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Whitehaven

Void Closure Plan

Blackwater Mine

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Void Closure Plan

Blackwater Mine

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ACRONYMS AND ABBREVIATIONS

Acronym	Description
3D	Three-dimensional
AEP	Annual exceedance probability
AHD	Australian height datum
AQP	Appropriately qualified person
ARR	Australian Rainfall and Runoff
AWBM	Australian Water Balance Model
BNEP	Blackwater North Extension Project
BoM	Bureau of Meteorology
BWM	Blackwater Mine
C	(Geochemical) controls
CCS	Consistent Climate Scenario
CHPP	Coal handling and processing plant
CSM	Conceptual site model
DEM	Digital elevation model
EA	Environmental Authority
Eh	Electrode potential of hydrogen (measured electric potential)
EEP Water	Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld)
EP Act	*Environmental Protection Act* 1994
ERM	Environmental Resources Management Pty Ltd
ESA	Environmentally sensitive area
EV	Environmental value
FoS	Factor of safety
GDE	Groundwater dependent ecosystem
GLM	General lake model
GMA	Groundwater management area
HES	High ecological significance

Acronym	Description
IA	Improvement Area
IFD	Intensity Frequency Duration
LOD	Land outcome document
ML	Mining lease
MM	Management Milestone
NC	No (geochemical) controls
NC Act	Nature Conservation Act 1992
n.d.	No date
NUMA	Non-use management area
pe	Logarithmic scale of electron activity
pH	Logarithmic scale of hydrogen activity
PMF	Probable maximum flood
PRC Plan	Progressive Rehabilitation and Closure Plan
PRCP	Progressive Rehabilitation and Closure Plan
QLD	Queensland
RCM	Rangal Coal Measure
RE	Regional ecosystem
ROM	Run-of-mine
SA	Surface area
SI	Saturation index
TDS	Total dissolved solids
the Mine	Blackwater Mine
TSF	Tailings storage facility
URBS	Unified River Basin Simulator
VCP	Void closure plan
Water Act	Water Act 2000
WBM	Water balance model
Whitehaven	Whitehaven Coal Ltd
WQO	Water quality objective

UNITS

Acronym	Description
°	Degrees

Acronym	Description
g	Gram
ha	Hectare
kg	Kilogram
km	Kilometre
L	Litre
m	Metre
m^3	Cubic metre
mAHD	Meters relative to the Australian Height Datum
ML	Megalitre
mole	$6.022*10^{23}$ particles
mV	Millivolt
t	Tonnes
V	Volt
yr	Year

1. INTRODUCTION

Blackwater Mine (BWM, *the Mine*) is an open-cut metallurgical coal mine with historical underground workings, owned and operated by Whitehaven Coal Ltd (Whitehaven), approximately 4.5 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland. BWM operates across various mining leases (MLs), namely ML1959, ML1760, ML1761, ML1767, ML1771, ML1772, ML1773, ML1792, ML1800, ML1812, ML1929, ML1860, ML1962, ML1907, ML70091, ML70104, ML70139, ML70167, and ML70329.

BWM is approved under the Environmental Authority (EA) EPML00717813 and the *Environmental Protection Act 1994* (the EP Act) requires EA holders to submit a Progressive Rehabilitation and Closure (PRC) Plan.

Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by Whitehaven to develop a void closure plan (VCP) (this document), which serves as an appendix to the BWM PRC Plan as required by the Department of Environment, Tourism, Science and Innovation (DETSI) *Progressive rehabilitation and closure plan (PRC plans) Statutory Guideline (version 3.01),* known as the *PRCP Guideline*, last reviewed on 16 September 2024 (DETSI, 2024).

The scope of the BWM PRC Plan Revision 3 includes the Blackwater North Extension Project (BNEP) (the Project), which involves the extension of open cut mining operations to the north-east of the existing BWM mining area within ML1759 Surface Area (SA) 10 and ML1762 SA 7. The Project has an anticipated commencement date of around 2030. The Project forms part of the operational footprint relevant to the BWM PRC Plan Revision 3 and therefore has been incorporated into this VCP. The BNEP results in changes to the extent and configuration of several residual voids and associated NUMAs, with a net increase in total NUMA footprint relative to the BWM PRC Plan Revision 2 (Section 3.1).

The current final landform design is referred to as version 4.4.

This VCP has been prepared using the following technical assessments that consider the updated final landform designs:

- Blackwater Mine Transitional PRC Plan Hydrogeology Assessment – Revision 2 (SLR, 2026);
- Blackwater Mine Progressive Rehabilitation and Closure Plan Final Landform Flood Assessment (WRM, 2026a);
- Blackwater Mine Progressive Rehabilitation and Closure Plan Voids in Floodplain Modelling (WRM, 2026b);
- Progressive Rehabilitation and Closure Planning - Blackwater Mine –Final Void Water Balance (WRM, 2026c);
- Long-Term Geotechnical Stability of Highwalls and Endwalls at Blackwater Mine (Henderson Geotech, 2026a);
- Assessment of Geotechnical Stability of LF#4.4 Residual Void Lowwalls at Blackwater Mine (Henderson Geotech, 2026b); and
- Residual Void Water Quality and Limnology Assessment – Blackwater Mine (ERM, 2026).

This Void Closure Plan provides supporting technical evidence for the proposed designation of residual voids as non-use management areas (NUMAs), including consideration of the requirements of Sections 126C and 126D of the EP Act.

1.1 PURPOSE AND OBJECTIVES

BWM mines multiple open-cut pits at various stages of operation and with varying completion dates. The final landform design (version 4.4) retains 15 residual voids. Two of these, Bonnie Doon and Ramp 74, also function as in-pit tailings storage areas.

The residual voids present in the final landform design version 4.4 are:

- Ramp 8;
- Bonnie Doon;
- Mimosa/Besgrove;
- Ramp 30;
- Deep Creek;
- Stewarton North;
- Stewarton South;
- Tannyfoil;
- South Ballamoo;
- Kenmare;
- Ramp 74;
- Togara/North Marshmead;
- South Marshmead;
- Kennedy West; and
- Comet Downs East.

The objective of this VCP is to outline an approach to achieving safe, stable and non-polluting residual voids at closure. This plan also supports the broader rehabilitation strategy by aiming to:

- Reduce environmental and safety risks associated with the residual voids and surrounding NUMA areas;
- Minimise the need for ongoing active management post-closure; and
- Prevent unmitigated access by people and livestock.

This document addresses the requirements of sections 3.4 and 3.6.3 of the PRC Plan Guideline as outlined in Table 1-1 below.

TABLE 1-1 ALIGNMENT OF VCP SECTIONS WITH PRCP GUIDELINES

Reference in PRCP Guidelines	Content Summary	Section(s) in this VCP
Section 3.4 – Voids in flood plains	Voids in flood plains must be rehabilitated to a stable condition to be approved in the PRCP schedule.	Section 5 – Flooding Assessment
	Flood plain modelling is required in accordance with ARR 2019 and must exclude artificial features. The flood plain model report must include specific technical details (e.g. model inputs, groundwater influence, spatial data, calibration).	

Reference in PRCP Guidelines	Content Summary	Section(s) in this VCP
	All voids in flood plains must have an associated PMLU and be identified in the PRCP schedule.	Section 3 – Proposed Residual Voids
	Transitional arrangements apply to pre-existing NUMAs in land outcome documents.	
	The PRC plan must demonstrate how void locations minimise environmental risk.	
Section 3.6.3 – Voids	Options available for minimising final void area and volume (where a final void is proposed).	Section 3 – Proposed Residual Voids; Section 9 8.4.2– Residual Void Management
	Proposed final dimensions of the void (i.e. depth, length and width).	
	Proposed final slope angles of high wall, low wall and end walls of each final void.	
	Pit wall geotechnical and geochemical stability, considering the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events.	Section 7 – Geotechnical Stability; Section 8 – Geochemical Stability
	Void hydrology, addressing the long-term water balance and water level in the voids, stratification connections to groundwater resources and potential for overflow.	Section 4 – Groundwater; Section 6 – Void Water Balance; Section 8 – Geochemical Stability
	Groundwater modelling to determine whether the void is acting as a sink or a source for groundwater.	Section 4 – Groundwater
	A water balance study including an assessment of void surface and groundwater interactions such as: • groundwater lowering/reduction in hydraulic head (from new voids) (e.g. caves/karst systems); • cones of depression and associated impacts; • the drainage and flooding behaviours of surface waters in the vicinity of the void; • the potential extent of flooding and implications of interactions with the void; • a conceptual model that incorporates all projected inflows, outflows and recharge rates; • water storage and long-term water balance; • each of the major water fluxes into and out of the void; and • the sources of surface water within the mine catchment that are likely to influence the water quality in the void.	Section 4 – Groundwater Section 6 – Void Water Balance

Reference in PRCP Guidelines	Content Summary	Section(s) in this VCP
	Predicted water quality in the long-term including potential stratification.	Section 8 – Geochemical Stability
	A 3D void design plan.	Section 3 – Proposed Residual Voids; Section 9 8.4.2– Residual Void Management
	Rehabilitation strategies.	Section 9.1 – Void Rehabilitation

1.2 RELEVANT GUIDELINES AND LEGISLATION

This VCP has been developed in accordance with the legislative and regulatory framework applicable to mine closure and residual voids in Queensland. The following documents have informed the preparation of this plan:

- *Environmental Protection Act 1994* (Qld): The primary legislation governing environmental protection, including requirements for progressive rehabilitation and mine closure.
- *Progressive Rehabilitation and Closure Plan Guideline*, Version 3.01 (September 2024): Provides the required structure and content for PRC plans.
- *Environmental Authority EPML00717813*, dated 20 April 2026: Defines site-specific conditions for environmental management, residual voids and rehabilitation activities at BW. Specifically in relation to residual voids, conditions E10 and E11 require:
    - Residual voids must not cause any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself and subject to any other condition within this environmental authority; and
    - The investigation must at a minimum include the following:

        (a) a study of options available for minimising final void area and volume;

        (b) develop design criteria for rehabilitation of final voids;

        (c) a void hydrology study, addressing the long-term water balance in the voids, connections to groundwater resources and water quality parameters in the long term;

        (d) a pit wall stability study, considering the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events;

        (e) a study of void capability to support native flora and fauna; and

        (f) a proposal/s for end of mine void rehabilitation success criteria and final void areas and volumes.

2. SITE OVERVIEW

BWM is a conventional strip mine open-cut metallurgical coal mine with historic underground workings and is located approximately 4.5 km southwest of Blackwater in the Bowen Basin, Central Queensland. The Bowen Basin is a major coal-producing region and BWM is located near several other operational open-cut coal mines.

Mining activities at BWM include topsoil removal and stockpiling, followed by drilling and blasting of overburden and interburden. These materials are removed using draglines and truck-and-shovel fleets. Coal is also mined using truck-and-shovel fleets. As mining progresses, overburden and interburden are placed into spoil dumps within the voids created by previous mining strips. In-pit spoil placement increases as pits deepen, reducing the need for out-of-pit dumping.

Coal is transported from the pits to the run-of-mine (ROM) area or to stockpiles. It is processed at the coal handling and preparation plant (CHPP). The CHPP generates coal fines, which are disposed of in dedicated tailings storage facilities (TSFs), and coarse rejects, which are placed in spoil dumps. Product coal is loaded onto trains at the load-out facility located next to the CHPP and product stockpiles.

Mining at BWM began in 1967. Current life-of-mine planning supports continued mining of the approved area until 2113, based on existing production rates.

An overview of the existing environmental conditions at and around BWM is provided in the PRC Plan and is not repeated in this VCP.

3. PROPOSED RESIDUAL VOIDS

This section describes the location, dimensions and characteristics of residual voids to be retained at closure. It is required under the PRCP Guideline to justify why full rehabilitation is not feasible.

This section also addresses:

- *Options considered for minimising the final void area and volume.*
- *Proposed final dimensions of each void, including depth, length and width.*
- *A 3D design plan illustrating the final landform configuration.*

In addition, to support the requirement that void locations minimise environmental risk, this section includes:

- *A conceptual site model illustrating key environmental and geotechnical interactions.*
- *An ecological impact assessment identifying potential impacts to flora, fauna and habitats.*
- *An assessment of groundwater environmental values, including beneficial uses and connectivity.*
- *An assessment of surface water environmental values, including potential impacts to downstream environments.*

This section outlines the characteristics of the 15 residual voids at BWM. It contains a conceptual site model (CSM), a summary of ecological assessment findings and a review of groundwater environmental values (EVs) relevant to the post-mining landform.

The residual voids at BWM are identified and authorised under Schedule E (Conditions E10 and E11) of the BWM EA, as the primary Land Outcome Document (LOD) for BWM as pre-approved NUMAs.

Residual voids will be partially backfilled with spoil to reduce their size. The extent of each residual void has been designed to ensure the area is safe for both people and wildlife. This includes the area below natural ground level (high-wall, end-walls, low-wall, floor), setback distances from the crest to achieve a factor of safety (FoS) of at least 1.5 and the provision of a safety bund and fencing.

The total proposed NUMA area is 3,360 hectares (ha). This area has been minimised by backfilling ramp voids during mining and by backfilling parts of the final voids at the end of operations.

A three-dimensional (3D) representation of the BWM residual voids, including potential void lakes, is shown in Figure 3-1 (North) and Figure 3-2 (South). Indicative final dimensions of the residual voids are provided in Table 3-1.

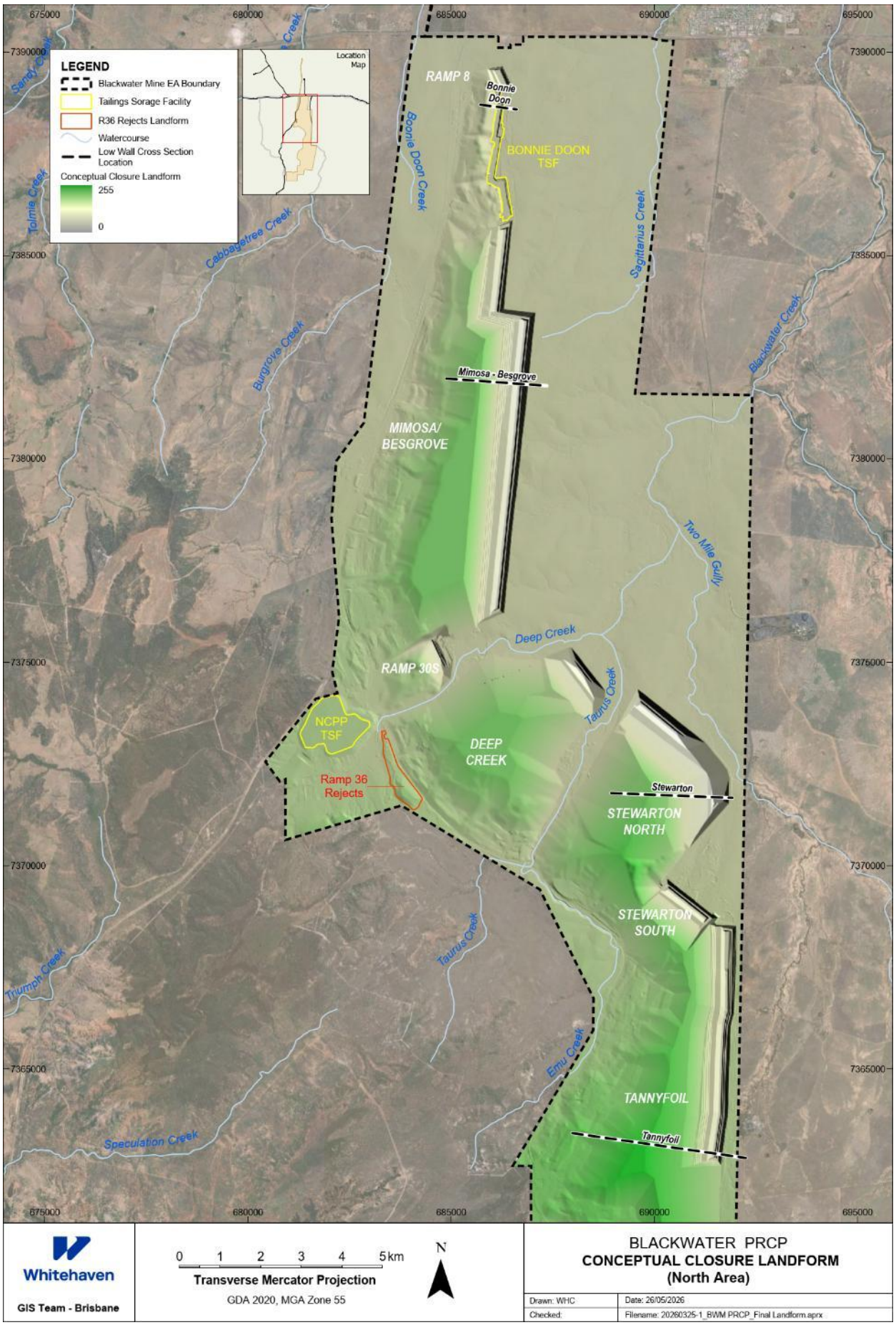


FIGURE 3-1 BWM CONCEPTUAL FINAL LANDFORM DESIGN – NORTHERN AREA

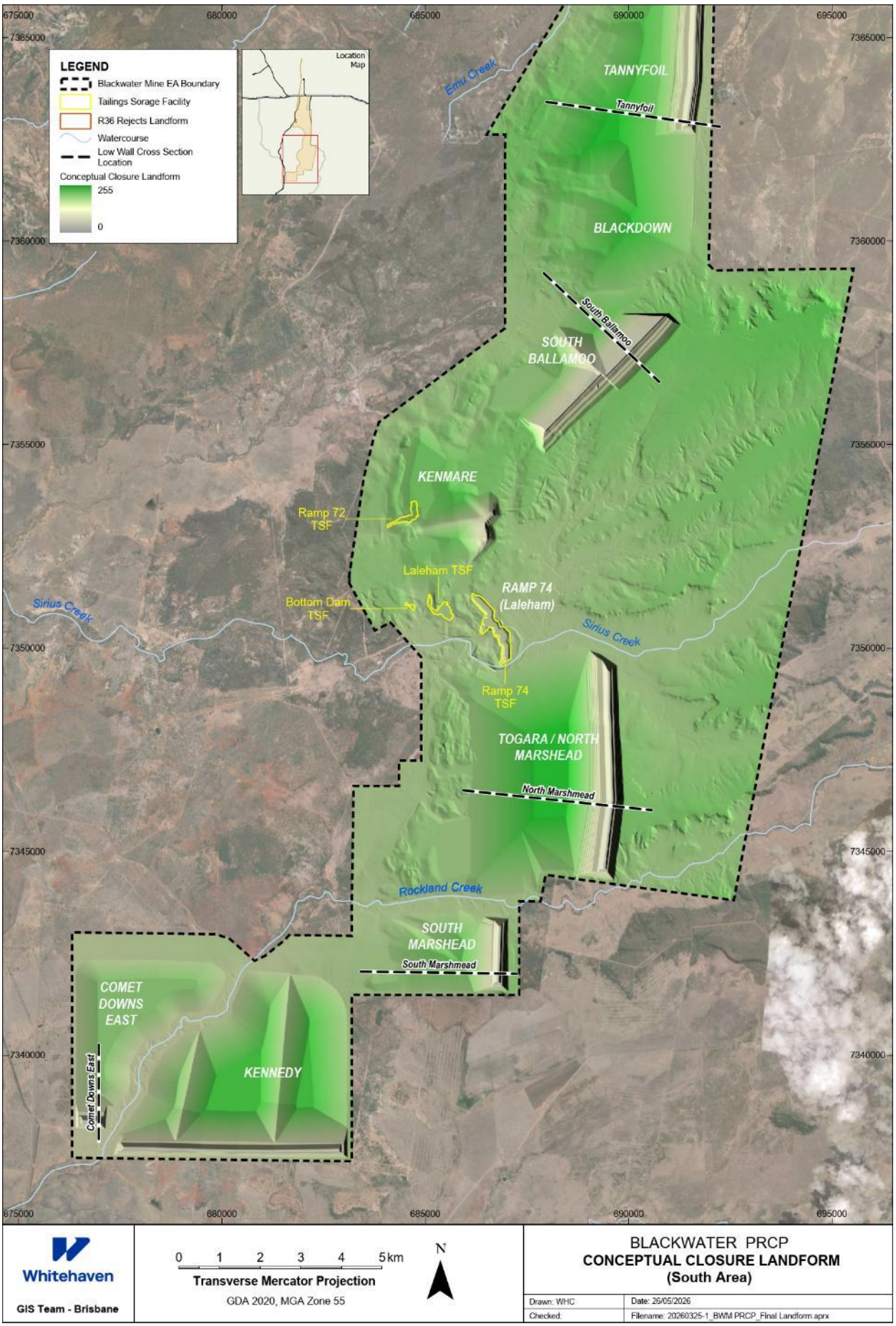


FIGURE 3-2 BWM CONCEPTUAL FINAL LANDFORM DESIGN – SOUTHERN AREA

TABLE 3-1 INDICATIVE RESIDUAL VOID DIMENSIONS

Residual Void	Indicative Length	Indicative Width	Crest at Spill Point	Indicative Depth	Volume to Crest	NUMA Area	Highwall Grade	Endwall Grade	Low Wall Grade
Unit	*m*		*mAHD*	*m*	*ML*	*ha*	*Degrees (°)*		
Ramp 8	650	360	188[1]	66	6,530	26	40	40	27
Bonnie Doon	3,000	250	188[1]	26	3,630	105	36.5	40	29
Mimosa/Besgrove	10,100	650	200	176	375,000	701	42	41	18
Deep Creek	1,600	600	202	150	54,900	102	43	16	27
Stewarton North	3,700	800	204	208	303,000	334	44	41	20
Stewarton South	1,400	500	232	140	42,600	93	41	39	19
Kenmare	1,800	500	297	122	93,800	85	20	20	17
Togara/North Marshmead	5,500	850	271	202	293,000	511	42	41	20
South Marshmead	1,800	650	270	162	74,700	123	43.5	40	22
Kennedy	5,700	700	221	122	93,800	357	45.5	42	20
Comet Downs East	800	570	222	132	20,400	49	44.5	41	20
Ramp 74	2,000	300	266	32	9,950	59	34	38	30
South Ballamoo	4,600	1,100	290	206	377,000	350	28	32	17
Tannyfoil	6,000	630	237	122	160,000	400	36.5	34	19
Ramp 30	1,200	300	217	78	16,300	64	34	17	18

[1] 188 mAHD represents the elevation at which the Ramp 8 and Bonnie Doon residual voids would spill to the receiving environment. The internal crest level between Ramp 8 and Bonnie Doon residual voids is 175 mAHD. Source: Whitehaven Coal Final Landform Version 4.4.

3.1 VOID EXTENT MINIMISATION

The PRC Plan must demonstrate that the size and potential for environmental harm from the NUMAs has been minimised. The proposed NUMA area has been progressively reduced through multiple iterations of mine planning and rehabilitation design. Since the original PRC Plan submission by Whitehaven (Revision 1) which was predominantly based on former owner's (BMA) mine plans, the total NUMA area was reduced by 789 ha from approximately 3,967 ha (Revision 1) to 3,178 ha (Revision 2). This reduction was achieved through:

- Reducing the number of ramp voids through backfilling during mining operations, and backfilling sections of the residual voids at the end of mining;
- Reshaping remaining ramp voids to a suitable slope to allow a PMLU; and
- Redefining the low-wall NUMA extent to be based on a geotechnical FOS of 1.5, which has enabled revegetation of a greater portion of residual void low-walls, which now form part of the designated PMLU areas.

Further reductions to NUMA areas are not technically achievable under the current mine design and closure assumptions, including those associated with the BNEP, due to:

- The depth and geometry of remaining voids, which exceed the safe angle of repose for reprofiling;
- Geotechnical constraints preventing reshaping of the pit floor and lower benches to meet rehabilitation slope requirements; and
- The requirement to maintain wall stability and avoid unacceptable geotechnical risks if additional slope reduction were attempted.

In addition, the residual voids at BWM are predicted to function as a hydraulically connected system in which most voids act as groundwater sinks, with inward hydraulic gradients and inter-void flow processes resulting in containment of groundwater and associated solutes within the tenure boundary. These conditions would be altered if voids were backfilled, potentially reducing the capacity of the system to contain solutes within the mine domain.

The above constraints have been assessed through iterative mine planning and closure design and remain applicable under Revision 3.

Consistent with the constraints outlined above, including limitations as associated with void depth and geometry, geotechnical stability requirements and hydrogeological behaviour, retention of the residual voids represents the minimum and lowest risk closure outcome. Further reduction through backfilling or re-profiling would introduce additional environmental and geotechnical risks and would not achieve a safer or more sustainable post-mining landform.

The BNEP results in changes to the extent and configuration of several voids, and consequently the NUMA footprint, including:

- Mimosa/Besgrove void extending to the north and a large proportion progressing further east;
- A Deep Creek final void location further to the northeast; and
- Segregation of the Stewarton void into Stewarton North and Stewarton South; with
    - The new Stewarton North final void located further to the northeast; and
    - The new Stewarton South final void not progressing as far northeast as planned in Revision 2.

The NUMA footprint of the Mimosa/Besgrove residual void increases by 140 ha and the NUMA footprint of the combined Stewarton North and South residual voids, when compared to the single Stewarton residual void planned in Revision 2, increases by 131 ha. The Deep Creek residual void NUMA footprint has reduced by 87 ha.

Overall, these changes result in a net increase in NUMA footprint of 182 ha, increasing the total NUMA area from 3,178 ha (Revision 2) to 3,360 (Revision 3).

Accordingly, the current 3,360 ha NUMA footprint represents the minimum safely achievable area while maintaining compliance with geotechnical, hydrological and safety requirements.

3.1.1 IMPACT OF VOID LOCATION ON ENVIRONMENTAL RISKS

In accordance with the PRCP guideline, this VCP provides justification for the selected residual void locations and demonstrates how they minimise long-term risks to the environment.

The placement of each residual void has been determined through an integrated assessment of hydrology, hydrogeology, geotechnical stability, land use compatibility and environmental values. The final locations reflect a balance between operational feasibility and environmental performance, as outlined below:

- **Surface water value:** Most residual voids are positioned outside the modelled 0.1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) pre-mining flood plain extents. The Deep Creek residual void is partially within 0.1% AEP flood extents of Taurus Creek. Protection against the 0.1% AEP flood event will be achieved by incorporating a relatively minor amendment to the final landform along the southern endwall of the Deep Creek residual void. The landform in this area will be raised to ensure it is above the 0.1% AEP event and will be reviewed during closure execution and upgraded if necessary. The Ramp 74 void is situated across the Sirius Creek inundation extent for the 0.1% AEP flood event and will require protection by a permanent diversion. Modelling that includes the existing temporary Sirius Creek diversion shows immunity from the 0.1% AEP flood event can be achieved;
- **Groundwater-dependent ecosystems:** Hydrogeological modelling indicates that the selected void locations do not intersect with known groundwater dependent ecosystems (GDEs) and the likelihood of actual GDEs being present is low due to the depth to groundwater in many locations. Drawdown impacts in locations with potential to support GDEs are interpreted to be a result of the approved mining activities and not the final landform;
- **PMLU compatibility:** The positioning of the voids supports landform drainage, landform surface stability and visual integration with the surrounding post-mining landscape. The location of residual voids is not anticipated to affect the surrounding PMLUs; and
- **Water quality risk management:** The geochemical stability of a selection of residual voids has been modelled to identify likely water quality conditions. This modelling has considered geochemistry of the highwall, geochemistry of inflow sources (groundwater, catchment runoff), rainfall and evaporation. Whilst some residual void lake water quality is predicted to become hypersaline (i.e. total dissolved solids (TDS) > 35,000 mg/L (SWRCB, 2017)), most residual voids are groundwater sinks. Groundwater outflows from the four residual voids predicted to have net outward fluxes will be drawn towards the neighbouring voids with lake levels at lower elevations rather than away from the mined areas. No residual voids were predicted to overtop to surface waters under any of the modelled scenarios.

3.2 ALTERNATIVE PMLUS

Residual voids at BWM are proposed to remain as long-term water bodies post-closure. Alternative PMLUs were considered as part of the closure planning process, such as partial/complete backfilling and land-based rehabilitation. These options were assessed in the context of geotechnical feasibility, available spoil volumes, final landform configuration and environmental performance.

Complete backfilling was found to be impractical due to significant additional disturbance to adjoining landforms and excessive economic implications.

As such, the proposed use of voids as permanent, stable water bodies is considered the most practicable, safe and environmentally acceptable post-closure option.

3.3 CONCEPTUAL SITE MODELS

An end-of-mining conceptual site model (CSM) and a post-mining CSM were developed to conceptually represent the hydrogeological and surface water regime of the site in the presence of residual voids both when mining is anticipated to cease (~2110) and once residual void lake levels and groundwater recovery levels have stabilised (SLR, 2026).

Visual representations of the CSMs for the northern area of BWM and the southern area of BWM are provided in Figure 3-3 to Figure 3-4.

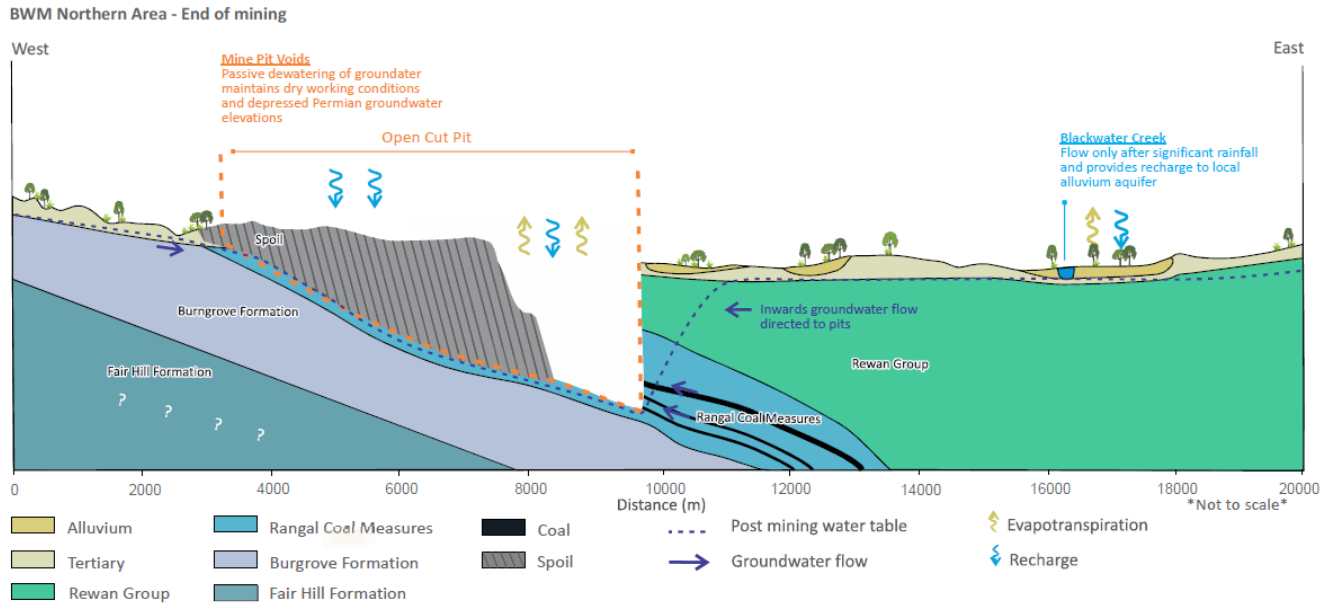
Key features of the CSMs are summarised in Table 3-2.

TABLE 3-2 END OF MINING AND POST-MINING CONCEPTUAL HYDROGEOLOGICAL MODEL SUMMARY

Category	**Groundwater Conditions**	
	End of Mining	**Post-Mining**
Groundwater levels and drawdown	Groundwater level drawdown of the Rangal Coal Measures, associated with passive dewatering into the active BWM mine pit voids.	Partial groundwater system recovery outside the residual voids, primarily in the Rangal Coal Measures.
	The magnitude of the drawdown will be most significant in the immediate vicinity of the pits, but will extend northwards, eastwards and southwards of BWM by several kilometres.	Continued groundwater drawdown in the Rangal Coal Measures is driven by evaporative discharge from the void lakes. Inward hydraulic gradients persist, maintaining groundwater discharge to the residual voids as sinks.
Hydraulic gradients and seepage	Residual voids capture seepage from spoil emplacements due to the local hydraulic gradient oriented towards the residual voids.	Continued groundwater drawdown within the Rangal Coal Measures maintains inward hydraulic flow gradients and ongoing groundwater discharge to the residual voids, keeping them as groundwater sinks.
Shallow hydrostratigraphic units	Limited potential for groundwater level drawdown in the alluvium and Tertiary strata due to limited saturation, and poor lateral connectivity of water-bearing zones.	Formation of residual void lakes, with lake levels stabilising significantly below shallow post-Permian strata, including the base of surficial weathering and shallow

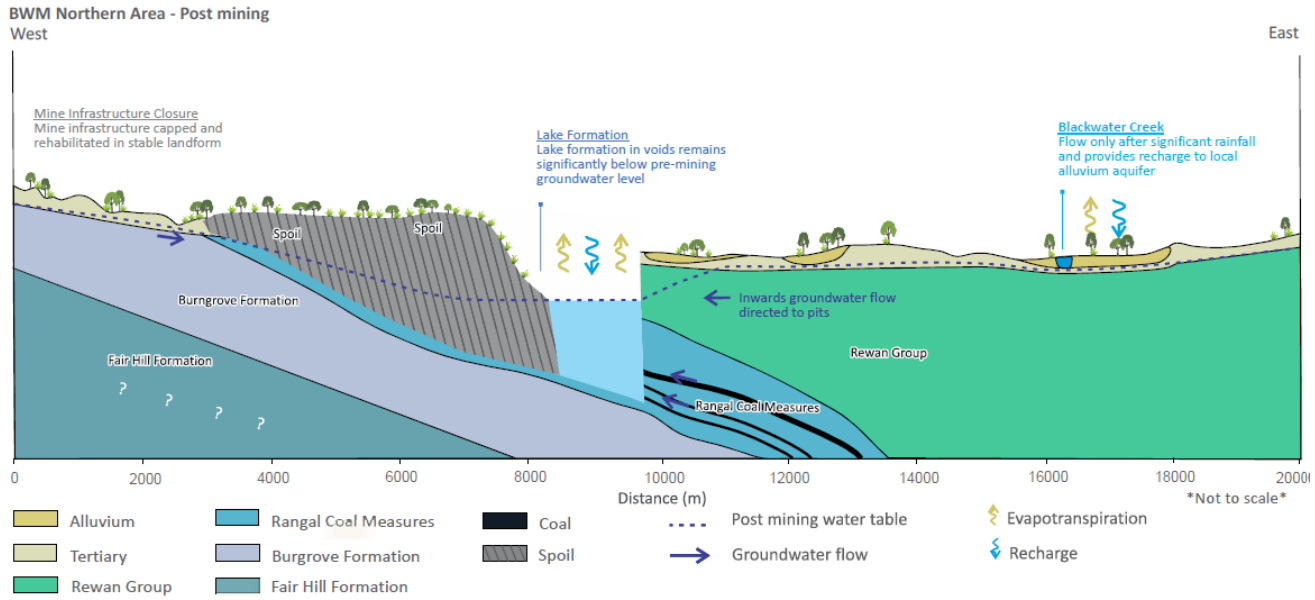
Category	**Groundwater Conditions**	
	End of Mining	**Post-Mining**
	No groundwater level drawdown of the alluvium away from BWM.	hydrostratigraphic units (i.e. alluvium and Tertiary strata). This applies to all voids but Ramp 74 and Comet East Downs.
GDEs	Limited potential exists for groundwater level drawdown impacts to terrestrial GDEs, due to the limited predicted drawdown in the alluvium and Tertiary strata, and no aquatic or subterranean GDEs have been identified within 5 km of BWM, indicating negligible risk to these receptors.	
Residual void behaviour	-	Residual void lake formation, with lake levels stabilising significantly below any shallow post-Permian strata, including the base of surficial weathering and shallow hydrostratigraphic units (i.e. alluvium and Tertiary strata) for most voids except Ramp 74 and Comet East Downs.
		Potential for ongoing salinisation of the residual void lakes associated with evaporative discharge from the lakes.
Underground workings	-	Reflooding of historical underground workings.
Groundwater quality – spoil	No potential for groundwater quality impacts outside of BWM associated with spoil dumps, due to the inward groundwater flow gradients towards the pit voids capturing all potential seepage.	No potential for groundwater quality impacts outside of the BWM Area associated with residual voids or spoil emplacements, due to the inward groundwater flow gradients towards the residual voids continuing to capture all potential seepage.
Groundwater quality – tailings	-	No potential for groundwater quality impacts outside of the BWM Area associated with in-pit tailings emplacements at Bonnie Doon and Laleham, due to the inward groundwater flow gradients towards the residual voids continuing to capture all potential seepage.

Source: SLR, 2026.



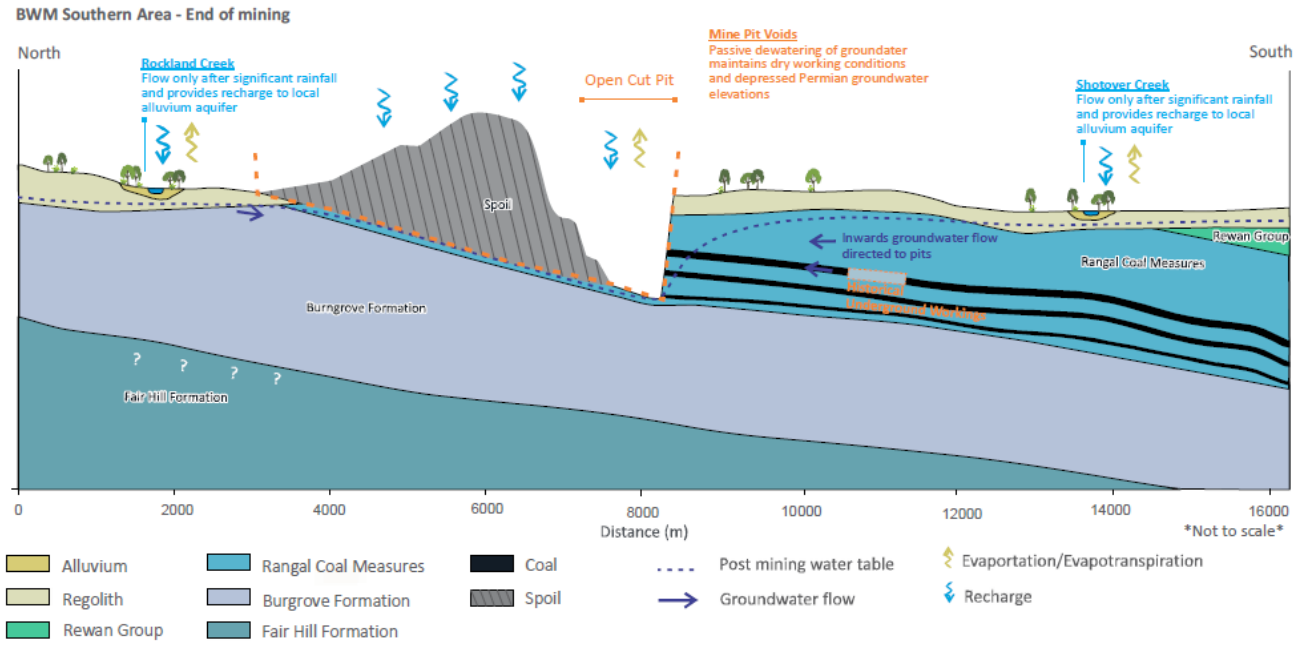
Source: SLR, 2026.

