.

Figure 8-66 shows the proposed drainage layout for the rehabilitation design that would be required to meet the rehabilitation objectives. The detailed design will further consider the drainage material types and liner systems presented in Table 8-10. The key areas that require drainage improvements are catchments for the following areas:

- **Rifle Range Gully** – this forms part of the catchment for southern area of YTF Western Batters and northern area of YTF Hernes Oak Batters. Requires flows to be directed into the pit.
- **Melbourne Swamp Drain** – forms part of catchments for southern area of YTF Hernes Oak Batters and most of YTF Southwest Batters. This requires improvements to the Melbourne Swamp Drain to ensure drain integrity can be maintained to meet geotechnical design requirements. To cater for excess flows during design event, some area will require partial redirection of drains into the pit. Regrading of the area on the mine side of the railway line is required such that surface flows are directed away from this public asset and surface infiltration is minimised.
- **Remnant Morwell West Drain** – forms part of the catchment for MVF Eastern Batters where controlled drainage into the pit is required along the eastern end of these batters. A northern section of this remnant Morwell West Drain will potentially require redirection of flows into the pit.
- **Latrobe Road Batters** – portion of the catchment that report to the crest of these batters will require redirection of flows into the pit.

Detailed design and approval of these structures is still required (KG09 in Table 17-1).

12.8 Spillways

Technical studies for MRD in Section 8.12 highlight the requirements for spillways to be constructed along the MRD and upstream section of Morwell River. Key objective of these spillways is to mitigate the risks associated with structural integrity of MRD. Section 8.6 presents the design requirements drawn from hydraulic investigation of the Latrobe and Morwell River systems.

To manage water heights within the MRD to remain within design level and lake water balance, a system of four spillways will be constructed. Three of these spillways will direct flood water from the Morwell and Latrobe River into Lake Yallourn, and one spillway is the lake overflow at the north-east of the site which returns excess water to the Latrobe River near Thoms Bridge. Concept planning regarding the size of these spillways has been completed with detailed design acknowledged as a gap (KG14, KG16 in Table 17-1).

Figure 8-61 presents a plan view of the spillway locations, labelled as Spillway 1 to 4. Table 8-7 presents the design heights and widths of spillways. The key role of each spillway is as follows:

- **Spillway 1 (Morwell River Upstream to Township Field)** – manage Morwell River dominant floods
- **Spillway 2 (MRD to East Field)** – manage Latrobe River dominant flood below design AEP of 1:2000 (0.05%) with Morwell Rivers coincidental floods
- **Spillway 3 (MRD to Township Field)** – manage Latrobe River dominant floods up to design AEP of 1:2000 (0.05%) with Morwell River coincidental floods and minimise overtopping along the eastern levy of remediated MRD.
- **Spillway 4 (Lake to Latrobe River)** – direct excess water in the lake to Latrobe River.

The detailed design for MRD, Spillways and associated infrastructure will consider the river levee system at the site. This includes river levees along Morwell River and Latrobe River (KG10 in Table 17-1).

12.9 Design Contours and Sections

Combining the learnings from historical monitoring, technical studies, progressive rehabilitation, and risk assessments, the landform design has been developed for the Yallourn Mine. Figure 12-6 includes a 1m contour plan with RL +37m lake level. A typical section is shown in Figure 12-5 presents the adopted grades, slope lengths, coal cover, topsoil, vegetation, and erosion protection adopted.

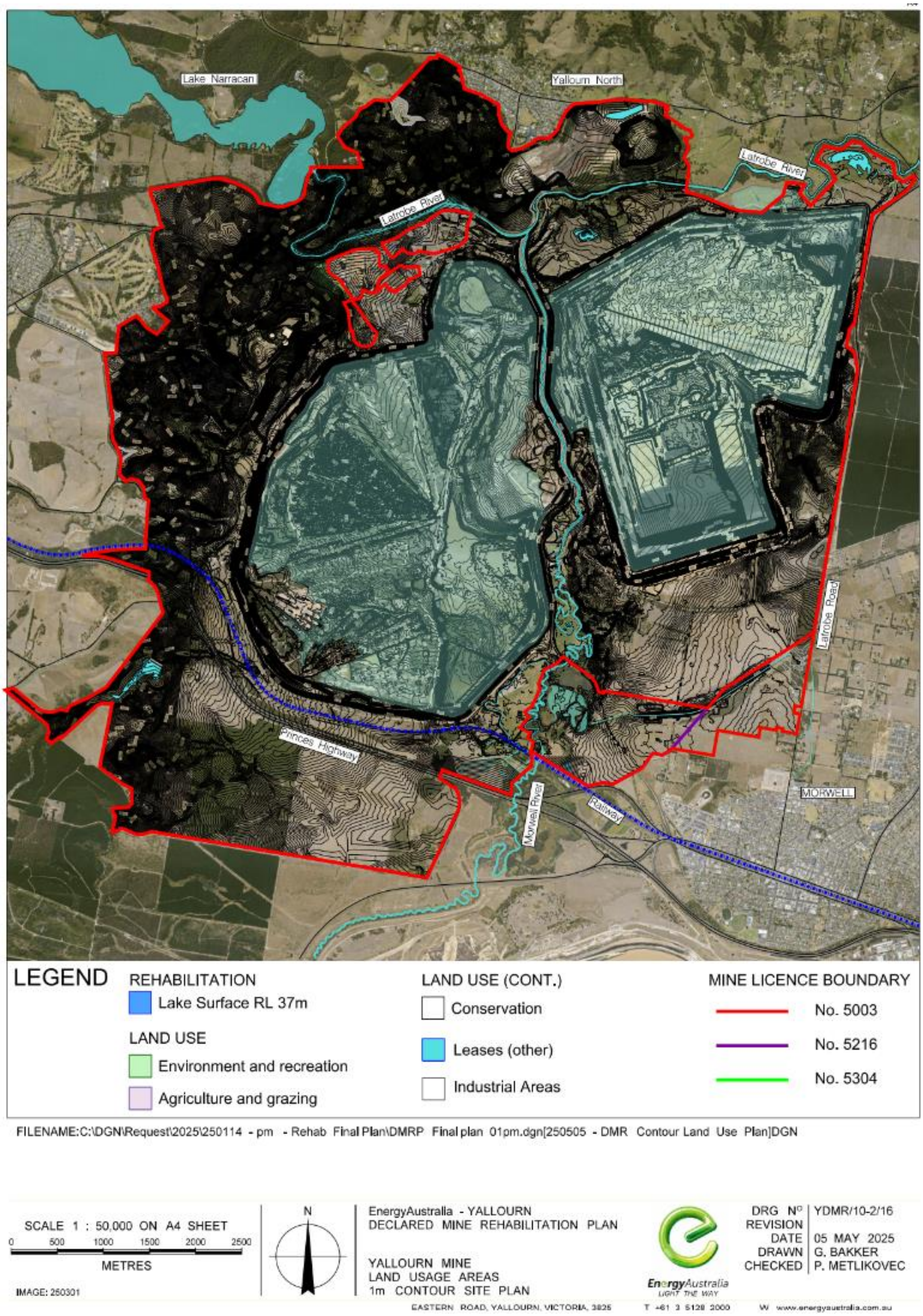


Figure 12-6 Yallourn Mine Rehabilitation – 1m Contours with RL +37m Lake

Chapter 13 Closure Criteria

Closure criteria set the specific targets for each objective against the nominated land use. If met, these criteria showcase the execution success of the rehabilitation program in meeting the agreed objective (ICMM 2025).

The Draft Guidelines (2024) state that closure criteria are based on relevant legislation, regulations, guidelines, standards, codes of practice, licences/permits, plans, commitments or other references, developed in consultation with key stakeholders and should be appropriately developed to the phase of the project. There may be several closure criteria that collectively measure the achievement of each rehabilitation objective.

Closure criteria should follow the S.M.A.R.T principle and be:

Specific enough to reflect a site-specific set of environmental, social and economic circumstances.

Measurable to demonstrate achievement of rehabilitation objectives.

Achievable in the context of the projected conditions at the estimated time of closure, and flexible enough to adapt to a reasonable range of changing conditions without fundamentally compromising rehabilitation objectives.

Relevant to the outcomes being sought and the risks being managed.

Time-bound so that monitoring can demonstrate closure criteria have been met, or that conditions are trending toward closure criteria being met at the anticipated rate.

Whilst closure criteria are published below, EAY acknowledges that there are knowledge gaps which are prolonging the development of overarching objectives and a detailed suite of closure criteria. Executing these knowledge gaps together with input from community, Traditional Owners, government, and other stakeholders will facilitate the development of the full rehabilitation objectives and suite of closure criteria. Expanding on the closure criteria to include all nominated land uses within the mine licence is included in the knowledge gap section in Chapter 17 of this report (KG 25). It is expected that this will be completed prior to closure in 2028.

Table 13-1 Yallourn Mine Rehabilitation – Closure Criteria

End Land Use	Objective	Closure Criteria	Measurement	Timeframe
Lake Yallourn	All pit voids and other excavations are made safe through backfilling, grading slopes according to approved geotechnical design and ensuring controlled access as required.	Final batters are built to design to enable a stable landform that can withstand fluctuating water levels and wave action. Geotechnical Design Factor of Safety no less than 1.3 for most areas. Where FoS of 1.3 is not achievable, exclusion zones to land use may apply. Construct to Design	Engineering Design Report based on measurement and modelling with as built report. Digital survey record of final coal and fill surfaces. Monitoring during filling to ensure landform is consistent with modelling. Construction QA/QC records are kept	Assessments completed by 2028 Live digital survey file available.
Lake Yallourn	Pit lakes and water bodies are formed with designated entry points which allow safe ingress and egress.	Designated entry points meet the same standards as those for other recreational lakes in surrounding area.	As constructed report by suitably qualified personnel to demonstrate compliance with design. Construction QA/QC records are kept	Completed prior to relinquishment of mine licence.
Lake Yallourn	Exposed coal is managed appropriately to manage the risk of fire in the long term.	Water in Lake Yallourn covers exposed coal within lake footprint. Management plan in place for any uncovered coal	Aerial photography included in annual report to show extent of coal coverage	Completed prior to relinquishment of mine licence.

End Land Use	Objective	Closure Criteria	Measurement	Timeframe
Lake Yallourn	Remove or make safe all light and industrial infrastructure from the mine site with the associated footprint rehabilitated in accordance with the respective post mining land use.	All infrastructure nominated to be removed are removed and Records are kept on where the infrastructure has been disposed of or recycled.	Aerial photographs / surveys are undertaken throughout the closure period to demonstrate that any infrastructure nominated to be removed has been removed.	Retreating operation which will occur over the lake fill period with annual checkpoints to ensure ongoing compliance
Lake Yallourn	Pit lake water quality remains stable in the long term without becoming a source of water quality that has an unacceptable impact on downstream receptors.	Pit water quality is within the limits set out in the Water Quality Monitoring Program. The development of this criteria is part of the knowledge gaps to be developed prior to 2028 and will include input from key stakeholders Criteria will include limits for: pH TDS Turbidity Metal and chemical concentrations Biological concentrations	There will need to be a demonstrated trend of water quality being within acceptable limits as per the Water Quality Monitoring Program with trigger levels and actions to maintain water quality.	The duration of this trend and frequency of monitoring will be established as required by the Program

End Land Use	Objective	Closure Criteria	Measurement	Timeframe
Lake Yallourn	All potentially contaminated areas are investigated and managed in accordance with statutory guidelines and legislation to ensure that the land supports the respective post mining use.	All potentially contaminated areas are investigated and managed in accordance with statutory guidelines and legislation to ensure that the land supports the respective post mining use.	Assessment and report by suitably qualified personnel to confirm all potentially contaminated areas have been adequately rehabilitated to support their proposed uses.	To be completed periodically as potentially contaminated land is rehabilitated.
Lake Yallourn	Surface runoff or seepage from the rehabilitated mine site does not have an unacceptable impact on downstream receptors.	Water Quality Monitoring Program aimed to set the criteria for this objective is marked as a knowledge gap to be developed prior to 2028.	There will need to be a demonstrated trend of water quality being within acceptable limits as per the Water Quality Monitoring Program with trigger levels and actions to maintain water quality.	The duration of this trend and frequency of monitoring will be established as required by the Program
Lake Yallourn	Stakeholders and the community are engaged throughout the closure planning phase.	Stakeholder management plan is executed and lake specific commitments delivered	Engagement commitments undertaken and feedback loops completed. Engagement plan subject to ISO 9001 accreditation.	Annual engagement update report until 2033

End Land Use	Objective	Closure Criteria	Measurement	Timeframe
Lake Yallourn	The quality and diversity of downstream aquatic ecosystems is not compromised due to seepage, runoff or mixing processes from the rehabilitated mine site.	Downstream number of macroinvertebrate families greater than 20 SIGNAL2 (unweighted) above 3.0	Aquatic monitoring program completed as per EPA Rapid Bioassessment Methodology	Annual until 2032 then every five years until relinquishment
Lake Yallourn	Rehabilitated surfaces support a resilient and self-sustaining vegetated ecosystem that is compatible with the post mining land use.	Create designated exclusion zones for high biodiversity and conservation protection. Shoreline vegetation zones have a minimum 40% graminoid cover and total cover of 95%	Signage and inspection Landscape Function Analysis	Annual conservation assessments to demonstrate trend Annual assessment of rotating sites
Lake Yallourn	Post closure care and maintenance requirements are minimised, with no ongoing earthmoving, water treatment or ecosystem management requirements beyond comparable land uses in the broader region.	Post closure maintenance and monitoring plans will be developed for each nominated land use through consultation with key stakeholders to establish criteria which will need to be satisfied to meet this objective. It is expected that the plan will establish a hold point to be achieved before it transitions to the post closure phase.	Parameters as set out in the Post closure maintenance and monitoring that will be developed.	The timeframe to achieve this objective will be set as part of the development of the post closure maintenance and management plans
Agriculture	The land is suitable for use as agriculture and can maintain either livestock or pasture	The land parcel is assessed to adequately maintain pasture to support either livestock or cropping guided by industry practices	Report by a suitable qualified and/or experienced personnel that states the	Assessments at five yearly intervals.