FIGURE 3-3 END OF MINING CONCEPTUAL HYDROGEOLOGICAL MODEL – BWN NORTH



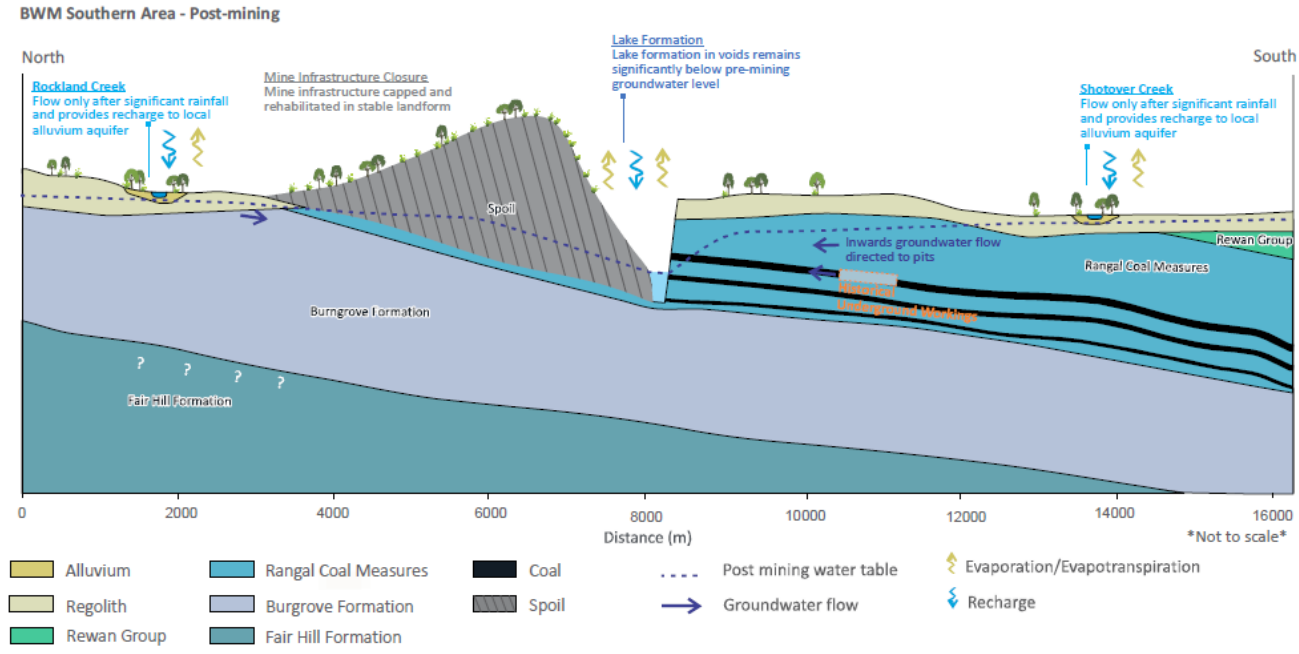
Source: SLR, 2026.

FIGURE 3-4 POST-MINING CONCEPTUAL HYDROGEOLOGICAL MODEL – BWM NORTH



Source: SLR, 2026.

FIGURE 3-5 END OF MINING CONCEPTUAL HYDROGEOLOGICAL MODEL – BWM SOUTH



Source: SLR, 2026.

FIGURE 3-6 POST-MINING CONCEPTUAL HYDROGEOLOGICAL MODEL – BWM SOUTH

3.4 ECOLOGICAL ASSESSMENT

The BWM site has experienced extensive vegetation disturbance due to historical agricultural clearing and mining development. The most heavily modified area runs along a central north-south corridor; however, significant remnants of native vegetation persist in the south-western and south-eastern parts of the site. Ground-truthed regional ecosystems (REs) include a

variety of communities adapted to Cainozoic sand and clay plains, with several classified as *Endangered* under Queensland's Vegetation Management Act 1999 and listed as Category B Environmentally Sensitive Areas (ESAs) under the *Environmental Protection Regulation 2019 (Qld)* (Figure 3-7).

Endangered REs identified on site include:

- RE 11.3.1: *Acacia harpophylla* and/or *Casuarina cristata* open forest (alluvial plains);
- RE 11.4.3, 11.4.7–11.4.9a: Brigalow woodlands and open forests dominated by *A. harpophylla*, *Casuarina cristata*, *Eucalyptus populnea*, *E. cambageana*, *Terminalia oblongata*, and *Lysiphyllum carronii;*
- RE 11.5.15–11.5.16: Semi-evergreen vine thickets and open forests on Cainozoic sand plains;
- RE 11.8.13: Semi-evergreen vine thicket and microphyll vine forest on igneous substrates; and
- RE 11.9.1, 11.9.5: Brigalow-dominated open forests on sedimentary rock.

These ecosystems support important habitat for a range of threatened plant and animal species.

3.4.1 THREATENED FLORA SPECIES (NC ACT)

The following flora species listed under the *Nature Conservation Act 1992 (Qld)* have been recorded at BWM:

- *Solanum elachophyllum* – Endangered; found on cracking clays in brigalow communities with *Eucalyptus thozetiana* or *E. cambageana;*
- *Solanum dissectum* – Endangered; found in solodic clay soils within RE11.4.8;
- *Cadellia pentastylis* (*ooline*) – Vulnerable; recorded on lower scarps of RE11.7.1 and 11.7.2; and
- *Cerbera dumicola* – Near Threatened; found in vine forests and woodlands on sandstone and acidic soils (e.g. RE11.7.2).

3.4.2 THREATENED AND NOTABLE FAUNA SPECIES (NC ACT)

Several threatened fauna species are known to occur on site, including:

- *Phascolarctos cinereus (*Koala*)* – Endangered; habitat mapped along drainage lines with preferred feed trees (*Eucalyptus camaldulensis*, *E. tereticornis*, *E. populnea*, *E. coolabah*, *E. melanophloia*, *E. crebra*, *Corymbia citriodora*);
- *Denisonia maculata (*Ornamental snake*)* – Vulnerable; prefers gilgai landscapes within brigalow and *E. coolabah* woodlands;
- *Geophaps scripta scripta (*Squatter pigeon*)* – Vulnerable; associated with open woodlands near water;
- *Rostratula australis (*Australian painted snipe*)* – Endangered; found in shallow ephemeral wetlands (gilgai and farm dams);
- *Gallinago hardwickii (*Latham's snipe*)* – Special Least Concern; occurs in wetland habitats.
- *Tachyglossus aculeatus (*Short-beaked echidna*)* – Special Least Concern; broadly distributed;

- Migratory birds:
  - *Hirundapus caudacutus (*White-throated needletail*)* – Vulnerable;
  - *Apus pacificus (*Fork-tailed swift*)* – Special Least Concern; and
  - *Rhipidura rufifrons (*Rufous fantail*)* – Special Least Concern.

Potential habitat for Koala, the Ornamental snake and Squatter Pigeon is shown in Figure 3-8.

3.4.3 REHABILITATION STRATEGY

The rehabilitation strategy at BWM prioritises restoring woodland and watercourse PMLUs in areas adjacent to undisturbed or high-value regrowth ecosystems. This aims to re-establish ecological connectivity and support habitat requirements for species of conservation concern (e.g. *Phascolarctos cinereus*, *Tachyglossus aculeatus*). Revegetation will include *Eucalyptus spp.*, *Corymbia spp.*, and suitable understorey species to provide long-term structural and functional habitat diversity for both mobile and sedentary fauna.

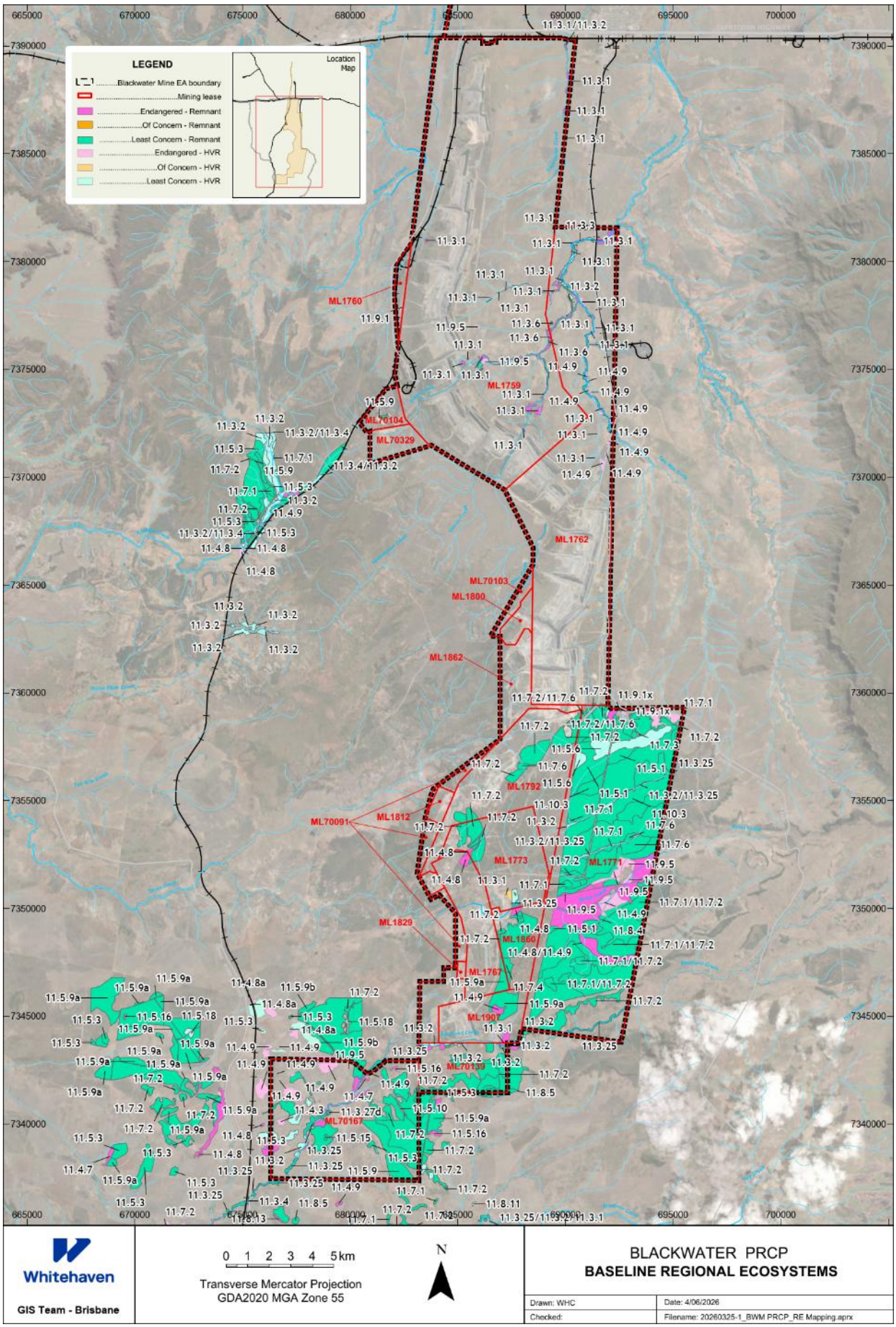


FIGURE 3-7 BWM BASELINE REGIONAL ECOSYSTEM

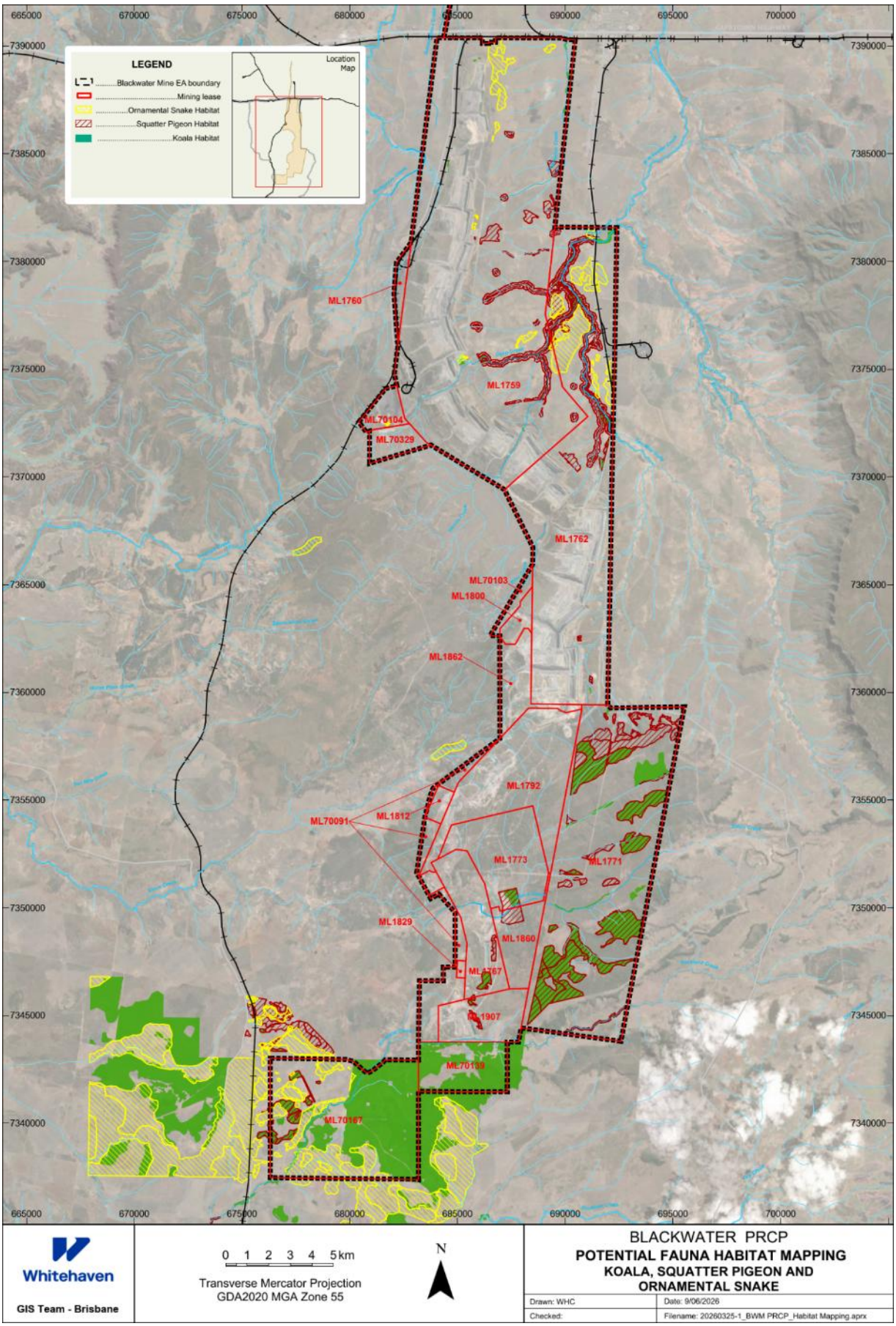


FIGURE 3-8 BWM BASELINE POTENTIAL FAUNA HABITAT MAPPING FOR KOALA, ORNAMENTAL SNAKE AND SQUATTER PIGEON

3.5 GROUNDWATER ENVIRONMENTAL VALUES

BWM is within the Highlands Groundwater Management Area (GMA) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. The Highlands GMA consists of the following:

- Highlands Groundwater Unit 1, containing the aquifers of the Quaternary alluvium associated with the Sandy Creek Alluvium sub-area (to the distant northwest of BWM but not located within the Study Area); and
- Highlands Groundwater Unit 2, containing all sub-artesian aquifers within the Highlands GMA other than the aquifers included in Highlands Groundwater Unit 1.

Volumetric limits apply to extraction of groundwater within the GMA for non-stock and domestic purposes.

Groundwater resources are scheduled under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld) (EP Water) as Comet Groundwaters and Mackenzie Groundwaters of the Fitzroy Basin water plan (WQ1310). The legislated environmental values EVs for these Groundwaters are show in Table 3-3 along with a comparison of potential EVs based on the bore census results in EMM (2019).

TABLE 3-3 GROUNDWATER ENVIRONMENTAL VALUES

Environmental Values	Comet Groundwaters	Mackenzie Groundwaters	EMM (2019) Bore Census
Aquatic ecosystems	✓	✓	✓
Irrigation	✓	✓	
Farm supply/use	✓	✓	✓
Stock water	✓	✓	✓
Aquaculture			
Human consumer			
Primary recreation	✓		
Secondary recreation			
Visual recreation			
Drinking water	✓	✓	
Industrial use	✓	✓	✓
Cultural and spiritual value	✓	✓	

Source: SLR, 2026.

EMM (2021) concluded that based on the bores that were surveyed in the 2019 bore census:

> "The environmental values for groundwater in the area are limited to farm supply/use, stock water and industrial use (i.e. mining). Aquatic ecosystems may also be associated with shallow alluvial systems".

Further discussion on groundwater quality and its suitability for supporting EVs is provided in Section 4.5 and greater detail is provided in SLR (2026). A comparison by SLR (2026) of available groundwater quality data from the monitoring bore network indicates that all hydrostratigraphic units at BWM generally exceed one or more relevant parameter criteria (e.g. salinity as TDS for the scheduled EVs.

3.5.1 GROUNDWATER USERS

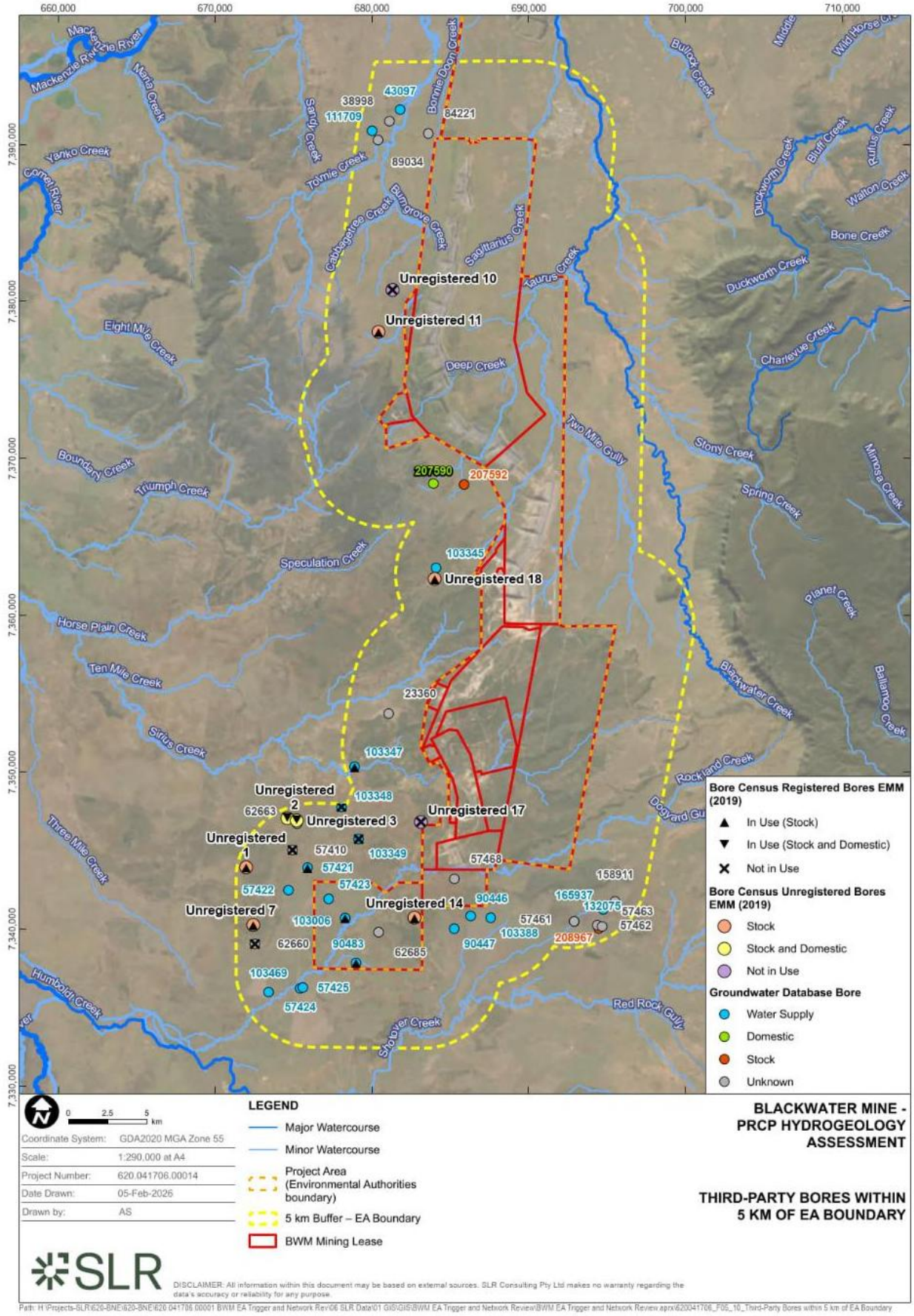
A search of groundwater receptor data was conducted using the Queensland Government's Registered Groundwater Bore Database (DRDMW, 2026) and the Bureau of Meteorology's National Groundwater Information System (BoM, 2017), with results reviewed by SLR (2026).

The search identified 315 registered bores within and surrounding the BWM mining lease area. Bore registrations were attributed to the following uses:

- 238 mine monitoring bores;
- One petroleum exploration bores;
- 19 sub-artesian monitoring bores;
- One water resource investigation bores;
- 19 water supply bores;
- Seven stock bores, two stock/domestic bores and one domestic bore;
- 13 unknown use bores; and
- 21 decommissioned bores.

In addition, a landholder bore census undertaken by EMM (2019), identified 44 third-party or potential third-party bores within 5 km of the BWM EA boundary, of which 18 have been subject to a bore census to confirm location, status and usage. Additional unregistered bores may also be present.

The locations of the third party groundwater bores within 5 km of BWM are shown in Figure 3-9.



Source: SLR, 2026.

FIGURE 3-9 THIRD-PARTY BORES WITHIN 5 KM OF BWM

3.6 SURFACE WATER ENVIRONMENTAL VALUES

Surface water resources are also scheduled under the EPP Water. Details of the prescribed surface water EVs and Water Quality Objectives (WQOs) are contained in the following Department of Environment and Heritage Protection (DEHP) documents:

- Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin September 2011; and
- Comet River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Comet River Sub-basin September 2011.

EVs of the sub-catchments at BWM are summarised in Table 3-4.

TABLE 3-4 SURFACE WATER ENVIRONMENTAL VALUES

Environmental Values	Comet Eastern Tributaries	Mackenzie Southern Tributaries
Aquatic ecosystems	✓	✓
Irrigation	✓	
Farm supply/use	✓	✓
Stock water	✓	✓
Aquaculture		
Human consumer	✓	✓
Primary recreation	✓	✓
Secondary recreation	✓	✓
Visual recreation	✓	✓
Drinking water	✓	✓
Industrial use	✓	✓
Cultural and spiritual value	✓	✓

The northern portion of BWM predominantly lies at the top of the local creek catchments with surface runoff from the eastern side draining towards Sagittarius and Taurus Creeks and the western side draining to Burngrove Creek. Sagittarius, Taurus and Burngrove Creeks run in a northerly direction towards the Mackenzie River.

The surface water drainage within the southern portion of BWM generally runs from east to west and the site falls within the local creek catchments of Sirius and Rockland creeks. Sirius Creek runs through a diversion channel to the south of the Laleham Pit/Ramp 72 tailings storage before running in a north-westerly direction towards the Comet River. Rockland Creek traverses the site to the south of Marshmead Pit, through the Rockland Creek Dam and a diversion channel. Rockland Creek beyond the EA boundary flows in a south westerly direction towards Comet River.

The watercourses and drainage lines are highly ephemeral, with flows only occurring for short periods during and immediately after rainfall events. The watercourses that intersect BWM are shown in Figure 3-10.

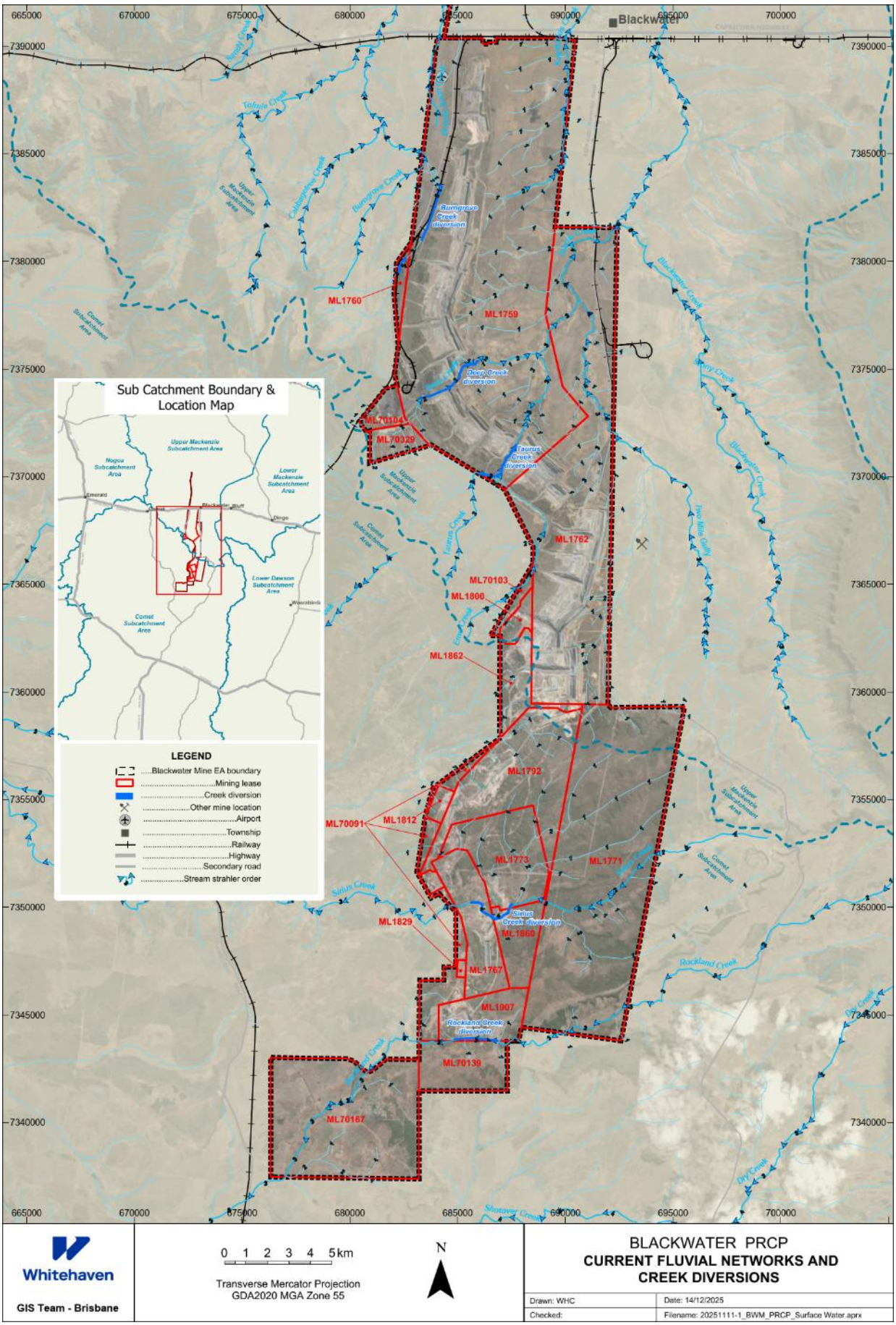


FIGURE 3-10 CURRENT FLUVIAL NETWORK AND CREEK DIVERSIONS

4. GROUNDWATER

This section assesses how residual voids interact with groundwater systems post-mining, supporting the PRCP requirements to evaluate containment, recovery and risks to environmental values.

It includes groundwater modelling to determine whether each residual void will function as a sink (drawing in groundwater) or a source (discharging to the surrounding aquifer), and assess the implications for:

- *Groundwater flow paths and hydraulic gradients;*
- *Connectivity with surrounding aquifers and surface water systems;*
- *Potential for contaminant migration or dilution; and*
- *Long-term changes in groundwater levels and quality.*

This section assesses how residual voids interact with groundwater systems post-mining, supporting the PRCP requirements to evaluate containment, recovery and risks to environmental values. It includes the results of the groundwater modelling undertaken by SLR (2026) to determine whether each residual void will function as a sink (drawing in groundwater) or a source (discharging to the surrounding aquifer), and assess the implications for:

- Groundwater flow paths and hydraulic gradients;
- Connectivity with surrounding aquifers and surface water systems;
- Potential for contaminant migration or dilution; and
- Long-term changes in groundwater levels and quality.

The calibrated BWM regional numerical groundwater model was updated to MODFLOW-USG Transport, recalibrated to Revision 3 of the PRCP, and the final landform design version 4.1 was replicated for the post-mining period. MODFLOW-USG is a recent version of industry standard MODFLOW code and was determined to be the most suitable modelling code for accomplishing the model objectives.

The primary objective of the hydrogeological assessment was to assess the potential groundwater related impacts at the completion of mining and until conditions stabilise post-mining (i.e. groundwater equilibrium). The focus was to demonstrate the suitability of the final landform for the intended PLMUs with respect to the groundwater system. The key objectives were to demonstrate:

- That the final landform is non-polluting with respect to groundwater:
  - The final landform overall is demonstrated to be a sink for groundwater, including groundwater contained within spoil; and
  - Final void lake levels remain below shallow groundwater bearing units, i.e. there is sufficient freeboard to negate risk of void water discharge to any shallow groundwater system;
- That there are minimal additional impacts to groundwater receptors post-closure caused by the final landform that have not already occurred as a result of approved mining:
  - Little to no additional groundwater drawdown at potential GDE locations; and
  - Little to no additional groundwater drawdown at anthropogenic bore users.

The BWM regional groundwater model was extended to simulate approved mining until 2110 and simulate the post-mining landform from 2110 until post mining equilibrium. The post mining period in the model extends for 1,930 years over 22 stress periods.

The groundwater model was used to predict:

- Groundwater inflow to the pit shell from the surrounding geology, including inflow from the natural geology to the spoil backfill and inflow from the natural geology directly to the residual voids; and
- Groundwater inflow originating from the indirect catchment (i.e. areas of spoil backfill that receive rainfall recharge that then flows through the spoil into the residual voids).

Inflows were developed through an iterative process of model refinement with the water balance model until which time as the influence of changing groundwater flux on the water balance had reduced to a point considered acceptable. The model incorporated the 15 residual voids, associated spoil emplacements and the two in-pit tailings emplacements at Bonnie Doon and Ramp 74 (Figure 3-1 and Figure 3-2).

4.1 POST-MINING RESIDUAL VOID LAKE DEVELOPMENT AND FLUX DYNAMICS

4.1.1 STABILISED LAKE LEVELS

Residual void water level recovery is a process that takes decades to centuries, with the recovery rate generally declining as the lakes reach equilibrium conditions. For the majority of the residual voids, equilibrium water level conditions are reached after approximately 100 to 300 years (WRM, 2026c). The residual void lake levels at Kennedy and Comet Downs East take longer to stabilise at approximately 400 and 450 years respectively.

Predicted void lake levels remain significantly below the surface 'spill' point (Table 3-1) for each of the residual voids. The predicted stabilised water levels, approximate times to stabilisation and anticipated available freeboard is shown in Table 4-1. The modelled increase in water levels, above predicted stabilised levels, under a 0.1% AEP, 72-hour (3 day) design storm are also provided. Predicted freeboard values indicate that all residual void lake levels remain well below spill crest elevations at equilibrium and under the modelled extreme storm event.

TABLE 4-1 STABILISED RESIDUAL VOID LAKE LEVELS

Residual Void	Stabilised Water Level	Approx. Time to Stabilisation	Available Freeboard	Storm Event Increase
Unit	*mAHD*	*Years*	*m*	*m*
Ramp 8	146.5	200	41.5	2.2
Bonnie Doon	154.5	150	33.5	5.3
Mimosa/Besgrove	83.7	200	116.3	4.4
Deep Creek	134.5	300	67.5	2.6
Stewarton North	74.0	200	130.0	4.5
Stewarton South	103.9	100	121.8	11.6

Residual Void	Stabilised Water Level	Approx. Time to Stabilisation	Available Freeboard	Storm Event Increase
Kenmare	218.0	150	79.0	3.5
Togara/North Marshmead	165.7	300	105.3	2.0
South Marshmead	171.1	300	98.9	2.9
Kennedy	166.4	400	54.6	2.4
Comet Downs East	191.2	450	30.8	1.8
Ramp 74	234.1	100	31.9	10.2
South Ballamoo	141.5	300	148.5	2.8
Tannyfoil	144.7	250	92.3	3.6
Ramp 30	143.3	150	73.7	19.3

Source: WRM, 2026c.

The difference between the predicted residual void lake levels and the shallow geologic formations are provided in Table 4-2.

Predicted residual void lake levels remain below the base of the shallow geologic formations for each of the residual voids, with the exception of Comet Downs East. Residual void lake level modelling indicates that the Comet Downs East residual void lake will form above the base of the shallow formations at the start of the post-mining period and remain higher at equilibrium. Particle tracking (Section 4.3) shows that whilst the Comet Downs East residual void lake water is predicted to stabilise above the shallow geologic formations, the predicted lake elevations are higher than the neighbouring voids, resulting in a hydraulic gradient which drives any outflows from Comet Downs East towards the lower elevation neighbouring void lakes rather than away from the voids.

TABLE 4-2 PREDICTED DIFFERENCE BETWEEN RESIDUAL VOID LAKE LEVELS AND SHALLOW GEOLOGICAL FORMATIONS

Residual Void	Base of Shallow Formations[1]	Difference Between Base of Shallow Formations and Adjacent Void Lake Level[2]	
		Start of Post-mining	Post-mining Equilibrium
Unit	*mAHD*	*m*	
Ramp 8	176	29	31
Bonnie Doon	175	12	16
Mimosa/Besgrove	187	103	103
Deep Creek	204	55	65

Residual Void	Base of Shallow Formations[1]	Difference Between Base of Shallow Formations and Adjacent Void Lake Level[2]	
		Start of Post-mining	Post-mining Equilibrium
Stewarton North	204	128	130
Stewarton South	204	105	99
Kenmare	269	52	54
Togara/North Marshmead	251	111	87
South Marshmead	222	83	52
Kennedy West	187	44	26
Comet Downs East	188	-46	-1
Ramp 74	241	7	7
South Ballamoo	251	114	111
Tannyfoil	218	73	75
Ramp 30	210	63	67

[1] The lowest elevation of the base of shallow unconsolidated sediments adjacent to the void.

[2] A negative value indicates the void lake level is higher than the base of shallow formations by that value.

Source: SLR, 2026.

The predicted lake levels in the Kenmare residual void are above the Kenmare Underground and Laleham Underground workings. This indicates that the Kenmare Underground and Laleham Underground workings remain permanently flooded and there is no potential for oxidisation within the underground workings. This is consistent with the post-mining conceptual hydrogeological model, which assumes long-term saturation of underground mine workings.

4.1.2 GROUNDWATER INFLOW CONTRIBUTIONS AND RATES

Model results indicate that across all the voids with net groundwater inflow at equilibrium, spoil contributes between 90% to 100% of the total net groundwater inflows to the void. The equilibrium groundwater inflows to the voids represent a range of approximately 0% (Bonnie Doon, Stewarton South, Ramp 30) to 70% (Comet Downs East) of the total volumetric inflow to each residual void's water balance, indicating that groundwater inflows plays an important role for some voids, but are not always the dominant driver of predicted residual void lake levels (Table 4-3). This includes the volume of water moving between void and is not exclusively groundwater flowing towards the voids.

During early model stress periods prior to equilibrium, groundwater flux between the residual voids and the adjacent spoil and geological formations are more variable than towards the end of the recovery simulation. However, as equilibrium conditions are approached, groundwater flux stabilises and most residual voids behave as net groundwater sinks.

The equilibrium sink behaviour of the residual voids is driven by evaporative losses from the void lakes as predicted by the residual void water balance (WRM, 2026). The direct evaporation from the surface of the void lake maintains void lake levels lower than the surrounding groundwater levels in the long-term equilibrium state. All residual voids, except for Stewarton South, Ramp 30, Ramp 74 and Bonnie Doon, are predicted to behave as groundwater sinks at post-closure equilibrium with no net outflows to spoil or natural geology and the groundwater gradient remains towards the voids. The Stewarton South, Ramp 30, Ramp 74 and Bonnie Doon residual voids have net negative fluxes via movements of water between final voids. These residual voids are predicted to lose void water to adjacent voids via the natural geology between the voids at relatively small rates. Each of these voids have predicted lake elevations that are higher than the neighbouring voids (Table 4-1), resulting in a hydraulic gradient between the voids that drives this outwards flux from each void to its neighbouring void. Therefore, the outwards water flux is driven by, and would eventually be captured by, the adjacent voids with lower lake levels.

TABLE 4-3 EQUILIBRIUM GROUNDWATER INFLOW TO THE RESIDUAL VOIDS

Residual Void	**Average Equilibrium Groundwater Inflow Rate**			
	Spoil	**Tailings**	**Natural Geology**	**Total**
Unit	*ML/day*			
Bonnie Doon[1]	-0.12	-0.01	-0.01	**-0.14**
Ramp 74[1]	-2.33	-0.01	0.01	**-2.32**
Comet Downs East	0.85	0.00	0.10	**+0.94**
Kennedy	2.31	0.00	0.04	**+2.36**
South Marshmead	0.89	0.00	0.00	**+0.89**
Togara/North Marshmead	3.29	0.00	0.03	**+3.33**
Kenmare	0.49	0.00	0.00	**+0.50**
South Ballamoo	1.83	0.00	0.00	**+1.83**
Tannyfoil	1.51	0.00	0.02	**+1.52**
Stewarton North	1.23	0.00	0.05	**+1.28**
Stewarton South[1]	-0.05	0.00	0.00	**-0.05**
Deep Creek	0.79	0.00	0.00	**+0.79**
Ramp 30[1]	-0.21	0.00	0.00	**-0.21**
Mimosa/Besgrove	2.38	0.00	0.02	**+2.40**
Ramp 8	0.35	0.00	0.02	**+0.37**

[1] *Negative values indicate the void acts as a groundwater source.*

Source: SLR, 2026.

4.2 GROUNDWATER SYSTEM RECOVERY AND PREDICTED POST-MINING LEVELS

Groundwater levels surrounding the residual voids are controlled by the predicted residual void lake levels, which in turn are controlled by the rate of evaporation from the void lakes balancing surface inflows and groundwater inflows to the lakes. At equilibrium, the residual void lakes system acts as long-term groundwater sink, with evaporative losses maintaining inward hydraulic gradients.

The water table is predicted to remain depressed in the immediate vicinity of the residual voids in the long term, driven by the ongoing inwards groundwater flow gradients towards most residual void lakes (Figure 4-1).