End Land Use	Objective	Closure Criteria	Measurement	Timeframe
			suitability of the land for agriculture use.	
Environment and Recreation	Landforms are stable and non-erosive	No gullies greater than 30cm erosion depth. Rilling trend improving	Erosion Monitoring per Landscape Function Analysis (LFA) program	Annual assessments to demonstrate trend.
Environment and Recreation	Rehabilitated landforms are congruent with the surrounding landscape as far as practicable.	Plant density targets to be established	Point Centred Quarter Point Wandering Quarter	To be established as part of Vegetation Monitoring Program.
Conservation	No net loss of biodiversity in conservation areas	Flora and fauna assessments show no decrease in habitat quality	Biodiversity Assessments including Point Centred Quarter, Point Wandering Quarter, Habitat Hectare, Fauna Monitoring	Rotating program assessments every three years.
Commercial and Industrial	Commercial and industrial areas are capable of land use	Commercial and industrial areas are capable of land use	Land capable of development per Latrobe Planning Scheme	As required.

Chapter 14 Implementation Plan and Milestones

14.1 Project Timeframes

Effective project planning uses a Gantt chart to show the timelines and linkages between key activities. A high-level schedule of the rehabilitation timeline and key activities is shown below

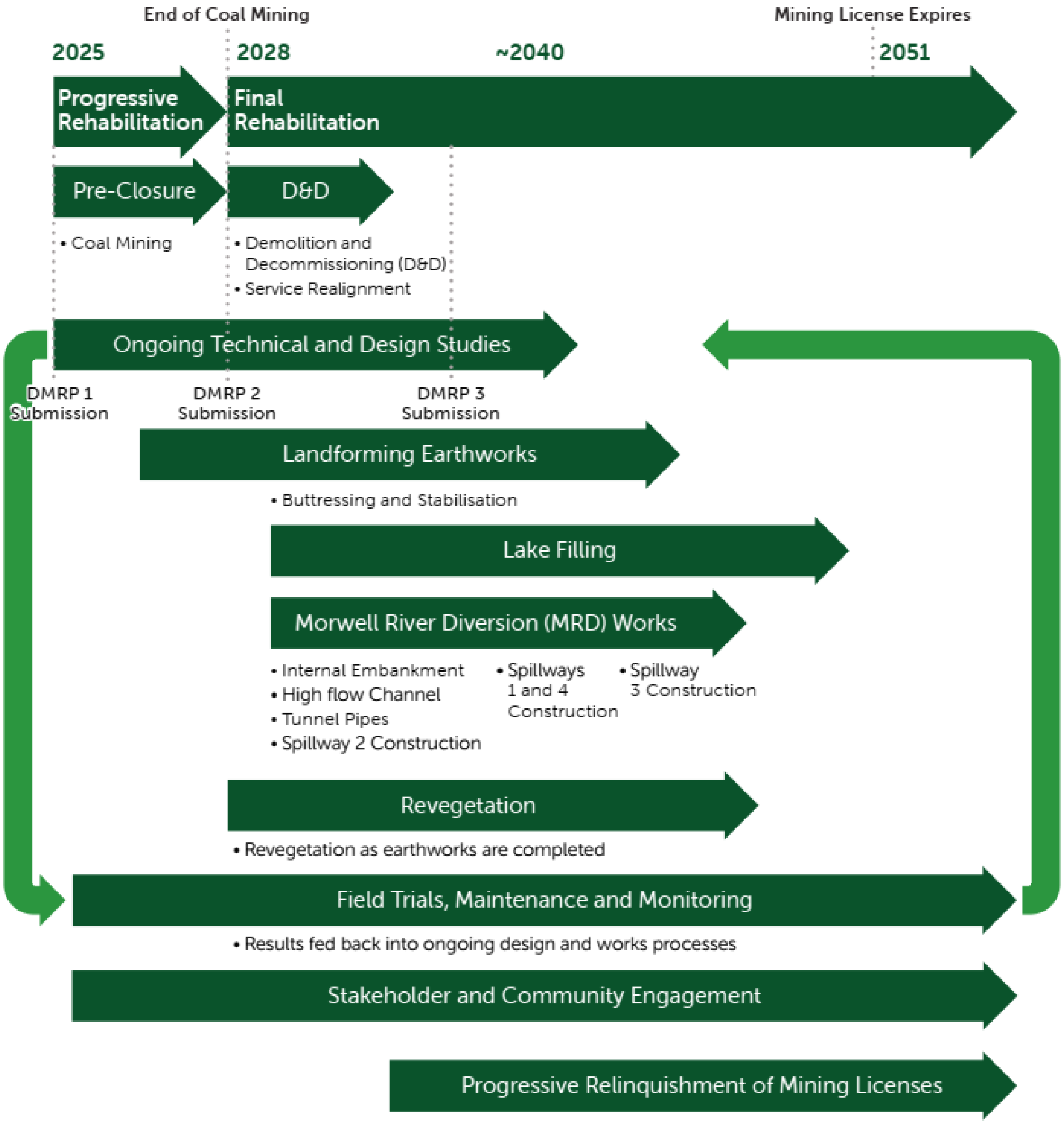


Figure 14-1: Rehabilitation project timeframes

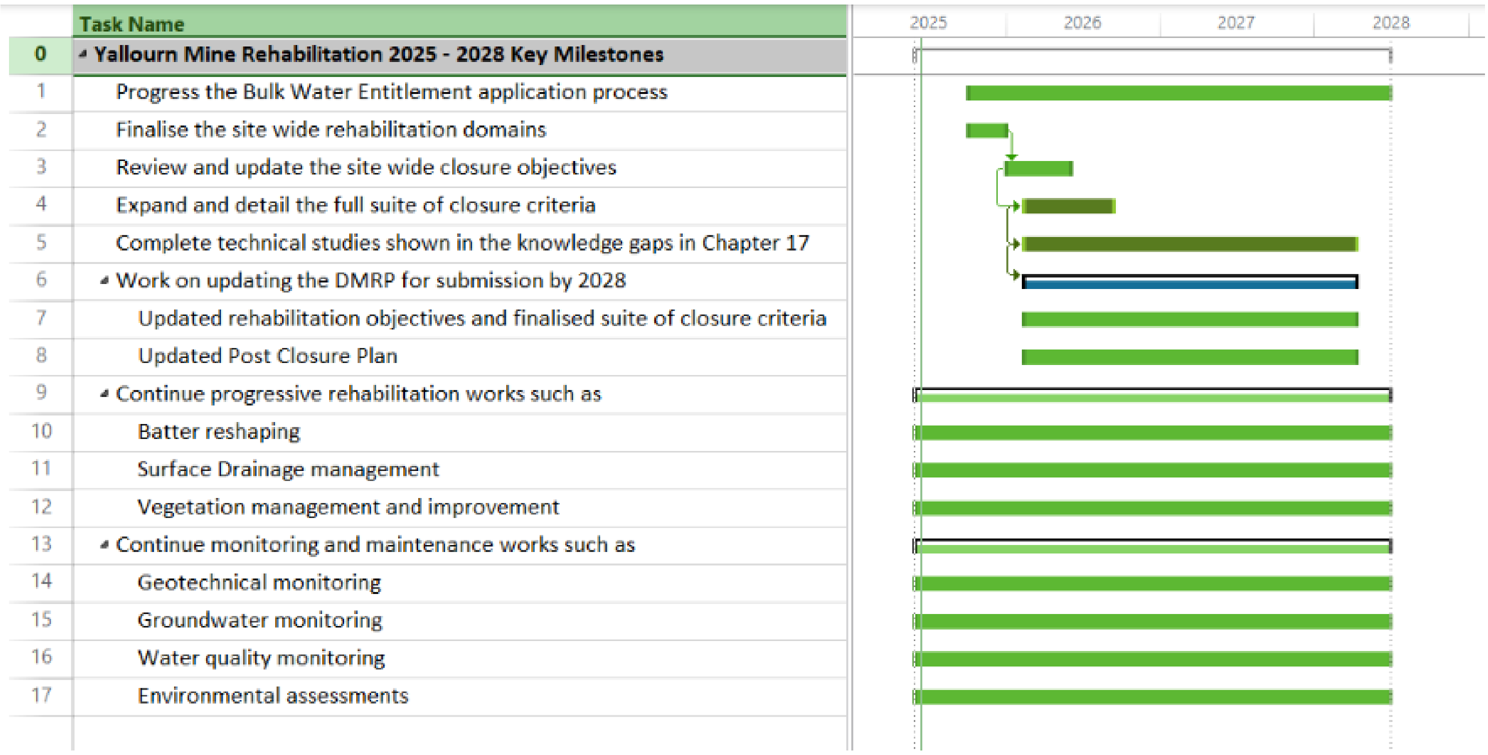
14.2 Key Milestones

Milestones are a good tool for monitoring project implementation against the nominated schedule. These milestones usually sit on the project's critical path with any delay to one key milestone forcing a longer duration to the entire project. That said, some milestones can be completed in parallel, they do not need to have started and finished sequentially. Key milestones for Yallourn Mine Rehabilitation are shown below:

- Approval of DMRP
- Complete knowledge gaps to nominated timeframes
- Decommissioning and removal of operational infrastructure preventing lake fill
- MRD Tunnel repurposing complete
- Completion of geotechnical buttressing
- Surface stabilisation of the MRD
- Begin pit lake filling
- Decommission pump bore N6899
- Completion of East Field bulk reshaping
- Pit lake reaches RL 20m (significant interim measurement point)
- Completion of Maryvale Field bulk reshaping
- Completion of MRD East Spillway
- Completion of Township Field bulk reshaping
- Completion of topsoil placement and revegetation
- Completion of additional spillways
- Lake filling complete
- Reshaping of the MRD Levees
- Monitoring confirms agreed closure criteria
- Remove remaining infrastructure that has not been repurposed
- Mining Licence relinquishment
- Post closure management program begins

Completing the identified knowledge gaps and having key regulatory approvals (Section 4.6) will give confidence to assigning actual dates and a detailed Gantt chart for these milestones.

However, EAY will be focused on achieving the following key milestones between now (2025) and closure in 2028 where EAY proposes to submit an updated DMRP.



	Task Name
0	**Yallourn Mine Rehabilitation 2025 - 2028 Key Milestones**
1	Progress the Bulk Water Entitlement application process
2	Finalise the site wide rehabilitation domains
3	Review and update the site wide closure objectives
4	Expand and detail the full suite of closure criteria
5	Complete technical studies shown in the knowledge gaps in Chapter 17
6	Work on updating the DMRP for submission by 2028
7	Updated rehabilitation objectives and finalised suite of closure criteria
8	Updated Post Closure Plan
9	Continue progressive rehabilitation works such as
10	Batter reshaping
11	Surface Drainage management
12	Vegetation management and improvement
13	Continue monitoring and maintenance works such as
14	Geotechnical monitoring
15	Groundwater monitoring
16	Water quality monitoring
17	Environmental assessments

14.3 Roles and Responsibilities

EAY is responsible for the rehabilitation of Yallourn Mine until relinquishment. Due to the size and complexity of Yallourn Mine, roles and responsibilities are delegated through various business units, however ultimate responsibility remains with the Mine Leader for management of the mining licence and with the Mine Rehabilitation Leader for execution of mine rehabilitation in accordance with the rehabilitation plan.

Below shows a summary of the key roles that have been identified to manage the activities to be undertaken for mine rehabilitation, inclusive of responsibilities, qualifications, competency requirements and accountabilities for each role. Additional resources whether through employment, contractor, or consulting will report to these key positions, ensuring quality of work and appropriate risk mitigation throughout rehabilitation.