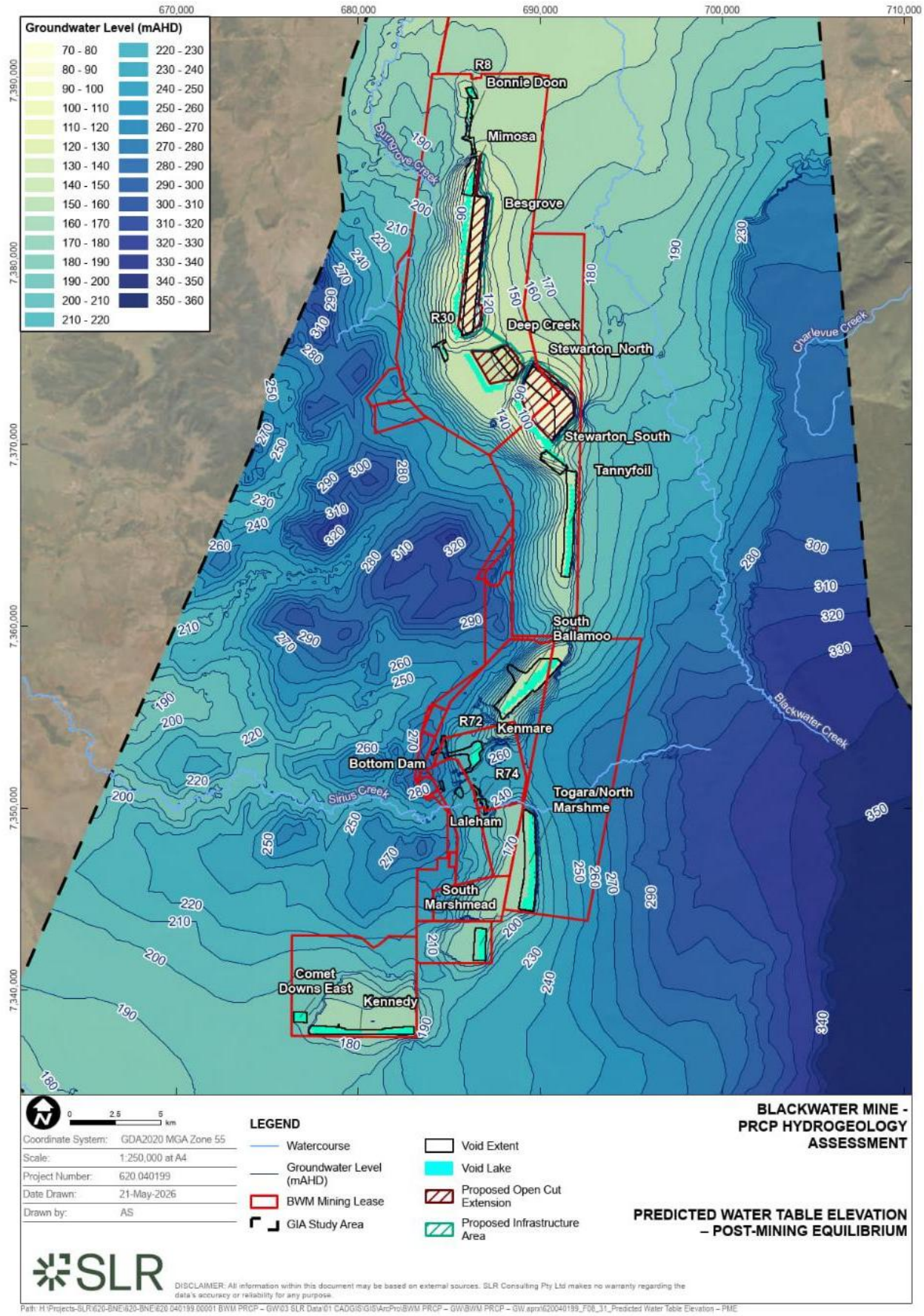
Predicted groundwater levels for the Aries, Castor and Pollux Seams of the Rangal Coal Measures indicate groundwater levels in the Permian sequence will remain depressed in the long term, driven by the residual void lakes. This condition reflects residual drawdown associated with mining and ongoing equilibration, rather than additional drawdown induced by the post-mining landform.

Figures showing predicted groundwater contours for the seams of the Rangal Coal Measures as well as the Burngrove Formation are provided in SLR (2026).

Some saturation is predicted west of the residual voids in the model layers that formerly represented the coal seams but now represents emplaced spoil within former mining pits. These zones reflect localised storage within spoil materials, with groundwater movement remaining directed toward, and ultimately captured by, adjacent residual void lakes.

Groundwater flow paths indicate that water migrating within the system is captured by residual void lakes, with no predicted migration beyond the mine lease.

Predictive hydrographs indicate that groundwater responses during the post-mining period are dominated by system stabilisation rather than continued regional change. Groundwater level behaviour at surrounding monitoring locations and third-party bores therefore reflects ongoing equilibration of conditions established during mining. In areas where drawdown persists, groundwater depths remain sufficiently deep to limit interaction with potential groundwater dependent ecosystems, indicating no additional risk associated with the final landform.



Source: SLR, 2026.

FIGURE 4-1 POST-MINING PREDICTED WATER TABLE ELEVATION

Predictive hydrographs for locations adjacent to residual void lakes are provided in SLR (2026).

The hydrographs demonstrate the vast majority of groundwater level drawdown in the coal measures occurs during active mining. While deeper coal seams show partial recovery from peak drawdown conditions in the post-mining phase, groundwater levels generally remain below pre-mining conditions. Most shallow groundwater units show persistent drawdown post-recovery.

4.3 GROUNDWATER CONTAINMENT AND FLOW PATHWAYS

Particle tracking modelling was undertaken for two scenarios:

- Scenario 1: Particles released at the start of the post mining period (year 2094) until the end of the post mining simulation period (year 4040) for a simulation period of 1,946 years; and
- Scenario 2: Particles released at post mining equilibrium (year 2641) until the end of the post mining period in the model (year 4040) for a simulation period of 1,399 years. Year 2641 was selected based on the final void hydrographs, where all final voids have reached equilibrium (i.e. flat lined).

Scenario 1 flow path analysis indicates the particles generally move toward the void lakes, with all of the particles captured in the voids. This behaviour reflects inward hydraulic gradients maintained by evaporative losses from residual void lakes.

Particles shown to be moving away from residual voids represent the four residual voids that have net outward fluxes, but for which outflows travel toward neighbourhood residual void lakes with an equilibrium water level at lower elevations.

This can be observed in the particle movements shown on Figure 4-2 with:

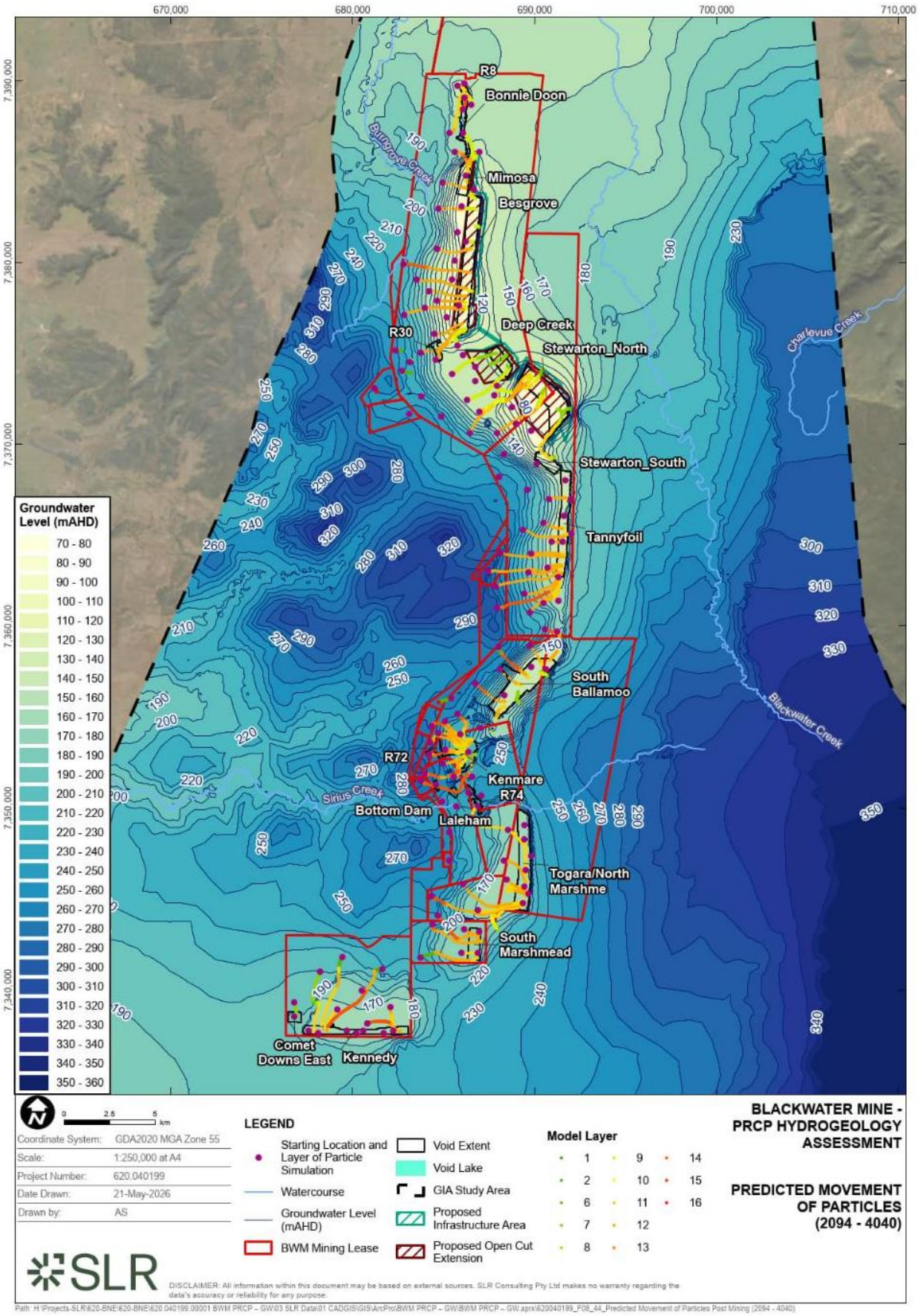
- Particles released to the west of Ramp 30 moving toward Mimosa/Besgrove;
- Particles released to the southwest of Ramp 30 moving toward Deep Creek;
- Particles released to the north of Bonnie Doon moving toward Ramp 8; and
- Particles released to the east of Ramp 74 moving toward Togara/North Marshmead.

These flow paths confirm that outward groundwater flux is redistributed internally between adjacent voids rather than migrating away from the mine domain.

Differences in the flow paths between Scenarios 1 and 2 are minimal. A comparison of the two results indicates some particles travel a slightly different path; however, their destinations do not change. For particles still traveling at the end of the simulation, i.e. not captured by evapotranspiration or final void lakes, particles in the Scenario 1 simulation travel a slightly longer distance owing to the longer simulation period.

Across both scenarios, particle tracking results demonstrate that groundwater movement remains confined within the mine lease and is ultimately captured by residual void lakes. No particles are predicted to travel beyond the mine lease in either scenario.

Further detail of the particle tracking simulations are provided in SLR (2026).



Source: SLR, 2026.

FIGURE 4-2 SCENARIO 1 PREDICTED PARTICLE TRACKING (2094-4040)

4.4 POST-MINING CONCEPTUAL HYDROGEOLOGICAL MODEL

The post mining conceptual hydrogeological model indicates that groundwater behaviour at BWM is governed by residual void lakes, which act as the primary hydraulic control on the system following mine closure. Groundwater conditions reflect a transition from mining induced disturbance toward long term equilibrium, with flow systems becoming progressively stable over time.

Key characteristics of the post-mining groundwater system include:

- Residual void lakes act as long-term groundwater sinks, maintaining inward flow gradients driven by evaporation;
- Groundwater flow is directed toward voids via spoil and surrounding geological units, with spoil pathways typically dominant;
- Localised inter-void flow may occur, where higher elevation voids discharge to adjacent lower elevation voids; this represents internal redistribution rather than external loss;
- Groundwater movement remains contained within the mine domain, with no predicted migration beyond the lease boundary; and
- Hydrogeological conditions reflect continuation of mining induced drawdown, with gradual stabilisation toward equilibrium rather than new impacts associated with the final landform.

Overall, the system evolves toward a stable, internally contained groundwater regime, with residual void lakes providing long term hydraulic control and no predicted offsite impacts.

4.5 GROUNDWATER QUALITY

A detailed discussion of the baseline groundwater quality at BWM is provided in SLR (2026).

Baseline groundwater quality at BWM varies between hydrostratigraphic units and reflects a wide range of salinity conditions as defined by TDS. As shown in Table 4-4 and Figure 4-3, groundwater spans classifications from fresh through to highly saline, with variability both within and between hydrostratigraphic units.

Groundwater is predominantly sodium-chloride type and is generally unsuitable for most environmental values, with limited suitability for stock watering in selected units.

Key observations for each hydrostratigraphic units are as follows:

- Alluvium (Quaternary):
  - Groundwater is Na-Cl type with neutral pH, indicating evaporative concentration under low flushing conditions;
  - Elevated solute concentrations result in unsuitability for all assessed environmental values; and
  - Interpretation is constrained by limited data availability (single monitoring bore);
- Tertiary Sediments:
  - Groundwater is Na-Cl to Na-CO_3-HCO_3 type with a wide pH range, indicating mixed recharge influence and variable water-rock interaction;

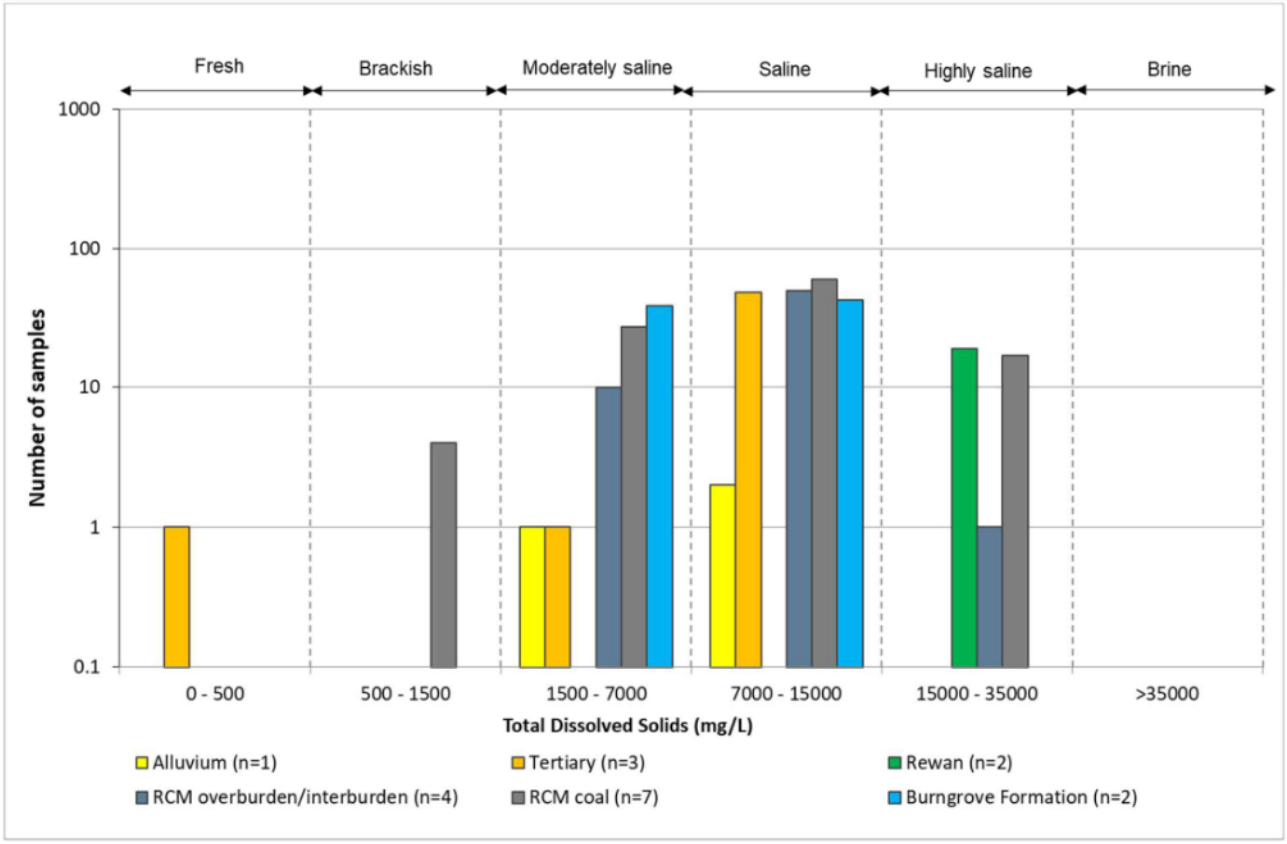
- Elevated solute concentrations result in unsuitability for drinking and irrigation uses. Localised suitability for stock watering is observed where water quality is less saline; and
- Groundwater quality is highly variable between bores, reflecting heterogeneous lithology and recharge conditions;

- Rewan Group:
  - Groundwater is Na-Cl type with near-neutral pH, indicating chemically evolved conditions under low permeability and limited recharge;
  - Consistently elevated solute concentrations result in unsuitability for all environmental values; and
  - Assessment is based on a limited dataset, reducing confidence in spatial variability;
- Rangal Coal Measures:
  - Groundwater is Na-Cl to Na-Cl-HCO_3 type with a broad pH range, indicating heterogeneous geochemical conditions and variable redox environments within coal seams;
  - Elevated salinity and solute concentrations result in widespread unsuitability for drinking and irrigation uses. Most monitoring bores exceed stock watering criteria; and
  - This unit exhibits the greatest variability and highest overall salinity conditions across the groundwater system;
- Burngrove Formation:
  - Groundwater is Na-Cl type with a moderately alkaline and relatively stable pH range, indicating more consistent geochemical conditions;
  - Elevated solute concentrations result in unsuitability for aquatic ecosystem, drinking water and irrigation uses. Groundwater is generally suitable for stock watering, with only isolated exceedances; and
  - This unit displays comparatively lower salinity and improved water quality relative to the Rangal Coal Measures.

TABLE 4-4 SUMMARY OF BASELINE GROUNDWATER QUALITY BY HYDROSTRATIGRAPHIC UNIT

Hydrostratigraphic Unit	Groundwater Type	Salinity Range	EV Suitability				Key Notes
			Aquatic Ecosystem	Drinking Water	Irrigation	Stock Watering	
Alluvium (Quaternary)	Na-Cl, neutral pH	Brackish to moderately saline	Not suitable				Limited data (single bore); highly saline groundwater
Tertiary Sediments	Na-Cl/ Na-CO_3-HCO_3, large pH range: 3.3-8.4 (median 7.4)	Fresh to moderately saline	Not suitable			Variable (locally suitable)	High variability between bores; direct rainfall recharge influence

Hydrostratigraphic Unit	Groundwater Type	Salinity Range	EV Suitability				Key Notes
			Aquatic Ecosystem	Drinking Water	Irrigation	Stock Watering	
Rewan Group	Na-Cl, near neutral pH	Highly saline	Not suitable				Elevated salinity and limited permeability
Rangal Coal Measures	Na-Cl/Na-Cl-HCO_3, large pH range: 6.9-11.9 (median 7.7)	Brackish to highly saline	Not suitable			Mostly not suitable	Wide range in salinity
Burngrove Formation	Na-Cl, pH range: 7.1-8.9 (median 8.0)	Moderately saline to saline	Not suitable			Generally suitable	Lower salinity relative to coal measures; isolated exceedances



Note: n = number of bores

Source: SLR, 2026.

FIGURE 4-3 SALINITY RANKING BY HYDROSTRATIGRAPHIC UNIT

4.5.1 GROUNDWATER QUALITY SUMMARY

Groundwater quality at BWM is variable across hydrostratigraphic units but is generally characterised by elevated solute concentrations that exceed relevant criteria for most EVs. This reflects the combined influence of lithology, groundwater residence time and limited flushing within much of the groundwater system.

The post-closure groundwater system at BWM is predicted to be dominated by the residual voids acting as groundwater sinks, maintaining inward hydraulic gradients and limiting outward migration of groundwater and solutes. Outflows from the Bonnie Doon, Ramp 30, Ramp 74 and Stewarton South residual voids move towards adjacent lower elevation voids, resulting in a localised (internal) redistribution of groundwater rather than interaction with the surrounding groundwater system.

Accordingly, the residual voids are not anticipated to result in any material change to groundwater quality beyond the project area.

4.6 GROUNDWATER-DEPENDENT ECOSYSTEMS

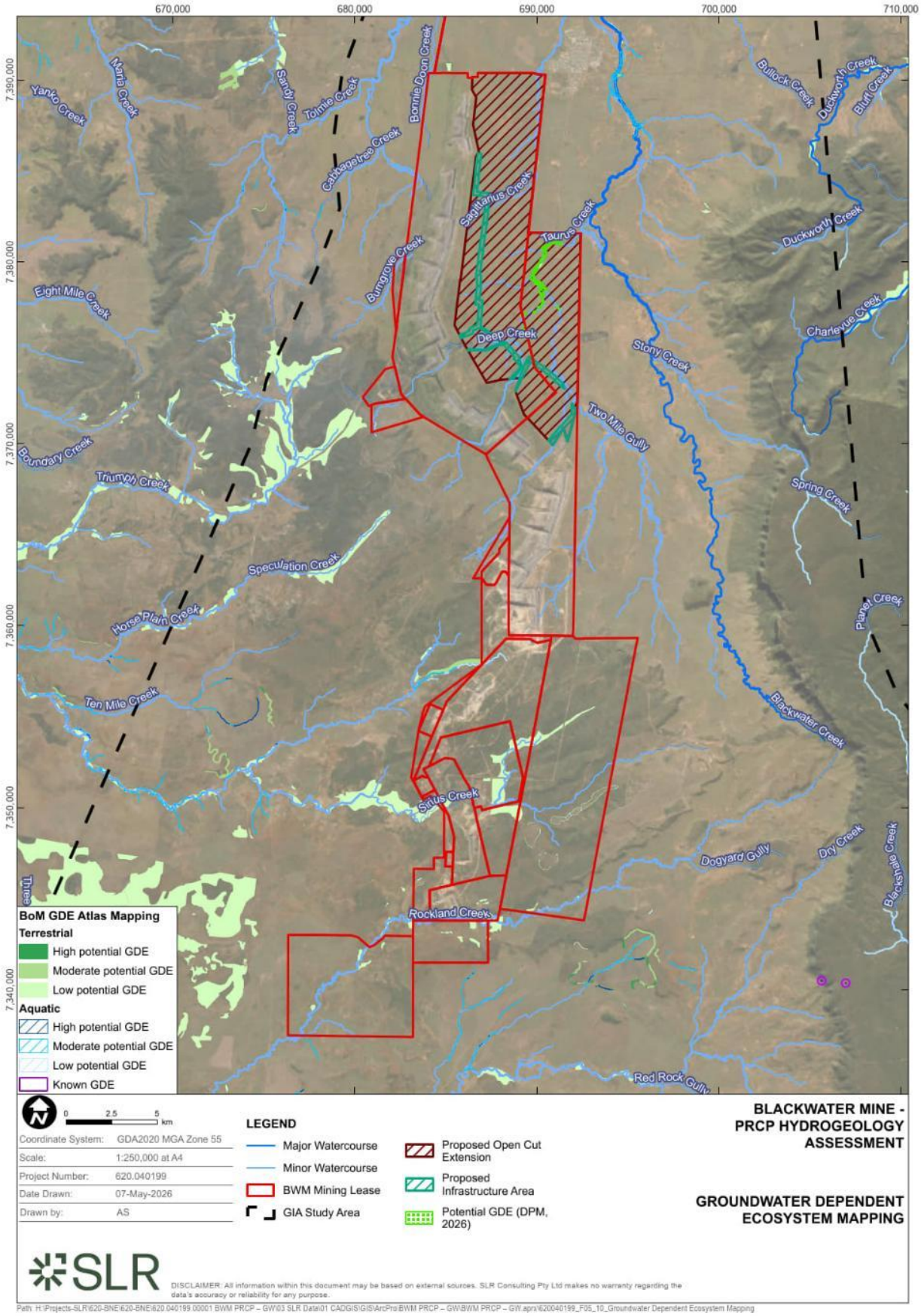
Areas with potential for terrestrial and aquatic GDEs in the southern BWM project area are shown in Figure 4-4. These locations are based on the Bureau of Meteorology (BoM) GDE Atlas data and ground-truthing results from 2026 (Section 4.6.2). Given the absence of indicators identified during field verification surveys in the northern Project Area, the GDE Atlas mapping is considered conservative and may not accurately reflect local site conditions.

In addition:

- There are no registered springs within a 10 km buffer of the Project area. The closest registered spring is located approximately 14.8 km southeast from the Project area. At this distance it is not considered relevant to the Project's impact assessment; and
- No wetlands of High Ecological Significance (HES) have been identified within a 10 km buffer of the Project area. The closest wetland is located approximately 19.7 km southeast from the Project area and is not considered relevant to the Project's impact assessment.

Predictive hydrographs prepared by SLR (2026) indicate that several of the sites are unlikely to contain actual GDEs based on the predicted depth to groundwater being greater than 8 to 10 m. At these depths, groundwater is unlikely to be accessible to vegetation, reducing the potential for groundwater dependency.

Drawdown in the vicinity of potential GDEs is predicted to occur prior to the end of mining (i.e. associated with approved active mining). Post-mining groundwater level trends represent continuation of these pre-existing conditions, with no additional drawdown attributable to the final landform in the future.



Source: SLR, 2026.

FIGURE 4-4 GROUNDWATER DEPENDENT ECOSYSTEMS

4.6.1 HISTORICAL GDE ASSESSMENTS

Ground-truthed regional ecosystems in BWM North that may represent terrestrial GDEs are shown in Figure 4-4. Potential GDEs are limited to riparian vegetation associated with Taurus Creek along the eastern margin of the Project Area and a small area along Sagittarius Creek to the north. Field verification surveys of these areas were summarised in EMM (2023) as follows:

> "Prolonged dry conditions in the lead-up to the December 2019 surveys provided ideal conditions for identifying surface expressions of groundwater (i.e. aquatic GDEs). However, no flows, salt seeps, hydrophytes, or other obvious indicators of aquatic GDEs were encountered. Further, the concentration and relative proportion of major anions and cations in surface water samples collected from the survey area in December 2019 and May 2020 showed no obvious groundwater influence. Field verification of riparian vegetation and aquatic habitats of the survey area found no obvious on-ground indicators of aquatic GDEs."

4.6.2 2026 GDE ASSESSMENTS

Recent investigations (DPM Enviroscienses, 2026) provide the most up to date assessment of groundwater dependent ecosystems within the BWM North Study Area. The assessment identified that:

- Terrestrial GDEs are present but limited in extent, occurring only within parts of the Taurus Creek riparian corridor;
- No aquatic or subterranean GDEs were identified, with no surface groundwater expression observed; and
- No stygofauna were detected during targeted sampling, indicating the absence of subterranean groundwater dependent ecosystems.

Subsequent ecological assessment (E2M, 2026) supports these findings and refines the interpretation of terrestrial GDE occurrence. Potential groundwater dependency is restricted to facultative species within the Taurus Creek corridor, while vegetation communities in other areas (e.g. Two Mile Gully and upstream reaches) are unlikely to rely on groundwater due to species composition and rooting characteristics.

The mapping produced by DPM Enviroscienses (2026) has been adopted for this assessment and provides the basis for identifying GDE extent within the Project Area.

4.7 THIRD-PARTY GROUNDWATER BORES

Forty-eight (48) third party water supply bores have been identified surrounding the project area and within study area (Figure 3-9). These bores are generally used for stock or farm supply purposes.

Predictive hydrographs (SLR, 2026) were prepared to assess the potential for additional impacts attributable to the final landform that may occur in the post-mining period and are unrelated to those that have occurred as a result of approved mining.

The following summarises the predicted impacts on third-party groundwater bores:

- Hydrographs for bores interpreted to be screened within the weathered zone are not predicted to experience additional groundwater drawdown of greater than the relevant 2 m drawdown 'bore trigger threshold' for unconsolidated aquifers (Chapter 3, *Water Act 2000;* Water Act) during the post-mining period:

    - This indicates negligible additional impact attributable to the final landform;
- Hydrographs for bores interpreted to be screened in the Burngrove Formation are not predicted to experience additional groundwater drawdown of greater than the relevant 5 m drawdown 'bore trigger threshold' for consolidated aquifers in the Water Act during the post-mining period:
    - This indicates no material post-mining impact;
- Hydrographs for three of the seven bores interpreted to be screened in the Rewan Formation indicate negligible to no additional drawdown over the post-mining period:
    - The remaining four bores show additional drawdown; however, this is interpreted to represent continuation of drawdown from approved mining rather than an impact of the final landform;
- Drawdown in the bores screened in the Rangal Coal Measures is also interpreted to be a continuation of the drawdown from approved mining and not the final landform. No Rangal Coal Measure bores are predicted to experience additional drawdown of more than the relevant 5 m 'bore trigger threshold' from the Water Act, with predicted additional drawdown generally remaining below threshold levels.

Overall, predicted groundwater responses at third-party bores reflect continuation of mining-induced drawdown, with no additional or significant impacts attributable to the post-mining landform.

4.8 CONCLUSIONS

The groundwater assessments indicate that post-mining conditions at BWM are controlled by residual void lakes, which act as long-term hydraulic sinks. These maintain inward groundwater gradients driven by evaporation and therefore dominate post-closure groundwater behaviour.

- Groundwater levels reflect continuation of mining-induced drawdown, with gradual stabilisation rather than new impacts. The final landform does not introduce additional drawdown beyond approved mining;
- Groundwater flow remains contained within the mine domain. Localised outward flux represents internal redistribution between voids, not migration to the surrounding system;
- Groundwater quality is variable and characterised by elevated solute concentrations; however, no material offsite impacts are expected from the final landform;
- GDEs are limited in extent and largely confined to parts of the Taurus Creek corridor. Predicted groundwater depths indicate these ecosystems are unlikely to rely on groundwater influenced by the final landform; and
- Third-party bores are predicted to experience minimal groundwater level changes within applicable trigger thresholds, with any drawdown representing continuation of mining-related impacts.

Overall, the residual void landform will result in a stable, internally contained groundwater system with no material adverse impacts to surrounding third party users or receptors, and represents the lowest risk closure outcome when compared to further disturbance or modification of the residual voids.

5. FLOODING ASSESSMENT

This section evaluates flood risk to residual voids under current and future climate conditions. It aims to ensure voids are protected from inundation, in line with PRCP Guideline sections 3.4 and 3.6.3.

In accordance with the Mined Land Rehabilitation Policy (DES, n.d.), and relevant provisions of the EP Act and EP Regulation, the assessment must demonstrate that residual voids are not located within flood plains, or if they are, that they will be rehabilitated to a stable, safe, and sustainable condition.

The flood plain modelling must:

- *Be undertaken in accordance with Australian Rainfall and Runoff (2019) (ARR) guidelines;*
- *Exclude artificial features within the tenure boundary;*
- *Include hydrologic and hydraulic modelling, calibration, sensitivity analysis and spatial mapping;*
- *Identify all relevant watercourses, diversions and potential groundwater influences; and*
- *Assess impacts of 0.1% AEP flood levels to determine floodplain extent.*

Where floodwaters may interact with voids or backfilled areas, assessments must consider:

- *Erosion risks and wall instability from floodwater ingress;*
- *The hydraulic properties of backfilled material; and*
- *Design modifications required to maintain long-term stability.*

A Final Landform Flood Modelling Assessment was prepared by WRM (2026a) for the BWM final landform design version 4.2. The assessment addresses the requirements of Section 3.6.1 – General rehabilitation practices (flooding) of the PRCP guideline (DETSI, 2024).

Further to the Final Landform Flood Modelling Assessment, WRM (2026b) also prepared a Voids in Flood Plains Assessment to specifically address the requirements of the Information Sheet - Void in flood plains (ESR/2019/4966; Version 1.02). The voids in flood plain assessment identified the proposed residual voids in the BWM final landform would be situated wholly or partially in a "flood plain", defined in PRCP guideline as land that is the same height as, or lower than, the level modelled as the peak water level during a 0.1% (1 in 1,000) AEP flood event for a relevant watercourse.

5.1 METHOD OF ASSESSMENTS

Hydrologic models were developed using the URBS (Unified River Basin Simulator) software package. URBS incorporates the latest climate change guidance from Australian Rainfall and Runoff 2019 Version 4.2 (ARR 2019 v. 4.2) (Ball et al, 2019).

Seven URBS hydrologic models for the catchments that drain BWM were developed, calibrated and validated. The modelled catchments are:

- Bonnie Doon Creek;
- Sagittarius Creek;
- Burngrove Creek;
- Blackwater Creek (including Taurus Creek and Two Mile Gully);
- Speculation Creek;
- Sirius Creek; and
- Rockland Creek.

These models formed the foundation for both the Final Landform Flood Modelling Assessment (WRM, 2026a) and the Void in Floodplain Modelling Assessment (WRM, 2026b). The URBS models were calibrated to recorded rainfall and water level data for the March 2017 and January 2020 flood events.

Existing TUFLOW hydraulic models were updated to incorporate the updated final landform as well as updated design inflows from the new URBS hydrologic models. Hydrologic and hydraulic modelling were undertaken for the 1% (1 in 100) and 0.1% (1 in 1,000) AEP events as well as the PMF model event.

The Final Landform Flood Modelling Assessment (WRM, 2026a) considered the risk of flood water ingress into the final voids, as well as the risk of erosion and scour due to floodwater being in contact with rehabilitated landform. The Void in Floodplain Modelling Assessment (WRM, 2026b) specifically considered only the pre-mining 0.1% AEP flood event for 'relevant watercourses'. Relevant watercourses are defined as stream order 4 or higher under the Strahler stream order classification system. Relevant watercourses at BWM for the Void in Floodplain Modelling Assessment are:

- Blackwater Creek;
- Two Mile Gully;
- Taurus Creek (downstream of the Emu Creek confluence); and
- Sirius Creek.

Detailed accounts of the modelling approach and methods of calibration and validation are documented in the Hydrologic Model Development, Calibration and Validation Report, provided as Appendix E of WRM (2026a) and Appendix B of WRM (2026b).

5.2 FINAL LANDFORM FLOOD ASSESSMENT

Hydraulic modelling was undertaken for the 1% AEP, 0.1% AEP and PMF design flood events under proposed final landform conditions by WRM (2026a). Modelling for the Final Landform Flood Assessment was completed using the SSP2-4.5 (year 2100) future climate scenario, with design rainfall inputs adjusted in accordance with ARR (2019) climate change guidance.

The full set of flood maps showing flood depths, levels, extents and velocities are provided in WRM (2026a).

When considering erosion risk, the Final Landform Flood Modelling Assessment assumed the final landform, including flood protection landforms and rehabilitated dumps, will be:

- Rehabilitated to achieve at least 70% groundcover;
- Erosion resistant materials will be placed along the toe of landforms which are subjected to flooding; and
- The topographic gradient along the toe of the landform would generally be less than 1%.

5.2.1 FLOOD IMMUNITY

Flood immunity of the residual voids was assessed based on hydraulic modelling results for the 0.1% AEP design event and PMF under final landform conditions, with PMF results used to evaluate performance under extreme conditions. The assessment considers the extent of modelled flooding relative to each void, as well as the influence of diversion structures, local topography and catchment characteristics on potential floodwater ingress.

All residual voids are modelled to be immune to ingress from the 0.1% AEP design event under final landform conditions.

Whilst the current diversions at BWM are considered temporary, conceptual designs for permanent diversions are under development. The final landform with the inclusion of permanent diversions will maintain at least the current level of flood protection for the residual voids.

Flood depth maps for all study catchments and events are provided in WRM (2026a).

A flood risk profile was prepared to assess the risk associated with flood ingress during a PMF event. The risk of flood ingress to residual voids during a PMF event, accounting for the proposed 0.1% AEP mitigation measures, was deemed to be low. This is largely attributed to the rarity of a PMF occurring.

5.2.2 EROSION AND SCOUR RISK

Modelling results indicate flood protection landforms and rehabilitated dumps are located in areas where flood velocities are lower than 2 m/s for all events up to the 0.1% AEP. As such, the final landform is expected to remain stable for all events up to the 0.1% AEP design flood event. For events rarer than 0.1% AEP, such as the PMF, elevated erosion and scour are expected to occur throughout the catchment during PMF events, consistent with natural responses to extreme flooding conditions.

5.3 VOIDS IN FLOOD PLAINS ASSESSMENT

The Voids in Flood Plains Assessment focused on the voids within the flood plains of the following relevant watercourses:

- Blackwater Creek;
- Two Mile Gully;
- Taurus Creek (downstream of the Emu Creek confluence); and
- Sirius Creek.

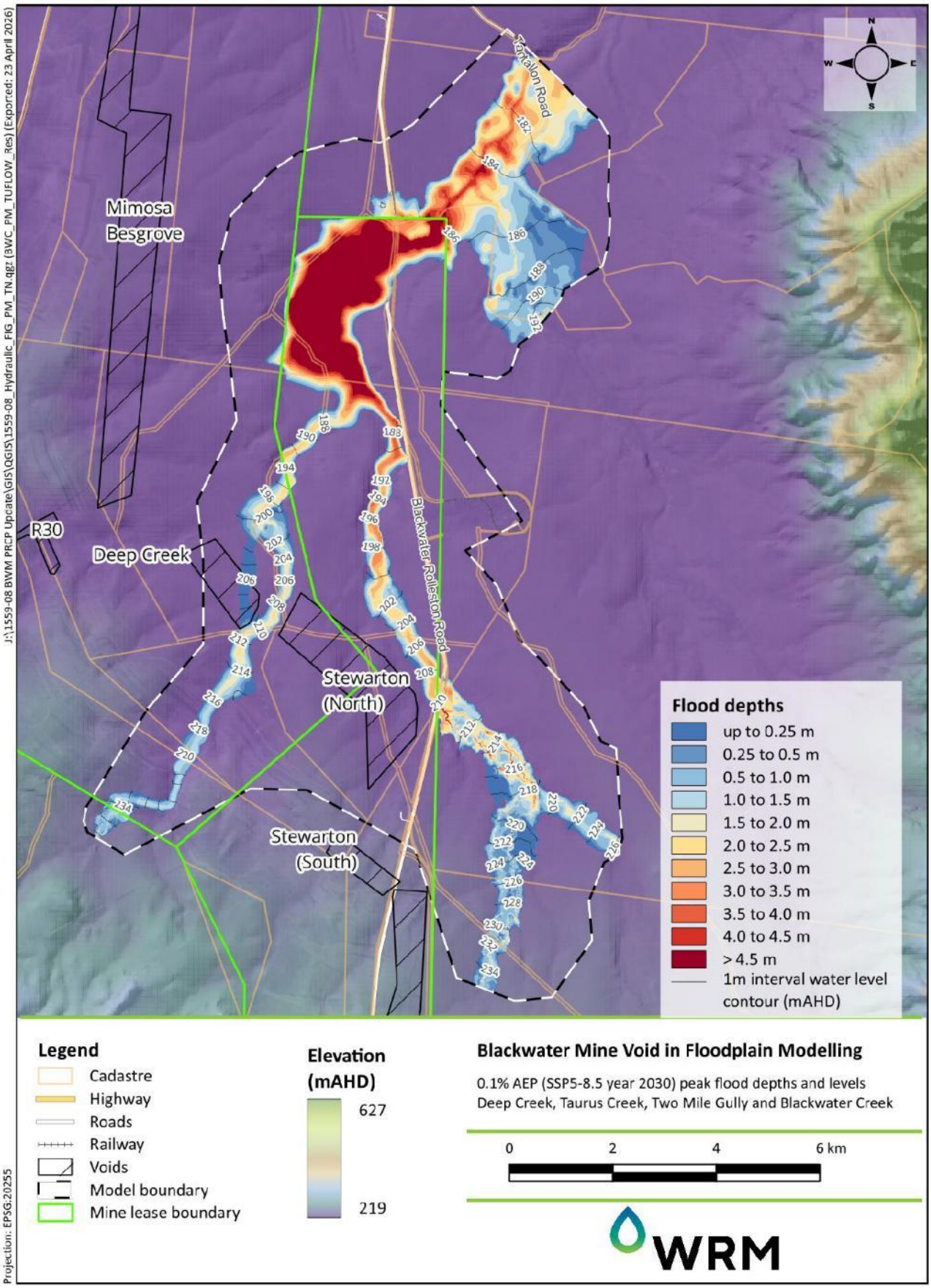
Unlike the Final Landform Flood Assessment, based on the post-mining final landform conditions, voids in flood plain modelling must represent the flood plains at a time when all temporary structures or features have been removed. Therefore, the detailed topographic data used for the Final Landform Flood Assessment was not suitable as it contained levees, mining pits, overburden dumps, stream diversion channels as well as road, rail and cross drainage infrastructure.