Table 14-1: Yallourn Mine Rehabilitation Roles & Responsibilities

Mine Leader
Responsibility
The Mine Leader is responsible for maintaining the site to achieve compliance with mining licence conditions and associated regulatory requirements including the oversight of planning and resourcing for activities for ongoing management of mine stability, fire risks and environmental obligations until such time as the mining licence is relinquished.
Competency / Qualifications
Management qualifications and experience. Knowledge and understanding of mine regulatory and licensing requirements.
Accountabilities
• Management of planning and resourcing for execution of Risk Management Plan. • Management of compliance with Mineral Resources Act, Regulations and Mine Licence conditions. • Review and update of Management Plans for managing risks related to ground movement, fire and the environment. • Planning and oversight of activities to coordinate site management and rehabilitation project works. • Regulatory reporting requirements in accordance with legislative requirements and licence conditions. • EA business reporting requirements related to management of the Mine Licence.
Site Supervisor
Responsibility
The Site Supervisor is responsible for planning and supervision of personnel for works conducted related to ongoing management of mine stability, fire risks and environmental obligations in accordance with mine licence conditions and associated regulatory requirements.
Competency / Qualifications
Mining / construction supervisory experience.
Accountabilities
• Site operational personnel coordination, planning and management. • Planning for activities related to fire control management and site maintenance works. • Management of operational infrastructure including activities for planning, procurement, dismantling, demobilising, demolition, relocation and calibration. • Coordination of works to compliment rehabilitation project activities.
Mine Rehabilitation Leader
Responsibility
The Mine Rehabilitation Leader is responsible for management and oversight of activities associated with completion of the Declared Mine Rehabilitation Plan (DMRP) including management of risks related to ground movement, ground water, surface water, fire, environment and site security until completion of the plan is achieved.
Competency / Qualifications
Management qualifications and experience. Knowledge and understanding of mining rehabilitation regulatory requirements.

Accountabilities
• Delivery of DMRP projects related to mine closure and relinquishment including planning and resourcing requirements. • Management of compliance with legislative requirements associated with DMRP completion. • Planning and oversight of activities to coordinate rehabilitation project works and site management activities. • Regulatory reporting requirements in accordance with legislative requirements. • EA business reporting requirements related to DMRP implementation.
Community & Stakeholder Engagement Lead
Responsibility
The Community and Stakeholder Engagement Lead is responsible for maintaining communications related to rehabilitation and repurposing activities in accordance with the Community and Stakeholder Consultation Plan.
Competency / Qualifications
Background and experience in community engagement.
Accountabilities
• Maintenance and update of communication mediums including website and social media. • Coordination and promotion of community information sessions related to rehabilitation plans, status and updated information. • Continued community consultation, collaboration and communication via local media, scheduled meetings and presence at community events. • Coordination of feedback to community members upon request for information or following lodgement of complaint of concern by community members. • Coordination of meetings and communications with stakeholders for consultation and communication about DMRP implementation.
Site Security and Emergency Management Coordinator
Responsibility
Coordination of personnel and equipment related to site security and emergency response and management.
Competency / Qualifications
Planning and emergency management experience and qualifications.
Accountabilities
• Review and maintenance of the Emergency Response Plan and management of personnel and activities associated with the plan. • All site security arrangements including maintenance of infrastructure and equipment, and management of personnel.

14.4 Management of information and data

Adequate management of information and data is vital to control and maintain information relevant to rehabilitation and closure (DEMIRS 2025). EAY has established systems for information and data management as outlined in the following sections.

14.4.1 Document Management

EAY utilises document management software (Objective) and has established procedures for management of records. The use of Objective, or an equivalent program, will be used throughout the rehabilitation project to ensure that relevant records are retained for EAY and the future landowners or managers.

The use of Objective also ensures that information is readily available to provide to regulatory agencies.

14.4.2 Data Management

This section provides an overview of the data management and reporting tools used to collate, assess, and report on activities related to the rehabilitation of the mine.

Comprehensive data management during mine rehabilitation is essential as it:

- assists in planning rehabilitation activities
- streamlines regulatory compliance and reporting requirements
- aids in the identification of knowledge gaps
- compliments stakeholder consultation and communication
- allows for monitoring and evaluation of the progress of the mine rehabilitation

Data collected during the Yallourn Mine rehabilitation can be classified into three main time-based categories as follows:

- **Operational & Closure Planning** – Data collected as part of the technical studies, ongoing monitoring and detailed designs undertaken while the Yallourn Power Station and Mine remain operational,
- **During rehabilitation implementation** - Construction data including quality control and quality assurance documents, monitoring data and reports required during the rehabilitation works and infrastructure decommissioning, and,
- **Post-rehabilitation** - Monitoring data required for post closure rehabilitation activities, to demonstrate achievement of criteria.

The current data management system is a GIS-based system run via ESRI ArcMap software. There are dedicated SQL (Structured Query Language) and SSRS (SQL Server Reporting Services) servers which allows for data collection, storage, and automated reporting on key mine operation activities.

The GIS-based system collects, stores and reports on information such as, but not limited to:

- Borehole locations
- Groundwater levels
- Ground movement data (fractures and cracking)
- Fire services infrastructure
- Historical aerial photographs
- Water quality and water levels in the Latrobe River and the Morwell River
- Soil testing

As part of the closure planning, EAY is expanding its data management system (which is currently focused on mining operational activities) to incorporate mine rehabilitation activities.

The expanded data management system will result in a Common Data Environment which centres on integrated models or groups of IT solutions which provide a centralised repository for data storage, access, transfer, and management associated with the many components of the Yallourn Mine rehabilitation. This will allow EnergyAustralia Yallourn to efficiently report on key rehabilitation activities at different stages of the mine closure as shown in Table 14-2 to Table 14-4.

Table 14-2: Data Inputs – Operation and Closure Planning

Description	Example Data Inputs
Geotechnical	Ground movement – vectors, cracks, fractures
Groundwater	Groundwater levels (automated continuous monitoring and manual monitoring) Groundwater quality (analytical laboratory data) Horizontal bore flow rates Bore locations
Surface water	Surface water levels Surface water quality (analytical laboratory data) Sample point locations Aquatic flora and fauna reports Flow rates Designs for surface water infrastructure
Pit lake	Water quality Water levels Geochemical data and reports Rainfall and evaporation data
Soil	Contaminated site polygons, photographs, and reports Soil quality (laboratory data) Geotechnical (laboratory data) Geochemistry (laboratory data) Erosion reports
Ecology	Terrestrial flora and fauna reports CMP information
Design (Reports and documents)	Batter design Surface water feature design Cover design Seeding/re-vegetation program
Air	Air quality (automated monitoring and reports, and laboratory data)
Heritage	Cultural heritage locations Cultural Heritage Management Plans (if required)/ Surveys

Table 14-3: Data Inputs – Rehabilitation Implementation

Description	Example Data Inputs
Batters	Batter length (survey and drone data) Batter slope (survey and drone data) Batter profile (geology) Photographs As-constructed survey data
Cover	Topsoil thickness Subsoil/overburden thickness Application of native seed Compaction
Air	Air quality (automated monitoring and reports, and laboratory data)
Pit Lake	Water quality Water levels Geochemical data and reports Rainfall and evaporation data Aquatic flora and fauna reports Evaporation reports
Infrastructure and Validation	Decommissioning of infrastructure report Soil sampling and validation (laboratory data) As constructed survey for surface water infrastructure QA/QC data for new infrastructure
Groundwater	Groundwater levels (automated continuous monitoring and manual monitoring) Groundwater quality (analytical laboratory data)
Surface water	Surface water levels Surface water quality (analytical laboratory data) Aquatic flora and fauna reports
Geotechnical	Ground movement – vectors, cracks, fractures
Soil remediation	Erosion Importation of clean overburden/virgin excavated natural material

Table 14-4: Data Inputs – Post Rehabilitation

Description	Example Data Inputs
Photographs	Photographic record of rehabilitation (before and after as a minimum)
Geotechnical	Ground movement – vectors, cracks, fractures
Pit lake	Water quality Water levels Geochemical data and reports Rainfall and evaporation data Aquatic flora and fauna reports Evaporation reports Wave action reports
Soil	Contaminated site polygons and reports Soil quality (laboratory data) Geotechnical (laboratory data) Geochemistry (laboratory data) Erosion reports
Ecology	Terrestrial flora and fauna reports
Groundwater	Groundwater levels (automated continuous monitoring and manual monitoring) Groundwater quality (analytical laboratory data)
Reports	Technical reports linked to the rehabilitation domain of interest.

14.4.3 Community and Stakeholder Engagement

EAY already uses a "centralised stakeholder relationship manager platform" called Consultation Manager (Consultation Manager 2024). This platform allows EAY to keep a register of all stakeholders and record any interactions (e.g. meetings, public events, email correspondence). EAY intends to continue to use Consultation Manager during the rehabilitation period to ensure accurate records of engagement are maintained.

The Consultation Manager program will allow retrieval of information for the Annual Report (section 14.8). Additional information on community and stakeholder engagement can be found in Chapter 10.

14.4.4 Compliance tracking

EAY has systems for tracking regulatory obligations, non-compliances and remedial/corrective actions. All DMRP commitments will be tracked, along with any non-compliances and remedial actions. Systems will ensure relevant information can be retrieved for the Annual Report (section 14.8).

14.4.5 Audit Information

The annual reports (section 14.8) require a *summary of any environmental audits and land contamination assessments required under the Act, the Water Act 1989, the Environment Protection Act 2017, the Environment Effects Act 1978 and the Environment Protection and Biodiversity Conservation Act 1999 of the Commonwealth*.

In the event that an audit or land contamination assessment is completed, the existing reporting systems (section 14.4) will be utilised.

14.5 ISO accreditation

As outlined in section 4.1.3, the site currently maintains certifications for:

- *Environmental management systems—Requirements with guidance for use (ISO 14001:2015)* (ISO 2015a),
- *Occupational health and safety management systems—Requirements with guidance for use (ISO 45001:2018)* (ISO 2018a), and
- *Quality management systems—Requirements (ISO 9001:2015)* (ISO 2015b).

The intention is to maintain these certifications during rehabilitation to provide strong systems, governance and quality control throughout the project.

14.6 Project Governance

EA has an existing Project Management Governance System (PMGS) for planning and executing major projects. The PMGS process provides strong governance of projects with set Gates and Checkpoints to review the project planning, execution and delivery. This PMGS process also includes procedures and toolkits for change management, project risk assessments and financial reviews.

14.7 DMRP Review

The DMRP is intended to be live document that is reviewed and updated as the knowledge base grows (MLRA 2024a).

Variations to the DMRP could arise from:

- Increased understanding from monitoring data
- Updated knowledge from technical studies
- Learnings from field trials
- Learnings from remedial actions
- Risk assessment reviews / updates
- Identification of new opportunities
- Findings from stakeholder and community feedback
- Regulatory changes
- Specific feedback or instructions from regulators or government bodies
- Inability to meet original intentions of the plan

EAY will discuss potential changes to the DMRP with the Department before progressing with a DMRP update. Updates to the DMRP will provide a summary table outlining the changes that have been made, and the justification for those changes. Variations to the DMRP will be tracked via the document management system.

EAY anticipates that the next DMRP update will occur in 2028 to update the knowledge base and close out relevant knowledge gaps closer to operational closure.

14.8 Annual Report

An annual report will be submitted that covers the requirements of section 57A of the MRSDMIR.

The regulations and draft DMRP guidance do not specify the due dates of the annual reports (e.g. calendar year, financial year or based on DMRP approval date). EAY assumes that guidance will be provided on the timing of these annual reports once the DMRP is approved.

Table 14-5: Annual Report requirements

MRSDMIR section	MRSDMIR text	DMRP Reference
57A	**Requirements for annual reports for declared mine rehabilitation plans**	
(a)	the specified requirements are that an annual report in relation to a declared mine rehabilitation plan must comply with any relevant guidelines issued by the Minister under section 120A of the Act;	Guidelines have not been issued
(b)	The specified information is:	
(i)	details of the progress on components of the declared mine rehabilitation plan that require the submission of additional information;	Chapter 17
(ii)	an identification and assessment of any risks to the rehabilitation and post-closure management of the declared mine;	Chapter 11
(iii)	the reasons for any non-compliance with rehabilitation or closure milestones	Section 14.4.4
(iv)	details of the remedial action that will be undertaken in respect of any non-compliance with rehabilitation or closure milestones;	Section 14.4.4
(v)	details of any technical and economic studies (including details of expenditure on those studies) carried out under the licence during the reporting period that relate to— (A) the development of the mineral resource in accordance with principles of sustainable development; and (B) demonstrating the economic viability of the mineral resource;	Not applicable to Yallourn mine as no new mining development will be occurring during rehabilitation.
(vi)	a summary of the status of the regulatory processes that are required to be undertaken for the purposes of mine rehabilitation under the licence;	Chapter 4
(vii)	summary of any environmental audits and land contamination assessments required under the Act, the Water Act 1989, the Environment Protection Act 2017, the Environment Effects Act 1978 and the Environment Protection and Biodiversity Conservation Act 1999 of the Commonwealth;	Chapter 1414.4.5
(viii)	summary of community engagement programs focused on rehabilitation, including the feedback and outcomes resulting from the engagement;	Section 14.4.3
(ix)	summary of any reportable event, within the meaning of section 41AC of the Act, that has occurred;	As per current operations.
(x)	report of potential issues that exist in relation to the declared mine rehabilitation plan;	Section 14.7
(xi)	a report on the progressive rehabilitation of the declared mine land	Chapter 7

Chapter 15 Monitoring and Maintenance

With over 135 years of operation at Yallourn, substantial monitoring and maintenance has been completed with mature monitoring programs already in place. The *Environmental Management Plan* (YMA 2024), *Ground Control Management Plan* (EnergyAustralia 2024c), and *Mine Fire Control Management Plan* (EnergyAustralia 2023b) are all thorough documents subject to ISO audit and accreditation.