Floodplain hydraulic modelling was therefore undertaken by excluding all mine-related features to represent pre-mining conditions. The Fitzroy River catchment 25 m resolution Digital Elevation Model (DEM) embedded in the previous hydraulic model was considered to be the best representation of pre-mining topography within the BWM mine lease area and was adopted for areas within the BWM mine leases for the Voids in Flood Plains Assessment.

The other aspect of the voids in flood plains modelling that differed from the Final Landform Flood Assessment was to adopt the SSP5-8.5 (year 2030) climate scenario rather than the SSP2-4.5 climate scenario. Design Intensity-Frequency-Duration (IFD) design rainfall intensities were scaled up using uplift factors obtained from ARR datahub. The associated pre-

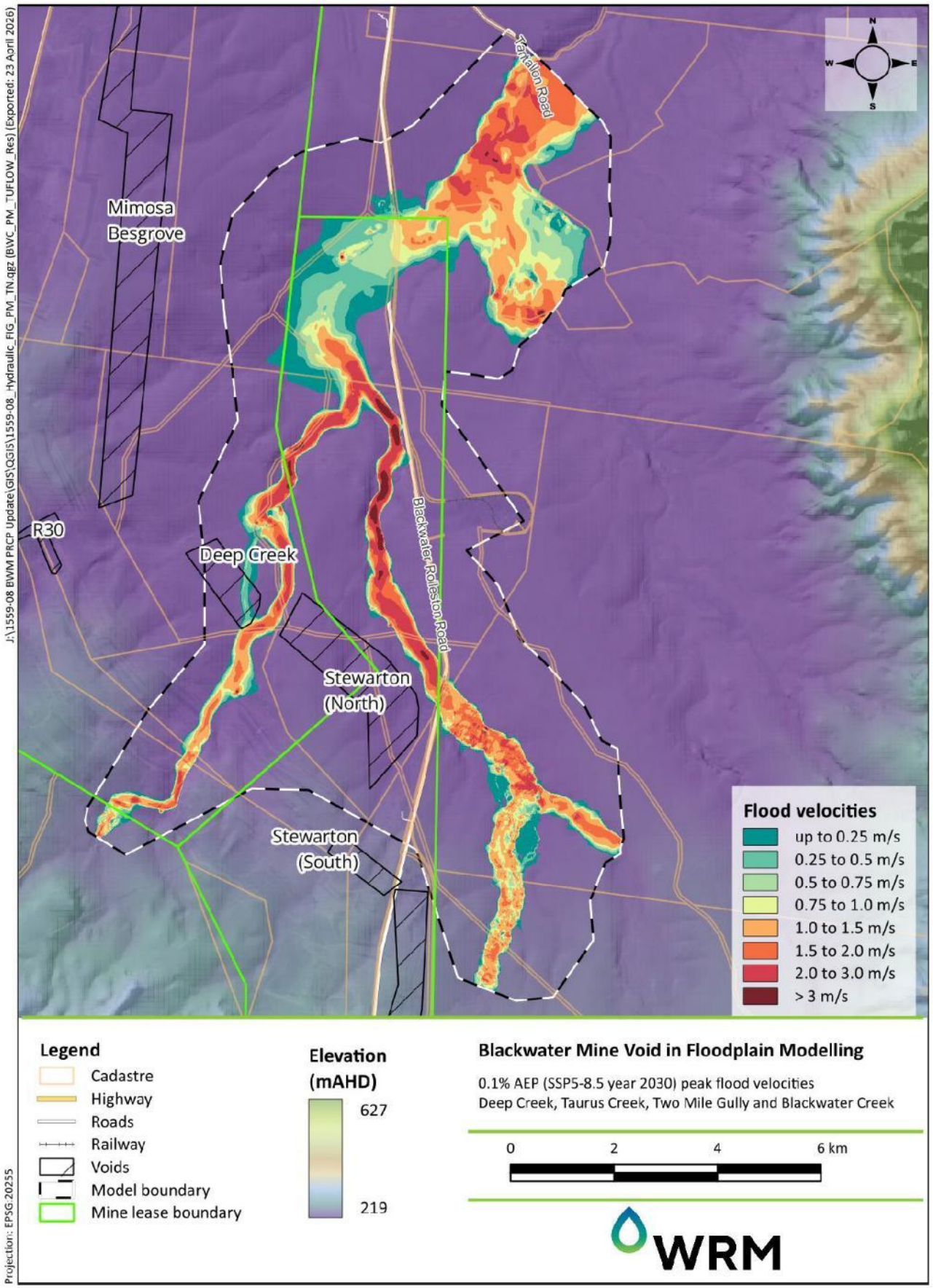
burst rainfalls were also scaled up accordingly. The SSP5-8.5 climate adjustments account for approximately 1.3°C of global warming up to 2025 since the historical baseline period of 1961-1990.

The predicted peak flood extents, levels, depths and velocities along Taurus Creek, Two Mile Gully and Blackwater Creek are provided in Figure 5-1 and Figure 5-2. Predicted peak flood extents, levels, depths and velocities along Sirius Creek are provided in Figure 5-3 and Figure 5-4.



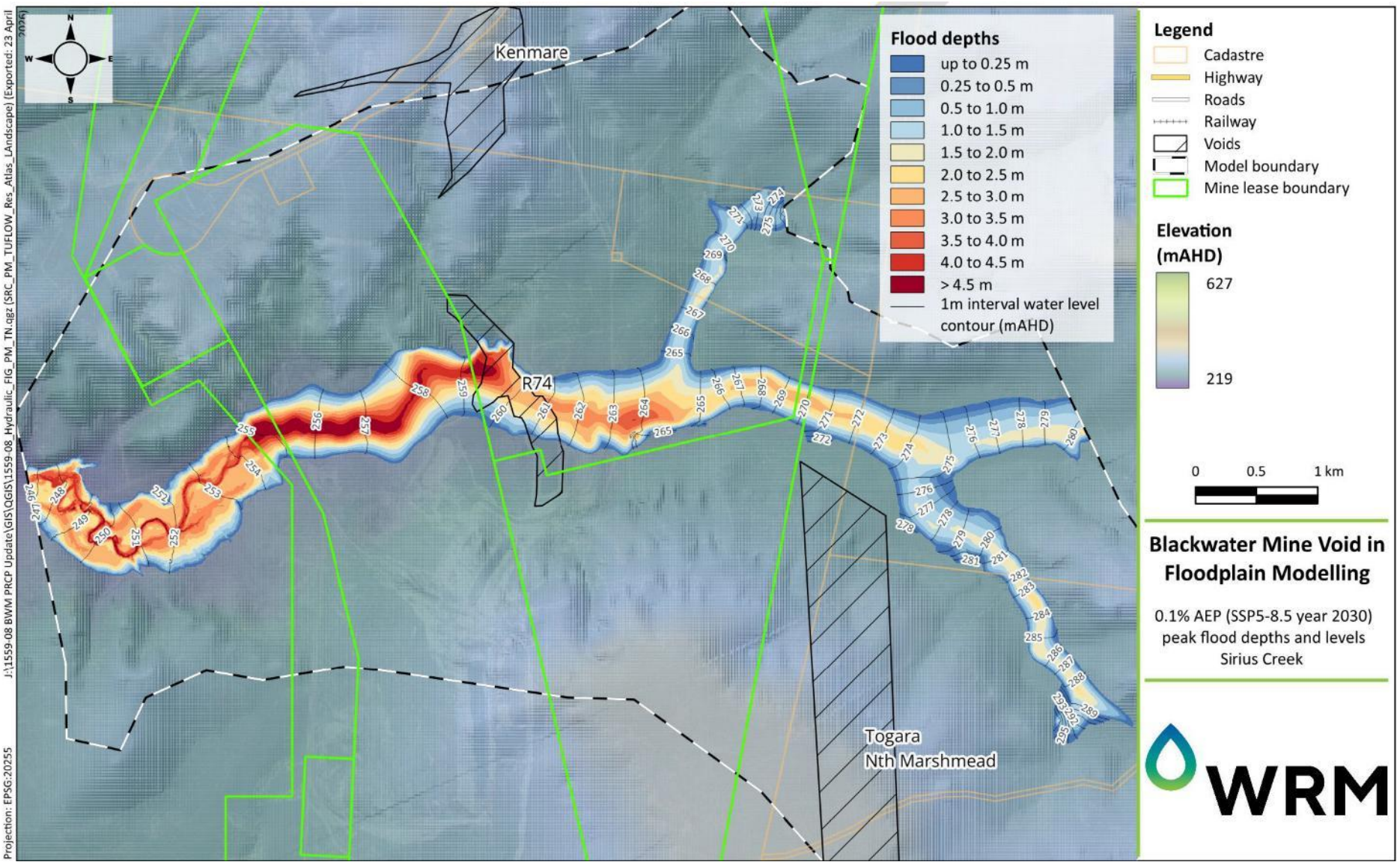
Source: WRM (2026b).

FIGURE 5-1 PEAK FLOOD EXTENT, LEVELS AND DEPTHS FOR THE 0.1% AEP EVENT – BLACKWATER CREEK



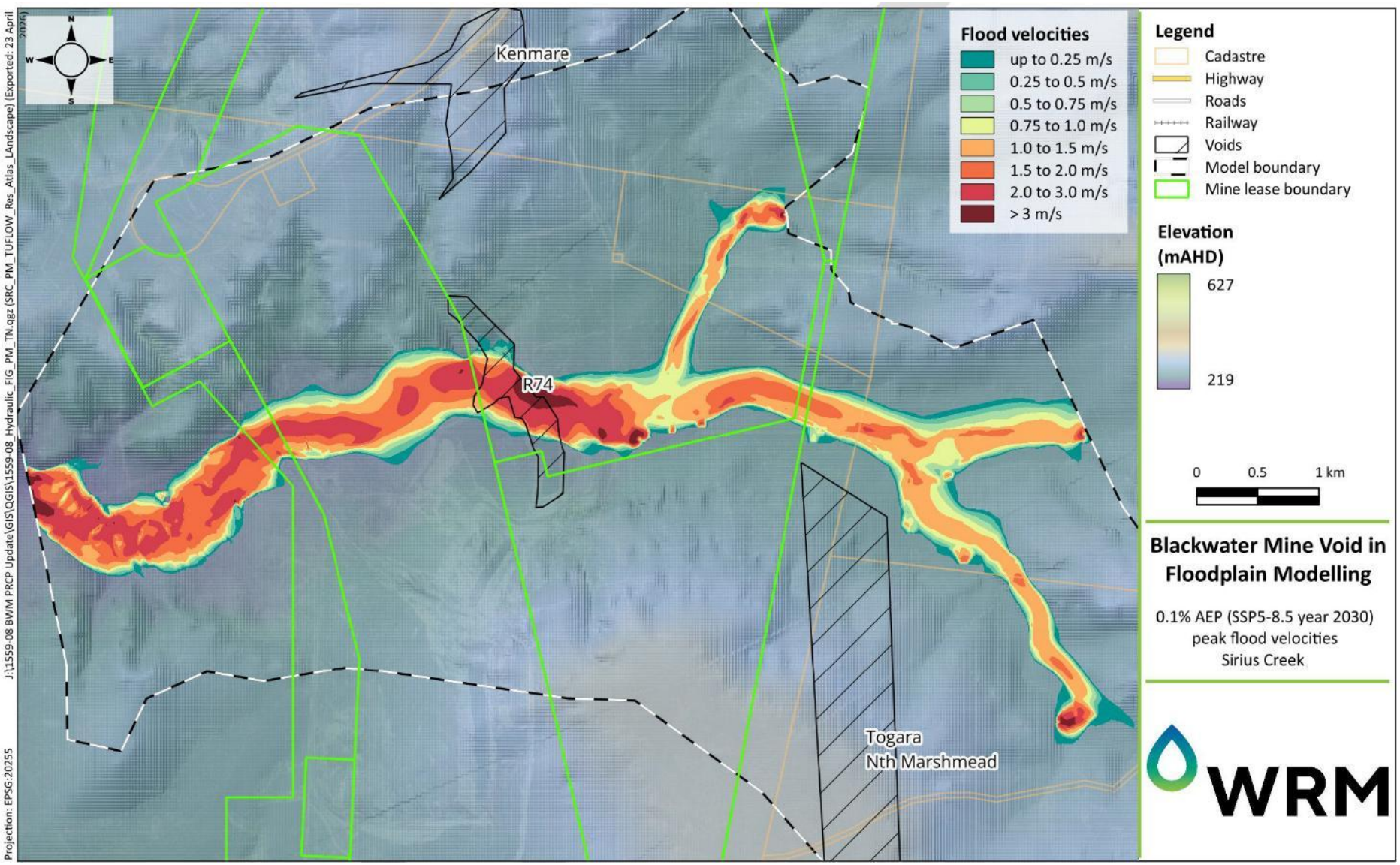
Source: WRM (2026b).

FIGURE 5-2 PEAK FLOOD VELOCITIES FOR THE 0.1% AEP EVENT – BLACKWATER CREEK



Source: WRM (2026b).

FIGURE 5-3 PEAK FLOOD EXTENT, LEVELS AND DEPTHS FOR THE 0.1% AEP EVENT – SIRIUS CREEK



Source: WRM (2026b).

FIGURE 5-4 PEAK FLOOD VELOCITIES FOR THE 0.1% AEP EVENT – SIRIUS CREEK

Residual voids were assessed against the modelled 0.1% AEP flood extent for relevant watercourses to determine whether they are located within a floodplain as defined by the PRCP guideline (DETSI, 2024). As summarised in Table 5-1, the majority of residual voids are located outside of the 0.1% AEP flood extent and are therefore not situated within a floodplain.

The Deep Creek residual void is partially located within the Taurus Creek inundation extent and the Ramp 74 residual void is situated within the Sirius Creek inundation extent.

The final landform design will prevent floodwater ingress to the Deep Creek void under the 0.1% AEP flood event.

The Ramp 74 void is situated within the Sirius Creek inundation extent for the 0.1% AEP flood event. Under current (operational) conditions, there is a licensed temporary diversion that diverts Sirius Creek around the southern end of the existing Ramp 74 void. The Ramp 74 void stores tailings and will remain under post-mining conditions as the Ramp 74 residual void and TSF. To maintain free drainage of the Sirius Creek catchment under post-mining conditions, a permanent diversion of Sirius Creek is required. A conceptual design for this permanent diversion is currently being developed in accordance with the watercourse diversion guideline (DNRME, 2019).

TABLE 5-1 RESIDUAL VOID LOCATIONS RELATIVE TO 0.1% AEP FLOOD EXTENT

Residual Void	Floodplain Status (0.1% AEP)	Relevant Watercourse	Basis
Deep Creek	Partially within flood extent	Taurus Creek	Partially intersected by inundation extent; final landform design intended to prevent floodwater ingress
Ramp 74	Within flood extent	Sirius Creek	Intersects inundation extent; temporary diversion in place; permanent diversion required post-mining
All remaining voids	Outside flood extent	-	Located outside the 0.1% AEP inundation extent and not within a floodplain as defined by DETSI (2024)

Source: WRM (2026b).

6. VOID WATER BALANCE

This section presents predicted long-term void water balance behaviour of the proposed residual voids. It also aims to support the assessment of geotechnical and geochemical stabilities over time.

As required under the PRCP framework, this section addresses:

- *Long-term water balance modelling results of inflows, outflows and equilibrium lake levels of the residual voids;*
- *Interactions with groundwater, including drawdown, hydraulic head reduction and potential cones of depression;*
- *Potential for stratification and connection to surrounding groundwater systems;*
- *Flooding and drainage behaviours of nearby surface waters, and potential void interactions;*
- *Conceptual water balance model incorporating all projected inflows, outflows and recharge rates;*
- *Assessment of each major water flux into and out of the voids; and*
- *Identification of catchment surface water sources likely to influence void water quality.*

A void water balance assessment was completed by WRM (2026c) to evaluate the hydrological behaviour of the 15 residual voids following the completion of mining.

6.1 WATER BALANCE MODEL

A GoldSim water balance model was used to simulate the generation, movement, and loss of water on a daily time-step within a residual void over a 1,000-year period, commencing the year mining is estimated to cease in each individual void.

The Australian Government Consistent Climate Scenarios (CCS) project was used to generate climate change adjusted rainfall and evaporation data from an historical climate dataset for the period 1960 and 2024 (64 years). The CCS project provides climate projections as a daily time series across Australia on a 0.05-degree grid. The grid point closest to the centre of BWM was selected for the assessment.

The Shared Socioeconomic Pathway SSP2-4.5 was selected as the emission pathway with a base case global warming sensitivity for the Year 2070. The Year 2070 was selected as it represents a general mid-point for when mining ceases across all voids.

The 64 years of historical climate data adjusted rainfall and evaporation data was looped to create a long-term (1,000-year) climate sequence.

Pan evaporation was converted to Morton's Lake (mLake) and Morton's Wet (mWet) evapotranspiration to account for evapotranspiration losses from the pit lake and catchment.

The final landform design version 4.2 was used to generate the residual void geometries provided in Table 6-1. The year mining is estimated to cease in each void is also included in this table.

TABLE 6-1 RESIDUAL VOID GEOMETRIES

Residual Void	Year[1]	Floor Level	Crest Level	Depth	Volume to Crest	Surface Area at Crest
Unit	-	*mAHD*		*m*	*ML*	*ha*
Ramp 8	2031	109	175[2]	66	6,528	21.0
Bonnie Doon	2041	150	175[2]	26	3,633	30.3
Mimosa/Besgrove	2089	24	200	176	374,878	597.2
Deep Creek	2050	52	202	150	54,895	109.4
Stewarton North	2037	-4	204	208	302,582	380.1
Stewarton South	2037	92	232	140	42,632	82.5
Kenmare	2095	161	297	136	51,258	116.4
Togara/North Marshmead	2110	69	271	202	292,542	363.8
South Marshmead	2097	108	270	162	74,727	112.8
Kennedy	2093	99	221	122	93,791	192.8
Comet Downs East	2103	90	222	132	20,377	41.7
Ramp 74	2023	234	266	32	9,954	60.5
South Ballamoo	2101	84	290	206	376,755	447.9
Tannyfoil	2041	115	237	122	160,141	303.2
Ramp 30S	2027	139	217	78	16,316	59.7

[1] The year mining is estimated to cease in that void.

[2] 175 mAHD represents the internal crest level between Ramp 8 and Bonnie Doon residual voids. Both Ramp 8 and Bonnie Doon residual voids will spill to the receiving environment at 188 mAHD.

Source: WRM, 2026.

6.1.1 CATCHMENT AREAS

The catchments were derived from the final landform design version 4.2 and were assigned as either natural, spoil or rehabilitated spoil. The void floor was characterised as spoil. Catchment boundaries are shown in WRM (2026c) and are summarised in Table 6-2.

TABLE 6-2 RESIDUAL VOID CATCHMENT AREAS

Residual Void	Contributing Catchment (ha)			
	Natural	Spoil	Rehabilitated Spoil	Total
Ramp 8	33.7	22.0	21.8	77.5
Bonnie Doon	98.1	84.1	184.4	366.6
Mimosa/Besgrove	39.1	596.5	622.4	1,258

Residual Void	Contributing Catchment (ha)			
	Natural	Spoil	Rehabilitated Spoil	Total
Deep Creek	0	52.9	167.3	220.2
Stewarton North	0	195.2	678.1	873.3
Stewarton South	0	50.9	150.3	201.2
Kenmare	0	146.1	236.0	382.1
Togara/North Marshmead	7.4	458.0	249.1	714.5
South Marshmead	0	119.4	80.3	199.7
Kennedy	0	188.6	481.1	669.7
Comet Downs East	8.9	27.7	69.4	106.0
Ramp 74	10.1	58.3	112.9	181.3
South Ballamoo	0	365.0	267.4	632.4
Tannyfoil	0	388.1	458.6	846.7
Ramp 30	0	24.1	149.2	173.3

Source: WRM, 2026c.

6.1.2 MODEL PARAMETERS

The GoldSim model incorporates the Australian Water Balance Model (AWBM) to estimate daily runoff from daily rainfall. The adopted AWBM parameters are discussed further in WRM (2026c).

Groundwater inflow parameters were developed by SLR (2026) as an output of the hydrogeological assessment (Section 4).

6.2 RESIDUAL VOID WATER BALANCE

The water balance model was used to predict residual void water levels for all 15 voids over a 1,000-year simulation period. Predicted residual void lake levels for all residual voids are plotted in WRM (2026c) and summarised in Table 4-1.

No residual voids overtopped during the simulation period, with most residual voids maintaining more than 30 m freeboard above the mean predicted residual void lake levels. The largest freeboard of approximately 148.5 m occurs in the South Ballamoo residual void. Most residual void lakes reach an equilibrium within approximately 100 to 300 years (SLR, 2026). The residual void lake levels at Kennedy and Comet Downs East take longer to stabilise at approximately 400 and 450 years respectively.

An assessment of the impact of an extreme storm event was also undertaken. The extreme event selected for assessment was the 0.1% AEP 72-hour (3 day) design storm. To further increase the conservatism of the assessment, residual void lake levels were set to their peak modelled long-term water levels and runoff from the event was increased to 100% of the surface catchment reporting to the residual voids, i.e. no losses.

No residual voids overtopped during the event, with freeboards within the voids being maintained at more than 16 m for most residual voids and 6.8 m for Comet Downs East. A summary of the impact of the storm event is provided in Table 6-3.

TABLE 6-3 RESIDUAL VOID WATER BALANCE – STORM EVENT ASSESSMENT

Residual Void	Runoff Volume	Lake Level Increase	Final Volume	Storm Event Lake Level	Crest Level	Freeboard
Unit	*ML*	*m*	*ML*	*mAHD*		*m*
Ramp 8	221	2.2	2,180	148.7	188[1]	39.3
Bonnie Doon	1,045	5.3	1,430	159.8	188[1]	28.2
Mimosa/Besgrove	3,585	4.4	25,763	88.1	200	111.9
Deep Creek	628	2.6	9,741	137.1	202	64.9
Stewarton North	2,489	4.5	59,120	78.5	204	125.5
Stewarton South	573	11.6	732	115.5	232	116.5
Kenmare	1,089	3.5	6,152	221.5	297	75.5
Togara/North Marshmead	2,036	2.0	39,873	167.7	271	103.3
South Marshmead	569	2.9	10,211	174.0	270	96.0
Kennedy	1,909	2.4	26,516	168.8	221	52.2
Comet Downs East	302	1.8	10,334	193.0	222	29.0
Ramp 74	517	10.2	795	244.3	266	21.7
South Ballamoo	1,802	2.8	14,952	144.3	290	145.7
Tannyfoil	2,413	3.6	11,023	148.3	237	88.7
Ramp 30	494	19.3	892	162.6	217	54.4

[1] 188 mAHD represents the elevation at which the Ramp 8 and Bonnie Doon residual voids would spill to the receiving environment. The internal crest level between Ramp 8 and Bonnie Doon residual voids is 175 mAHD.

Source: WRM, 2026c.

6.2.1 INFLOWS AND OUTFLOWS

The residual void water balance is dominated by direct rainfall, evaporation and groundwater exchange, with runoff providing a secondary, episodic contribution (Table 6-4). Modelled void water levels over 1,000 years are presented in Section 6.3 below.

- Across all voids, direct rainfall and evaporation are the dominant and most persistent fluxes:
  - Direct rainfall occurs in approximately 47-85% of timesteps for most voids (locally as low as ~7.8% at Ramp 74). Mean direct rainfall inputs range from ~0.16 to 38.3 ML/month; and

    - Evaporation is active in >90% of timesteps at nearly all sites. Mean evaporation rates range from ~0.28 to 143.8 ML/month, indicating a strong evaporative control on long-term void water balance;
- Rainfall runoff is episodic and typically minor, occurring in ~25-39% of timesteps, with median values of zero across all voids. Mean runoff contributions are low (typically ~1.3 to 27.5 ML/month), although higher maximum values (up to ~3,000 ML/month at Mimosa/Besgrove) demonstrate that runoff can be significant during high-rainfall events;
- Groundwater inflows are persistent in several voids, occurring in >90% of timesteps at many locations, i.e. Ramp 8, Mimosa/Besgrove, Togara/North Marshmead, Kennedy, South Ballamoo and Tannyfoil:
    - Mean inflows range from ~0.0004 to 94.8 ML/month for these voids;
    - Median groundwater inflows are commonly elevated (e.g. ~73 ML/month at Mimosa/Besgrove and ~102 ML/month at Togara/North Marshmead), indicating sustained hydraulic connection with surrounding hydrostratigraphic units at these sites;
    - In contrast, some voids (e.g. Bonnie Doon, Stewarton North) exhibit negligible groundwater inflow;
- Groundwater outflows are variable and site-specific.
    - Groundwater outflows occur in a small proportion of timesteps (typically <2%) at most voids; however, persistent outflow occurs at Bonnie Doon (~84%), Stewarton North (~89%), South Marshmead (~66%), Ramp 30 (~63%) and Kenmare (~54%), indicating sustained discharge conditions at these sites.

Net groundwater fluxes, following mine completion, show three distinct behaviours based on net groundwater exchange:

- Persistent net inflow (no net outflow at any time): Ramp 8, Mimosa Besgrove, Togara/North Marshmead, Kennedy, Tannyfoil, South Ballamoo, Comet Downs East and Deep Creek.
- Persistent net outflow: Bonnie Doon, Ramp 30, Stewarton South and Ramp 74.
- Variable net flux (alternating net inflow and net outflow): Stewarton North, South Marshmead and Kenmare.

Through time, most voids stabilise towards consistent net behaviour (either inflow- or outflow-dominated).

Overall, the BWM residual voids are an evaporation-dominated system, with sustained groundwater inflow at many locations and net groundwater outflow at Bonnie Doon, Ramp 30, Stewarton South and Ramp 74.

As discussed in Section 4.1.2, the outflows from these residual voids will be captured by neighbouring residual voids at lower elevations. Evaporation acts as the primary control on water balance across all voids, consistently removing water over long periods and limiting the potential for net accumulation. While groundwater inflow provides an ongoing source of water at some locations, this input is spatially variable and does not occur uniformly across all voids.

In contrast, groundwater outflow is either absent, intermittent, or persistently focused at a limited number of voids, meaning that water is primarily redistributed within the void network rather than lost from the system. Runoff contributions are irregular and dependent on rainfall events, resulting in short-term increases in inflow that do not persist over time.

Together, these dynamics indicate that the void system functions as a semi-closed system, where long-term behaviour of the residual voids is governed by evaporative concentration processes and internal groundwater redistribution, rather than continuous throughflow.

TABLE 6-4 SUMMARY OF AVERAGE WATER BALANCE FLUXES OVER 1,000 YEARS

Residual Void	Runoff	Direct Rainfall	Evaporation	Groundwater		
				In	Out	Net
Unit	*ML/month*					
Ramp 8	1.33	4.46	-16.7	11.1	0	+11.1
Bonnie Doon	7.89	1.85	-6.46	0.00036	-3.23	-3.23
Mimosa/Besgrove	27.5	34.7	-130	70.4	-0.076	+70.3
Ramp 30	4.15	0.555	-1.85	0.107	-2.95	-2.84
Deep Creek	4.58	9.87	-37.1	23.9	-0.473	+23.4
Stewarton North	19.3	20.3	-76.2	38.5	-0.471	+38.0
Stewarton South	4.80	1.27	-4.61	0.047	-1.46	-1.41
Tannyfoil	18.8	22.9	-86.0	45.3	-0.026	+45.3
South Ballamoo	13.5	23.7	-89.0	53.1	-0.066	+53.0
Kenmare	8.57	8.37	-31.5	15.1	-0.061	+15.0
Ramp 74	4.30	0.163	-0.276	0.304	-4.50	-4.20
Togara/North Marshmead	14.2	38.3	-144	94.8	0	+94.8
South Marshmead	4.03	9.91	-37.2	24.3	-0.070	+24.2
Kennedy	13.6	28.2	-106	66.6	0	+66.6
Comet Downs East	1.74	10.1	-37.8	27.1	-0.224	+26.9

Source: Adapted from BWM_PRCP_Rev3_FV_Outputs_HYDROBALANCE.xlsx dated 20 May 2026.

6.3 MODELLED RESIDUAL VOID LAKE LEVELS

Long-term residual void lake water levels for all BWM residual voids as modelled over 1,000 years are presented in Figure 6-1 to Figure 6-15 (WRM, 2026c).

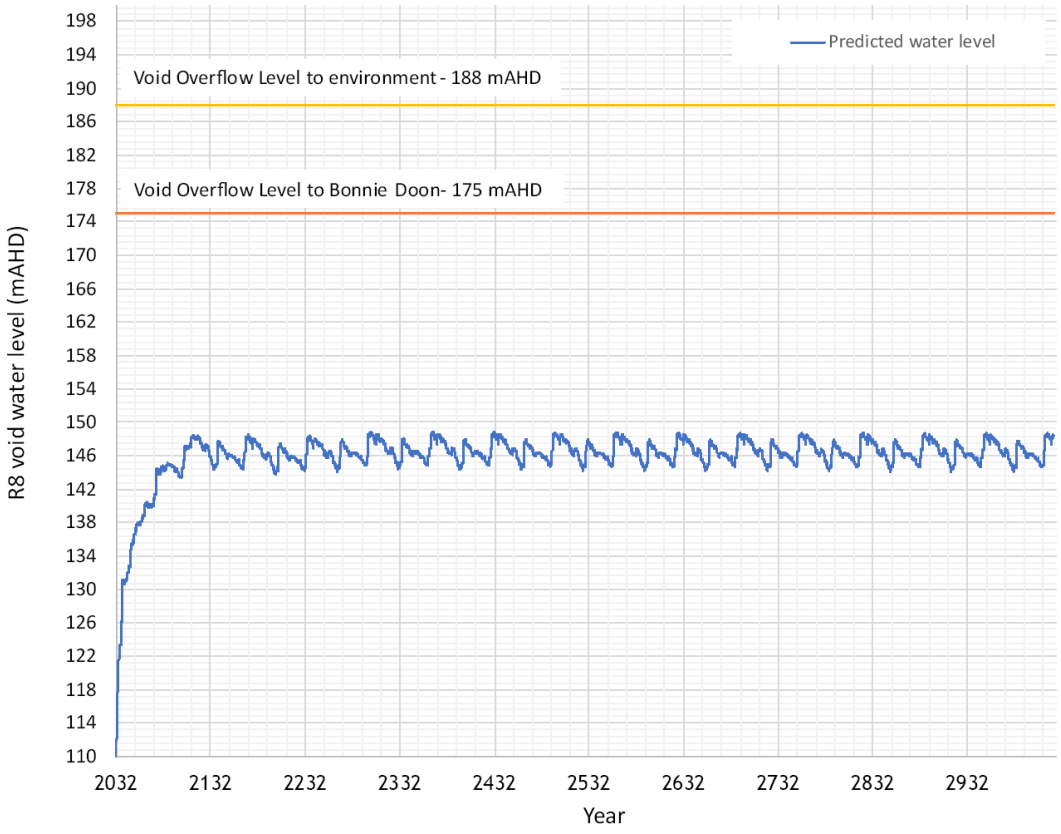


FIGURE 6-1 MODELLED RAMP 8 RESIDUAL VOID LAKE WATER LEVELS

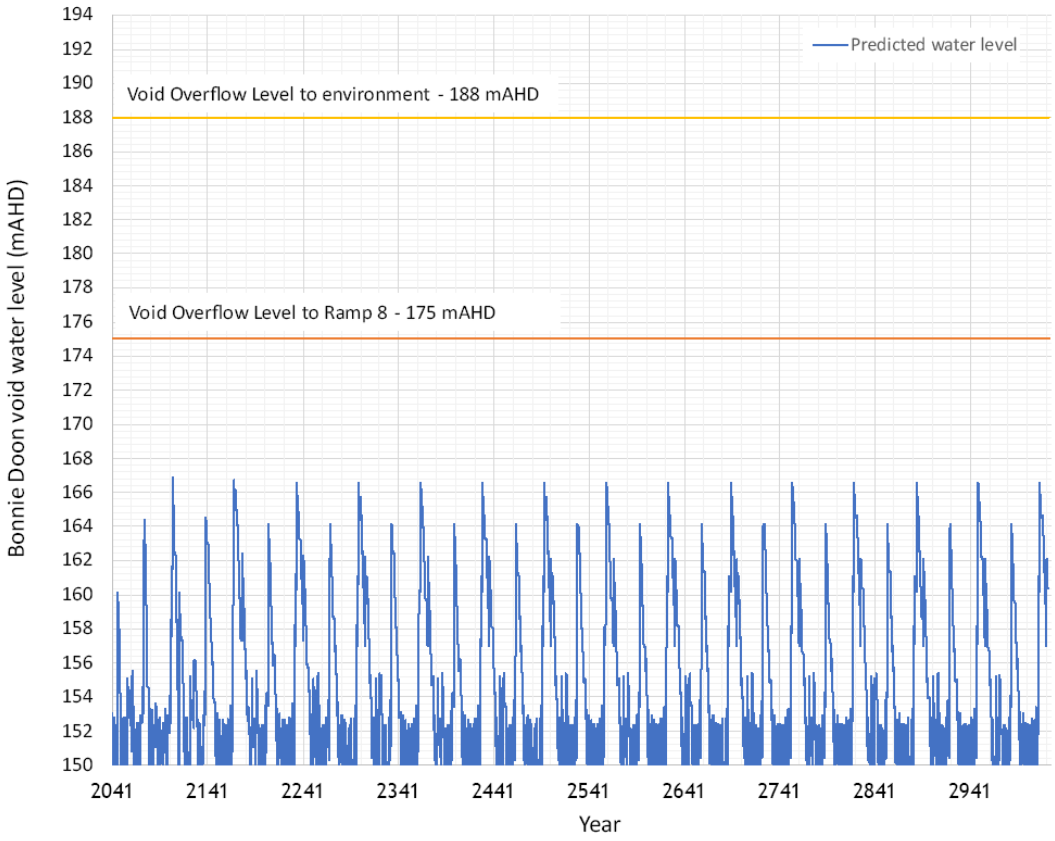


FIGURE 6-2 MODELLED BONNIE DOON RESIDUAL VOID LAKE WATER LEVELS

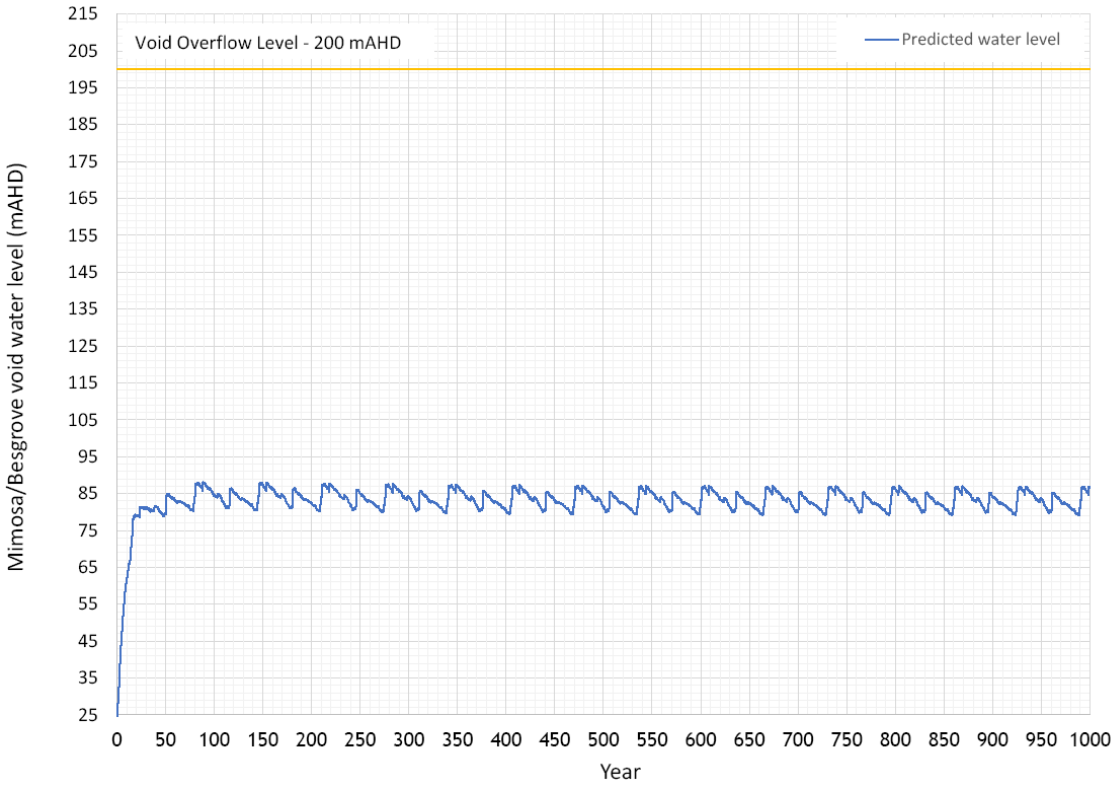


FIGURE 6-3 MODELLED MIMOSA/BESGROVE RESIDUAL VOID LAKE WATER LEVELS

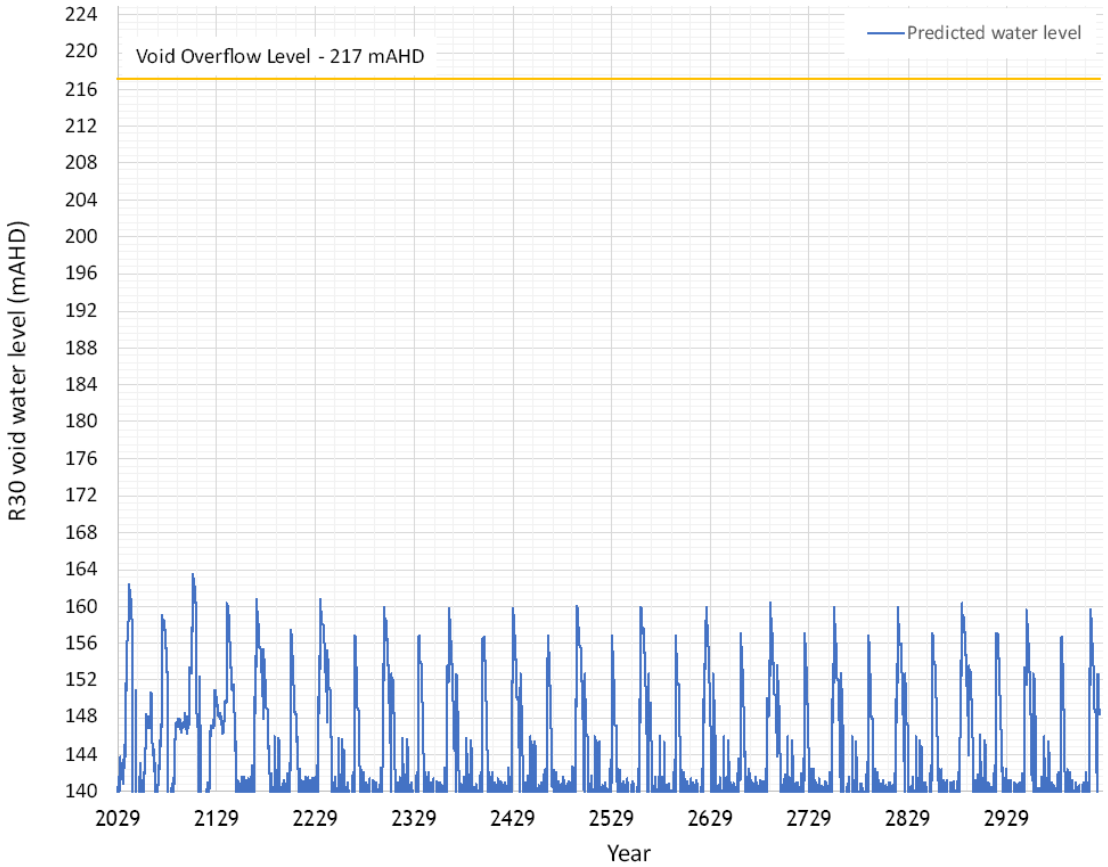


FIGURE 6-4 MODELLED RAMP 30 RESIDUAL VOID LAKE WATER LEVELS

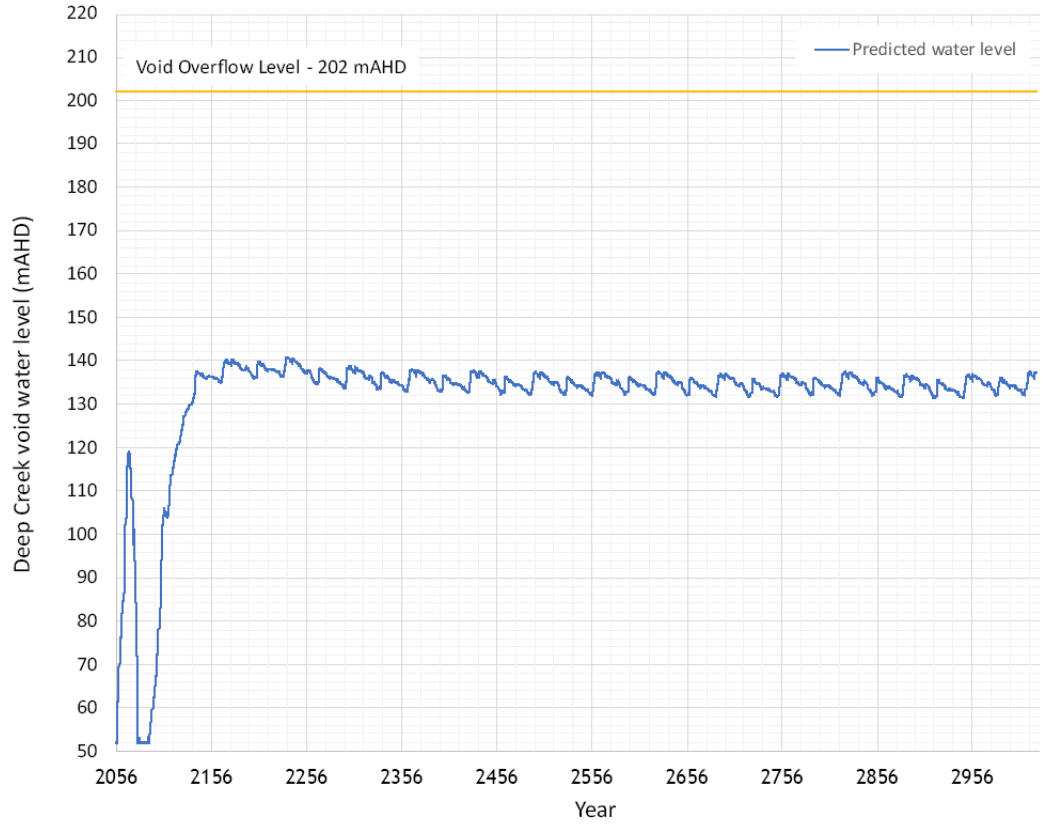


FIGURE 6-5 MODELLED DEEP CREEK RESIDUAL VOID LAKE WATER LEVELS

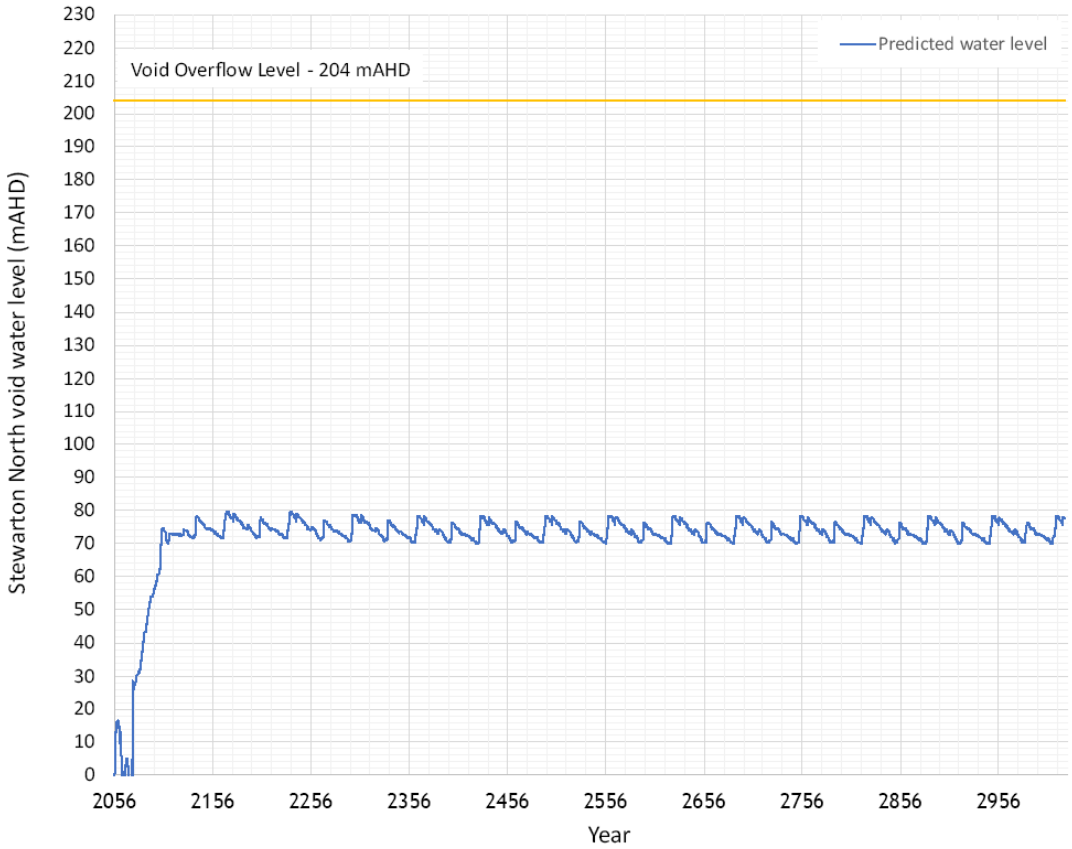


FIGURE 6-6 MODELLED STEWARTON NORTH RESIDUAL VOID LAKE WATER LEVELS

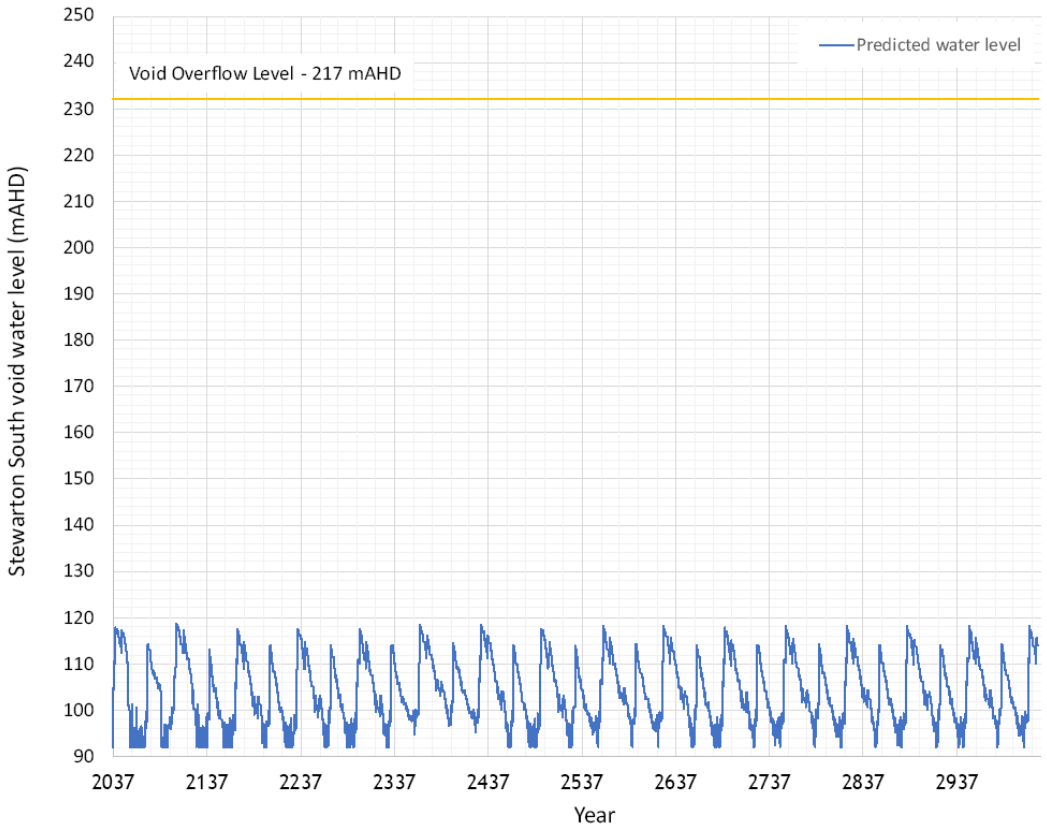


FIGURE 6-7 MODELLED STEWARTON SOUTH RESIDUAL VOID LAKE WATER LEVELS

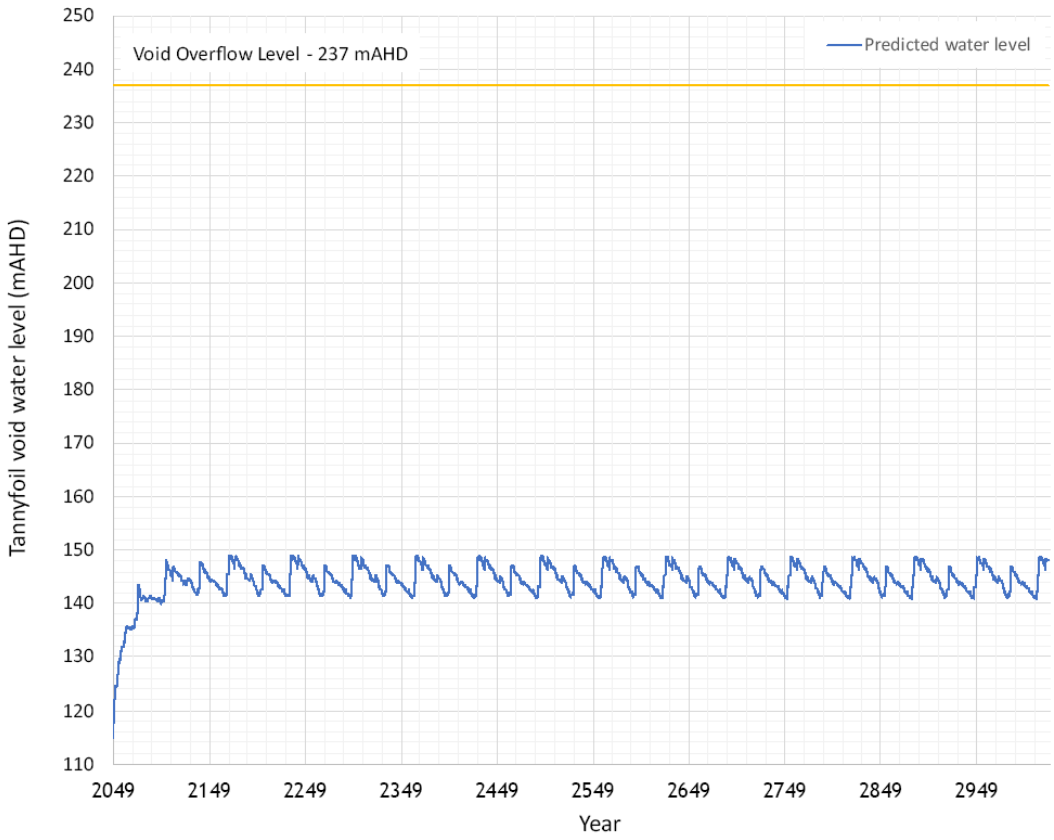


FIGURE 6-8 MODELLED TANNYFOIL RESIDUAL VOID LAKE WATER LEVELS

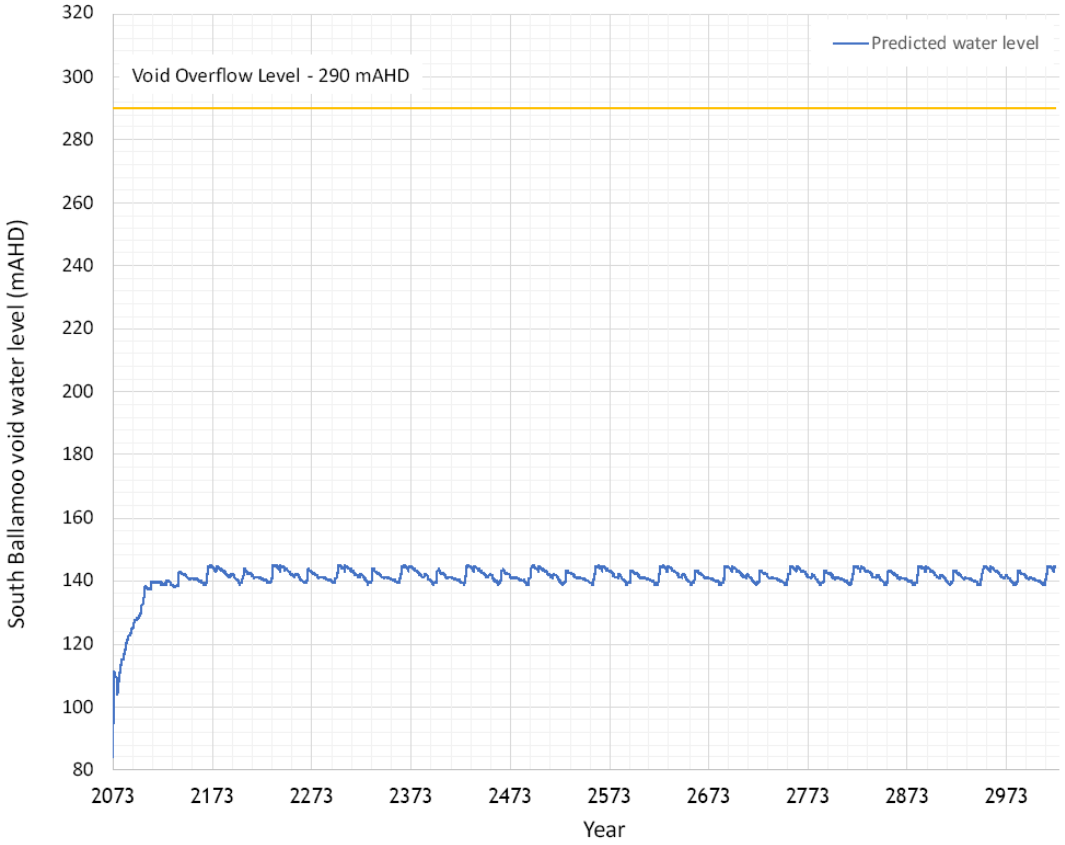


FIGURE 6-9 MODELLED SOUTH BALLAMOO RESIDUAL VOID LAKE WATER LEVELS

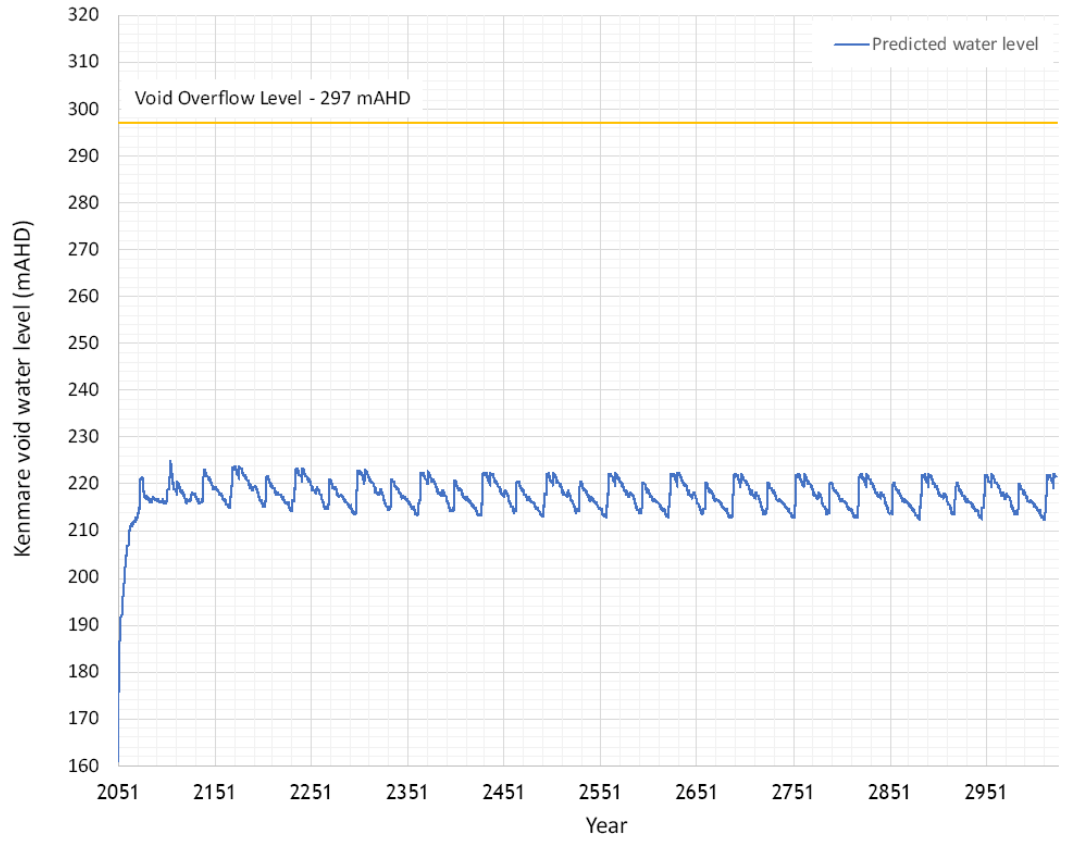


FIGURE 6-10 MODELLED KENMARE RESIDUAL VOID LAKE WATER LEVELS

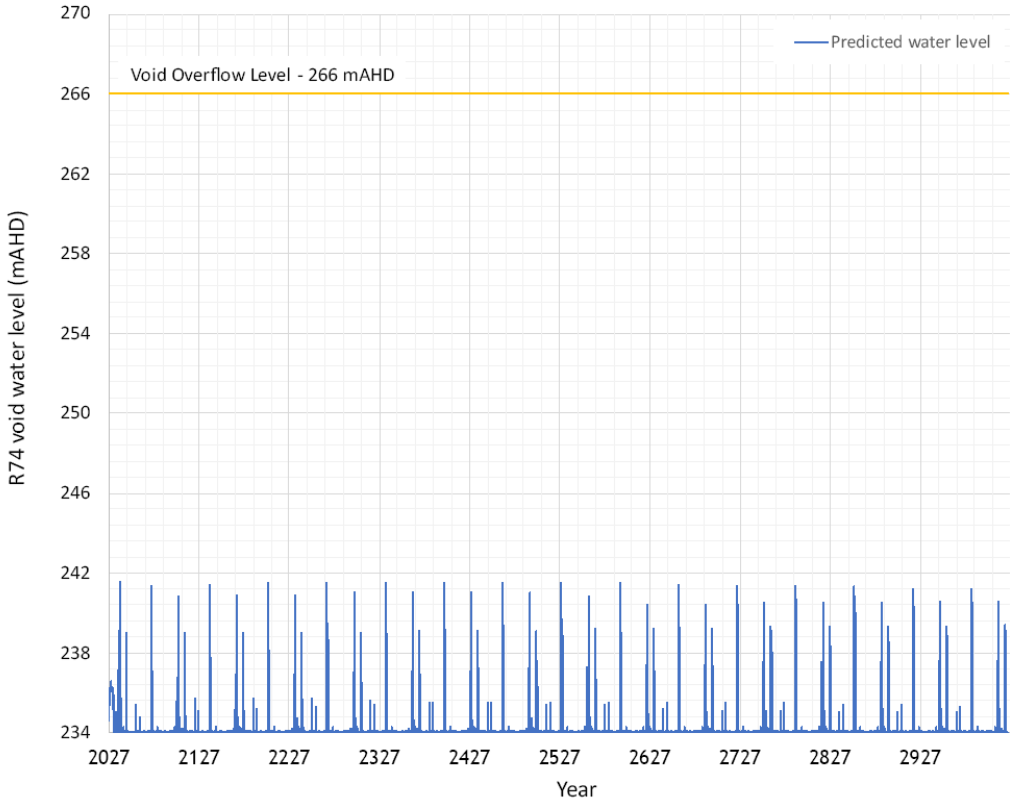


FIGURE 6-11 MODELLED RAMP 74 RESIDUAL VOID LAKE WATER LEVELS

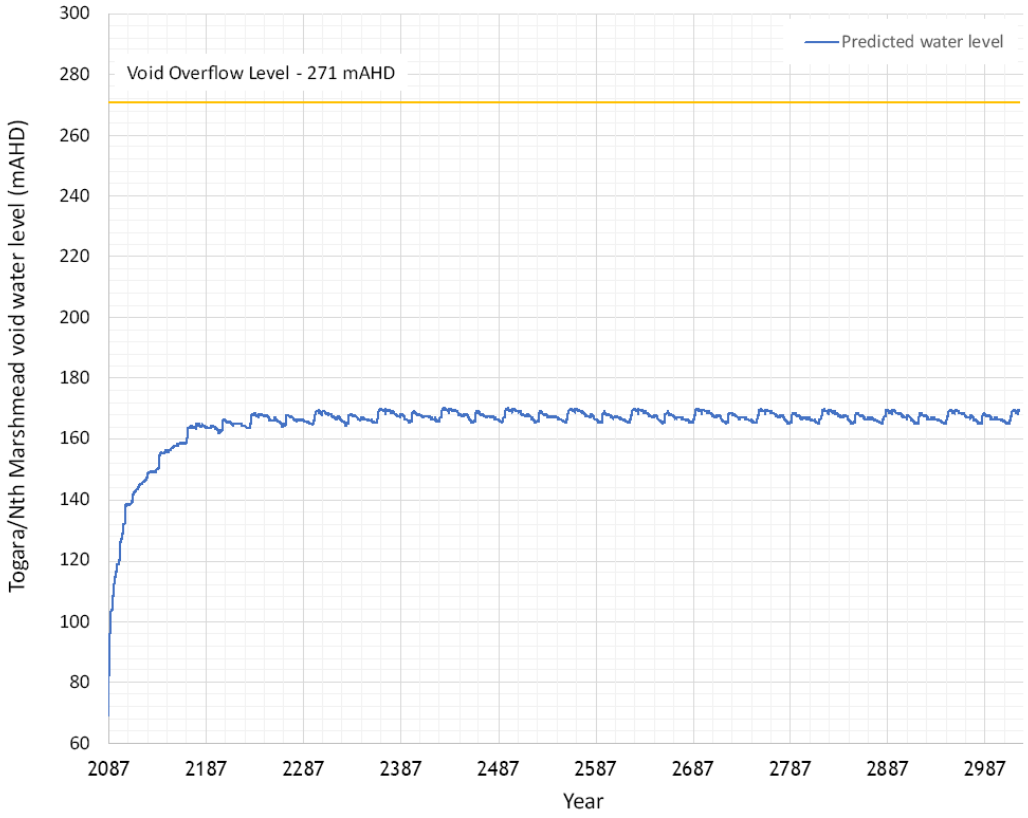


FIGURE 6-12 MODELLED TOGARA/NORTH MARSHMEAD RESIDUAL VOID LAKE WATER LEVELS

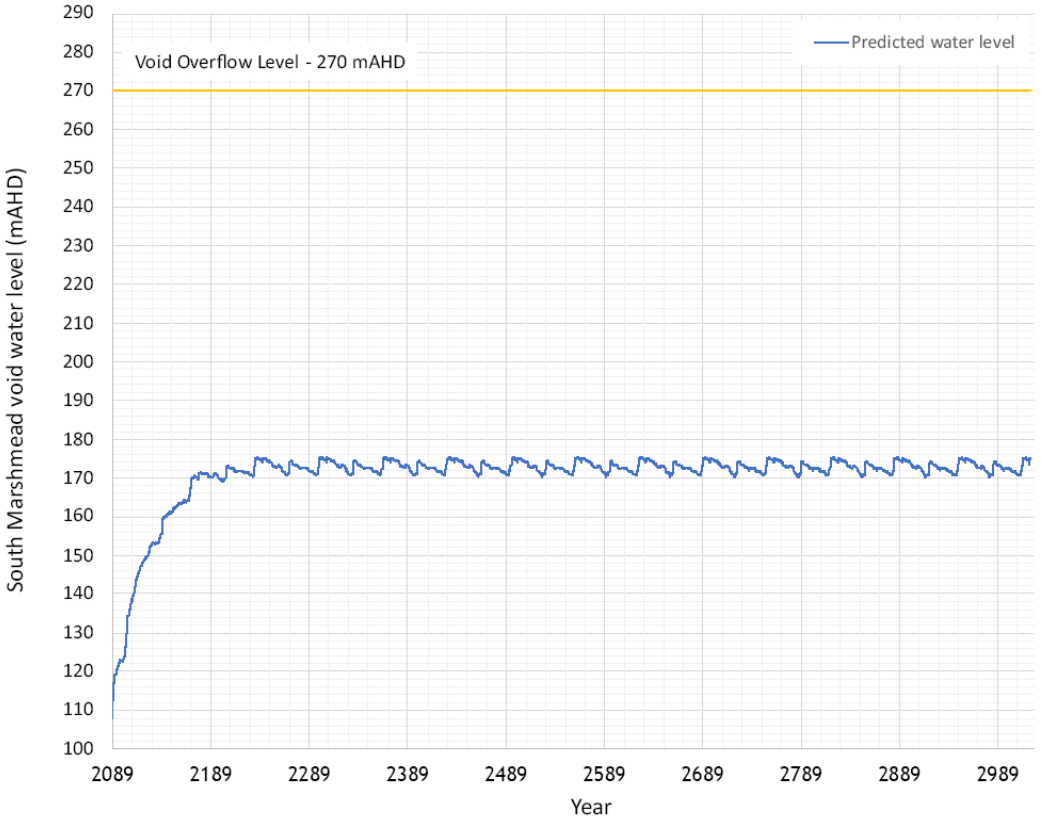


FIGURE 6-13 MODELLED SOUTH MARSHMEAD RESIDUAL VOID LAKE WATER LEVELS

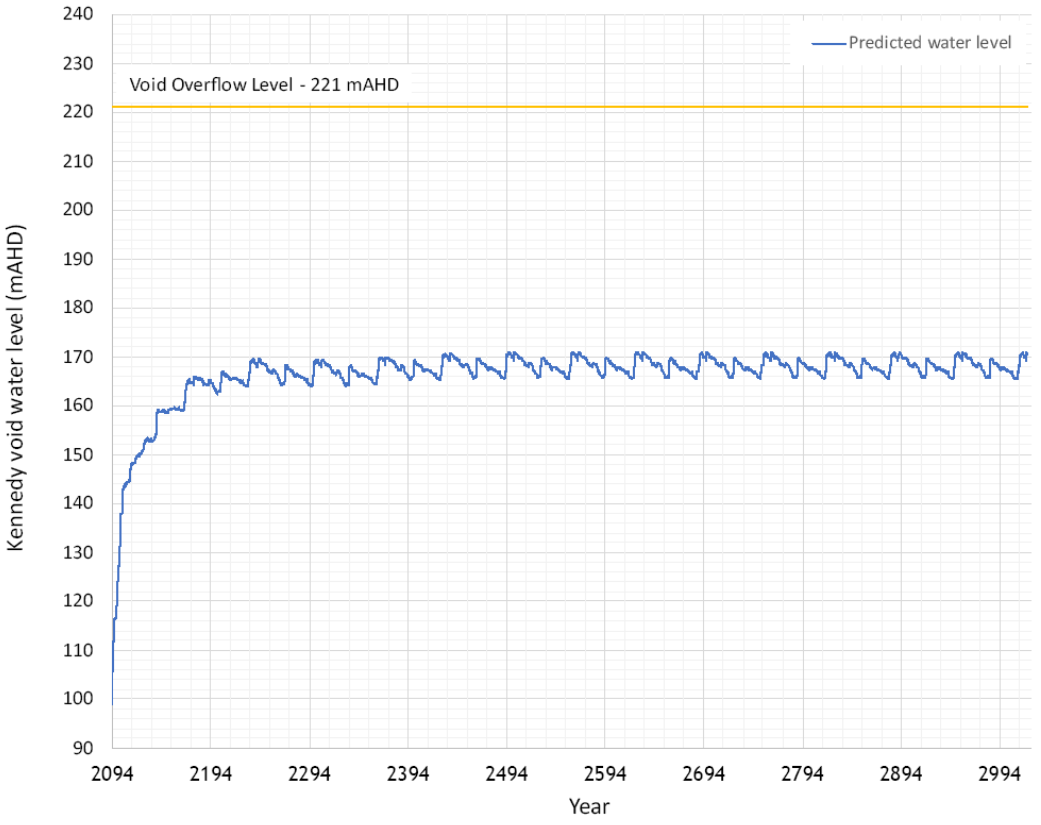


FIGURE 6-14 MODELLED KENNEDY RESIDUAL VOID LAKE WATER LEVELS

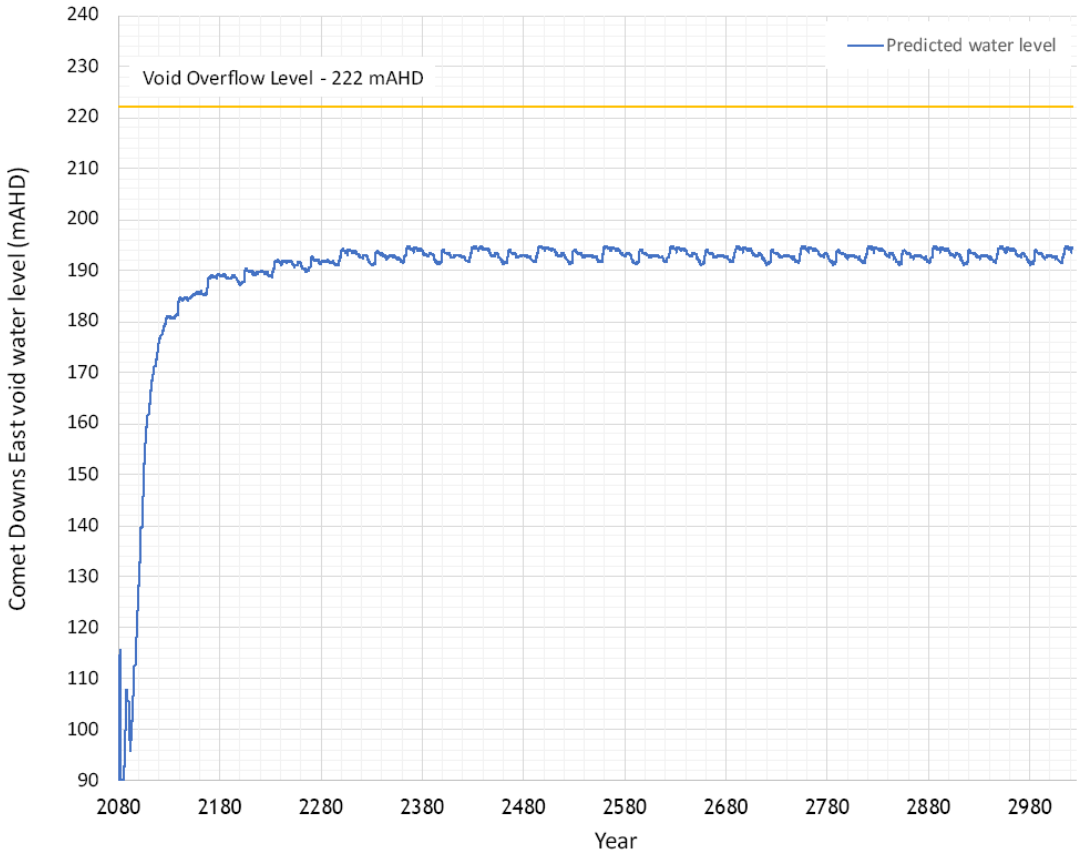


FIGURE 6-15 MODELLED COMET DOWNS EAST RESIDUAL VOID LAKE WATER LEVELS

6.4 CONCLUSIONS

Water balance modelling for the 15 proposed residual voids at BWM demonstrates:

- Residual void lakes reach an equilibrium level within 100 to 500 years after mining ceases, with most voids equilibrating within 100 to 300 years;
- The peak modelled water level is below the pit crest level for all residual voids and there are no modelled spills to the receiving environment over the 1,000-year simulation period, with freeboard typically exceeding 30 m and increasing to approximately 150 m in the largest voids:
  - No residual voids overtopped during the 1,000-year simulation period under the SSP2-4.5 emission pathway;
- The extreme storm event assessment shows runoff from a 0.1% AEP 72-hour storm event (with zero losses) is unlikely to result in an overflow to the receiving environment, with no overtopping predicted and freeboard maintained at more than 21 m in all residual voids; and
- Several residual void lakes (e.g. Ramp 8, Bonnie Doon and Ramp 74) exhibit cyclical behaviour, periodically approaching empty conditions during extended dry periods, indicating sensitivity to climatic variability. Water balance fluxes are dominated by evaporation, with sustained groundwater inflow at selected voids and generally negligible groundwater outflow. Runoff contributions are episodic, indicating that void behaviour is controlled by long-term evaporative losses rather than continuous throughflow.

7. GEOTECHNICAL STABILITY

This section assesses the geotechnical stability of the final void landforms. It is required to demonstrate that the landform is safe and stable over time under PRCP Section 3.6.3.

In summary, this section covers the following:

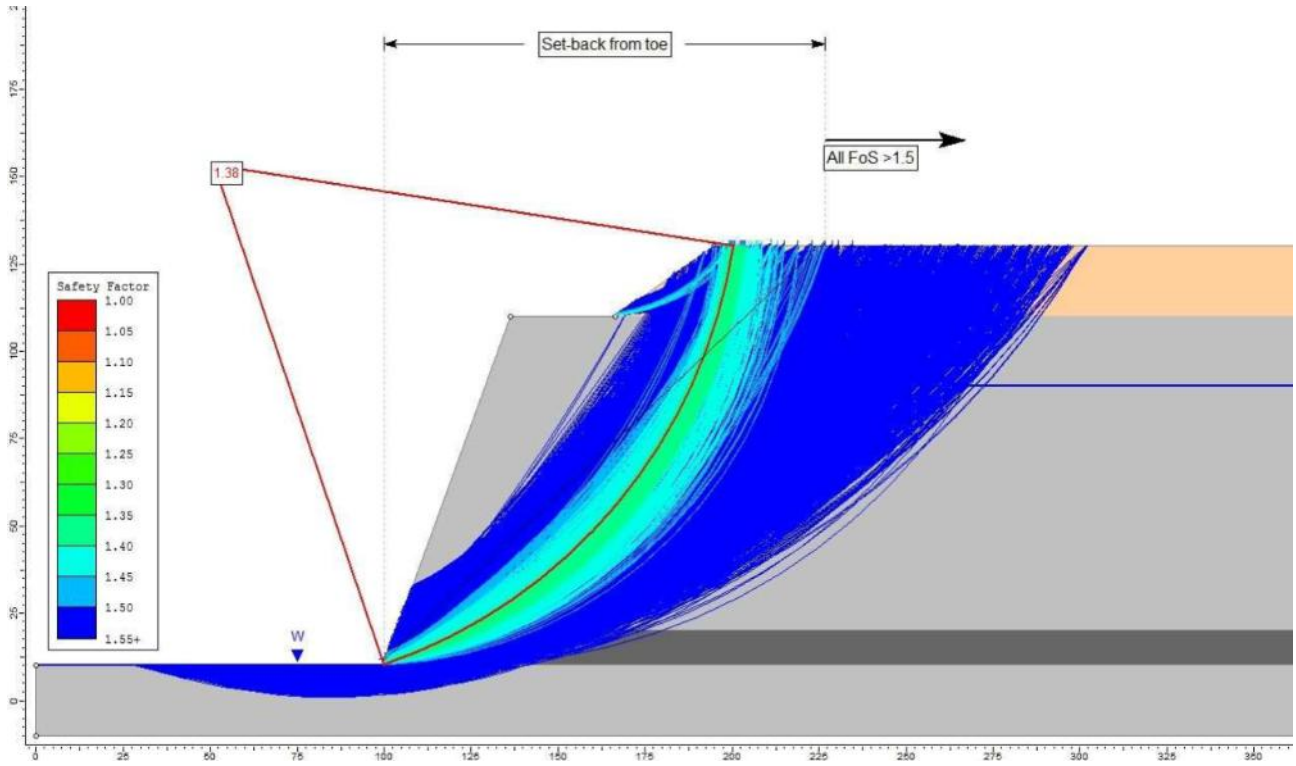
- *How post-closure void slopes will be stable and consistent with closure planning objectives;*
- *Measures to achieve geotechnical stability (e.g. backfilling, regrading, buttressing, benching):*
  - *Techniques for creating safe slope configurations must be specified where relevant.*
- *Potential effects of long-term erosion, weathering and hydrological impacts; and*
- *Proposed final slope angles of high-walls, low-walls and end-walls of each residual void.*

Geotechnical assessments were completed by Henderson Geotech (2026a; 2026b) to show that the conceptual high-wall, end-wall and low-wall slopes of the BWM residual voids within the final landform design are expected to remain stable in the long-term. This section outlines the key findings of the geotechnical stability assessments as they relate to the residual voids.

7.1 HIGH-WALL AND END-WALL STABILITY ASSESSMENT

The limit equilibrium method was used to assess the stability of the BWM residual void highwalls and endwalls. This method compares the resisting forces along a potential failure surface to the driving forces that could cause movement. It calculates a FoS, which is the ratio of these forces. A FoS greater than 1 indicates the slope is stable. A FoS less than 1 means instability is likely. For closure at BWM, a FoS of 1.5 has been adopted.

To avoid having to unnecessarily disturb more land by laying back the wall crest to achieve a FoS ≥1.5, the FoS is used to inform a set-back distance from the toe of the wall and in turn inform the boundary of the residual void NUMA. At closure, no third-party assets or PMLUs will be within zones where the FoS ≤1.5. This concept is demonstrated in Figure 7-1.



Source: BHP, 2023.

FIGURE 7-1 DEFINING THE SET-BACK DISTANCE/NUMA BOUNDARY USING A FoS ≥ 1.5.

A design tool, developed by the previous owner of BWM and based on a large number of stability analyses covering the range of expected scenarios for Bowen Basin coal mines, has been used to define the set-back distances for 11 of the 15 residual voids in the final landform design. Further details on the tool, its development and the bounds within which it can be used are provided in Henderson Geotech (2026a).

The geometries of the Bonnie Doon and Ramp 74 residual voids where outside the bounds of the design tool with depths of fresh Permian being <50 m due to both voids being partially backfilled with tailings. Auger mining of the Ramp 74 highwall also precluded the use of the tool in this void. The design tool is also not suitable for assessing the wall stability of Comet Downs East as the residual void lake is predicted to be above the base of weathering (Section 4 and Section 6). Bespoke geotechnical stability analyses were undertaken for those residual voids using the same general approach and material properties as the design tool. The Slide2 Modeler, 2D Limit Equilibrium Analysis for Slopes was used to perform these analyses.