The monitoring programs outlined in these plans serve as the foundation for rehabilitation monitoring. As pit lake filling begins, monitoring activities will intensify to accurately map the changing environment and validate the technical findings that inform the rehabilitation design. As rehabilitation implementation advances through the planned phases and design expectations are validated to align with expected trends, the intensity of monitoring will be reduced, corresponding to the assessed risk and uncertainty at that time. By the time rehabilitation approaches relinquishment (Phase 4), minimal monitoring and maintenance are expected to be necessary, with passive controls effectively supporting beneficial land uses and managing risk. For these reasons, the monitoring and maintenance plans will be maintained as a live program. The expected effort in monitoring (and maintenance) follows the Figure 15-1 below.

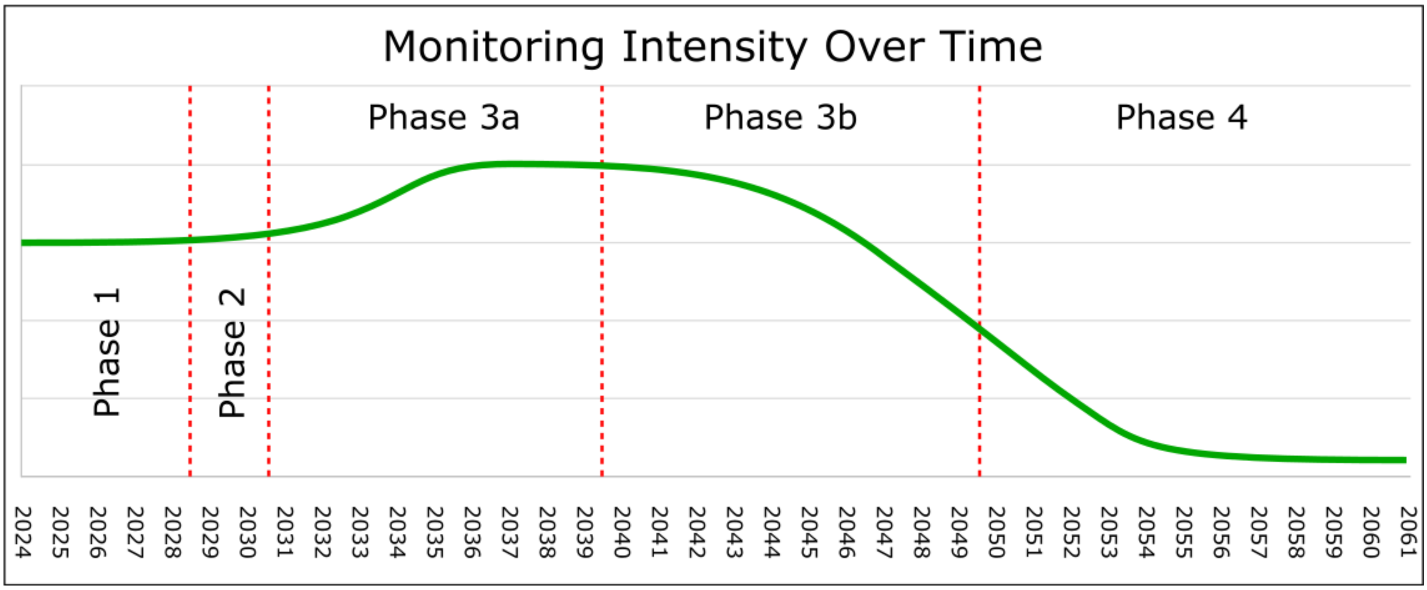


Figure 15-1: Change in Monitoring Intensity over the Rehabilitation Phases (Indicative)

Monitoring programs which will continue throughout the rehabilitation and the design intent period include:

- Geotechnical
- Groundwater
- Surface water quantity
- Surface water quality
- Land monitoring
- Flora and Fauna
- Air

15.1 Geotechnical Monitoring

15.1.1 Operational Monitoring and Maintenance

Monitoring and inspections are a key activity for maintaining stability of the Yallourn Mine. They are comprehensively detailed within and managed by the Ground Control Management Plan (GCMP) (EnergyAustralia 2024c). A summary of the key relevant aspects is provided below:

- Ground movement – Survey pins, online survey pillars, inclinometer bores
- Groundwater – Observational bore standpipes and piezometers, dataloggers, online telemetry, deep aquifer piezometers, MRD tunnel piezometers
- Horizontal drains
- Cracks/deformations database
- Routine inspections for all geotechnical domains
- Routine defect mapping
- Geotechnical Data Management System (GDMS) –Monitoring data storage
- GIS – Geographic information system for the site and all infrastructure
- Weight balance modelling
- Trigger Action Response Plan(s) (TARP)
- Data reviews – Daily, monthly, 6 monthly, external consultants
- Routine reporting – Monthly reports, Declared Mines Reporting, regional dewatering subsidence
- ANCOLD inspections – Dams engineer (consultant)
- Infrastructure inspections/maintenance (e.g. Fire Service Mains)

These items (and more, refer to the GCMP (EnergyAustralia 2024c)) form the basis of the Geotechnical Critical Control 05 (GCC05): Monitoring, Inspection and Implementation of TARPs (refer Chapter 11) where controls are discussed). There is an extensive array of monitoring instrumentation around the site, which is used to collect large volumes of ground movement and groundwater data. Plans showing the bore (observational, horizontal and inclinometer) and survey pin (pins and online GPS pillars) monitoring networks are provided in Figure 15-2 and Figure 15-3. This vast amount of data is stored in the GDMS. The monitoring data is regularly reviewed and assessed to determine the performance of each geotechnical domain. This includes assessment against the various geotechnical TARPs. Routine site inspections are completed for all geotechnical domains. These provide visual confirmation of the performance of each domain in the field. Regular reporting is also conducted, which includes monthly summaries of the performance of each domain.

Preventative routine and reactive maintenance is also required to maintain stability of the mine, and this too creates a significant resource burden. Water is the is the primary driver of coal slope instability. Therefore, a significant amount of effort is put into maintaining surface water infrastructure within and surrounding the mine. This includes both routine maintenance schedules and reactive maintenance as determined through monitoring and inspections. Prevention and treatment of erosion also creates significant resource demand, to prevent excess siltation of water bodies and damage to operational and progressively rehabilitated batters. Erosion can also damage stabilising structures such as slope stabilising buttresses, reducing their effectiveness and increasing risk of coal slope instability.

The monitoring, inspection and maintenance regime is a live program, as defined by the GCMP and is a critical component of maintaining stability of the open pit mine during operations. However, it requires a significant amount of resources to conduct, maintain, collect, process, store, review, analyse and report on. It is not feasible to sustain this level of resource requirement indefinitely into the future. One of the key objectives of the DMRP is to develop a targeted monitoring and maintenance strategy, informed by performance trends and progressively adjusted to address risks. The goal is to achieve a sustainable level of monitoring, inspection, and maintenance obligations for the site, comparable to the surrounding landscape. The full pit lake provides a mechanism to achieving this goal, as it offers the greatest reduction in post-rehabilitation monitoring and maintenance resource requirements.

15.1.2 Rehabilitation Monitoring and Maintenance

Despite no longer being operational post June 2028, Yallourn Mine will still require monitoring and maintenance for many years afterward. Monitoring and inspection requirements will increase during lake fill, at least during the early stages, as it will be important to capture the significant change to the landform and identify any changes in trends which may arise within the geotechnical domains. This is also reflected in the rehabilitation risk assessment results, which indicate that geotechnical and hydrogeological risks increase during the earlier stages of lake filling and reduce during the later stages of filling and the post fill stage. The lake water itself significantly reduces the maintenance requirement, as submerged land does not require ongoing maintenance (e.g. erosion, vegetation).

It is therefore envisaged that the overall monitoring and maintenance requirements will reduce as the lake approaches the full level and more data is captured, and trends are confirmed, however, this timing is uncertain and will be assessed as the project progresses. In contrast, the projected settlements of the MRD indicate that additional monitoring, inspection and maintenance of the structure may be required throughout the lake fill phase. This burden is expected to significantly reduce once the structure has been converted to the standard of a rural levee and a stable state is achieved (refer Section 8.12).

A critical component of the DMRP is the management of external catchment surface water through the use of diversion structures into the lake. This is due to the significant rising topography around the mine, which rises far above lake level (refer Section 8.9). Many of these, particularly around the western side of Township Field, will be permanent structures and will remain critical for maintaining stability of the rehabilitated mine. The structures are being designed to be low maintenance, with ongoing monitoring requirements being limited; however, they will remain essential for maintaining stability throughout the Design Intent Period (Section 0).

The GCMP (EnergyAustralia 2024c) will be the foundation of the monitoring and maintenance regime throughout the rehabilitation project. It will be routinely reviewed and updated throughout each phase, based on the performance of each of the geotechnical domains. The MRD Major Hazard GCMP will also be reviewed and updated on a similar basis. The outcomes of the GCMP will be routinely assessed against the closure criteria to ensure that the closure objectives are being met. The remediated MRD to Rural Levee will be managed in accordance with the Victorian Levee Management Guidelines (DELWP 2015).

Where performance does not meet the closure criteria, TARPs contain the corrective actions and responses required to bring the criteria to within their designated target range. Preventative routine and reactive maintenance will continue to be managed suited to the monitoring and maintenance requirement for relevant phase of rehabilitation and post-rehabilitation.

15.1.3 Post-Rehabilitation Monitoring and Maintenance

During lake fill it is expected that there will be changes to ground movement and groundwater trends within the pit and the surrounding land, as the landform reacts to the significant changes in stress induced by the lake and supporting activities. During the final phase of lake fill and post-lake fill the landform is expected to gradually stabilise, with movements no greater than the surrounding landform. In response to the stabilisation of the landform, the post-rehabilitation monitoring and maintenance regime will gradually reduce toward the baseline post-rehabilitation schedule. This is graphically represented in Figure 15-1. The exact monitoring and maintenance requirements will be determined following final detailed rehabilitation design. The goal is to minimis

e the monitoring and maintenance efforts as far as practicable, bringing them to a level comparable to that of the surrounding land uses.

15.1.4 Morwell River Diversion

The MRD currently has its own extensive monitoring and maintenance schedule. An array of ground movement and groundwater monitoring infrastructure is installed across the structure. This is regularly monitored and the data reviewed as part of the MRD Major Hazard GCMP. The structure is regularly inspected, including annual inspections by external consultants. This monitoring and inspection data is routinely analysed to assess the overall state of the structure.

The MRD requires routine maintenance to repair deformations which have occurred due to its continuous deterioration over time (refer Section 8.12 8.12). This includes ad hoc repairs of minor items such as sinkhole and crack repairs. Major maintenance and remedial works are informed by the performance reviews and mapped defects, with the most recent major works completed in 2022. As the structure is in a compromised state and is no longer capable of carrying the original design flood event, upstream diversions (emergency use only) are in place to damper large flood events.

In its current state the MRD will continue to deteriorate over time. As part of rehabilitation works, the embankment is planned to be converted to a less significant structure, which will effectively function as a rural levee running through the middle of two lakes. The lakes will operate at approximately the level of the MRD low flow channel. This is expected to significantly reduce the monitoring and maintenance demand, as well as the scale of potential failures and subsequent repairs to a feasible level.

15.1.5 Risk Assessment Considerations

The rehabilitation project risk assessment is detailed in Chapter 11 and presents a summary of the variations in geotechnical and hydrogeological risk ratings across each of the different phases of rehabilitation. Each value indicates the total number of risks for which the risk ranking has either increased or decreased compared to the previous phase. For example, when moving from Phase 2 to Phase 3b, there are 22 geotechnical risk scenarios that have increased in relative risk ranking and 31 that have decreased. This information is crucial for identifying the phases of rehabilitation that will require adjustments to monitoring and inspection protocols, in response to changes in the relative risk levels. It is evident that the most significant increase in risk occurs when transitioning into Phase 3a, followed by substantial reductions in risk during Phases 3b and 4. As a result, the frequency of monitoring and inspections will need to be increased as the project enters Phase 3a. Subsequently, these efforts can likely be scaled back as the project progresses through Phases 3b and 4, though this will be subject to further data review at those stages.