7.1.1 WEATHERING AND EROSION

In rare cases, minor weathering (physical and/or chemical) may affect geotechnical stability post-closure. For example, if weak, degradable rock lies beneath stronger layers, the weaker material may break down and fall away, leaving the stronger layer unsupported. This could lead to localised failures. These situations are generally only discovered during excavation. They cannot be fully predicted during planning but will be assessed and managed at the detailed design stage once mining ends (Henderson Geotech, 2026a).

On highwalls and endwalls in the Bowen Basin, erosion in fresh rock is generally minimal. Most erosion is limited to slaked or weathered material, as fresh, intact rock is too strong to break apart easily. Above the base of weathering, particles are more easily detached, and erosion can occur along flow paths.

In rare cases, intersecting erosion gullies could form a wedge-type failure. However, these are managed using surface water and erosion control measures, not by altering slope design. Overall, weathering and long-term erosion are not expected to significantly impact pit wall stability (Henderson Geotech, 2026a).

7.1.2 SIGNIFICANT HYDROGEOLOGICAL EVENTS

Water balance modelling for the BWM residual voids (see Section 6) indicates that long-term average void water levels will remain tens of metres below the base of weathering. Therefore, water is only expected to contact fresh rock. As a result, no adverse impact on pit wall stability is anticipated from long-term water storage in the voids (Henderson Geotech, 2026a).

The most serious potential impact of severe rainfall events would be inrush of floodwaters to the void. However, this scenario will be prevented by including appropriate drainage diversions and landforms to protect the voids from inundation (Section 5).

Draw-down failure is the other mode of instability related to water storage. Draw-down failure can occur when pore water pressures in the containing earth and rock have equilibrated with the water level in the storage and that water level is then lowered quicker than the containing materials can drain and the pore pressures are no longer balanced. This is not considered a risk for the BWM residual voids as evaporation will not lower the water level quick enough to establish this imbalance. Due to the propensity of some of the residual void lakes to become hypersaline, the water is not anticipated to be useful for typical agricultural uses post closure. However, should a novel use for residual void lake water arise in the future that involves movement of large volumes of water, such as pumped hydro energy storage, stability under draw-down will need to be considered.

7.1.3 LOCAL MODEL INPUTS

Long sections extracted from the current geological model provided void wall profile data. This data is summarised in Table 7-1.

TABLE 7-1 GEOTECHNICAL PROFILES FOR RESIDUAL VOID WALLS

Residual Void	Depth of Tertiary/ Weathered Overburden			Depth of Fresh Overburden			Total Wall Depth		
	Ave.	Range	>90%	Ave.	Range	>90%	Ave.	Range	>90%
Unit	m								
Ramp 8	16	14-18	-	60	53-68	-	76	67-87	-
Bonnie Doon	15	10-21	21	13	0-40	33	29	10-50	45
Mimosa/ Besgrove	18	7-27	25	138	68-175	169	156	91-196	190

Residual Void	Depth of Tertiary/ Weathered Overburden			Depth of Fresh Overburden			Total Wall Depth		
	Ave.	Range	>90%	Ave.	Range	>90%	Ave.	Range	>90%
Deep Creek	12	11-12	12	118	90-147	145	130	101-159	157
Stewarton North	15	11-24	21	152	68-202	197	167	82-213	213
Stewarton South	20	15-24	24	104	59-126	123	124	83-141	139
Kenmare	47	38-53	52	106	82-124	120	153	131-163	163
Togara/North Marshmead	71	24-97	89	156	125-199	187	227	169-270	260
South Marshmead	67	54-82	79	118	104-125	125	185	157-206	204
Kennedy	34	28-43	41	84	57-126	114	118	90-167	148
Comet Downs East	36	35-37	-	97	96-97	-	134	133-135	-
Ramp 74	20	14-28	23	6	0-11	9	26	22-30	30
South Ballamoo	61	45-81	77	192	148-224	222	253	215-290	286
Tannyfoil	16	12-23	21	114	79-135	132	130	101-151	149
Ramp 30	11	11-12	-	72	70-72	-	75	62-83	-

Note: - indicates insufficient data to calculate values.

Source: Henderson Geotech (2026a).

For the three bespoke analyses, a typical cross-section was considered for each void. More precise geotechnical profiles were used, in particular with Tertiary overburden and weathered Permian overburden differentiated. Pit lake levels and hydraulic properties were adopted from, or broadly consistent with those provided in SLR (2026). The specific details used for analysis of these residual voids are provided in Henderson Geotech (2026a).

7.1.4 ASSESSMENT RESULTS

Highwall and endwall stability assessment results for the 11 residual voids assessed using the design tool are summarised in Table 7-2. The complete computations are provided in Henderson Geotech (2026a). Results are provided for average fresh Permian wall angles of 50° and 60°. Set-back distances will determine the boundary of the NUMAs adjacent to the highwalls and endwalls.

TABLE 7-2 HIGHWALL AND ENDWALL SET-BACKS TO ACHIEVE FoS≥1.5 (DESIGN TOOL)

Residual Void	Set-back Distance from Wall Toe (m)					
	50°[1]			60°[1]		
	Ave.	Range	>90%	Ave.	Range	>90%
Ramp 8	104	95-113	111	99	91-96	94
Mimosa/Besgrove	180	120-248	236	176	102-249	236
Deep Creek	146	121-171	169	136	98-180	175
Stewarton North	207	107-295	290	201	89-298	293
Stewarton South	146	113-157	157	124	98-142	138
Kenmare	186	169-198	195	163	147-175	173
Togara/North Marshmead	298	186-389	367	299	193-392	369
South Marshmead	232	194-273	267	213	167-253	249
Kennedy	149	125-195	173	129	110-183	144
South Ballamoo	356	277-434	423	359	277-438	427
Tannyfoil	148	122-166	163	129	99-161	153
Ramp 30	100	89-107	-	83	76-88	-

[1] *Average wall angle of fresh Permian overburden.*

Note: - indicates insufficient data to calculate values.

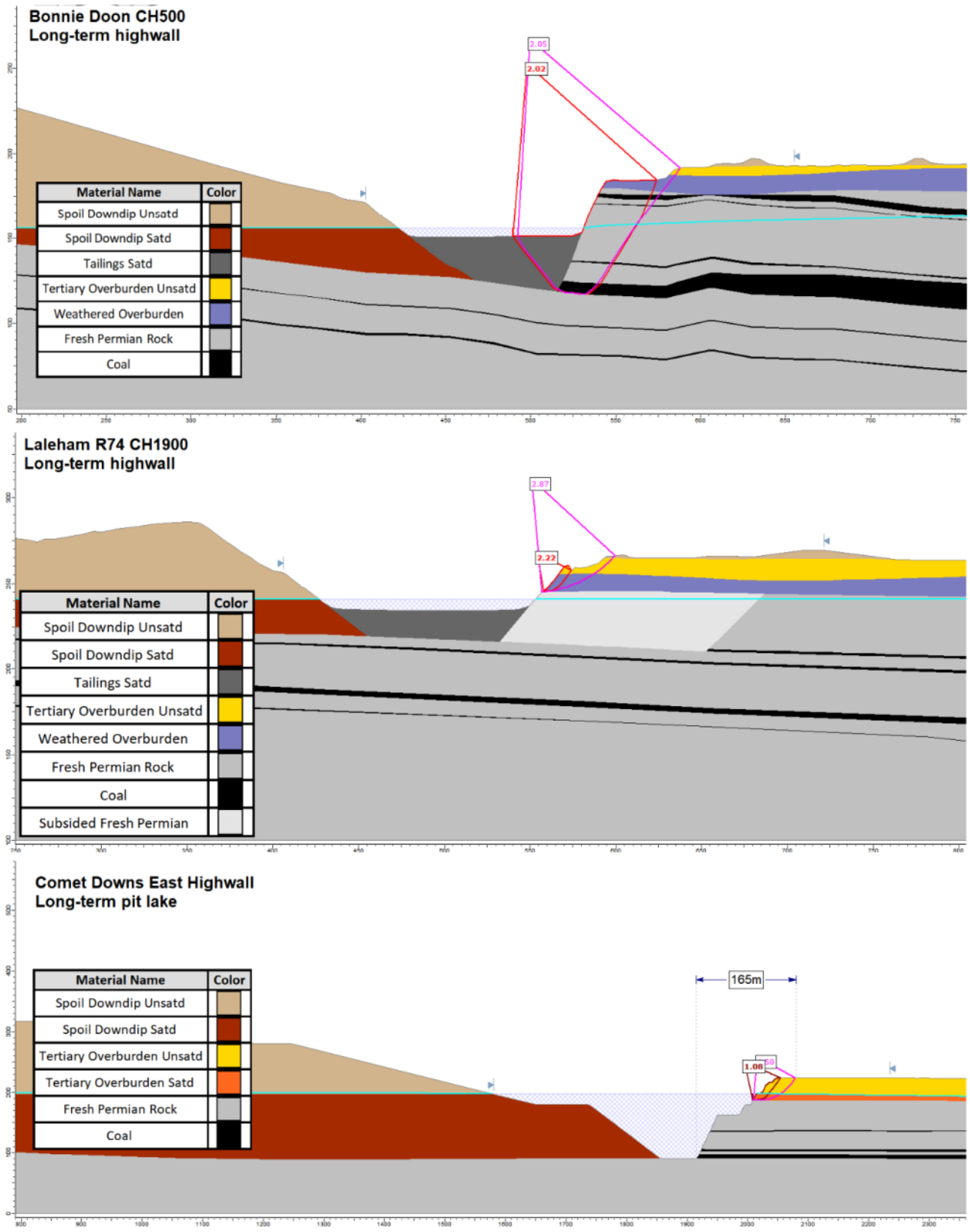
Source: Henderson Geotech (2026a).

The results of the bespoke analysis completed for Bonnie Doon, Ramp 74 and Comet Downs East is summarised in Table 7-3 and shown in Figure 7-2.

TABLE 7-3 LONG-TERM WALL STABILITY (BESPOKE ANALYSIS)

Design Property	*Unit*	Bonnie Doon (CH500)	Ramp 74 (CH1900)	Comet Downs East
Tertiary overburden	*m*	12	10	24
Weathered Permian overburden		29	10	11
Water cover below base of weathering		24	4	-11
Water depth		5	7	107
Tailings depth		32	18	N/A
Assumed angle of draw	*(°) Degrees*	N/A	60	N/A
Min. FoS	-	2.02	2.22	1.08
Set-back from wall toe to FoS≥1.5	*m*	Crest	Crest	165

Source: Henderson Geotech (2026a).



Source: Henderson Geotech (2026a)

FIGURE 7-2 BESPOKE STABILITY ANALYSIS RESULTS

7.2 LOW-WALL STABILITY

The geotechnical stability of selected residual void low walls was assessed to understand landform stability over the long-term. Eight cross sections were selected to represent, typical low walls, areas with the highest spoil, steepest floor dip and the deepest residual void lake. Analysis was completed on low walls of the following residual voids:

- Tannyfoil;
- South Marshmead;
- Stewarton North;
- Mimosa/Besgrove;
- Togara/North Marshmead;
- Comet Downs East;
- South Ballamoo; and
- Bonnie Doon.

The cross-sections were analysed using Slide2 Modeler, 2D Limit Equilibrium Analysis for Slopes. The analytical methods used initially were Morgenstern/GLE - Vertical Slices - Circular Surfaces and Sarma - Vertical Slices - Non-Circular Surfaces, both with Auto Refine Search Method. Groundwater and residual void pit lake levels used in the analysis were sourced from SLR (2026). The following three groundwater scenarios were applied in geotechnical stability analyses for each cross-section:

- End-of mining;
- Long-term equilibrium post-mining, and
- Interim condition, with pit lake half the long-term depth and total head boundaries mid-way between end-of-mining and long-term.

7.2.1 ASSESSMENT RESULTS

The results of the low wall stability analysis are provided in Figure 7-3 to Figure 7-10 (Henderson Geotech, 2026b). These results have been used to assist with defining several NUMA boundaries on the low wall side of the residual voids. This has led to a reduction in the area of NUMA and an increase in the area of PMLU.

A consequence category assessment for the low walls was undertaken in Henderson Geotech (2026b) and concluded there was:

- Negligible consequence for geotechnical instability within the NUMAs;
- Low consequence for geotechnical instability that extends into the Woodland PMLUs; and
- Low consequence for geotechnical instability that extends into the Grazing PMLUs.

Low wall PMLUs are expected to be geotechnically stable and achieve a FoS≥1.5 based on current NUMA boundaries. The geotechnical model and/or slope geometry within the NUMA should be reassessed as each pit approaches its final configuration when more detailed spoil characterisation is available and observation may justify changes to the conservative strength parameters applied in this initial stability analyses. During the final stages of operation, void design details can be refined to optimise the final landform and confirm it will achieve the required degree of stability in the long-term.

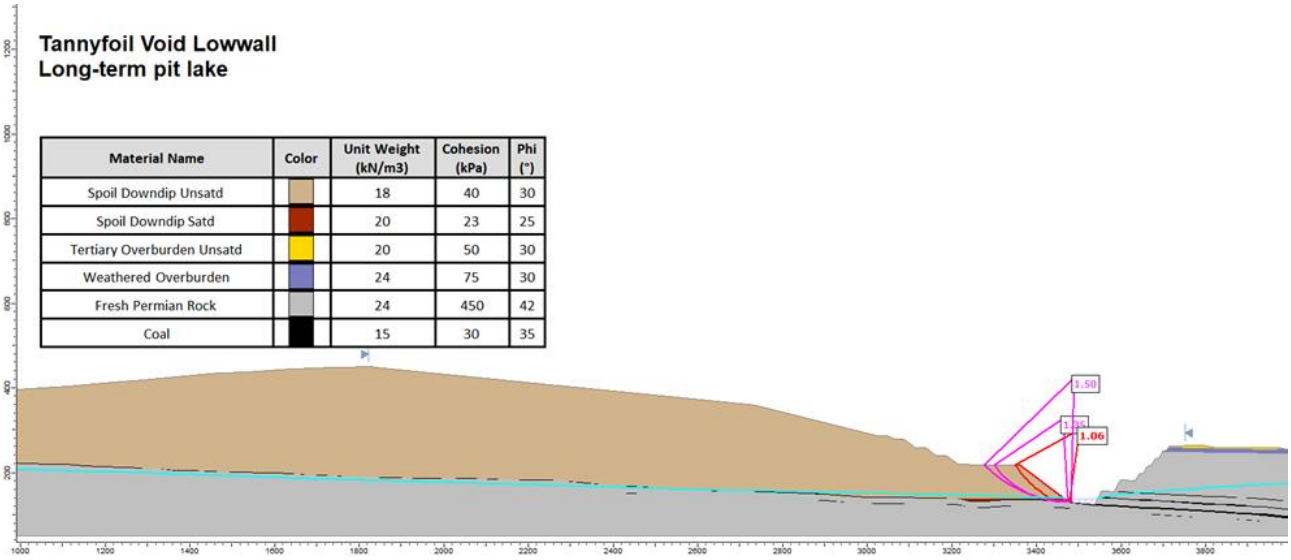


FIGURE 7-3 TANNYFOIL LOW WALL STABILITY ANALYSIS RESULTS

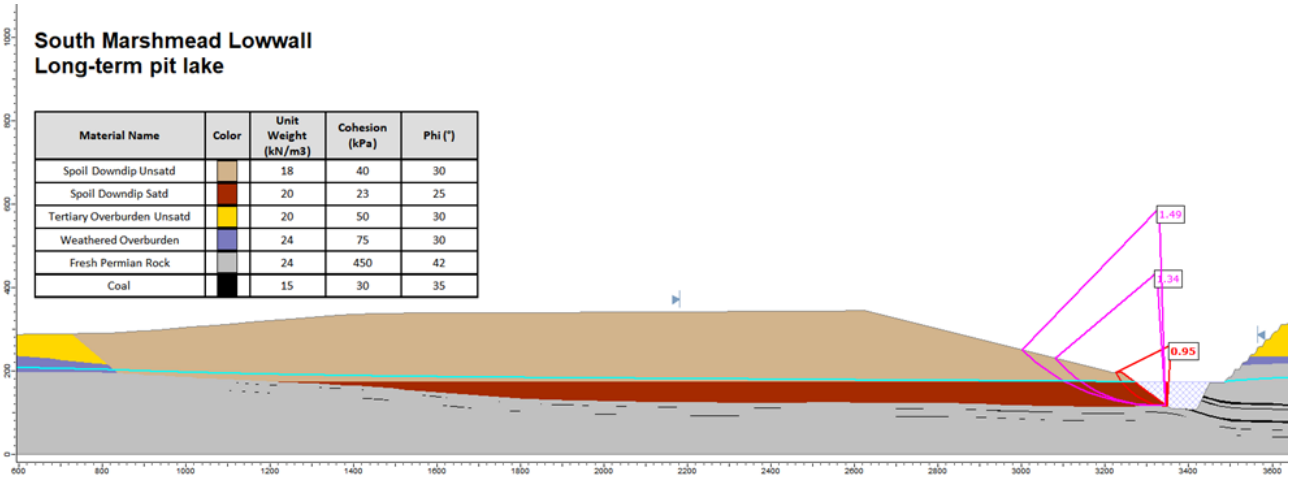


FIGURE 7-4 SOUTH MARSHMEAD LOW WALL STABILITY ANALYSIS RESULTS

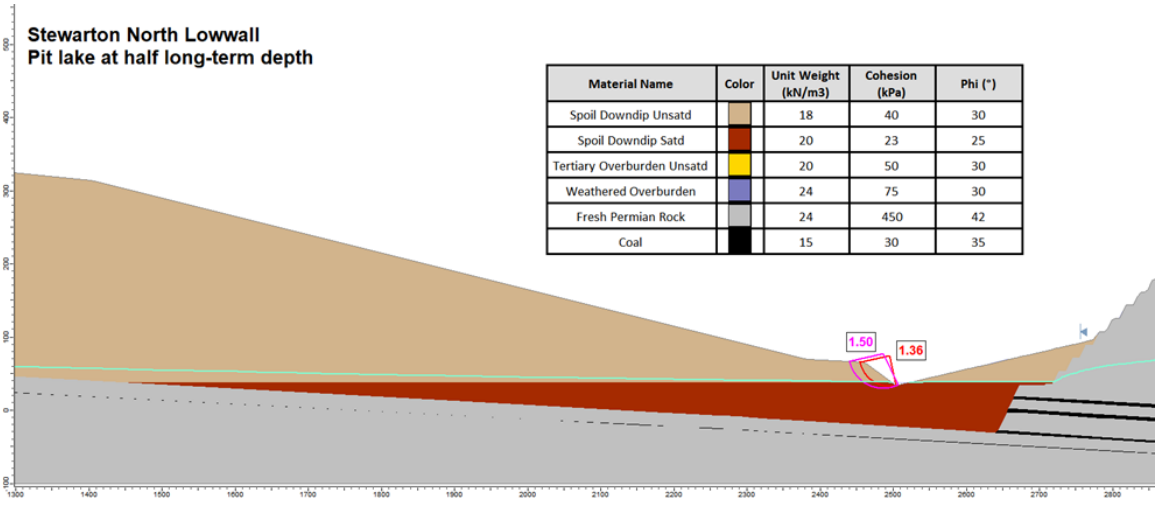


FIGURE 7-5 STEWARTON NORTH LOW WALL STABILITY ANALYSIS RESULTS

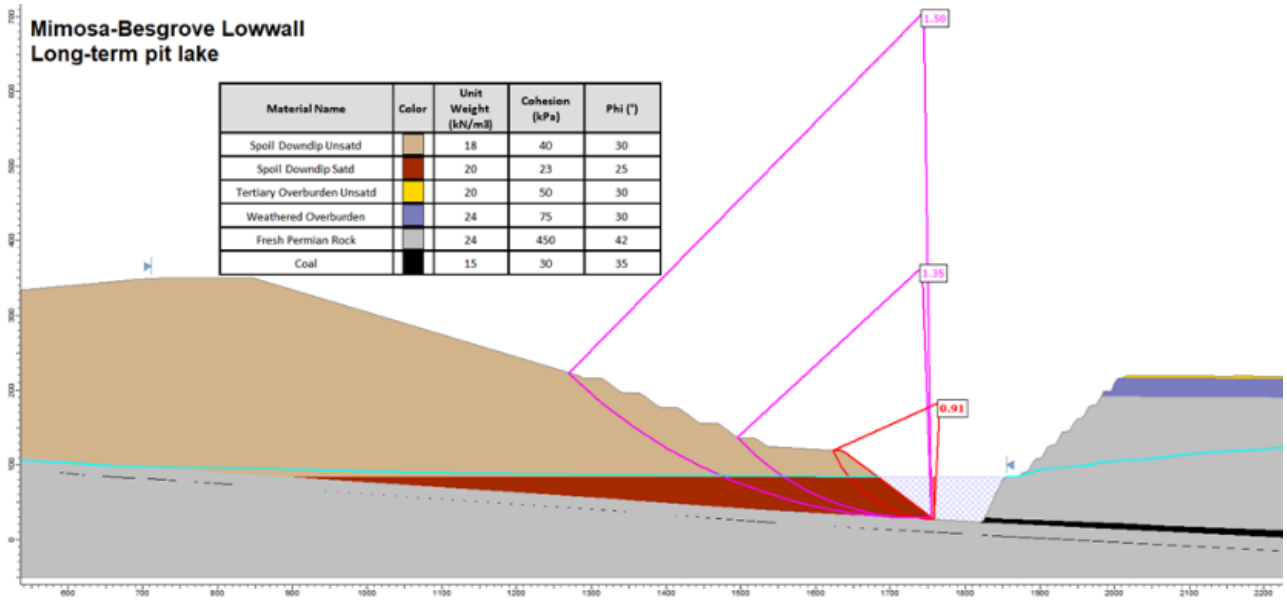


FIGURE 7-6 MIMOSA/BESGROVE LOW WALL STABILITY ANALYSIS RESULTS

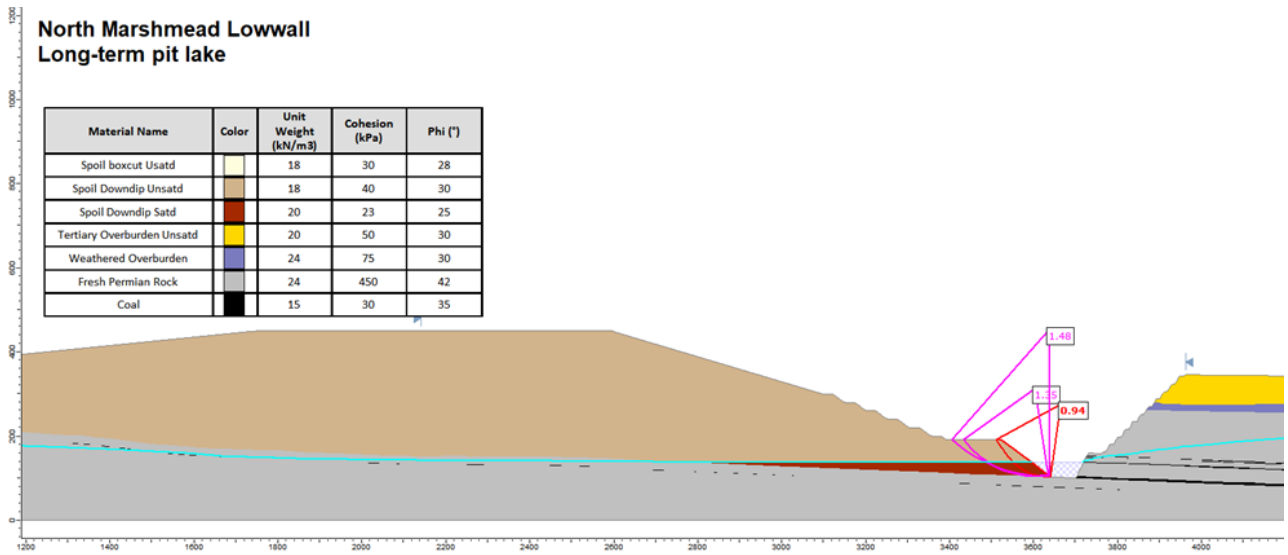
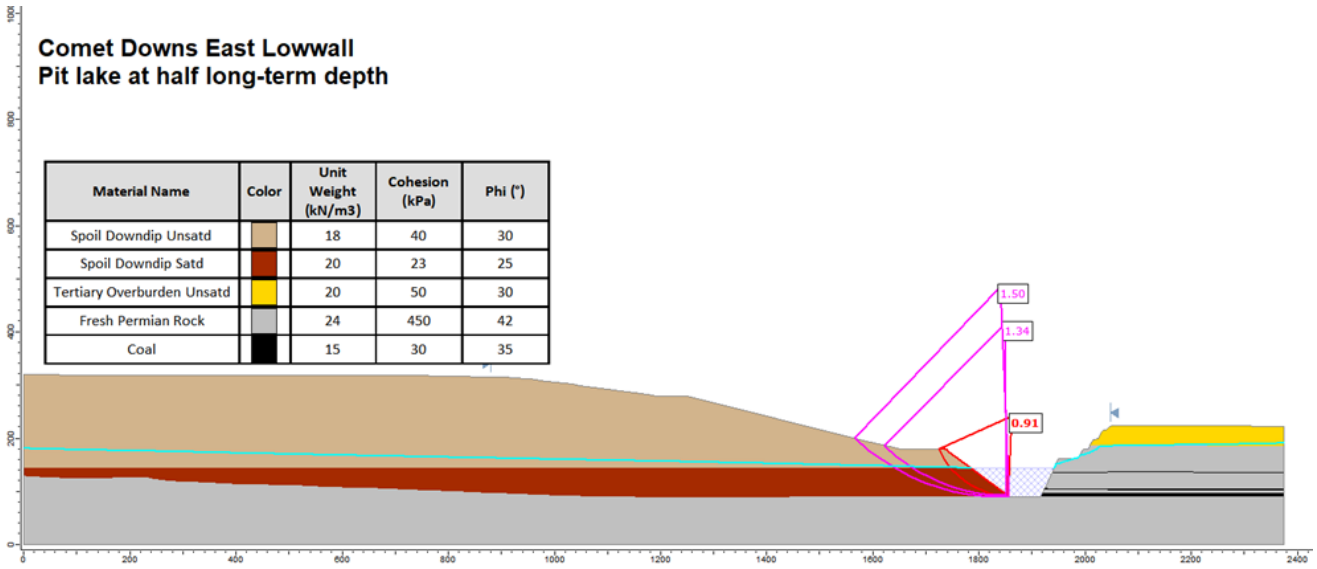


FIGURE 7-7 NORTH MARSHMEAD LOW WALL STABILITY ANALYSIS RESULTS



Note: The point where a FoS≥1.5 occurs is at a higher elevation when the residual void lake is partially filled. The point where a FoS≥1.5 occurs is lower once the lake has reached equilibrium. However, as Comet Downs East is estimated to take up to 450 years to reach equilibrium, the NUMA boundary will be informed by stability analysis under a partially filled residual void lake condition.

FIGURE 7-8 COMET DOWNS EAST LOW WALL STABILITY ANALYSIS RESULTS

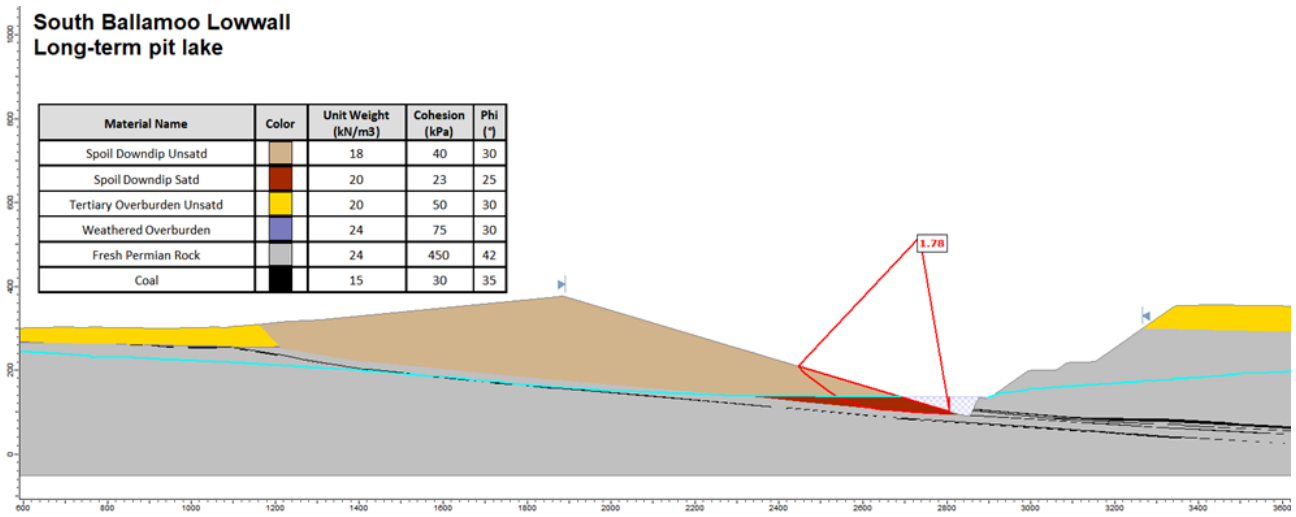


FIGURE 7-9 SOUTH BALLAMOO LOW WALL STABILITY ANALYSIS RESULTS

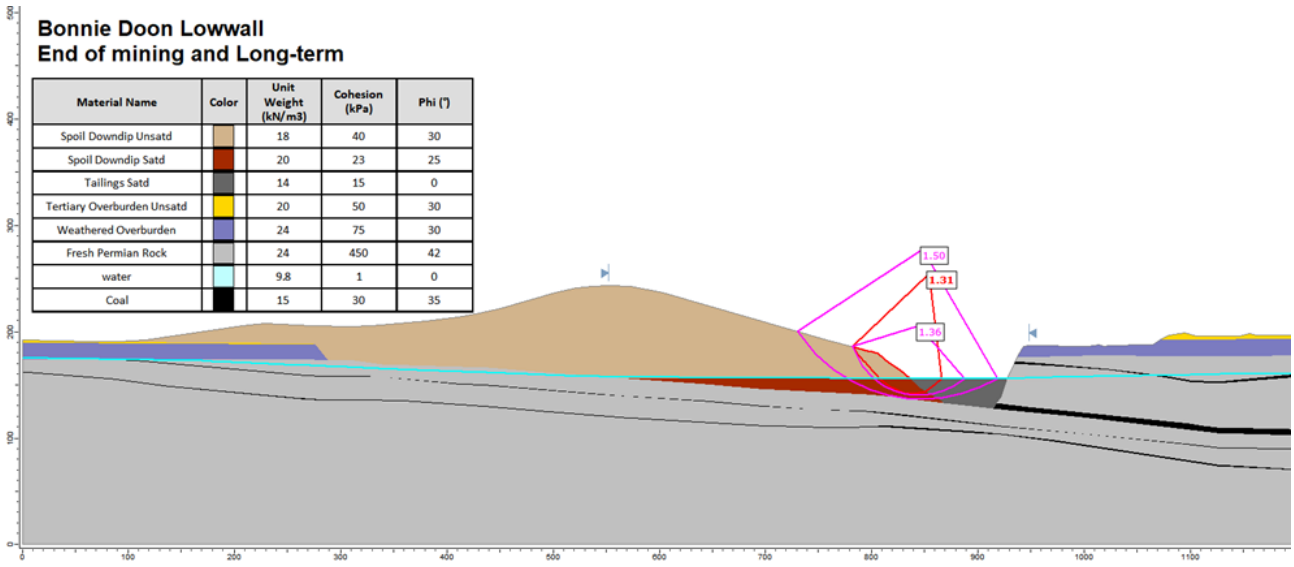


FIGURE 7-10 BONNIE DOON LOW WALL STABILITY ANALYSIS RESULTS

8. GEOCHEMICAL STABILITY

This section evaluates long-term water quality in the void lakes, including potential stratification. It supports the PRCP requirements in Section 3.6.3 to assess potential environmental risks from salinity and contaminants.

A geochemical assessment was conducted to evaluate long-term water quality in nine (9) of the 15 BWM residual voids under closure conditions. The assessment aimed to:

- Predict the long-term evolution of void lake water quality;
- Assess the potential for environmental impact by comparing predicted water quality to EA groundwater trigger values; and
- Identify whether stratification may develop within the voids.

8.1 MODEL SUMMARY

A geochemical water quality model was developed using PHREEQC (Parkhurst, 2013) with the minteq.v4 thermodynamic database.

Nine (9) of the fifteen (15) residual void pit lakes were modelled separately to simulate the evolution of pH, TDS, major ions and metal(loid)s over 900-1,000 years, depending on when the voids start accumulation water in the WBM.

Key features include:

- Source waters were combined at annual timesteps based on GoldSim-derived water balance flows by HydroBalance (2026) (Section 6.2.1);
- Modelling was incremental, using each previous timestep's lake water as input for the next; and
- Geochemical processes such as mineral precipitation/dissolution, gas exchange and surface adsorption.

The assumptions in Table 8-1 were applied in the PHREEQC modelling to represent long-term equilibrium behaviour. These are standard for pit lake geochemical simulations and are designed to isolate chemical processes from hydrodynamic and biological effects.

TABLE 8-1 PHREEQC MODEL ASSUMPTIONS AND IMPLICATIONS

Assumption	Description and Rationale	Potential Implications
Fully mixed water column	• The model assumes a single, well-mixed lake with uniform chemistry. • This is standard in equilibrium modelling, as PHREEQC does not simulate physical stratification. • Mixing and layering are addressed separately in the general lake model (GLM) limnology model (Section 8.4).	• Reasonable and typical assumption. • Physical stratification is discussed in Section 8.4.

Assumption	Description and Rationale	Potential Implications
Instant (equilibrium) geochemical reactions	• Reactions are assumed to occur rapidly enough to reach equilibrium each timestep. • This isolates equilibrium trends without the complexity of kinetic rate data.	• Conservative assumption. • Real systems may react more slowly, meaning actual chemical change would occur more gradually than modelled.
No initial mineral solids	• The model begins with dissolved inputs only, allowing minerals to precipitate or dissolve dynamically based on evolving water chemistry.	• Ensures secondary mineral formation is simulated directly.
No solute release from submerged wall rock, tailings or spoil	• Once submerged, wall rock, tailings and spoil are assumed to have negligible ongoing leaching. • Any early solute release is represented through the inflow source terms.	• Reasonable for closure conditions. • Supported by low PAF proportions (<5%) and realistic neutralising capacity of bulk spoil. • Minor early leaching would have limited long-term impact.
Methane release negligible	• Anaerobic methane generation is excluded due to low organic content and strongly oxidising conditions expected in the lake.	• Very low likelihood of significant methane production; exclusion has negligible influence.
No biological processes simulated	• Microbial reactions (e.g. sulfate reduction, iron oxidation) are not included, as PHREEQC does not handle biological kinetics.	• Typical for long-term models. • Biological effects may locally alter redox conditions but are unlikely to change the overall geochemical trajectory.

Sensitivity analyses were conducted to examine the influence of geochemical controls on predicted water quality (refer to Table 8-2). Note that depending on the type of precipitated iron oxide mineral in each simulation, either ferrihydrite ($Fe(OH)_3$) or lepidocrocite (γ-FeOOH) adsorption was modelled. The same specific surface area was used for both minerals (60 m^2/g), but their site densities differ: Ferrihydrite: 2.3 sites/nm^2 (Dzombak & Morel, 1991); Lepidocrocite: 1.67 sites/nm^2 (Zhang, 1992).

TABLE 8-2 PHREEQC SENSITIVITY ANALYSIS PARAMETERS

Simulation	Atmospheric CO_2 Equilibrium	Oxic/Anoxic Conditions	Mineral Precipitation	Surface Sorption
Geochemical controls (C)	Equilibrium at partial pressure $10^{-3.37}$ atm (~430 ppm)[1]	O_2 equilibrium at partial pressure 10^{-11} atm (pe ≈ 8.5; Eh ≈ 0.5 V)[2]	Equilibrium	Adsorption onto precipitated ferrihydrite or lepidocrocite particle surfaces.
No geochemical controls (NC)	No CO_2 equilibrium	No O_2 equilibrium	No equilibrium	No sorption

Simulation	Atmospheric CO_2 Equilibrium	Oxic/Anoxic Conditions	Mineral Precipitation	Surface Sorption

Notes:
[1] 430 ppm is representative of 2026 atmospheric CO_2 concentrations. Any future change of CO_2 levels in the atmosphere is not included in current model scenarios.
[2] pe = logarithmic scale of electron activity; Eh = measured electric potential; V = volt (unit).

8.1.1 GEOCHEMISTRY SCREENING LEVELS

Water quality modelling results were compared against the groundwater contaminant limits in Table 8-3 from Table I2 of the BWM EA. Note that for metals and metalloids, limits are for dissolved analytes. Relevant voids were chosen by proximity to each bore and were included to enable water quality comparison with PHREEQC geochemistry results. Locations of the groundwater monitoring bores are in Figure 8-1.

TABLE 8-3 GROUNDWATER CONTAMINANT LIMITS FOR BWM GROUNDWATER BORES (TABLE I2 OF THE EA)

Parameter	***Unit***	**MB1**	**MB18**	**MB21**	**MB19BW M2A**	**MB19BW M01P**	**MB19BW M08P**	**MB19BW M27P**	**MB20BW M03P2**	**BG-1**	**BG-2**	**MB02_02**	**MB15_01**	**MB17_01, MB17_02**
Relevant Void(s)	-	*Ramp 8, Bonnie Doon*	*Stewarton North, Stewarton South, Ramp 30*	*Ramp 74, Kenmare, Togara/ North Marshmead*	*Ramp 8, Bonnie Doon*	*Ramp 8, Bonnie Doon*	*Stewarton North, Stewarton South*	*Ramp 70, Mimosa/Besgrove, Deep Creek*	*Ramp 8, Bonnie Doon*	*Ramp 8, Bonnie Doon*	*Mimosa/Besgrove*	*Tannyfoil, South Ballamoo*	*Togara/ North Marshmead*	*Comet Downs East*
pH	-	6.3-7.4	6.5-8.5	6.1-7.1	6.0-6.3	6.5-8.5						6.5-8.7	3.08-3.24	6.5-8.5
EC	*µS/cm*	39,560	18,610	15,890	37,860	26,430	7,260	15,190	20,180	15,780	18,170	TBC		
TDS[1]	*mg/L*	26,505	12,469	10,646	25,366	17,708	4,864	10,177	13,520	10,572	12,174			
SO_4		426	210	600	530	210	210	210	210	210	1,660			
Al		0.055										0.55	62.00	0.55
As		0.019	0.013									TBC		
Fe		6.3	4.62	4.7	1.4	2.1	1.4	3.53	1.84	1.4	1.4			
Hg		0.0006												
Mo		0.034												
Sb		0.009												
Se		0.011												

Note: [1] TDS was calculated using an approximate conversion factor of TDS = EC × 0.67.