Table 15-1: Change in Relative Risk Rankings over the Rehabilitation Phases

Risk Aspect	Change	Phase 1	Phase 2	Phase 3a	Phase 3b	Phase 4
Geotechnical	Increase	0	0	22	0	0
	Decrease	3	2	31	61	41
Hydrogeological	Increase	0	0	12	0	0
	Decrease	0	2	10	0	17

The 22 increasing geotechnical risks in Phase 3a are linked to the following events:

- 4x Elevated groundwater levels
- 14x Floor heave
- 3x Relating to unbalanced loading from two different lake levels (MRD)

The increase in risk of floor heave is due to the requirement to decommission two of the three deep aquifer pump bores, which will be submerged during Phase 3a, reducing capacity to depressurise the aquifer. It is noted that this risk assessment is qualitative and future weight balance assessment will provide quantification of this risk.

The 12 increasing hydrogeological risks in Phase 3a are all linked to a decrease in groundwater levels, resulting in potential impact to groundwater quality and/or subsidence.

It should be noted that the risk ratings in Chapter 11 are inclusive of current and planned controls. The current monitoring and inspections requirement is quite high. The GCMP and associated monitoring and inspection program will be iteratively reviewed and updated throughout the rehabilitation and lake-fill phases, with increases and decreases in monitoring expected to broadly correlate with the change in relative risk. The overall monitoring is expected significantly decrease towards the later end of rehabilitation, in line with the long-term monitoring requirements.

Figure 15-2 Yallourn bore monitoring network

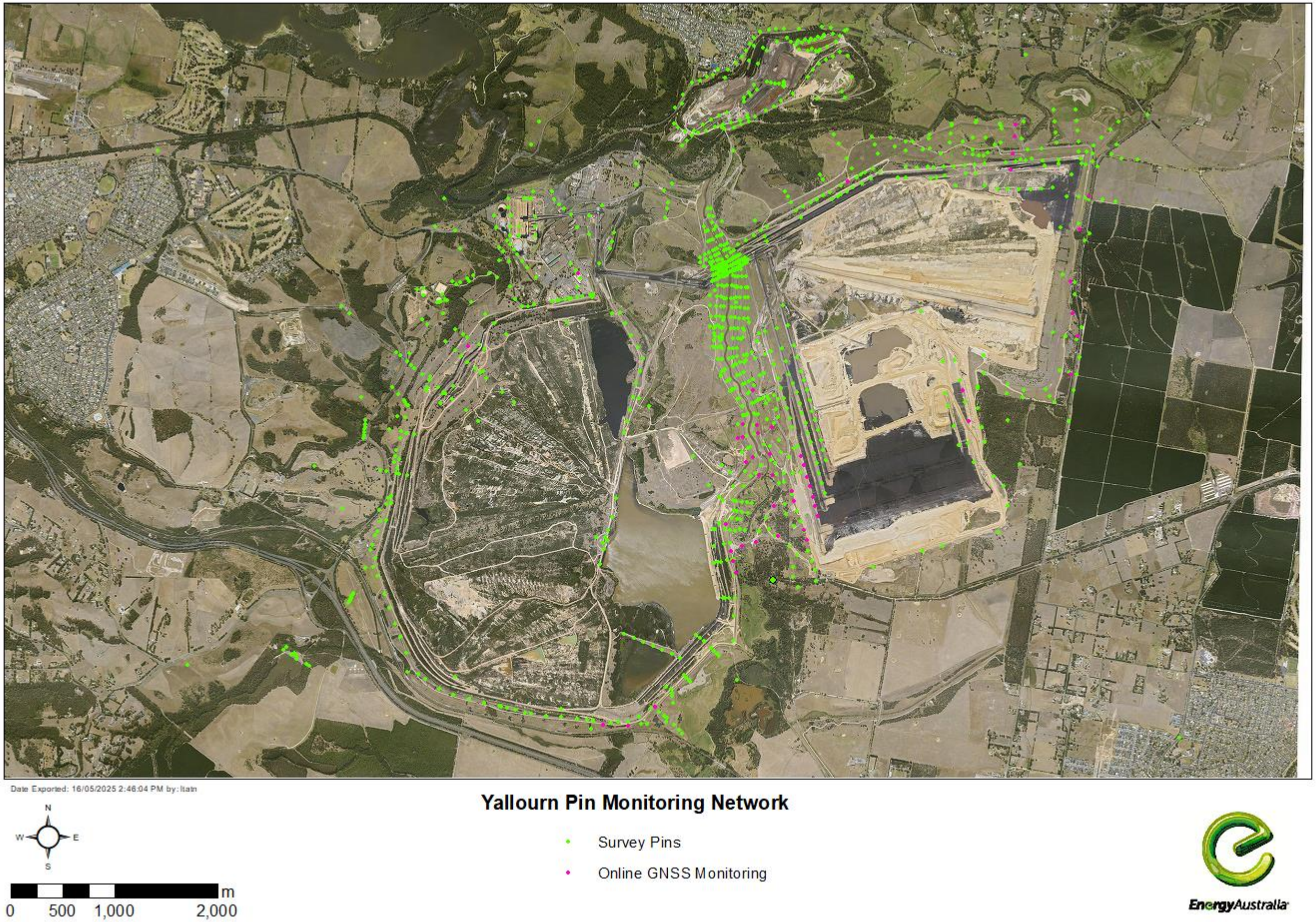


Figure 15-3 Yallourn survey pin monitoring network

15.2 Water Quality Monitoring

15.2.1 Surface Water Quality

The EAY surface water quality monitoring program has been in continuous operation since 1991 with weekly readings of physical parameters the immediate focus for EPA Licence compliance. Over time, the program developed as knowledge grew, risks were better understood, and the pit lake vision became more certain.

The current operational surface water quality program monitors 11 sites weekly for mainly physical parameters consistent with the EPA Licence parameters. In addition, monthly sampling is performed at those 11 sites plus an additional five locations to gather baseline data for rehabilitation purposes. The monthly water quality program includes the weekly physical parameters whilst including metals analysis, both dissolved and total concentrations. Some sites are also tested for a range of PFAS chemicals within the program. This testing includes the Fire Service Pond (YFSR), and Maryvale Field Floor (Y202) which are the start conditions for our future pit lake. These water bodies are the baseline for the water quality modelling and forecasting performed by the water quality technical study.

For the rehabilitation period, surface water testing will be reduced to the Fire Service Pond (YFSR), Maryvale Field Floor (Y202), and Latrobe River Intake (Y97) with the lake site locations continuously moved depending on the shoreline location. Metal concentrations will be tested at total and dissolved loads.

The proposed program for initial implementation is shown below in Table 15-2. As confident trends are established and modelling results are confirmed, sampling frequency will be reviewed and minimised in the future.

Table 15-2: Rehabilitation Water Quality Monitoring Parameters

Item	Parameter	Detection Limit	Testing Frequency
1	Time/Date	1 min	weekly
2	Temperature	0.5 °C	weekly
3	Suspended Solids	1 mg/l	weekly
4	PH	0.1 unit	weekly
5	Colour	5 Pt/Co	weekly
6	Electrical Conductivity	0.5 mS/m	weekly
7	Total Dissolved Solids	1 mg/l	weekly
8	Turbidity	0.05 NTU	weekly
9	Dissolved Oxygen	1 mg/l	monthly
10	Bicarbonate Alkalinity	0.5 mg/l	monthly
11	Carbonate Alkalinity	0.5 mg/l	monthly
12	Hydroxide Alkalinity	0.5 mg/l	monthly

Item	Parameter	Detection Limit	Testing Frequency
13	Sulphate	1 mg/l	monthly
14	Chloride	1 mg/l	monthly
15	Silica	0.5 mg/l	monthly
16	Sodium	0.1 mg/l	monthly
17	Potassium	0.05 mg/l	monthly
18	Calcium	0.02 mg/l	monthly
19	Magnesium	0.01 mg/l	monthly
20	Mercury	0.2 ug/l	monthly
21	Cadmium	0.1 ug/l	monthly
22	Aluminium	1 mg/l	monthly
23	Selenium	0.1 ug/l	monthly
24	Iron	25 ug/l	monthly
25	Manganese	0.3 ug/l	monthly
26	Zinc	5 ug/l	monthly
27	Copper	0.1 ug/l	monthly
28	Nickel	0.5 ug/l	monthly
29	Lead	0.1 ug/l	monthly
30	Chromium	0.1 ug/l	monthly
31	Molybdenum	0.5 ug/l	monthly
32	Arsenic	0.1 ug/l	monthly
33	Beryllium	0.1 ug/l	monthly
34	Boron	0.1 ug/l	monthly
35	Total Kjeldahl Nitrogen	0.01 mg/l	monthly
36	Ammonia	0.02 mg/l	monthly
37	Nitrate	5 ug/l	monthly
38	Nitrite	1 ug/l	monthly
39	Fluoride	1 ug/l	monthly
40	Ortho-Phosphate	0.01 mg/l	monthly
41	Total Phosphate	0.01 mg/l	monthly
42	Oil and Grease	5 mg/l	monthly

Item	Parameter	Detection Limit	Testing Frequency
43	E-coli	10CFU/100ml	monthly
44	PFAS suite	variable	Six monthly

15.2.2 Groundwater Quality

Shallow groundwater quality information is a key input in the water balance/water quality modelling process and provides the background quality of seepage water that is likely to enter a future pit lake.

Since 2022 SGS (a laboratory with National Association of Testing Authorities (NATA) accreditation) have been engaged to undertake routine groundwater sampling of 18 ex-pit locations and 13 in-pit locations as per Figure 15-4 below.

Samples were originally taken on a three-monthly basis but have since been reduced to a six-monthly basis (notionally summer / winter) due to the consistency of results found. Each sample is tested for the analytical suite shown in Table 15-3 below. The frequency of this sampling will be reviewed on an ongoing basis and is likely to be reduced as rehabilitation progress.

Table 15-3: Groundwater Quality Monitoring Parameters

General Parameters – ALL BORES	
pH	Gadolinium
Electrical Conductivity	Holmium
Dissolved Oxygen	Hafnium
Alkalinity Bicarbonate as $CaCO_3$	Indium
Alkalinity Carbonate	Iron
Alkalinity Hydroxide as $CaCO_3$	Lead
Alkalinity Total	Lanthanum
Acidity as $CaCO_3$	Lithium
Hardness Total as $CaCO_3$	Lutetium
Total Dissolved Solids	Manganese
Major elements (Dissolved)	Mercury
Calcium	Molybdenum
Chloride	Neodymium
Fluoride	Nickel
Potassium	Praseodymium
Magnesium	Rubidium

General Parameters – ALL BORES	
Sodium	Samarium
Sulphate	Selenium
Nitrate as N	Silver
Nitrite + Nitrate as N	Strontium
Nitrite as N	Terbium
Ammonia as N	Thallium
Total Kjeldahl Nitrogen as N	Thorium
Total Phosphorus as P	Tin
Reactive Phosphorus as P	Thulium
Total Organic Carbon	Tellurium
Trace metal(loids) (Dissolved)	Titanium
Aluminium	Uranium
Antimony	Vanadium
Arsenic	Ytterbium
Boron	Yttrium
Beryllium	Zinc
Barium	Zirconium
Cadmium	Ionic Balance
Cerium	Total Anions
Chromium - total	Total Cations
Cobalt	Organics – SELECTED BORES*
Copper	TRH and BTEXN
Dysprosium	PAHs
Erbium	Low-level PFAS – Full Suite
Europium	
Gallium	
*Only in-pit groundwater wells and ex-pit well N7447 are be analysed for organics.	

Figure 15-4: Ground Water Sampling Location (Yellow in-pit / Red-ex pit)

As monitoring progresses in line with modelling expectations and risk is reduced, groundwater monitoring sites and frequencies will be reduced.

15.3 Water Quantity Monitoring

15.3.1 River Monitoring

DEECA and Southern Rural Water (SRW) monitor regional river heights and flows around the Yallourn site. In addition, EAY has installed four additional live monitoring points which give good coverage across the Mining Licence.

These flow and height measurements will continue throughout the rehabilitation period, continually measuring against nominate trigger points and design flow estimates. A plan of the monitoring sites is shown below.

Figure 15-5: River Height and Flow Monitoring at the Yallourn Site

15.3.2 Mine Water Monitoring

Understanding the operational water balance is essential for planning a pit lake. The operational water balance provides information on the inflows, outflows, and changes in storage within the Mine. These variables can then be used as a basis for modelling and forecasting lake filling times. Flow metering, ultrasonic height readers, piezometric pressure gauges, and weather stations, all provide data which feeds into the site water balance.