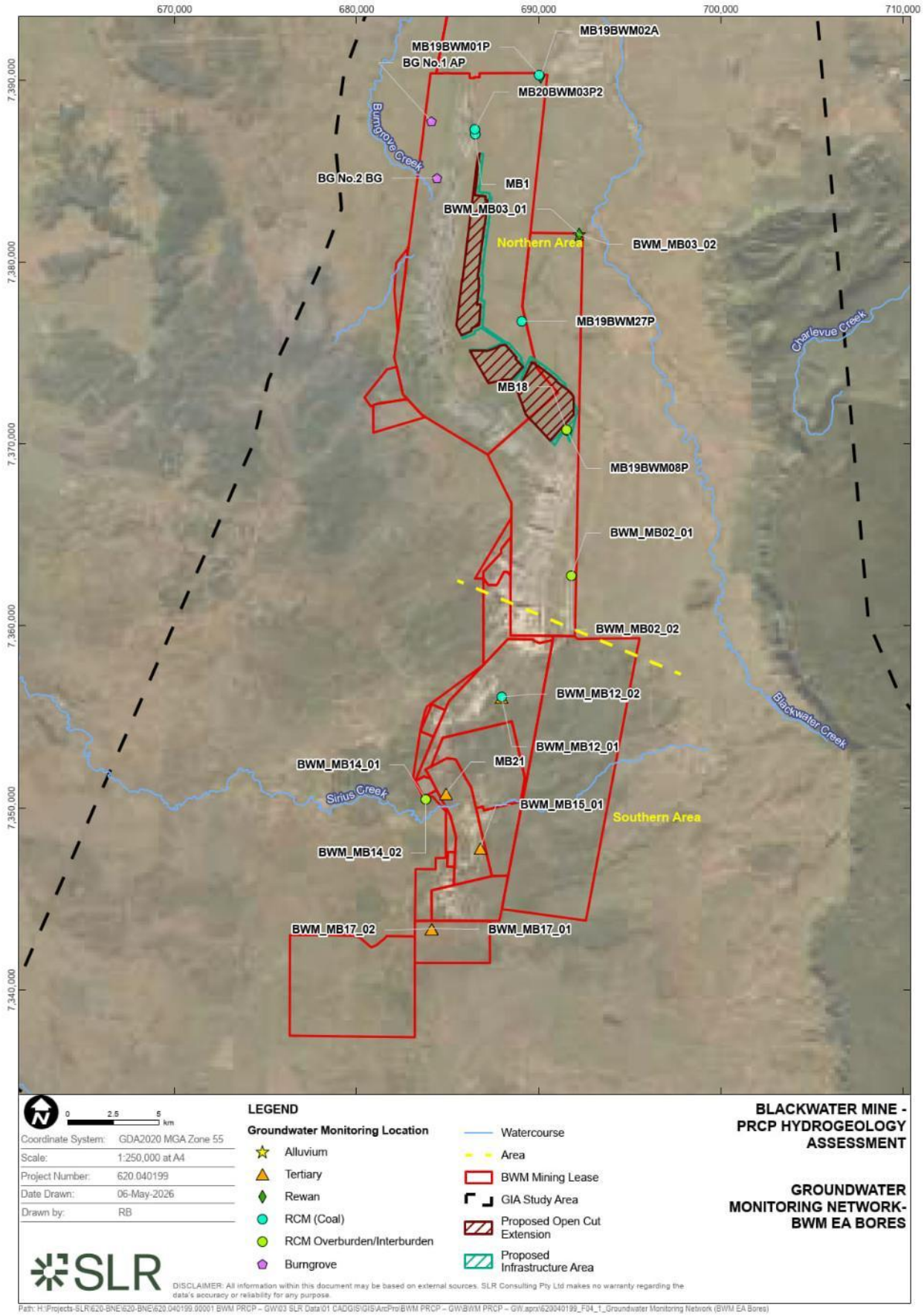


FIGURE 8-1 BWM EA GROUNDWATER MONITORING BORES (SLR, 2026)

8.1.2 VOID WALL MATERIAL COMPOSITION

Information on the composition of the residual void walls were obtained from *Blackwater Mine Environmental Geochemical Characterisation and Risk Assessment of Mineral Waste* (TES, 2026).

The geochemical assessment considered how different geological and mine waste materials at BWM may interact with water and influence solute release or immobilisation. Key interactions included rainfall and runoff contacting highwall lithologies, spoil, rejects, tailings and natural catchments. Infiltration into wall rock and spoil pore water was not modelled explicitly, as any associated solute release is represented within the source term chemistry for seepage and runoff.

BWM will retain 15 residual voids at closure, each with variable depth because the pit floors are not flat. Most void floors will expose the P&L Lower coal seam group, except Bonnie Doon and Ramp 74 which retain tailings. Geological logs, coal quality data and geochemical testing were used to characterise wall and floor materials to provide void wall runoff source terms for each residual void.

Key points from TES (2026) include:

- Highwalls contain a mix of weathered and fresh material, with 40% weathered and 60% fresh on average:
    - Coal exposure on walls is limited, generally 2-7% across voids; and
    - AMD likelihood from walls is low, with only about 3.5-6% of wall material classified as PAF;
- For voids without tailings, AMD from floors is also unlikely even under a conservative assumption of full coal exposure;
- Tailings floors in Bonnie Doon and Ramp 74 contain a high proportion of PAF material (~46-72%), so AMD is probable before capping and inundation; and
- Overall, AMD risk from void walls and non-tailings floors is low, while AMD risk from tailings floors is reduced once voids are capped or submerged post-closure.

Excavated wall materials were grouped into lithological domains based on weathering state and carbonaceous content (Table 8-4). Their distributions for each residual void were estimated using stratigraphic data from drillholes. Materials with unknown classifications were reassigned to carbonaceous or non-carbonaceous groups based on estimated carbonaceous content.

TABLE 8-4 ESTIMATED PERCENTAGES OF LITHOLOGIES IN THE RESIDUAL VOID WALLS

Residual Void	Weathered non-carbonaceous/coal	Weathered carbonaceous/coal	Fresh non-carbonaceous/coal	Fresh carbonaceous/coal	Unknown overburden/interburden	Coal, fresh
Unit	*%*					
Bonnie Doon (and Ramp 8[1])	17	0.1	73	3.5	-	6.7
Comet Downs East	33	0.6	54	3.0	6.3	3.3
Deep Creek	22	1.0	68	1.2	0.6	7.1
Kennedy	76	2.0	13	<0.1	6.8	1.9
Kenmare	25	<0.1	65	1.2	4.1	5.1
Mimosa/Besgrove (and Ramp 30[1])	20	0.6	70	1.2	2.4	5.4
Ramp 74	11	<0.1	82	0.8	-	6.0
Stewarton North, Stewarton South, Tannyfoil and South Ballamoo[2]	23	1.6	65	1.1	1.7	7.2
South Marshmead	59	1.3	37	0.7	-	2.6
Togara/North Marshmead	73	5.6	19	0.4	-	2.0

Notes:

[1] Ramp 8 and Ramp 30 could not be assessed individually due to limited data, so their wall rock and seam proportions were assumed to match nearby voids with similar geology.

[2] Stewarton North and South, Tannyfoil and South Ballamoo were assessed together and the values shown represent averaged conditions because differences between the three voids are minor.

Source: TES (2026)

8.1.3 GEOCHEMICAL SOURCE TERMS

Table 8-5 presents the types of water inflows considered in the PHREEQC model, along with their associated source term assumptions and data sources.

TABLE 8-5 SUMMARY OF DATA USED TO CALCULATE GEOCHEMICAL SOURCE TERMS

Water Inflow Type	Comment	Data Source
Rainfall runoff	Represented by leachate data from relative proportions of catchment type using weathered non-carbonaceous drill core samples.	BWM drill core database
Rehabilitated catchment/in-pit spoil runoff	Represented by leachate data from fresh non-carbonaceous drill core samples.	
High-wall runoff	Based on exposed lithological domains on the high-wall. The BWM drill core databases were used to derive source terms for each lithological domain/grouping.	
Groundwater inflow	Median water quality from BWM groundwater database.	BWM groundwater database
Direct rainfall	Characterised using rainfall chemistry data from the Newcastle region (77 samples from 11 rainfall events), adjusted for charge balance.	Evans (2006)

8.1.3.1 RUNOFF SOURCE TERMS

Table 8-6 presents the source terms for rainfall runoff for each residual void, derived from leachate results in combination with catchment runoff areas and wall lithology proportions by TES (2025). These values are considered representative solute concentrations derived from site runoff characterisation and provide the solute loads associated with rainfall runoff entering each pit lake.

In summary, runoff chemistry is broadly dilute across the site, with low major ion and trace metal concentrations except where elevated alkalinity or specific metals reflect local geology, such as higher alkalinity in Ramp 8 and Bonnie Doon or higher chromium and molybdenum in Ramp 74.

TABLE 8-6 RUNOFF GEOCHEMICAL SOURCE TERMS FOR THE RESIDUAL VOIDS

Parameter	*Unit*	Bonnie Doon	Comet Downs East	Deep Creek	Kenmare	Mimosa/ Besgrove	Ramp 30	Ramp 74	Ramp 8	Togara/North Marshmead
pH	-	8.48	7.84	7.70	7.70	7.72	7.70	8.28	8.44	7.72
pe		8	8	8	8	8	8	8	8	8
Al	*mg/L*	0.0855	0.0584	0.05	0.05	0.0509	0.05	0.0684	0.0935	0.051
Sb		0.0097	0.0047	0.005	0.005	0.005	0.005	0.0129	0.0037	0.005
As(3)		0.0165	0.0042	0.0005	0.0005	0.0009	0.0005	0.0092	0.0195	0.001

Parameter	*Unit*	Bonnie Doon	Comet Downs East	Deep Creek	Kenmare	Mimosa/ Besgrove	Ramp 30	Ramp 74	Ramp 8	Togara/North Marshmead
Ba		0.0122	0.0174	0.018	0.018	0.0179	0.018	0.0118	0.015	0.0179
Be		0.0003	0.0001	0.0001	0	0.0001	0.0001	0.0001	0.0005	0.0001
B		0.059	0.0542	0.05	0.05	0.0505	0.05	0.0464	0.0717	0.0505
Ca		0.634	0.542	0.5	0.5	0.504	0.5	0.528	0.717	0.505
Mg		0.762	0.771	0.75	0.75	0.752	0.75	0.684	0.859	0.753
Na		59.7	54.2	53	53	53.1	53	58.1	59.1	53.1
K		3.29	2.34	2.0	2.0	2.04	2.0	2.54	3.74	2.04
Sr		0.0294	0.013	0.005	0.005	0.0059	0.005	0.0088	0.0463	0.006
Fe		0.0477	0.0321	0.025	0.025	0.0258	0.025	0.0297	0.062	0.0259
Mn		0.0115	0.0028	0.003	0.003	0.003	0.003	0.0161	0.0021	0.003
Cu		0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0005
Ni		0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0005
Zn		0.0041	0.0039	0.0038	0.0037	0.0038	0.0037	0.0038	0.0043	0.0038
Cr		0.0451	0.0313	0.025	0.025	0.0257	0.025	0.0292	0.0576	0.0258
Mo		0.0052	0.0023	0.001	0.001	0.0011	0.001	0.0017	0.008	0.0012
Ag		0.0001	0.0001	0.0001	0	0	0.0001	0.0001	0.0001	0
Pb		0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0005
Cd		0.0003	0.0001	0.0001	0	0.0001	0.0001	0.0001	0.0005	0.0001
Cl		22.7	33.0	35	35	34.8	35	25.0	24.6	34.8
S(6)		10.7	10.1	9.5	9.5	9.57	9.5	8.73	12.8	9.58
F		0.351	0.392	0.4	0.4	0.399	0.4	0.362	0.357	0.399
Si(4)		0.0505	0.0005	0.0005	0.0005	0.0005	0.0005	0.074	0.0003	0.0005
N(5)		0.0127	0.0187	0.02	0.02	0.0199	0.02	0.0143	0.0135	0.0198
C(4)		43.0	14.2	7.0	7.0	7.77	7.0	30.8	44.4	7.89

Note: Oxidation states for some elements are given in brackets.

8.1.3.2 GROUNDWATER AND RAINFALL SOURCE TERMS

Table 8-7 summarises the source water chemistry used in the PHREEQC models for all modelled residual voids at BWM.

The groundwater source terms were derived from the site-wide average analytical results obtained from the Blackwater groundwater monitoring database (WHC, 2025) with records from 2009 to 2025. The rain chemistry reflects regional median values from Evans (2006).

TABLE 8-7 PHREEQC SOURCE TERMS FOR GROUNDWATER AND RAINFALL

Parameter	Unit	Groundwater (Site-Wide Average)	Direct Rainfall (Evans, 2006)
pH	-	6.81	5
pe	-	2 (assumed)	8 (assumed)
Temperature	*°C*	26.96	25
Na	*mg/L*	1,180	9
Ca		113	3
Mg		202	-
K		11.3	-
Li		0.63	-
Sr		3.37	-
Cl		1,940	14
S(6) as SO_4		304	8
F		0.47	-
Br		9.34	-
C(4)		276 as HCO_3	0.00005 as $CaCO_3$
Si as SiO_2		44.3	-
N(-3) as NH_3		0.444	-
N(5) as NO_3		-	2.0
Ba		0.195	-
Fe		0.82	-
Mn		0.194	-
B		0.6	-
Zn		0.0693	-
Al		0.0131	-
Ni		0.0113	-

8.1.3.3 GEOCHEMICAL CONTROLS

The equilibrium mineral phase assemblage used in the "controlled" PHREEQC modelling are displayed in Table 8-8. It was selected based on two criteria:

- Only minerals that are realistic for mine void waters in the Bowen Basin were included.
- The phases were validated through initial saturation index screening of each pit lake to confirm that they were close to saturation.

The chosen assemblage stabilises model behaviour while remaining geochemically defensible:

- Carbonate phases regulate Ca, Mg, alkalinity and pH.
- Sulfate minerals control Na, K, Fe, Ca and Ba.
- Ferrihydrite, lepidocrocite, alunite, chalcedony and gibbsite provide realistic sinks for Fe, Si and Al under oxidised conditions.
- Gas phases for CO_2 and O_2 maintain atmospheric control on carbonate speciation and redox state.

TABLE 8-8 PHREEQC EQUILIBRIUM PHASE ASSEMBLAGE

Phase	Chemical Formula	SI/log Fugacity (f) Value	Initial Reservoir	Justification
Calcite	$CaCO_3$	0	0	Provides stable geochemical buffering that keeps pH and dissolved constituents within realistic environmental ranges while avoiding forced or unrealistic mineral precipitation.
Aragonite	$CaCO_3$	0	0	
Dolomite	$CaMg(CO_3)_2$	0	0	
Gypsum	$CaSO_4 \cdot 2H_2O$	0	0	
Barite	$BaSO_4$	0	0	
Gibbsite	$Al(OH)_3$	0	0	
Alunite	$KAl_3(SO_4)_2(OH)_6$	0	0	
Lepidocrocite	γ-FeO(OH)	0	0	
Jarosite	$XFe_3(SO_4)_2(OH)_6$ (X = Na, K, H)	0	0	
Chalcedony	SiO_2	0	0	
Ferrihydrite	$Fe(OH)_3$	0	0.007 moles (when needed)	Small seed mass stabilises Fe redox and adsorption behaviour. Prevents numerical instability.
$CO_2(g)$		-3.37 log $f(CO_2)$	0	Represents atmospheric CO_2 of 430 ppm. Ensures realistic carbonate speciation and buffering.
$O_2(g)$		-11 log $f(O_2)$	999999 moles	Produces oxidising conditions consistent with pe~8.5 and Eh~0.5 V. Large reservoir maintains stable redox conditions.

A set of mineral phases was intentionally suppressed to prevent unrealistic geochemical behaviour during the simulations. These phases either require extreme pH, pressure or redox conditions, or are not expected to form from dilute pit lake waters. Table 8-9 below summarises each suppressed phase and the rationale for excluding it from PHREEQC modelling.

TABLE 8-9 PHREEQC SUPRESSED MINERAL PHASES

Supressed Phase	Chemical Formula	Target SI	Initial Reservoir	Reason for Suppression
Alumina	Al_2O_3	999	0	High-temperature phase not relevant under low-temperature aqueous conditions.
Barium arsenate	$Ba_3(AsO_4)_2$			Would unrealistically constrain aqueous chemistry via solid-phase control.
Cupricferrite	$CuFe_2O_4$			High-temperature phase not relevant under low-temperature aqueous conditions.
Cuprousferrite	$CuFeO_2$			
Iron hydroxychloride	$Fe(OH)_{2.7}Cl_{0.3}$			Would unrealistically constrain aqueous chemistry via solid-phase control.
Iron vanadate	$Fe(VO_3)_2$			
Goethite	FeOOH			
Hematite	Fe_2O_3			High-temperature phase not relevant under low-temperature aqueous conditions.
Hercynite	$FeAl_2O_4$			
Magnetite	Fe_3O_4			Not compatible with oxidising conditions defined in the model.
Maghemite	Fe_2O_3			High-temperature phase not relevant under low-temperature aqueous conditions.
Magnesioferrite	Fe_2MgO_4			

8.2 RESIDUAL VOID WATER QUALITY

This section summarises the key findings of the PHREEQC modelling presented in the Residual Void Water Quality and Limnology Assessment (ERM, 2026). For the purpose of this VCP, only key parameters and their temporal trends and water quality assessments have been included.

The below tables include results for both simulations (geochemical controls – C, and no geochemical controls – NC) to compare the effect of these controls on void lake water quality. For the purpose of this study, the C results are considered the most realistic scenario.

Where applicable, groundwater quality comparisons were made using the EA trigger values for groundwater bores in Table 8-3. Note that the comparison to these trigger levels is provided for context only, as all residual voids at BWM will remain as NUMAs and not be subject to specific water quality criteria. The triggers offer a relevant local reference point and help illustrate how predicted water quality compares with surrounding groundwater conditions, rather than representing compliance requirements.

Precipitated minerals were included in this section to show the geochemical processes controlling each void's long-term water quality. These minerals directly influence pH, salinity and metal mobility through ongoing precipitation and dissolution, which explains why key parameters stabilise, rise or decline over time. Their inclusion highlights how differences in void lithology and inflow chemistry produce distinct mineral assemblages and water quality outcomes.

The annual timestep results for key parameters summarised in Table 8-10 to Table 8-18 are provided in Appendix A.

8.2.1 BONNIE DOON

The modelled water quality for Bonnie Doon in Table 8-10 remains stable throughout the simulation period. pH remains within the alkaline range and TDS remains very low with no upward trend. Major ions and metals show minor variability but do not accumulate over time. NC and C values are similar for pH, pe and TDS, and applying geochemical controls does not materially change the predicted outcomes.

Comparisons were made against EA trigger levels for bores near Bonnie Doon in Table 8-3, and all evaluated parameters remain within or below these thresholds.

Mineral precipitation increases slowly, but the total mass represents less than 0.03% of the lake's median water mass and less than 0.001% of its peak water mass, remaining small relative to lake volume and cumulative solute input and does not negatively influence water quality.

TABLE 8-10 BONNIE DOON PHREEQC SUMMARY OVER 982 YEARS

Parameter	*Unit*	NC Value	C Value	Trend
pH	-	7.95-8.32	7.88-8.38	Stable
pe	-	6.53-7.16	9.79-10.30	
TDS	*mg/L*	125-227	120-136	
Na		-	47.0-77.6	
K		-	2.46-3.05	
Ca		-	0.88-1.22	
Mg		-	0.58-0.69	
Cl		-	51.3-58.8	
SO_4		-	10.0-10.4	
HCO_3		-	32.1-37.7	
F		-	0.263-0.314	
Si		-	0.018-0.021	
Al		-	0.011-0.024	
Fe		-	0	
Mn		-	0.009-0.014	

Parameter	*Unit*	NC Value	C Value	Trend
Precipitated phases at end of run				
Dolomite	*tonnes*	-	0-0.20	Increasing
Ferrihydrite		-	1.27-9.22	
Gibbsite		-	0.91-16.6	
Barite		-	0	Stable
Gypsum		-	0	
Chalcedony		-	0	

8.2.2 MIMOSA/BESGROVE

The modelled water quality for Mimosa/Besgrove in Table 8-11 was simulated over 967 years and does not remain stable over the simulation period because the void is dominated by highly mineralised groundwater inputs in combination with evaporative concentration.

pH stays within a mildly acidic to neutral range for NC outputs and rises into a neutral range under geochemical controls, with no long term decline. TDS increases through the simulation, reflecting progressive concentration of salts as groundwater inflows exceed dilution capacity. Major ions and metals follow the same trajectory as TDS, with concentrations increasing across both NC and C outputs, with similar ranges indicating limited influence of geochemical controls on overall solute accumulation.

Comparisons were made against EA trigger levels for bores near Mimosa/Besgrove in Table 8-3. pH is within the MB18 containment limits but exceeds the upper limits for MB1 and MB19BW M2A at the upper bound of the C scenario. TDS and SO_4 exceed limits across much of the simulation, particularly at later stages. Arsenic exceeds trigger levels at the upper bound of the C scenario.

Mineral precipitation increases slowly but the total mass represents less than 1.5% of the lake's median water volume (1,810 ML) and less than 1.3% of its peak water volume (2,150 ML), remaining small relative to lake volume and cumulative solute input.

TABLE 8-11 MIMOSA/BESGROVE PHREEQC SUMMARY OVER 967 YEARS

Parameter	Unit	NC Value	C Value	Trend
pH	-	**5.55**-6.88	6.75-**7.96**	Decreasing
pe	-	5.59-7.62	9.98-11.2	Increasing
TDS	mg/L	2,430-**186,000**	2,590-**174,000**	
Na		694-53,100	755-53,300	
K		7.64-531	8.17-532	
Ca		65.6-5,040	56.3-1,170	
Mg		114-8,890	116-7,970	

Parameter	Unit	NC Value	C Value	Trend
Cl		1,320-101,500	1,430-102,000	
SO4		183-**13,700**	199-**8,220**	
HCO3		128-1,780	3.29-43.3	
F		0.478-27.5	0.490-27.6	
Si		11.7-912	12.8-915	
Al		**0.0756-1.13**	0	Stable
Fe		1.24-39.5	0	
Mn		0.129-8.66	0-1.87	Increasing
As	µg/L	0.36-**15.3**	0.35-**15.3**	
Cr		10.2-436	9.90-438	
Cu		1.01-12.7	1.01-12.8	
Mo	µg/L	**0.436-18.7**	**0.424-11.2**	Fluctuating, overall stabilising after 600 years
Ni		10.5-77.4	10.5-77.6	Increasing
Pb		2.31-21.5	1.83-21.6	
Sb		1.98-**84.9**	1.93-**85.2**	
Se		0.865-5.90	0.868-5.60	
Zn		2.21-67.4	2.18-67.6	
Precipitated phases at end of simulation				
Gypsum	*tonnes*	-	15,600	Increasing
Dolomite		-	11,500	
Lepidocrocite		-	100	
Pyrolusite		-	21.1	
Barite		-	24.1	
Diaspore		-	4.07	
Surface-adsorbed ions at end of simulation				
Ca	*g*	-	167	Increasing
Mg		-	813	
SO4		-	420	

*Note: Values outside groundwater bore trigger levels are marked in **bold**.*

8.2.3 RAMP 30

The modelled water quality for Ramp 30 in Table 8-12 shows greater variability and higher maximum concentrations under NC conditions, compared to lower and more stable concentrations under C conditions throughout the simulation period. pH remains within near-neutral to slightly alkaline conditions, but exhibits fluctuations associated with periodic lake drying due to evaporation and groundwater outflow.

These drying events reduce water volume, concentrating solutes and causing short-term increases in TDS and dissolved constituents. Subsequent refilling dilutes concentrations, resulting in the observed fluctuations. pe is higher under C conditions (9.90-10.8) compared to NC conditions (5.48-8.05), indicating more consistently oxidising conditions when geochemical controls are applied.

TDS shows a wide range under NC conditions (140-10,700 mg/L), reflecting repeated concentration during dry periods, whereas under C conditions, TDS remains lower (138-2,830 mg/L), indicating that solute concentrations do not build up to the same extent despite the same hydrological fluctuations. Major ions and metals display similar behaviour, with higher peaks under NC conditions, and lower peak concentrations under C conditions.

Mineral precipitation is limited, with a total cumulative mass of approximately 24.1 tonnes across all phases (dominated by dolomite and diaspore). This represents approximately 0.014% of the modelled average water mass (172 ML) and 0.0012% of the maximum water mass (2,010 ML), confirming that precipitation is negligible relative to system scale.

Consistent with above, comparison of NC (no precipitation) and C (precipitation and surface adsorption enabled) results shows that aqueous solute concentrations are reduced under C conditions, but the overall trends and ranges remain similar, indicating that precipitation and adsorption limit peak concentrations rather than fundamentally altering system behaviour or controlling water quality evolution.

TABLE 8-12 RAMP 30 PHREEQC SUMMARY OVER 967 YEARS

Parameter	*Unit*	NC Value	C Value	Trend
pH	-	6.75-7.63	7.18-8.08	Fluctuating
pe	-	5.48-8.05	9.90-10.8	
TDS	*mg/L*	140-10,700	138-2,830	
Na		51.3-3,060	50.0-824	
K		1.52-33.0	1.42-8.22	
Ca		0.552-282	0.55-60.6	
Mg		0.753-498	0.75-128	
Cl		73.1-5,800	72.3-1,580	
SO_4		9.53-784	9.49-211	
HCO_3		6.49-489	6.39-54.0	
F		0.271-2.80	0.255-0.425	
Si		0.0016-51.0	0.002-14.2	

Parameter	*Unit*	NC Value	C Value	Trend
Al		0.025-0.26	0-0.001	
Fe		0.024-2.08	0	
Mn		0.003-0.49	0	
As	*µg/L*	0.155-2.34	0.125-0.537	
Cr		7.74-117	6.26-24.8	
Cu		0.155-2.34	0.125-0.496	
Mo		0.309-4.69	0.250-0.993	
Ni		0.479-29.1	0.460-7.88	
Pb		0.155-2.34	0.125-0.496	
Sb		1.55-23.4	1.25-4.96	
Se		0	0	
Zn		3.53-180	3.36-48.5	
Precipitated phases				
Diaspore	*tonnes*	-	0-5.57	Increasing
Dolomite		-	0-14.2	Decreasing
Lepidocrocite		-	**0-3.68**	Increasing
Pyrolusite		-	0.631	Increasing
Barite		-	0-0.0249	Decreasing
Surface-adsorbed ions				
Ca		-	0-190	Fluctuating
Mg		-	0-3,280	
SO4		-	0-908	

*Note: Values outside groundwater bore trigger levels are marked in **bold**.*

8.2.4 RAMP 74

The modelled water quality for Ramp 74 in Table 8-13 remains stable throughout the simulation period. pH stays within a slightly alkaline range and TDS remains very low with no upward trend. Major ions and metals stay low in concentration and show no accumulation. NC and C values remain closely aligned for pH, pe and TDS, showing that applying geochemical controls does not materially change predicted outcomes.

Comparisons were made against EA limits for bores near Ramp 74 in Table 8-3, and all evaluated parameters remain within or below these thresholds for the full simulation.

Mineral precipitation is extremely small, totalling less than 0.01 tonnes at the end of the model run. This is negligible relative to the lake's median and peak water masses.

TABLE 8-13 RAMP 74 PHREEQC SUMMARY OVER 1,000 YEARS

Parameter	*Unit*	NC Value	C Value	Trend
pH	-	7.61-7.84	7.70-7.90	Stable
pe	-	7.45-7.83	10.3-10.5	Increasing
TDS	*mg/L*	222-842	112-124	Stable
Na		-	43.1-48.1	
K		-	1.76-2.03	
Ca		-	1.03-1.29	
Mg		-	0.47-0.55	
Cl		-	52.1-58.0	
SO_4		-	8.50-8.58	
HCO_3		-	21.2-24.3	
F		-	0.251-0.289	
Si		-	0.024-0.028	
Al		-	0.005-0.008	
Fe		-	0	
Mn		-	0.011-0.013	
Precipitated phases at end of run				
Dolomite	*tonnes*	-	0	Stable
Ferrihydrite		-	0.0002-0.0009	Stable
Gibbsite		-	0.0003-0.0096	
Barite		-	0	
Gypsum		-	0	
Chalcedony		-	0	

8.2.5 RAMP 8

The modelled water quality for Ramp 8 in Table 8-14 shows increasing solute concentrations over the simulation period due to the relatively small lake volume, high evaporative concentration and long term solute loading.

pH increases to a near-neutral range and major ions and metals stabilise under geochemical controls. NC and C values differ for pH, pe and TDS, but the C values show more stable long term behaviour.

Comparisons were made against EA trigger levels for bores near Ramp 8 in Table 8-3. Al and Fe remain within or below their respective triggers, while pH occasionally are below or above trigger levels. TDS and SO_4 exceed the relevant triggers but stabilise over time.

Mineral precipitation increases gradually but remains small relative to the lake's water mass. Total mineral mass remains less than 1% of median water mass and less than 0.5% of peak water mass, and therefore does not negatively influence water quality.

TABLE 8-14 RAMP 8 PHREEQC SUMMARY OVER 935 YEARS

Parameter	*Unit*	NC Value	C Value	Trend
pH	-	**5.99**-6.77	7.02-**7.76**	Increasing
pe	-	6.05-7.18	10.4-11.2	
TDS	*mg/L*	**13,700**-**136,000**	**13,300**-**127,000**	
Na		-	3,910-38,700	
K		-	38.2-378	
Ca		-	260-1,110	
Mg		-	594-5,850	
Cl		-	7,470-74,000	
SO_4		-	**1,010**-**6,600**	
HCO_3		-	31.2-6.40	Decreasing
F		-	1.66-16.4	Increasing
Si		-	7.04-3.86	Decreasing
Al		-	0.007-0.002	
Fe		-	0-1.70	Increasing
Mn		-	0.640-6.32	
Precipitated phases at end of run				
Dolomite	*tonnes*	-	1,440-24,100	Increasing
Ferrihydrite		-	15.1-231	
Gibbsite		-	0.510-9.42	
Barite		-	2.93-48.6	
Gypsum		-	0-27,500	
Chalcedony		-	368-6,430	

*Note: Values outside groundwater bore trigger levels are marked in **bold**.*

8.2.6 DEEP CREEK

The modelled water quality for Deep Creek in Table 8-15 shows consistent increases in dissolved solids and major ions over the simulation period.

pH moves into a near-neutral range when geochemical controls are applied (C higher than NC: 6.99-8.26 vs 5.95-7.21), and pe also increases under C conditions. Most solutes display long-term upward trends driven by evaporative concentration and cumulative solute input. Geochemical controls reduce key dissolved constituents, particularly SO_4 (lower in C than NC) and metals (Fe and Mn substantially lower in C).

Comparisons were made against EA limits for bores near Deep Creek in Table 8-3. pH, Al and Fe remain within trigger levels. There are sustained increases in TDS, SO_4, F and Mn across the entire simulation period with no indication of reaching equilibration.

TDS and SO_4 exceed relevant EA limits at most times. F and Mn increase but have no applicable triggers for this void. None of these parameters stabilise or plateau, and the system does not approach geochemical equilibrium within the modelled timeframe.

Mineral precipitation is limited, with a total cumulative mass of approximately 99,800 tonnes across all phases (dominated by gypsum and dolomite). This represents approximately 1.1% of the modelled median water mass (9,170 ML) and 0.92% of the maximum water mass (10,900 ML), confirming that precipitation remains minor relative to overall system scale.

TABLE 8-15 DEEP CREEK PHREEQC SUMMARY OVER 968 YEARS

Parameter	*Unit*	NC Value	C Value	Trend
pH	-	5.95-7.21	6.99-8.26	Decreasing
pe	-	4.56-7.59	9.76-10.9	Increasing
TDS	*mg/L*	223-**138,000**	254-**129,000**	
Na		75.1-39,200	75.1-39,200	
K		1.67-381	1.67-381	
Ca		2.84-3,740	14.3-1,140	
Mg		4.84-6,620	11.8-5,920	
Cl		119-75,100	119-75,100	
SO_4		15.5-**10,100**	15.6-**6,670**	
HCO_3		10.9-1,770	5.69-77.2	
F		0.243-17.9	0.24-17.9	
Si		0.424-680	0.42-680	
Al		0.02-0.734	<0.001	Decreasing
Fe		0.041-27	<0.0001	Increasing
Mn		0.007-6.39	0-0.19	Negligible until 400 years, then increasing
As	*µg/L*	0.05-3.04	0-0.35	Increasing
Cr		2.32-152	2.19-111	
Cu		0.05-3.04	0.02-0.35	
Mo		0.09-6.08	0.09-3.72	Increasing up to 700 years, then steady
Ni		0.71-374	1.16-370	Increasing
Pb		0.05-3.04	0-0.61	Negligible until 300 years, then increasing
Sb		0.46-**30.4**	0.46-**30.4**	Increasing
Zn		4.93-2,300	7.57-2,290	

Parameter	*Unit*	NC Value	C Value	Trend
Precipitated phases at end of run				
Gypsum	*tonnes*	-	52,600	Starts forming after ~400 years, then steadily increasing
Dolomite		-	46,600	Increasing
Lepidocrocite		-	379	
Pyrolusite		-	87.7	
Barite		-	96.5	
Diaspore		-	14.5	
Surface-adsorbed ions at end of run				
Ca	*g*	-	136	Increasing
Mg		-	624	
SO_4		-	1,026	

*Note: Values outside groundwater bore trigger levels are marked in **bold**.*

8.2.7 KENMARE

The modelled water quality for Kenmare in Table 8-16 shows a clear upward trajectory for all major salinity indicators.

pH increases to weakly alkaline and remains within limits. TDS, SO_4, F and Mn all increase over time with no sign of equilibrium. NC and C values remain closely aligned for pH, pe and TDS, showing that geochemical controls do not materially change predicted outcomes for these key metrics.

Comparisons were made against EA limits for groundwater bores near Kenmare in Table 8-3. TDS and SO_4 exceed the trigger levels at early stages of the simulation and continue to rise.

The cumulative mass of precipitated minerals remains small relative to the lake's median and peak water mass and does not drive negative changes in water quality.

TABLE 8-16 KENMARE PHREEQC SUMMARY OVER 929 YEARS

Parameter	*Unit*	NC Value	C Value	Trend
pH	-	6.34-6.79	7.26-7.84	Increasing
pe	-	6.09-6.76	10.3-10.9	
TDS	*mg/L*	8,210-**85,300**	7,980-**80,900**	
Na		-	2,350-24,400	
K		-	24.6-252	
Ca		-	157-1,090	
Mg		-	350-3,590	
Cl		-	4,470-46,400	

Parameter	*Unit*	NC Value	C Value	Trend
SO_4		-	**603-5,130**	
HCO_3		-	36.8-11.2	Decreasing
F		-	1.51-14.9	Increasing
Si		-	7.33-4.95	Decreasing
Al		-	0.008-0.003	
Fe		-	0	Stable
Mn		-	0.38-3.91	Increasing
Precipitated phases at end of run				
Dolomite	*tonnes*	-	1.21-23.1	Increasing
Ferrihydrite		-	0.0139-0.223	
Gibbsite		-	0.00078-0.0195	
Gypsum		-	0-0.0838	
Barite		-	0.00233-0.049	
Chalcedony		-	0.00484-101	

*Note: Values outside groundwater bore trigger levels are marked in **bold**.*

8.2.8 TOGARA/NORTH MARSHMEAD

The modelled water quality for Togara/North Marshmead in Table 8-17 shows sustained increases in TDS, SO_4, F and Mn with no indication of reaching equilibration. pH remains near neutral throughout. NC and C values remain closely aligned for pH, pe and TDS, showing that geochemical controls do not materially change model outcomes.

Comparisons were made against EA limits for bores near Togara/North Marshmead in Table 8-3. TDS and SO_4 exceed their respective triggers throughout and continue increasing. pH exceeds the trigger levels towards the end of the simulation. F and Mn increase but have no applicable triggers.

Mineral precipitation increases gradually, and although some minerals accumulate to high absolute masses, these remain very small relative to the lake's median and peak water mass and cumulative solute input and do not negatively influence water quality.

TABLE 8-17 TOGARA/NORTH MARSHMEAD PHREEQC SUMMARY OVER 914 YEARS

Parameter	*Unit*	NC Value	C Value	Trend
pH	-	6.17-6.76	7.14-**7.78**	Increasing
pe	-	6.09-6.58	10.4-11.0	
TDS	*mg/L*	**11,300-111,000**	**10,900-104,000**	
Na		-	3,220-31,600	
K		-	31.7-313	

Parameter	*Unit*	NC Value	C Value	Trend
Ca		-	216-1,100	
Mg		-	488-4,750	
Cl		-	6,160-60,500	
SO_4		-	**830-5,850**	
HCO_3		-	32.8-8.40	Decreasing
F		-	1.55-15.6	Increasing
Si		-	7.20-4.36	Decreasing
Al		-	0.008-0.002	
Fe		-	0	Stable
Mn		-	0.52-5.14	Increasing
Precipitated phases at end of run				
Dolomite	*tonnes*	-	4.90-90.7	Increasing
Ferrihydrite		-	50.8-879	
Gibbsite		-	2.23-46.1	
Barite		-	10.2-188	
Gypsum		-	0-88,000	
Chalcedony		-	1,240-24,400	

*Note: Values outside groundwater bore trigger levels are marked in **bold**.*

8.2.9 COMET DOWNS EAST

The modelled water quality for Comet Downs East in Table 8-18 shows increasing TDS, SO_4, F and Mn throughout the simulation with no evidence of equilibration. pH remains near neutral for the duration. NC and C values remain closely aligned for pH, pe and TDS, indicating that geochemical controls do not materially alter the predicted outcomes.

Comparisons were made against EA limits for bores near Comet Downs East in Table 8-3. TDS and SO_4 exceed the limits and continue to increase. F and Mn increase but have no applicable limits.

Mineral precipitation increases over time, and although some minerals accumulate at high absolute masses, these are very small relative to the lake's median and peak water mass and cumulative solute inputs and do not negatively influence water quality.

TABLE 8-18 COMET DOWNS EAST PHREEQC SUMMARY OVER 921 YEARS

Parameter	*Unit*	NC Value	C Value	Trend
pH	-	**6.33**-6.79	7.14-7.78	Increasing
pe	-	6.01-6.72	10.4-11.0	
TDS	*mg/L*	8,820-**86,600**	10,900-**104,000**	
Na		-	3,210-31,600	

Parameter	*Unit*	NC Value	C Value	Trend
K		-	31.8-314	
Ca		-	215-1,100	
Mg		-	486-4,730	
Cl		-	6,140-60,400	
SO_4		-	827-**5,850**	
HCO_3		-	32.9-8.50	Decreasing
F		-	1.54-15.5	Increasing
Si		-	7.21-4.37	Decreasing
Al		-	0.008-0.002	
Fe		-	0	Stable
Mn		-	0.52-5.13	Increasing
Precipitated phases at end of run				
Dolomite	*tonnes*	-	4.94-91.5	Increasing
Ferrihydrite		-	51.3-882	
Gibbsite		-	2.34-49.9	
Barite		-	9.34-189	
Gypsum		-	0-87,500	
Chalcedony		-	1,240-24,400	

*Note: Values outside groundwater bore trigger levels are marked in **bold**.*

8.3 WATER QUALITY SUMMARY TABLE

Table 8-19 summarises the predicted long term water quality outcomes for the residual voids based on the PHREEQC modelling. The table compares overall behaviour, identifies any parameters that fall outside the EA groundwater containment limits and highlights the dominant long term trends in salinity and major ions. Mineral precipitation outcomes are also included, as these reactions help explain the geochemical controls operating within each void lake.

The results also show a clear relationship between groundwater flux and salinity, where voids characterised by net groundwater outflow (Section 6.2.1) exhibit consistently low TDS, while voids dominated by net groundwater inflow develop moderate to very high TDS due to ongoing solute loading and evaporative concentration.