The operational water balance operates at a daily, monthly, and annual time step with different levels of detailed offered for each time step. This water balance will be modified to suit the pit lake filling period. Piezometers will be used for live water level recording with survey checks undertaken annually or by exception. An example of the rehabilitation water balance elements are shown below. These elements will be supported by flow, rainfall, and evaporation, modelling and monitoring.

- Inflow
  - Water via Bulk Water Entitlement
  - Groundwater
  - Catchment
  - Direct Rainfall
- Outflow
  - Evaporation
- Storage
  - Change in storage based on piezometric height measurement and DTM

Water balance analysis of operational areas currently produces an 8 GL excess volume of water annually. This excess will be tracked during rehabilitation against water balance modelling forecasts from the WB/WQ model in section 8.8.

15.4 Land Monitoring

15.4.1 Landscape Function Analysis

Landscape Function Analysis (LFA) is a field-based method used to assess the functionality of landscapes as biophysical systems (IDEM 2025). It involves evaluating various indicators to determine how well a landscape can capture, retain, and utilise resources like water, soil, and nutrients. LFA is particularly useful for monitoring mine rehabilitation efforts and understanding the spatial and functional organization of landscapes. The method includes a conceptual framework, field procedures for assessing indicators, and an interpretational framework to analyse the collected data.

LFA has been completed at Yallourn Mine since 2005, providing a good baseline of results and information which is used to develop closure criteria.

LFA monitoring will continue annually through rehabilitation to demonstrate compliance with the nominated closure criteria. Each individual site will be assessed at no longer than three years apart, with monitoring reducing once results are trending towards sustainable consistency.

15.4.2 Vegetation Assessments

The primary vegetation survey method conducted alongside LFA, is quadrat-based recording understorey structure, diversity, canopy basal area, canopy density and other attributes in rehabilitated areas (IDEM 2025). Plotless distance-measuring methods utilising the point-centred quarter (PCQ) and wandering quarter (WQ) surveys record density, species composition and growth rates for different lifeforms including trees, shrubs and grasses and are conducted concurrently with LFA in rehabilitated areas (IDEM 2025).

The PCQ method involves utilising the LFA transect (or other straight line) and dividing it into a minimum of 20 equal points (IDEM 2025). At each point, the distance to the nearest plant of interest (tree, shrub, grass, etc.) along with information including species, height, cover, etc. are measured from 4 sectors (see Figure 15-6) (IDEM 2025). The same plant cannot be sampled twice and the distance between each point depends on the lifeform and density of the plants being sampled. Once a minimum of 80 plants has been sampled, density can be calculated.

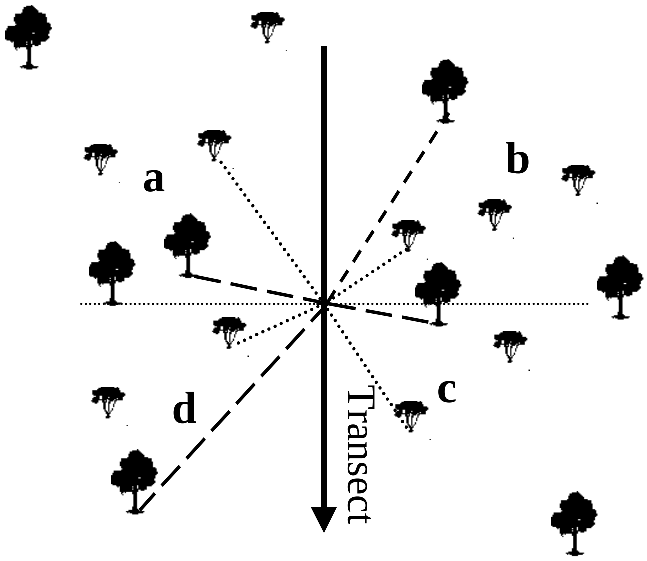


Figure 15-6: The point-centred quarter (PCQ) method of measuring spatial distribution of vegetation (IDEM 2025)

The WQ method is better suited to sparse vegetation. It begins at the start of the transect and using its compass bearing, measure the distance to base of the nearest plant which is within a 90 degree arc centred on the compass bearing (IDEM 2025). Then moving to that plant and on the same compass bearing find and measure the distance to the next plant. Continuing to do this until at least 25 plants are recorded or the other boundary of the monitored area is reached completed the method (see Figure 15-7) (IDEM 2025).

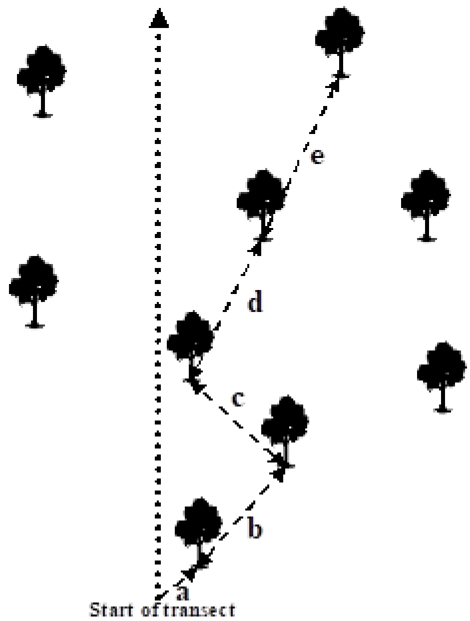


Figure 15-7: The wandering quarter (WQ) method of measuring spatial distribution of vegetation (IDEM 2025)

15.4.3 Erosion Monitoring

An erosion monitoring program has been established at EnergyAustralia Yallourn to address the requirements of the 2001 EES, which requires biological monitoring throughout all phases of the Maryvale Coal Field project including an evaluation of the diversion channel for channel stability (IDEM 2025).

Assessment for erosion on the Morwell River Diversion (MRD) is currently undertaken every 3 years to identify bank and bed erosion which is mapped to monitor areas of concern and compare to previous survey results.

In addition, rill monitoring has twice been conducted on the East Field Extension (EFEX) batters utilising the LFA transects as the reference. Transverse transects are established ±25 metres (for a total of 50m) along the contour of the batters at 25%, 50% and 75% of the LFA reference transect. The transverse transects are surveyed recording rill location and its corresponding width and depth. This provides results on the number of rills, spatial distribution and cross-section which can then be compared over time.

Erosion monitoring will continue throughout rehabilitation with the specific plan currently listed as a knowledge gap (KG24 in Table 17-1).

15.5 Flora and Fauna

15.5.1 Terrestrial Flora and Fauna

Annual terrestrial fauna surveys rotate through selected CMP remnants and rehabilitated areas of the township fields (IDEM 2025). These surveys involve active surveying at locations utilising Elliott trapping, Harp trapping, spotlighting and active searching; and remote surveying at locations utilising bat detectors and trail cameras with lures.

Visual bird surveys are conducted quarterly through the wetland CMP blocks by the Latrobe Valley Field Naturalists, recording all species observed.

Pest animals are monitored through the use of trail cameras. These trail cameras are installed quarterly in areas of known pest animal frequency which automatically take images when triggered after sensing movement. This method is not suitable for determining pest animal abundance, but trigger numbers are recorded pre- and post-pest animal control activities to corroborate control success.

15.5.2 Aquatic Flora and Fauna

The 2001 EES required an evaluation of the Morwell River Diversion (MRD) diversion channel for instream habitat and instream faunal diversity (IDEM 2025). Assessment for aquatic fauna, river health (i.e. aquatic macroinvertebrates and Rapid Bioassessment or RBA) are undertaken on a rotational schedule to fulfill this condition. RBA is completed annually, and aquatic fauna surveys completed every three years.

Aquatic fauna biodiversity values in the MRD and Morwell River are surveyed using backpack electrofishing, dip-netting, fyke nets and bait traps, aquatic macroinvertebrates or RBA are sampled and identified and in situ water quality is analysed from four locations.

15.6 Air Monitoring

15.6.1 Dust Monitoring

Dust monitoring includes live monitoring at three perimeter sites and dust deposition monitoring at six sites which are sampled each month. This monitoring will continue through the rehabilitation construction period until the risk from dust events is minimised.

15.7 Aerial Photography

Aerial photography is a good tool for visually seeing rehabilitation progress and issues. Aerial photos can be used internally and by the public to test rehabilitation area reporting, infrastructure removal, lake area, exposed coal area, and map continuous improvement of the site.

Chapter 16 Post Closure Plan

The Post Closure Plan applies to the post-relinquishment phase. A key objective of this DMRP is to require minimal or no post closure maintenance, however it is possible that actual monitoring results do not follow the projections of models and technical studies. Furthermore, environmental events outside of the design range, or other unforeseen risks, may result in the need for future remediation work post closure. To maintain ongoing confidence in the post closure landform, a post closure maintenance and monitoring program will be implemented with a Trigger, Action, Response, Plan (TARP). The TARP will nominate a response to an unwanted or unplanned rehabilitation outcome.

The monitoring programs below are conceptual, with monitoring completed during the rehabilitation implementation phase used to guide an appropriate number of sites, parameters, testing frequencies, and analysis requirements in the post closure phase.

If post closure maintenance is required due to unacceptable monitoring, or unplanned events, the Post Closure Fund contribution by EAY will be used for financial assistance.

16.1 Geotechnical Monitoring

Monitoring completed during the implementation phase will give confidence in achieving safe and stable geotechnical conditions. It is expected that a scaled program for geotechnical monitoring will remain post lake filling with a specific program to be developed at a later date. Also refer to 15.1.3.

16.2 Water Quality Monitoring

Although modelling suggests that water quality within the mine will support many beneficial uses of the lake, water quality monitoring is expected to continue in line with other recreational lakes within Victoria. This will ensure safe conditions for recreational users and environmental requirements. The locations and frequency of this program are yet to be determined.

16.3 Water Quantity Monitoring

Flows across all spillways will likely be monitored through well-established methods. Monitoring of the lake water balance during implementation will determine top up water requirements post closure. Any top up water required will also be monitored.

16.4 MRD Monitoring

Post closure, the MRD is expected to be in a safe and stable condition that functions as a rural levee in accordance with the Victorian *Levee Management Guidelines* (DELWP 2015). This will include an inspection program and targeted monitoring and maintenance program in accordance with the abovementioned guidelines and performance assessment. Also refer to 15.1.4.

16.5 Routine Maintenance

A key objective for site management of Yallourn site post-rehabilitation is to deliver a landform that requires minimal active monitoring and maintenance and can predominantly be managed passively. In response, the landform design removes much of the active maintenance requirements with only those listed below expected to be required:

- Targeted slashing program
- Targeted weed and pest control
- MRD Rural Levee (as per Victorian *Levee Management Guidelines* (DELWP 2015))

16.6 Response Maintenance

With routine maintenance limited in the post closure phase, majority of the maintenance requirement will be dependent on monitoring and inspection findings. TARPs will be developed for all monitoring programs with nominated actions completed based on risk.

16.7 Post Closure Cost

Costing the post closure program is a requirement of the MRSDA and MRSDMIR at relinquishment. However, with this program not scheduled for approximately 30 years, forecasting this activity accurately is not considered practical. The principles of this DMRP and Net Present Value (NPV) will lead to a low post closure cost if assessed today, however developing accurate post closure cost forecasts is nominated as a knowledge gap (KG31 in Table 17-1).

It is also expected that these maintenance and monitoring plans will be adapted to suit the nominated land use as below.

- Lake Water Maintenance and Monitoring Plan
- Environmental Area Maintenance and Monitoring
- Recreational Area Maintenance and Monitoring
- Conservation Area Maintenance and Monitoring
- Agricultural Land Maintenance and Monitoring
- Industrial Area Maintenance and Monitoring

Chapter 17 Knowledge Gaps

Whilst there is currently a good understanding of mine rehabilitation and the pit lake concept, EAY acknowledges that not all rehabilitation answers are currently known. This section outlines the current knowledge gaps, and the timelines proposed to address these gaps in the future.

Table 17-1: Action Plan to Reduce Knowledge Gaps

Item	Knowledge Gap	Required For	Complete by end
KG01	Prioritisation of groundwater dependent ecosystems that may be influenced by the pit lake, and field-based review of those GDE.	Technical Studies	2026
KG02	Review of groundwater dependent ecosystems with consideration of the groundwater numerical modelling findings to estimate any impacts from the lake.	Technical Studies	2026
KG03	Hydrodynamic modelling of pit lake Stage 1: Temperature and TDS	Technical Studies	2026
KG04	Agreed geotechnical design acceptance criteria	Technical Studies Landform Design	2026
KG05	Detailed design of geotechnical buttresses	Technical Studies Landform Design	2026
KG06	Detailed design of MRD Tunnel modifications	Technical Studies Water Delivery System	2026
KG07	Detailed design of MRD to transform to Rural Levee	Landform Design Risk Management	2026
KG08	Detailed design of MRD surface stabilisation	Landform Design Risk Management	2026
KG09	Detailed design of peripheral drain diversion structures	Landform Design Risk Management	2026
KG10	Condition assessment of all site levees along Morwell River and Latrobe River	Landform Design Risk Management	2026
KG11	Research coal capillary rise to inform coal cover designs.	Landform Design	2026
KG12	Detailed Mine Weight Balance Assessment against progressive filling and parallel pumping requirements	Landform Design Risk Management	2026
KG13	Optimisation of water delivery system	Technical Studies	2026

Item	Knowledge Gap	Required For	Complete by end
		Water Delivery System	
KG14	Detailed design of MRD and Lake Spillways and decision on time to construct.	Landform Design Risk Management	2027
KG15	Detailed Regional Water Quality, considering Water Balance and Water Quality impact assessment	Landform Design Risk Management	2027
KG16	Review of fish passage structures on spillways (inlet and outlets)	Technical Studies Landform Design	2027
KG17	Hydrodynamic modelling of pit lake Stage 2: Nutrients	Technical Studies	2027
KG18	Work Plan requirements post operational period	Legal Requirements	2027
KG19	Strategic plan for Fire Service System retreat as impacted by lake filling and batter reshaping	Infrastructure removal Risk management	2027
KG20	Detailed study of landform performance against design wave action forces	Technical Studies Landform Design	2027
KG21	Extent and impact of lake stratification and turnover	Technical Studies Monitoring and Maintenance	2027
KG22	Lake Yallourn operating range / heights including top up water trigger	Technical Studies Landform Design Monitoring and Maintenance	2027
KG23	Detailed Decommissioning, Demolition, and Removal Plan to be finalised	Key Activities • Infrastructure Removal • Pit Lake Filling	2027
KG24	Finalise detailed Erosion Monitoring Plan	Monitoring and Maintenance	2028
KG25	Detailed closure criteria developed for all DMRP aspects	Closure Criteria	2028
KG26	Review of whether lake water quality could support algal growth and undertake environmental risk assessment. Develop a testing program if required.	Technical Study Monitoring and Maintenance	2029

Item	Knowledge Gap	Required For	Complete by end
KG27	Measurement of actual evaporation rates to understand estimating method accuracy	Pit Lake Filling Project schedule	2032
KG28	Detailed designation of habitat land use against open space	Post Closure Land Use	2035
KG29	Detailed design for location and public access to lake areas	Post Closure Land Use	2035
KG30	Detailed design of engineered erosion protection	Technical Studies Landform Design	2035
KG31	Develop accurate post closure monitoring plan and cost forecast	Post Closure Plan	2040
KG32	Monitor water balance and apply for appropriate top up water quantities	Post Closure Plan	2040
KG32	Continue to review water quality modelling results, resolve data gaps, and undertake/update risk assessments. This will be dependent on the completion of other studies and timing will be determined as part of project planning.	Technical studies	2040

Noting the planning cycle raised in 3.7.1, completing the nominated knowledge gaps may result in further gaps to be addressed. Live tracking of these actions will be managed through existing site management systems.

Chapter 18 Conclusion

EAY has the following vision for the mine rehabilitation:

To transform the Yallourn site into a landscape that enables ongoing prosperity and amenity for all. One that is an example of what can be achieved when business, government, communities, and custodians of the land work together.

This vision centres around the transformation of the current pit voids into a pit lake and EAY's aspiration that it will be capable of supporting recreational uses.

This DMRP outlines the site setting, legal requirements, government policy and decision making, environmental setting, and objectives, which highlight the pit lake or fully flooded option as the preferred safe, stable, and sustainable, mine rehabilitation concept for Yallourn.

Enhancing this knowledge base through technical studies, progressive rehabilitation, and detailed risk assessments confirms the pit lake as the preferred concept but also highlights additional design considerations and work packages that are needed to control risk appropriately, and to enable post closure beneficial uses for the community. This journey of design work and further specialist studies has begun but there is further work committed through the knowledge gaps chapter.

A closure criteria framework with some specific metrics has been developed, with a monitoring program designed to ensure compliance or respond appropriately to triggers and alerts where unexpected results are found. Implementing the design to the nominated closure criteria will be the responsibility of the EAY team, with many expert consultants and 3rd parties engaged to ensure community and regulatory standards are met. Where closure criteria are not yet developed, community and stakeholder engagement will drive agreement forward.

The nominated timeframe for pit lake filling is 24 years, which primarily balances the need for adequate environmental water to stay in the Latrobe River system, against the water volume available for pit lake filling. EAY will investigate ways to complete this in the most optimum timeframe which best suits meeting safe, stable, and sustainable criteria, plus allowing the benefits of a pit lake to be enjoyed sooner.

We trust that this DMRP meets the expectations of government, our local community, GLaWAC, and other interested parties. EAY looks forward to transforming the Yallourn Mine into a lake and providing a surrounding landform and land use that honours Yallourn's legacy, whilst enabling ongoing prosperity for all.

Chapter 19 References

AECOM (2009) *Yallourn Coal Field Re-alignment Environment Report*. AECOM Australia Pty Ltd. 60022019. A1994452.

AGC Woodward-Clyde Pty Ltd (1999) *Environmental Effects Statement Maryvale Coal Field Development*. A1313912.

Alluvium (2020) *Latrobe environmental water requirements investigation* Alluvium Consulting Australia Pty Ltd, prepared for the West Gippsland Catchment Management Authority,. https://www.water.vic.gov.au/__data/assets/pdf_file/0030/672177/environmental-water-requirements-report-latrobe-environmental-water-requirements-investigation.pdf

Alluvium (2021) *Estimation of the flow rate and exceedance probability June 2021 flood event in the Morwell River – Detailed investigation* Alluvium Consulting Australia Pty Ltd. A2020575.

Alluvium (2025) *The Latrobe River system: Regional hydrologic assessment of EnergyAustralia Yallourn mine closure scenarios*. Alluvium Consulting Australia Pty Ltd.

Alluvium and HARC (2023) *Type of conditions that could apply to water access for Latrobe Valley mine rehabilitation and associated risks and benefits*. Prepared for the Department of Energy, Environment and Climate Action. https://resources.vic.gov.au/projects/lvrrs/reports

Anderson, T. and Butler, A. (2016). "A standard for design life and durability for engineered mine wastes structures." Journal of Cleaner Production, (141): pg 67-74.

ANZG (2018) *Australian & New Zealand Guidelines for Fresh & Marine Water Quality*. Water Quality Australia, Commonwealth of Australia,. https://www.waterquality.gov.au/anz-guidelines

Aquatica Environmental (2023) *Yallourn Morwell River Diversion, Autumn 2023 Habitat, Aquatic Fauna and Macroinvertebrate, Water Quality and Australian Grayling eDNA Assessment*. A2264425.

Australian Standards (2021) *Mine closure and reclamation – Vocabulary (AS ISO 20305:2021)*. A2394054. https://www.iso.org/standard/67591.html

Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M. and Testoni, I. (2019) *Australian Rainfall and Runoff: A Guide to Flood Estimation*. Commonwealth of Australia. https://arr.ga.gov.au/

Barnett, B., Townley, LR., Post, V., Evans, RE., Hunt, RJ., Peeters, L., Richardson, S., Werner, AD., Knapton, A. and Boronkay, A. (2012) *Australian groundwater modelling guidelines*. https://www.researchgate.net/publication/258245391_Australian_Groundwater_Modelling_Guidelines

Baumgartl, T. (2020) *Batter Stability Project Report*. Geotechnical and Hydrogeological Engineering Research Group (GHERG) of Federation University Australia.

Beamish, B. and Theiler, J. (2022) *Spontaneous combustion hazard assessment of lignite samples from Yallourn Mine*. B3 Mining Services Pty Ltd. TR062.

BlueSphere (2021) *Auditor verification of Yallourn Landfill and Twin Ash Pond Rehabilitation Plan*. BlueSphere Environmental Pty Ltd. A2040391.

BOM (2023). "*Groundwater Dependent Ecosystem Atlas*." Bureau of Meteorology. Accessed January 2023 by ERM, from http://www.bom.gov.au/water/groundwater/gde/.

BOM (2025a). "*Climate statistics for Australian locations: Summary statistics for Morwell (Latrobe Valley Airport)*." Bureau of Meteorology. Accessed 19/05/2025, from http://www.bom.gov.au/climate/averages/tables/cw_085280.shtml.

BOM (2025b). "*Design Rainfall Data System (2016)*." Bureau of Meteorology. Accessed 19/05/2025, from http://www.bom.gov.au/water/designRainfalls/revised-ifd/?multipoint.

Consultation Manager (2024). "*Streamline and synchronise your stakeholder relationships*." Accessed 07/05/2025, from https://www.consultationmanager.com/product-tour/.

DCCEEW ("*Protected Matters Search Tool*." Australian Government: Department of Climate Change, Energy, the Environment and Water. Accessed December 2022 by ERM, from https://pmst.awe.gov.au/.

DCCEEW (2025, 01/03/2025). "*Nature Repair Market*." Australian Government: Department of Climate Change, Energy, the Environment and Water,. Accessed 13/05/2025, from https://www.dcceew.gov.au/environment/environmental-markets/nature-repair-market.

DEECA (2023a) *Latrobe Valley Regional Rehabilitation Strategy - Amendment* Department of Energy, Environment and Climate Action. State Government of Victoria. A2329889. https://resources.vic.gov.au/projects/lvrrs

DEECA (2023b). "*Mapshare Vic*." Victorian Government: Department of Energy, Environment and Climate Action. Accessed January 2023 by ERM, from https://mapshare.vic.gov.au/mapsharevic/.

DEECA (2024a, 20/11/2024). "*Bioregions and EVC benchmarks*." Victorian Government: Department of Energy, Environment and Climate Action. Accessed 20/05/2025, from https://www.environment.vic.gov.au/biodiversity/bioregions-and-evc-benchmarks.

DEECA (2024b) *DRAFT Ministerial Guidelines for preperation of Declared Mine Rehabilitation Plans* Department of Energy, Environment and Climate Action. Resources Victoria, State of Victoria.

DEECA (2024c) *Victoria's Water Measurement Information System*. Department of Energy, Environment and Climate Action. State Government of Victoria. https://data.water.vic.gov.au/

DELWP (2015) *Levee Management Guidelines*. Department of Environment, Land, Water and Planning. State of Victoria. https://www.water.vic.gov.au/our-programs/floodplain-management/levee-management

DELWP (2017) *Protecting Victoria's Environment - Biodiversity 2037*. Department of Environment, Land, Water and Planning. State Government of Victoria. https://www.environment.vic.gov.au/biodiversity/biodiversity-plan

DELWP (2019) *Latrobe Valley Social History: Celebrating and recognising Latrobe Valley's history and heritage*. Department of Environment, Land, Water and Planning. State Government of Victoria. A1734693. https://resources.vic.gov.au/projects/lvrrs/reports

DELWP (2020) *Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria*. Department of Environment, Land, Water and Planning. State Government of Victoria. https://www.water.vic.gov.au/our-programs/climate-change-and-victorias-water-sector/climate-change-water-resources/water-availability-climate-change-guidelines

DELWP (2022) *Central and Gippsland Region Sustainable Water Strategy*. Department of Environment, Land, Water and Planning. State Government of Victoria. https://www.water.vic.gov.au/our-programs/long-term-water-resource-assessments-and-strategies/sustainable-water-strategies/central-and-gipps-sws

DEMIRS (2025) *Guideline for preparing Mine Closure Plans*. Department of Energy, Mines, Industry Regulation and Safety. Government of Western Australia https://www.wa.gov.au/system/files/2025-04/guideline_preparing_mining_closure_plan.pdf

DJPR (2020) *EnergyAustralia Yallourn 2019 Work Plan Variation (WPV) Conditions 5 & 6*. Department of Jobs, Precincts and Regions,. State Government of Victoria. A1910687.

DJPR and DELWP (2000) *Latrobe Valley Regional Rehabilitation Strategy*. Department of Jobs, Precincts and Regions, and Department of Environment, Land, Water and Planning,. State Government of Victoria. A2329886. https://resources.vic.gov.au/projects/lvrrs

DNRE (2002) *Work Plan Variation - Mining Licences 5003, 5216 and 5304*. Department of Natural Resources and Environment. State Government of Victoria. A1120924.

DPI (2011) *Mining Licence 5003*. Department of Primary Industries. State Government of Victoria. A1040310.

DSE (2004) *EVC/Bioregion Benchmark for Vegetation Quality Assessment*. Department of Sustainability and Environment. State of Victoria. https://www.environment.vic.gov.au/biodiversity/bioregions-and-evc-benchmarks

DTP (2023) *Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978*. Department of Transport and Planning. State Government of Victoria. https://www.planning.vic.gov.au/environmental-assessments/environmental-assessment-guides/ministerial-guidelines-for-assessment-of-environmental-effects

EnergyAustralia (2019) *SHEMS07-MIN-L02 Yallourn Mine Rehabilitation and Closure Plan (RCP)*. A1405987.

EnergyAustralia (2021). "*EnergyAustralia powers ahead with energy transition*." Accessed 14/5/2025, from https://www.energyaustralia.com.au/about-us/media/news/energyaustralia-powers-ahead-energy-transition.

EnergyAustralia (2023a) *Innovate Reconciliation Action Plan 2023 - 2025*. https://www.energyaustralia.com.au/about-us/community/supporting-first-nations-peoples

EnergyAustralia (2023b) *SHEMS13-SHE-L04 - Mine Fire Control Management Plan (FCMP)*. A1065137.

EnergyAustralia (2023c) *Wooreen Energy Storage System Project Fact Sheet*. https://www.energyaustralia.com.au/about-us/what-we-do/new-energy-projects/wooreen-energy-storage-system

EnergyAustralia (2024a) *Climate Transition Action Plan 2024*. https://www.energyaustralia.com.au/about-us/sustainability

EnergyAustralia (2024b) *Health, Safety, Security and Environment (HSSE) Policy*.

EnergyAustralia (2024c) *SHEMS13-SHE-L03 - Ground Control Management Plan (GCMP) Revision 13*. A1029761.

EnergyAustralia (2025) *EnergyAustralia Community Update April 2025*.

EPA (2022) *Environment Reference Standard*. Environment Protection Authority Victoria. State Government of Victoria. https://www.epa.vic.gov.au/about-epa/laws/compliance-and-directions/environment-reference-standard

EPA (2023) *Operating Licence OL000010961 for EnergyAustralia Yallourn Pty Ltd*. Environment Protection Authority Victoria. State Government of Victoria. A2218022. https://www.epa.vic.gov.au/about-epa/public-registers/permissions/public-register-details?id=OL000010961

ERM (2023a) *Groundwater Dependent Ecosystems (GDE) Review*. Environmental Resources Management Australia Pty Ltd. 0666315.

ERM (2023b) *Mine Rehabilitation Visioning Workshops: Outcomes Report*. Environmental Resources Management Australia Pty Ltd. 0681306.

ERM (2023c) *Mine Rehabilitation Visioning Workshops: Outcomes Report - Addendum*. Environmental Resources Management Australia Pty Ltd. 0696899.

ERM (2024) *Hydrogeological Numerical Model: summary of works letter*. Environmental Resources Management Australia Pty Ltd. 0576247_L05_Final.

ERR and EPA (2021) *Memorandum of Understanding*. Earth Resources Regulation Unit of The Department of Jobs, Precincts and Regions, and Environment Protection Authority Victoria,. https://resources.vic.gov.au/__data/assets/pdf_file/0004/685345/Earth-Resources-Regulation-and-Environment-Protection-Authority-MoU-23-June-2021-Final.pdf

FedUni (2023). "*Visualising Victoria's Groundwater (VVG) database*." Federation University Australia Mt Helen. Accessed January 2023 by ERM, from https://www.vvg.org.au/.

Foran, T., Reeves, J. and Haque, K. (2024) *Collaborative planning for people navigating mine land transition: progress in Australia's Latrobe Valley.* CRC TiME. ISBN 978-1-922704-31-3. A2331159. https://crctime.com.au/macwp/wp-content/uploads/2024/06/Project-1.7-Stage-1_Final-Report_approved.pdf

Fourie, A. B., Tibbett, M. and De Jong, J. (2021). *The fallacy of designing for in-perpetuity: geotechnical presumptions, ecosystem responses and concepts for managing inevitable change*. Mine Closure 2012: Proceedings of the Seventh International Conference on Mine Closure. Australian Centre for Geomechanics. Perth**:** pg 127-136.

Geo-Eng (1993) *Yallourn Open Cut Mine Rehabilitation Assessment of Open Cut Stability Proposed Flooding Option*. G.-e. P. Ltd. 1155/2. A1219556.

GHD (2009) *Mine Rehabilitation Options and Scenarios for the Latrobe Valley: Developing a Rehabilitation Framework*. Regional Monitoring Committee. 31/22098/152999. A1043124.

GHD (2012) *Report for Yallourn Mine Rehabilitation Geotechnical Assessment of Flooding Options*. GHD Pty Ltd. 31/27070/15819. A1047231.

GHD (2020) *Yallourn Mine Closure Lake Scenario MVF Batter Stability Assessment*. GHD Pty Ltd. 12510687. A1686295.

GHD (2023) *Yallourn Rehabilitation Hydrogeological Modelling: Hydrogeological Conceptual Model*. GHD Pty Ltd. 12521481. A2190941.

GHD (2024a) *Latrobe Valley Regional Groundwater and Land Level Monitoring Report: Annual Report July 2023 to June 2024*. Regional Monitoring Committee. 12643645. A2340136.

GHD (2024b) *Yallourn Mine Rehabilitation Mine Pit Lake Triggered Seismicity Preliminary Assessment*. GHD Pty Ltd. 12619712. A2265281.

GHD (2025a) *Declared Mine Rehabilitation Plan Risk Assessment Report*. GHD Pty Ltd. 12643220.

GHD (2025b) *Yallourn Rehabilitation Hydrogeological Modelling: Numerical Groundwater Model – Design, Construction and Calibration Report*. GHD Pty Ltd. 12521481.

GHD (2025c) *Yallourn Rehabilitation Hydrogeological Modelling: Numerical Groundwater Model – Rehabilitation Scenario Modelling Report*. GHD Pty Ltd. 12521481.

Gilbert, D. M., Coghlan, I. R. and Carley, J. T. (2025) *DRAFT Yallourn Mine pit closure – wind wave and shoreline protection analysis*. UNSW Water Research Laboratory. RWL Technical Report 2024/09.

GLaWAC (2015) *Gunaikurnai Whole-of-Country Plan* Gunaikurnai Land and Waters Aboriginal Corporation. https://gunaikurnai.org/our-news/publications/

Haque, K., Reeves, J. and Foran, T. (2024) *Regional development aspirations for the Latrobe Valley and Gippsland: Setting the context for post mine land use planning.* CRC TiME. ISBN 978-1-922704-32-0. https://crctime.com.au/macwp/wp-content/uploads/2024/06/Project-1.7-Stage-1_Reg-Dev-Report_approved.pdf

IAP2 (2023) *Quality Assurance Standard for Community and Stakeholder Engagement*. International Association for Public Participation. A2329889. https://iap2.org.au/resources/quality-assurance-standard/

ICMM (2025) *Integrated Mine Closure: Good Practice Guide 3rd edition*. International Council on Mining and Metals. A2393708. https://www.icmm.com/integrated-mine-closure

IDEM (2020) *Yallourn Conservation Strategy*. Indigenous Design Environmental Management. A2150344.

IDEM (2022) *Summary of vertebrate faunal diversity in Yallourn Conservation Management Plan blocks*. ID Ecological Management. A2126361.

IDEM (2023) *Revised EPBC Offset Management Plan: Yallourn Coal Field Re-alignment Project EPBC 2008/4454*. ID Ecological Management. https://www.energyaustralia.com.au/about-us/energy-generation/yallourn-power-station/environment/environment-protection-biodiversity-and-conservation-act-annual-report

IDEM (2025) *EAY Land and Conservation Monitoring Program Summary* ID Ecological Management. A2394229.

IDLM (2008) *Ecological Assessment: Yallourn Coal Field Development Maryvale Field Eastern Extension*. Indigenous Design Land Management P/L. A2394227.

IEC and ISO (2019) *Risk Management – Risk assessment Techniques (IEC 31010:2019)* International Electrotechnical Commission and International Organization for Standardization. https://www.iso.org/standard/72140.html

IESC (2024, 26/02/2024). "*About the Independent Expert Scientific Committee on Unconventional Gas Development and Large Coal Mining Development (IESC)*." Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining. Accessed 01/05/2025, from https://www.iesc.gov.au/about-us.

ISO (2015a) *Environmental management systems - Requirements with guidance for use (ISO 14001:2015)*. International Organization for Standardization. https://www.iso.org/standard/60857.html

ISO (2015b) *Quality management systems - Requirements (ISO 9001:2015)*. International Organization for Standardization. https://www.iso.org/standard/62085.html

ISO (2018a) *Occupational health and safety management systems - Requirements with guidance for use (ISO 45001:2018)*. International Organization for Standardization. https://www.iso.org/standard/63787.html

ISO (2018b) *Risk Management – Guidelines (ISO 31000:2018)* International Organization for Standardization. https://www.iso.org/standard/65694.html

ISO (2021a) *Mine closure and reclamation planning – Part 1: Requirements (ISO 21795-1:2021)*. International Organization for Standardization. A2394052. https://www.iso.org/standard/80425.html

ISO (2021b) *Mine closure and reclamation planning – Part 2: Guidance (ISO 21795-2:2021)* International Organization for Standardization. A2394053. https://www.iso.org/standard/80426.html

Jacobs (2020a) *Latrobe Valley Regional Rehabilitation Strategy Identification of Recognised Regional Receptors*. prepared for Department of Jobs, Precincts and Regions. LVRRS1617001. A2329883. https://resources.vic.gov.au/projects/lvrrs/reports

Jacobs (2020b) *Yallourn Landfills - Hydrogeological Assessment*. Jacobs Australia Pty Ltd. IS302300-3. A1746772.

Landloch (2022) *Preliminary erosion assessment Yallourn Mine*. 1483.21a.

LCC (2019) *Rural Land Use Strategy*. Latrobe City Council. https://www.latrobe.vic.gov.au/sites/default/files/Rural_Land_Use_Strategy.pdf

Maunsell McIntyre (2001) *Supplementary Report to the Maryvale Coal Field Development Environmental Effects Statement*. A1313905.

Minister for Planning (2002) *Assessment of the Supplementary Report to the Maryvale Coal Field Development EES - Yallourn Energy Pty Ltd*. Hon John Thwaites MP. A1122941.

Minister for Planning (2010) *Yallourn Coal Field Re-alignment Project Environment Report Assessment*. Justin Madden MLC. BMIN005344. A1035853. https://www.planning.vic.gov.au/__data/assets/pdf_file/0024/687111/Final_Ministers_Assessment_Yallourn_Environment_Report_June_2010.pdf

MLRA (2023) *Who is the Mine Land Rehabilitation Authority?* Mine Land Rehabilitation Authority. State Government of Victoria. A2394030. https://www.mineland.vic.gov.au/news/who-is-the-mine-land-rehabilitation-authority/

MLRA (2024a) *Fact Sheet: What is a Declared Mine Rehabilitation Plan?* Mine Land Rehabilitation Authority. A2394023. https://www.mineland.vic.gov.au/news/declared-mine-rehabilitation-plan-fact-sheet/

MLRA (2024b) *MLRA Vocabulary*. Mine Land Rehabilitation Authority. State Government of Victoria. A2394027. https://www.mineland.vic.gov.au/learn/vocabulary/

NRMMC (2011) *National Water Quality Management Strategy Australian Drinking Water Guidelines*. Natural Resource Management Ministerial Council.

PSM (2021) *Yallourn Mine Morwell River Diversion Investigation*. Pells Sullivan Meynink. PSM4487-001R. A2084582.

PSM (2025a) *Yallourn Mine Rehabilitation Design Lake Triggered Seismicity Study*. Pells Sullivan Meynink. PSM4487-219R. A2350364.

PSM (2025b) *Yallourn Mine Rehabilitation Project Feasibility Stage Design Report*. Pells Sullivan Meynink. PSM4487-200R. A2392851.

RGS (2025) *DRAFT Yallourn: Lake water balance and water quality* RGS Environmental Pty Ltd. 2024014.

SECV (1980) *Yallourn Open Cut Township Field Stability of Western Batters*. State Electricity Commission of Victoria. D.D.144A. A1042959.

Teague, B. and Catford, J. (2016) *Hazelwood Mine Fire Inquiry Report 2015/2016 Volume IV - Mine Rehabilitation*. Victorian Government Printer. A1091921. http://hazelwoodinquiry.archive.vic.gov.au/201516-report/index.html

TRUenergy (2011) *Submission for a variation to the Approved Work Plan for Mining Licences No. 5003, No. 5216 & No. 5304* TRUenergy Yallourn Pty Ltd. A1046135.

TRUenergy (2012) *Review of Yallourn Mine Rehabilitation Master Plan MIN5003 Work Plan Variation Condition 7*. TRUenergy Yallourn Pty Ltd. A1615655.

Yallourn Energy Pty Ltd (1995) *Mining Licence Work Plan Part "B" Environmental Monitoring Program*. A1066240.

Yallourn Energy Pty Ltd (2001) *Mine Rehabilitation Master Plan*. A1124153.

YMA (2024) *Environmental Management Plan (EMP)*. Yallourn Mine Alliance. A1030077.

EnergyAustralia Pty Ltd ABN 99 086 014 968.