TABLE 8-19 SUMMARY OF RESIDUAL VOID WATER QUALITY OUTCOMES (C RESULTS ONLY)

Residual Void	Overall Water Quality	Parameters Outside Range	Long Term Trends	Mineral Precipitation
Bonnie Doon	Water quality remains stable due to net groundwater outflow with low salinity (TDS: 120-136 mg/L) and neutral to slightly alkaline pH (pH: 7.88-8.38).	None.	All parameters remain stable.	Negligible mass.
Mimosa/ Besgrove	Water quality is dominated by saline groundwater inflow and evaporative concentration, with pH from mildly acidic to neutral (pH: 5.55-7.96) and very high salinity (TDS: 2,590-174,000 mg/L).	TDS, As and Sb are outside range.	TDS, major ions and metals increase continuously with no stabilisation; Al and Fe remain low under C conditions.	Total mineral mass less than 1.5% of median lake water mass.
Ramp 30	Water quality remains stable due to net groundwater outflow with low salinity (TDS: 138-2,830 mg/L) and near-neutral to slightly alkaline pH (pH: 7.18-8.08), and fluctuations due to periodic drying and refilling.	None.	Concentrations fluctuate with drying cycles but do not show long-term accumulation under C conditions.	Negligible mass (~0.01% of median water mass).
Ramp 74	Water quality remains stable due to net groundwater outflow with very low salinity (TDS: 112-124 mg/L) and slightly alkaline pH (pH: 7.70-7.90).	None.	All parameters remain stable.	Negligible mass.
Ramp 8	Significant increase in salinity (TDS: 13,300-127,000 mg/L) due to small lake volume, evaporative concentration and solute loading. pH is around neutral (pH: 7.02-7.76).	TDS and SO_4 are outside range.	TDS and major ions increase continuously with no stabilisation.	Total mineral mass less than 1% of median lake water mass.
Deep Creek	Water quality shows sustained increases in salinity and major ions (TDS: 254-129,000 mg/L) with near-neutral pH (pH: 6.99-8.26).	TDS, SO_4 and Sb are outside range.	TDS and major ions increase continuously with no stabilisation.	Total mineral mass approximately 1% of median lake water mass.
Kenmare	Water quality shows a clear long term increase in salinity (TDS: 7,980-80,900 mg/L). pH is weakly alkaline (pH: 7.26-7.84).	TDS and SO_4 are outside range.	TDS and major ions increase continuously with no stabilisation.	Negligible mass.

Residual Void	Overall Water Quality	Parameters Outside Range	Long Term Trends	Mineral Precipitation
Togara/North Marshmead	Water quality shows sustained increases in salinity (TDS: 10,900-104,000 mg/L). pH remains near neutral (pH: 7.14-7.78).	TDS and SO_4 are outside range.	TDS, SO_4, F and Mn increase with no indication of stabilisation.	Negligible mass.
Comet Downs East	TDS and major ions increase over time with no equilibration (TDS: 10,900-104,000 mg/L). pH remains near neutral (pH: 7.14-7.78).	TDS and SO_4 are outside range.	TDS and major ions increase continuously with no stabilisation.	Negligible mass.

8.4 LIMNOLOGY ASSESSMENT

Numerical limnology modelling was undertaken using R and SILO climate data and water balance modelling results for Mimosa/Besgrove (Section 6.2) over the simulation period.

The Mimosa/Besgrove void was selected for detailed limnological modelling as it represents a residual void expected to form a substantial residual void lake, with a final water level of approximately 85.5 mAHD and a mean water depth of around 55 m.

The void lake was assessed for thermal, salinity and density stratification, and the temporal evolution of these properties within the water column over 100 years post-closure.

Given the consistent climatic and hydrogeological setting across BWM, the results provide a suitable analogue for understanding the general limnological behaviour of the other voids, noting that stratification and redox cycling will be less pronounced in the shallower systems.

8.4.1 GENERAL LAKE MODEL SETTINGS

This section describes the key properties of the GLM modelling. It is provided here to provide context and explain the results in the sections below. More detailed information can be found in ERM (2026).

Note that the initial model lake level was set at a depth of 5 m (~29 mAHD) as GLM requires a starting lake level to allow model simulation to occur.

8.4.1.1 GLM SETUP

The GLM setup defines the numerical structure and mixing processes used to simulate stratification and water column dynamics. The model was configured with a high vertical resolution and fixed layer thickness constraints (0.5 m), which ensured a consistently fine discretisation of the water column and allowed detailed representation of thermal and salinity gradients. A minimum layer volume threshold (1.0 m^3) was specified to maintain numerical stability.

Water density was calculated using the standard GLM equation of state, which accounts for temperature and salinity effects on density stratification.

8.4.1.2 MIXING CONFIGURATION

The mixing configuration controls how energy inputs drive vertical exchange within the lake. Surface mixing was enabled, with contributions from convective overturn, wind-driven stirring, shear production, background turbulence and Kelvin-Helmholtz instabilities. These coefficients collectively regulate the strength of mixing within the surface and metalimnetic layers.

Deep mixing was parameterised using scheme 2, which is a stability-based formulation (Weinstock-type approach). In this approach, mixing is generated by shear-driven turbulence but is dampened by density stratification, such that diffusivity decreases with increasing stratification strength and increases where shear or instabilities weaken the density gradient.

The hypolimnetic mixing coefficient was set to a relatively low value (0.05), which is below typical ranges reported for natural lakes (~0.3-0.7). This parameterisation reflects the expected physical behaviour of deep pit lakes, where the hypolimnion is strongly density-stratified and largely decoupled from surface forcing. In such systems, wind-driven mixing energy is dissipated in the upper water column, and vertical exchange across the thermocline

is limited by strong thermal and salinity gradients. As a result, hypolimnetic mixing was dominated by weak, diffusion-controlled processes that are several orders of magnitude lower than surface mixing rates. It represents a conservative and physically realistic assumption, promoting persistent stratification and limiting vertical redistribution of heat and solutes in the deeper water column, consistent with the expected behaviour of saline, groundwater-influenced pit lakes (Rimmer et al., 2006).

A molecular diffusivity term (1.0×10^{-5} m^2/s) was also applied, representing baseline diffusive transport of heat and solutes throughout the water column.

8.4.1.3 INFLOW PROPERTIES

The GLM inflow configuration defined two inflow sources: Surface runoff and groundwater, with distinct physical representations that influence mixing and stratification within the lake. Note that direct rainfall was handled in the meteorological input file.

Runoff was treated as a surface inflow, entering at the lake surface with relatively low entrainment, such that it primarily affects the upper water column with limited mixing into deeper layers. Groundwater inflow was simulated as a submerged inflow, entering below the surface. Both inflows were oriented perpendicular to the shoreline and routed over a gently sloping bed with moderate drag, which governs the movement of density-driven flows along the lake bed.

Time series inputs for flow, temperature and salinity were read from external files and scaled to consistent units for the model. Collectively, these settings control the delivery of heat and solutes to the lake, with runoff primarily influencing near-surface conditions and submerged groundwater inflows contributing to subsurface mixing and the evolution of salinity and density structure.

8.4.2 LIMNOLOGY RESULTS

This section examines the development of limnological conditions over time within the Mimosa/Besgrove residual void lake over the simulation period. The analysis was undertaken to understand how temperature, salinity and density stratification behaviours evolve over time, and to determine whether persistent stratification, seasonal mixing or long-term stability is likely to occur.

The primary aim of this assessment is to characterise the timing and progression of key physical processes that influence water column behaviour. This includes the onset and breakdown of stratification, the establishment of seasonal overturn and the approach toward long-term equilibrium.

Figure 8-2 presents the thermal, salinity and density stratification over the entire simulation period.

Note that the stratification plots for temperature, salinity, and density represent the modelled conditions from lake surface to the bottom of the lake. It is important to interpret the y-axis as lake level above the lake bed (m), rather than elevation (mAHD) or depth below surface.

Thermal Stratification

The lake develops seasonal thermal stratification throughout the simulation period. Surface waters warm to above 25-35°C during summer and cool down during winter (15-20°C). As

shown in Figure 8-3, the water column mixes fully each winter, and as the lake level increases due to influx of groundwater, rainfall and runoff, there is a clear thermocline forming each summer as the lake fails to fully mix.

The thermocline generally forms at a depth of 10-15 m, with minor variations as surface water runoff and groundwater inflows enters the lake. Surface runoff enters at the lake surface at approximately ambient air temperature and therefore primarily influences the upper water column. In contrast, groundwater inflows enter below the surface along the pit walls and benches as submerged inflows. Depending on their density relative to the receiving water, these inflows can remain at depth or intrude at intermediate levels within the water column, thereby modifying the vertical density structure and influencing the depth and strength of the thermocline. This behaviour is reflected in Figure 8-3, which shows persistent seasonal thermal stratification with a stable thermocline despite increasing lake levels over time, indicating that inflows are not sufficiently energetic or dense to disrupt seasonal stratification.

The results indicate that rainfall variability has limited effect on the lake's temperature profile compared to other factors, such as regional weather patterns and seasonal solar heating.

Salinity Stratification

Salinity increases progressively throughout the 100-year simulation period, reflecting the combined influence of saline groundwater inflows and evaporative concentration.

An initial weak halocline is shown in Figure 8-4 , however this weakens further as the lake deepens and mixing occurs, resulting in full vertical mixing by approximately 20 years.

There is a consistent pattern in the model results showing reduction of lake salinity for a short period whenever there is an increase in lake level due to significant rainfall events. The low salinity rain and subsequent runoff temporarily decreases the lake salinity and creates a weak halocline.

After ~25 years, the water column remains well mixed, with salinity increasing gradually and uniformly across all depths. By year 100, and a lake depth of ~60 m, salinity has increased to 15 g/L and does not show any indications of stabilising. The model results indicate limited potential for long-term salinity stratification, with the lake tending to maintain a vertically homogeneous salinity profile over the long term.

Density Stratification

Density stratification persists throughout the simulation, driven primarily by temperature, with salinity playing a secondary role where vertical gradients are present rather than being uniformly distributed through the water column.

Density differences between surface and deep waters increase steadily, promoting long-term stability of the density gradient and limited deep mixing. The seasonal thermal mixing events during the winter months temporarily reduce stratification and allow partial homogenization of the upper and mid-depth layers, although complete and sustained mixing is not achieved.

Summary

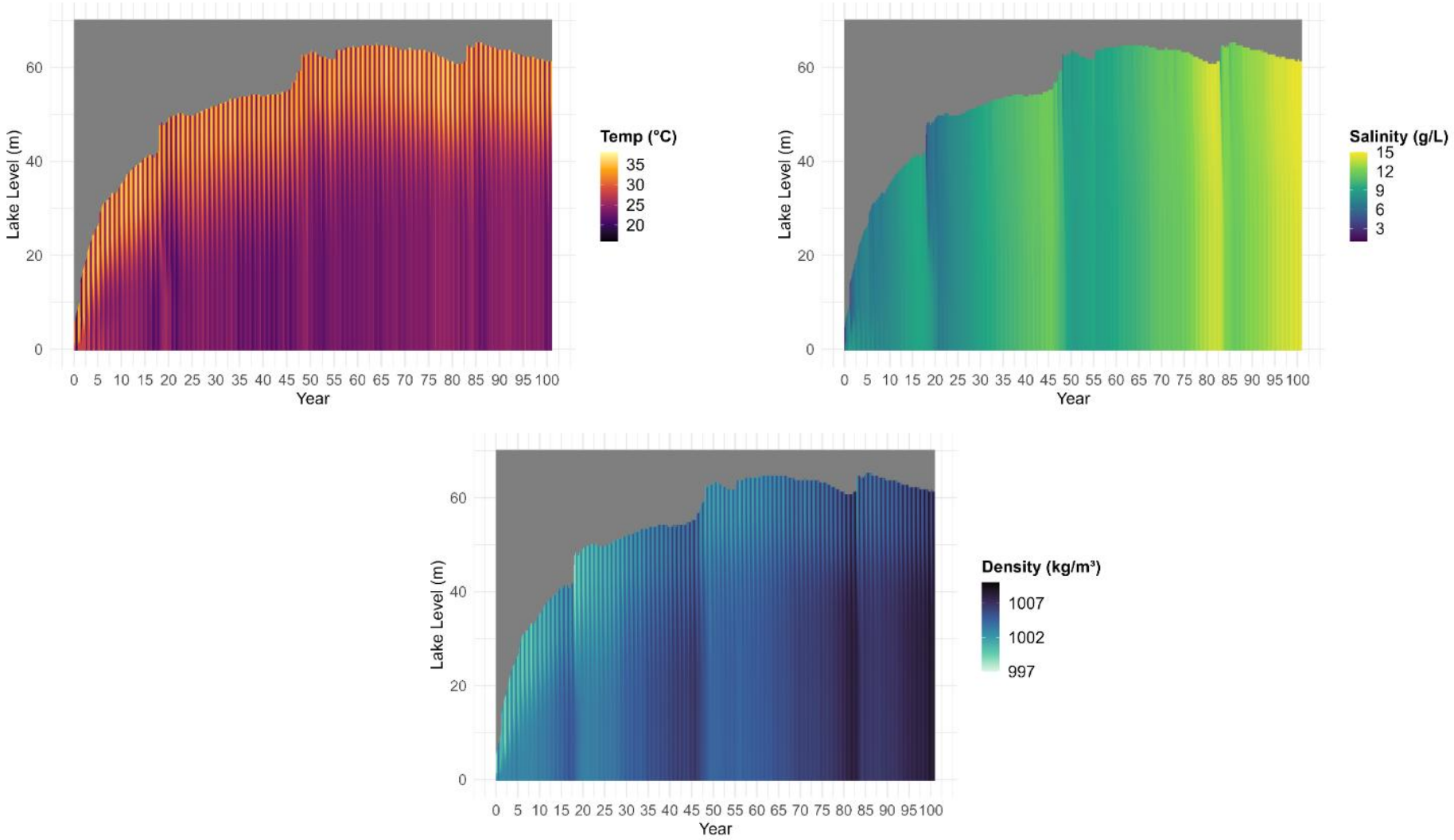
Overall, thermal effects exert the dominant control on short-term stratification, with surface heating generating strong seasonal density contrasts. Over time, salinity accumulation increasingly reinforces the density gradient, contributing to a progressive strengthening of

stratification rather than a stable or constant condition. As a result, Mimosa/Besgrove residual void lake limnology is expected to continue to evolve throughout the modelled period, with stratification becoming more persistent and resistant to complete mixing. While this trend is evident within the simulation timeframe, the long-term extent of strengthening and whether a steady state is ultimately reached beyond the model period remains uncertain.

Throughout the climatic period, rainfall intensity and inflow regime influence the magnitude and variability of stratification; however, these factors do not override the overall trend of increasing density-driven stability and limited deep mixing.

8.4.2.2 LIMNOLOGY EVOLUTION DURING SIGNIFICANT DECADES

Figure 8-3, Figure 8-4 and Figure 8-5 present temperature, salinity and density stratification results during ‘significant decades’ to illustrate the representative depth-dependent trends in temperature, salinity and density over time.



Note: Stratification profiles for temperature, salinity and density visualize the entire water column. While the y-axis indicates lake elevation measured upward from the lake bed (0 m), the uppermost edge of the plotted data physically represents the lake surface.

FIGURE 8-2 THERMAL, SALINITY AND DENSITY STRATIFICATION OF MIMOSA/BESGROVE RESIDUAL VOID OVER 100 YEARS

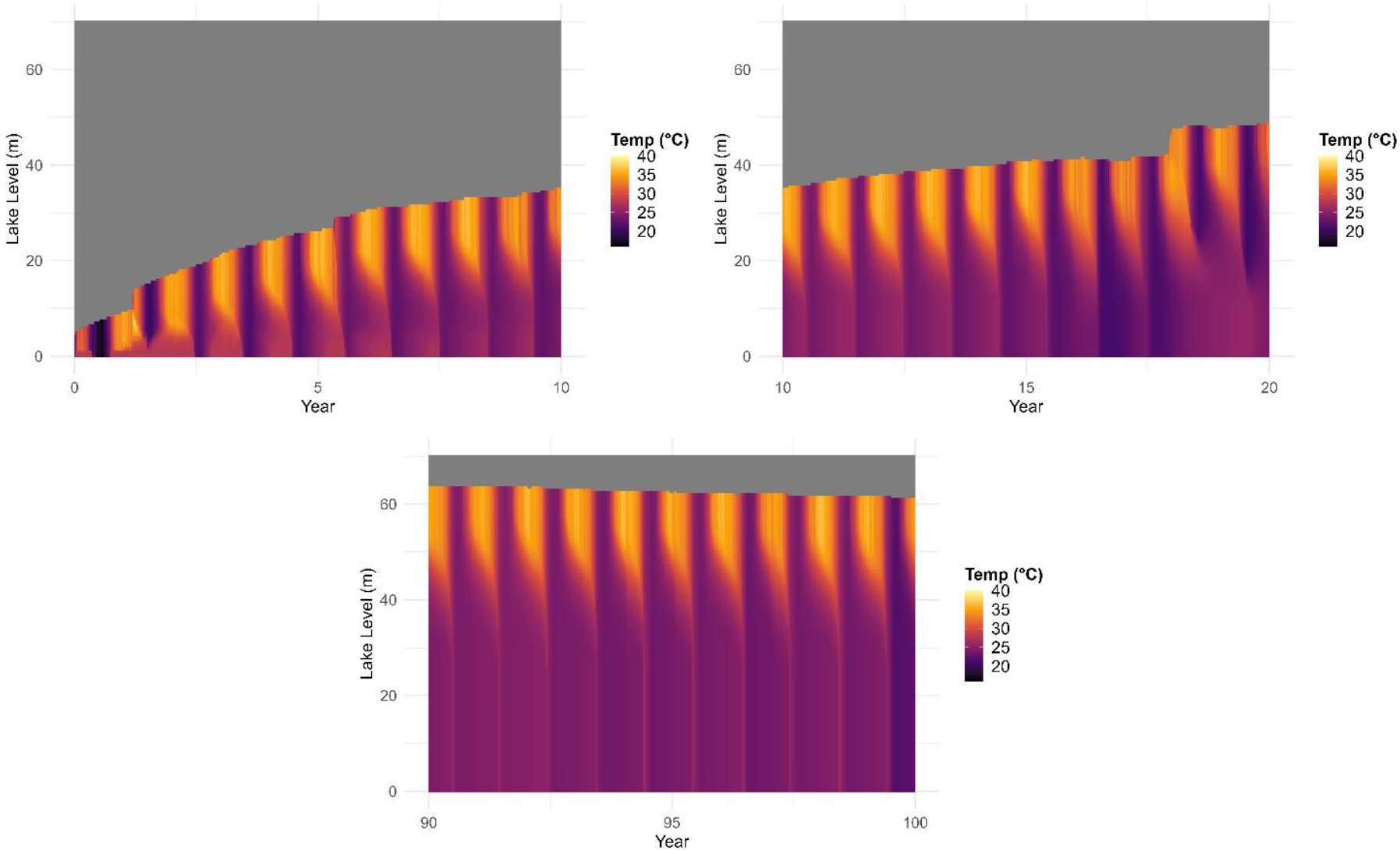


FIGURE 8-3 MIMOSA/BESGROVE THERMAL STRATIFICATION OVER SIGNIFICANT DECADES

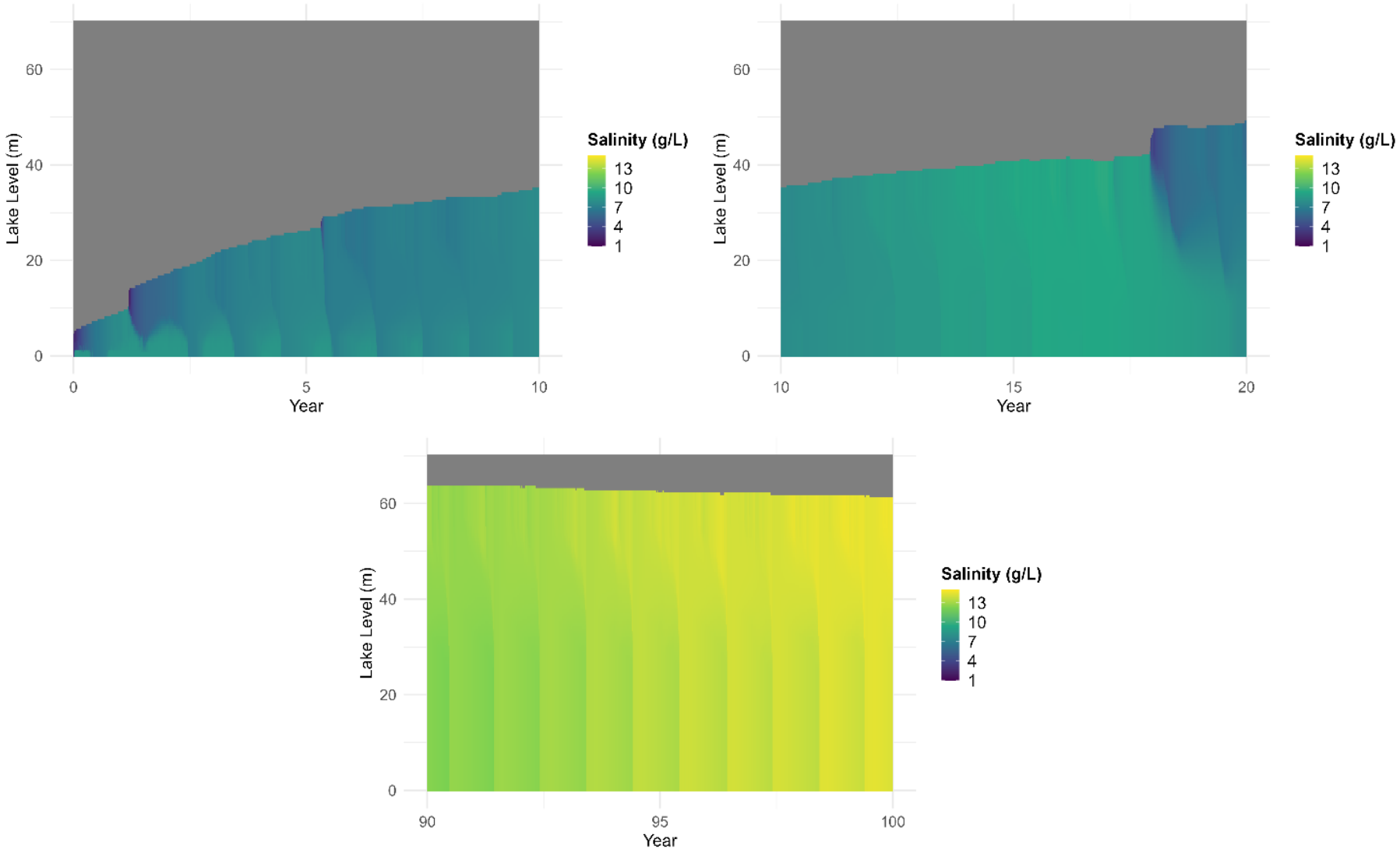


FIGURE 8-4 MIMOSA/BESGROVE SALINITY STRATIFICATION OVER SIGNIFICANT DECADES

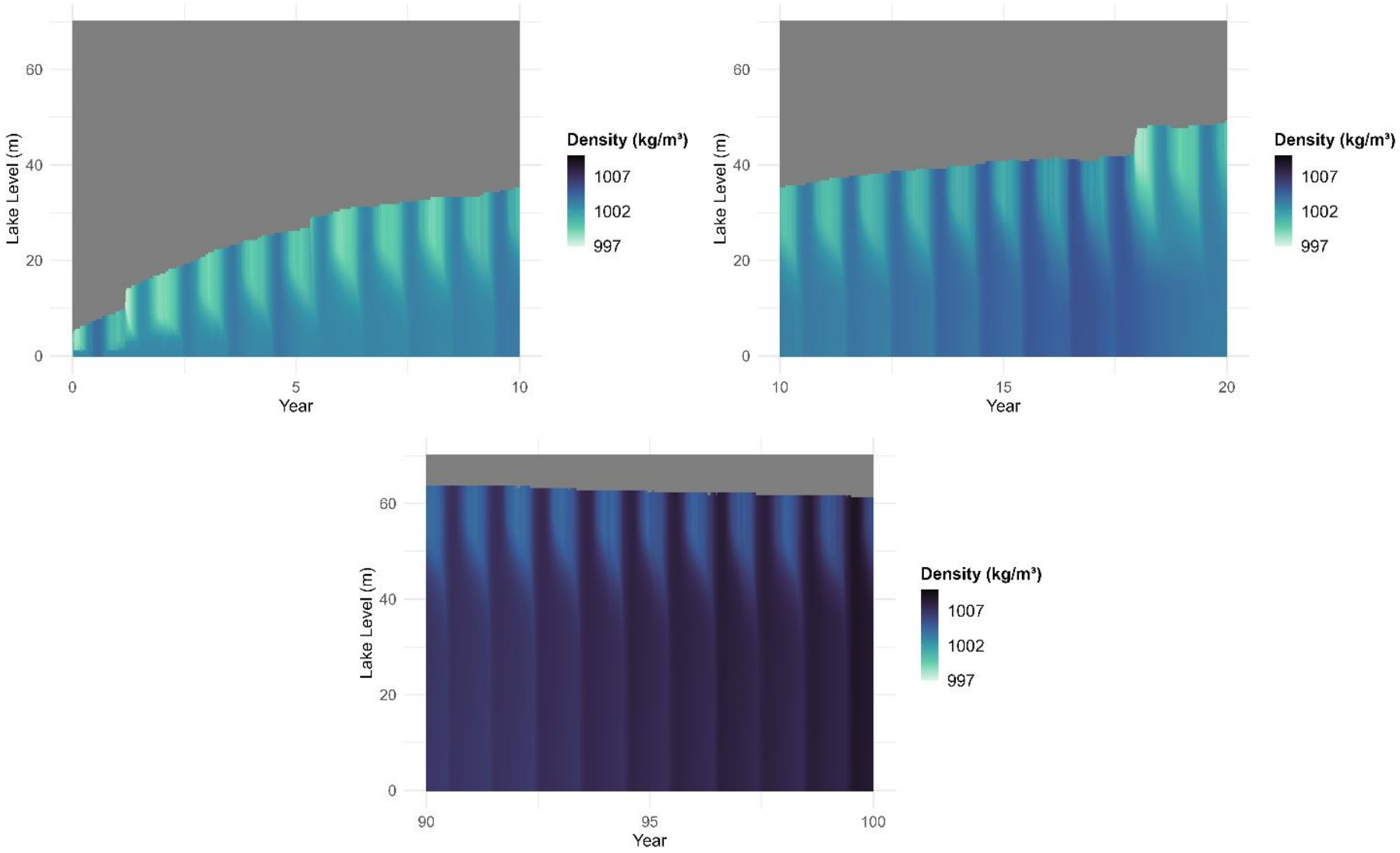


FIGURE 8-5 MIMOSA/BESGROVE DENSITY STRATIFICATION OVER SIGNIFICANT DECADES

8.4.2.3 TEMPORAL RESULTS SUMMARY

Table 8-20 summarises the simulated temporal variations across the 100-year simulation period during significant decades, representing early filling, mid-term transition and long-term equilibrium stages of pit lake development. Key observations include:

- Thermal behaviour remains consistently monomictic throughout the simulation, characterised by strong seasonal stratification and near-complete winter overturn; thermocline depth (~10-15 m) and overall thermal structure remain stable, with only short-lived disruptions associated with rapid lake level increases;
- Salinity progressively increases over time but becomes vertically uniform after ~20 years due to regular strong seasonal mixing, indicating that evaporative concentration drives long-term salinity trends rather than persistent salinity stratification; and
- Density stratification is strongest during early filling due to combined temperature and salinity gradients, but weakens over time as salinity becomes homogenised, resulting in density structure being increasingly dominated by seasonal thermal stratification rather than sustained salinity layering.

TABLE 8-20 SUMMARY OF MIMOSA/BESGROVE LIMNOLOGY RESULTS – TEMPORAL VARIATIONS

Aspect	Significant Decade	Results Summary
Thermal	Years 0-10	• Strong, seasonal thermal stratification forms each summer. A thermocline appears at around 15 m deep during the warmer months each year. • Each winter, the water column mixes fully, showing complete overturn.
	Years 10-20	• The same seasonal pattern continues, but the gradient becomes more consistent and slightly deeper. • Surface heating remains strong, but cooling penetrates deeper, indicating annual monomictic cycling during the winter months (one main mixing period per year). • Mixing cycle disruption occur around year 18, where a significant rainfall event rapidly increases the lake level from 40 to 48 m. This causes thermal stratification over several years as the water column fails to mix afterwards.
	Years 90-100	• Surface warming and winter mixing persist. • No evidence of long-term thermal isolation or stratification. • The lake behaves as a monomictic system with recurring seasonal stratification that fully mixes each winter. • Deep temperature remains steady (~16-21°C).
Salinity	Years 0-10	• Strong stratification develops immediately, with high salinity accumulating at lower depths due to saline groundwater inflow. • The lake becomes progressively saline as the lake level increases. • Mixing instabilities occur at Year 2 and 6, similar to lake temperature. Rising lake levels cause low salinity waters to float at surface level. Mixing cycle restabilises shortly after.
	Years 10-20	• The salinity gradient gradually increases. • Colours become nearly uniform from surface to bottom, i.e. clear evidence of complete vertical mixing. • Mixing cycle disruption occurs at year 18 with low salinity waters entering the lake as rainfall and runoff. Mixing cycle restabilises shortly after.
	Years 90-100	• Lake salinity progressively increases over time. • The water column shows uniform salinity at all depths (green to yellow shading ~13-14 g/L). • Lake salinity is recorded at 14.5 g/L at the end of simulation period. • No evidence of stratification or layering.

Aspect	Significant Decade	Results Summary
Density	Years 0-10	• Clear density stratification develops during early filling. • Significant stratification occurs at year 2 due to lake volume influx. Density stratification trend reverts back to normal shortly after. • The upper layer (teal-green) is less dense, forming a distinct two-layer system.
	Years 10-20	• The vertical density gradient weakens but remains visible, with surface and mid-depth layers mixing each winter. • Mixing cycle disruption occur at year 18, decreasing density levels from surface to 10 m. Density below 25 m did not show any significant changes despite the lake volume influx and instabilities. • The system undergoes seasonal overturn, with mixing extending to near the bottom each winter but not achieving complete full-depth mixing.
	Years 90-100	• Density increases and is nearly uniform through the column, with only minor differences between surface and bottom waters. • Seasonal density fluctuations occur in the upper 20 m, consistent with annual thermal mixing. • The system exhibits stable monomictic behaviour; nearly full mixing each winter, with a weak residual gradient as a result of more dense water in the bottom 40 m.

9. RESIDUAL VOID MANAGEMENT

This section outlines proposed monitoring and management measures for the residual voids. It ensures that residual risks are controlled post-closure, as required under the PRCP framework.

Specifically, this section contains strategies to address:

- *Monitoring during construction through supervision, verification and auditing of engineering works;*
- *Development and use of 'as built' profiles to assess consistency with design surfaces;*
- *Comparison of key earthworks criteria (e.g. compaction, settlement) against design specifications, with rectification of any shortcomings;*
- *Post-construction assessment of landform stability through visual inspection and survey; and*
- *Documentation of exclusion measures (if applicable) as part of ongoing post-closure management.*

The residual voids at BWM are proposed to remain as permanent features post-closure. In general, potential long-term risks associated with residual voids include water quality degradation, geotechnical instability and interaction with surrounding groundwater or surface water systems. These risks have to be managed through appropriate design measures, long-term monitoring and adaptive management planning.

Most residual voids act as groundwater sinks (Section 4). The flows from the four residual voids that have net outward fluxes (i.e. Bonnie Doon, Stewarton South, Ramp 30 and Ramp 74) are drawn to the neighbouring voids with lake levels at lower elevations rather than away from the mining area.

Flood modelling (Section 5) indicates that residual voids are either located outside mapped floodplains or are protected by the final landform configuration. All residual voids are predicted to be protected from floodwater ingress during the 0.1% AEP design event under final landform conditions. Modelling that includes the existing temporary Sirius Creek diversion shows a permanent creek diversion will provide flood immunity for the Ramp 74 residual void in a 0.1% AEP event.

The residual void water balance (Section 6) predicts no risk of water discharge or overtopping under a future climate scenario or extreme storm event. Freeboard ranges between 30-150 m for all residual voids.

Geotechnical modelling (Section 7) indicates satisfactory FoS values for all high-walls and end-walls can be achieved with appropriate set-backs used to delineate NUMA boundaries. FoS analysis of selected low walls has informed the NUMA boundaries on spoil dumps and contributed to a reduction in total NUMA footprint.

Geochemical modelling results (Section 8.2) predicts that five of the nine modelled residual void lakes will gradually become hypersaline due to evaporative concentration and inflow of saline groundwater: Mimosa/Besgrove, Ramp 8, Deep Creek, Kenmare, Togara/North Marshmead and Comet Downs East. All geochemically modelled hypersaline voids are groundwater sinks with inward hydraulic gradients and none of the voids have any risk of overtopping. Residual void lakes are not expected to pose a risk to surrounding groundwater environmental values.

Limnological modelling results (Section 8.4) of the Mimosa/Besgrove void lake over 100 years indicate that residual void lakes will exhibit persistent thermal stratification, characterised by recurring summer stratification and near-complete winter overturn (monomictic behaviour). Salinity stratification is not sustained over the long term, as regular seasonal mixing results in largely uniform salinity profiles despite progressive increases in overall salinity due to evaporative concentration and groundwater inputs. Density stratification is primarily thermally driven, with salinity contributing only where transient vertical gradients develop and reinforcing the density contrast rather than forming independent, stable chemical layering. Over time, increasing salinity may strengthen overall density gradients; however, stratification remains predominantly controlled by seasonal thermal processes.

Based on these findings, ongoing management requirements of the residual voids is expected to be minimal. A tailored monitoring program will be developed to confirm the stability of lake levels, water quality trends, void wall integrity over time and the condition of permanent creek diversions that provide flood immunity to the residual voids. Monitoring results will be reviewed periodically against closure performance criteria. If significant deviations are observed, adaptive management principles will be adopted and an adaptive management program will be developed closer to closure execution. Monitoring should also consider long-term salinity trends and potential density stratification behaviour within pit lakes where hypersaline conditions are predicted.

9.1 VOID REHABILITATION

Void rehabilitation at BWM will primarily involve shaping and stabilising pit walls to ensure long-term geotechnical stability and safe integration into the final landform. All final slopes have been designed in accordance with site-specific geotechnical investigations, and reshaped where necessary to meet minimum stability criteria.

The rehabilitation process will include:

- Completion of final earthworks to meet design surface levels and slope geometry;
- Construction QA/QC, including topographic validation against the final landform model;
- Erosion control measures (e.g. surface roughening, contour drains) where needed on areas of the low walls within the residual voids that have been assigned a PMLU;
- Installation of safety or exclusion infrastructure, such as fencing, bunding or signage where public access or fauna hazard is identified; and
- Documentation of the final constructed condition, including ‘as built’ survey data and photographic records.

9.1.1 LOW WALL REVEGETATION

The area and layout of the NUMAs for each residual void have been reviewed in line with *Management of Coal Mine Voids as Non-Use Management Areas*, published by the Queensland Mine Rehabilitation Commissioner. This guidance explains that voids approved under transitional arrangements may be retained as NUMAs under the EP Act. It also notes that some areas of a void, such as ramps or low walls, may be suitable for rehabilitation to stable condition and excluded from the NUMA footprint.

At BWM, the NUMA boundaries have been designed to maximise the extent of land that can be safely assigned a PMLU. All practicable areas where slope geometry, geotechnical stability and safety allow, are included in the PMLU footprint for future rehabilitation. Although some portions of the low wall may present as stable, active rehabilitation within the NUMA is not proposed due to access limitations, safety risks, and the geotechnical constraints inherent to void and adjacent landforms. Under the transitional provisions of the PRCP framework, rehabilitation is only required where it is safe, stable and practicable, and NUMA areas do not meet these criteria.

Vegetation establishment within the NUMA may occur through natural recruitment from the rehabilitated PMLU areas located above the NUMA boundary. This approach:

- Limits rehabilitation activities to landforms that can be safely accessed, constructed and maintained;
- Excludes NUMA low walls and pit floors from ground disturbing and revegetation works due to geotechnical and safety constraints; and
- Facilitates opportunity for natural recruitment from adjacent PMLU rehabilitation to contribute towards improved environmental outcomes within the NUMA.

Allows the PMLU rehabilitation areas above the residual voids to contribute towards long-term landform stability and minimisation of environmental harm void. The final NUMA and PMLU boundaries, including areas to be revegetated, are shown in Figure 9-1 (North) and Figure 9-2 (South).

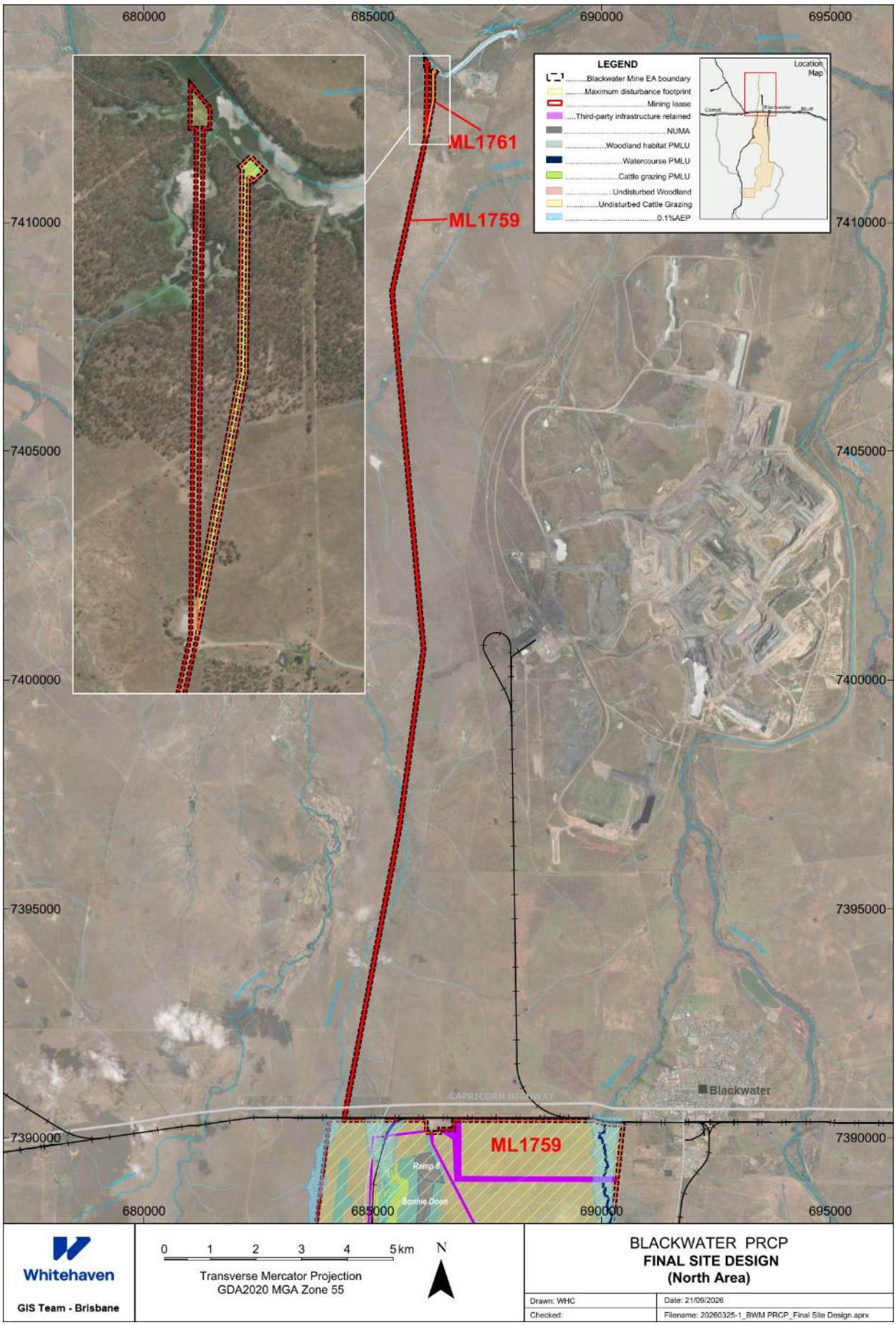


FIGURE 9-1 BWM NUMA AND PMLU AREAS (NORTH)

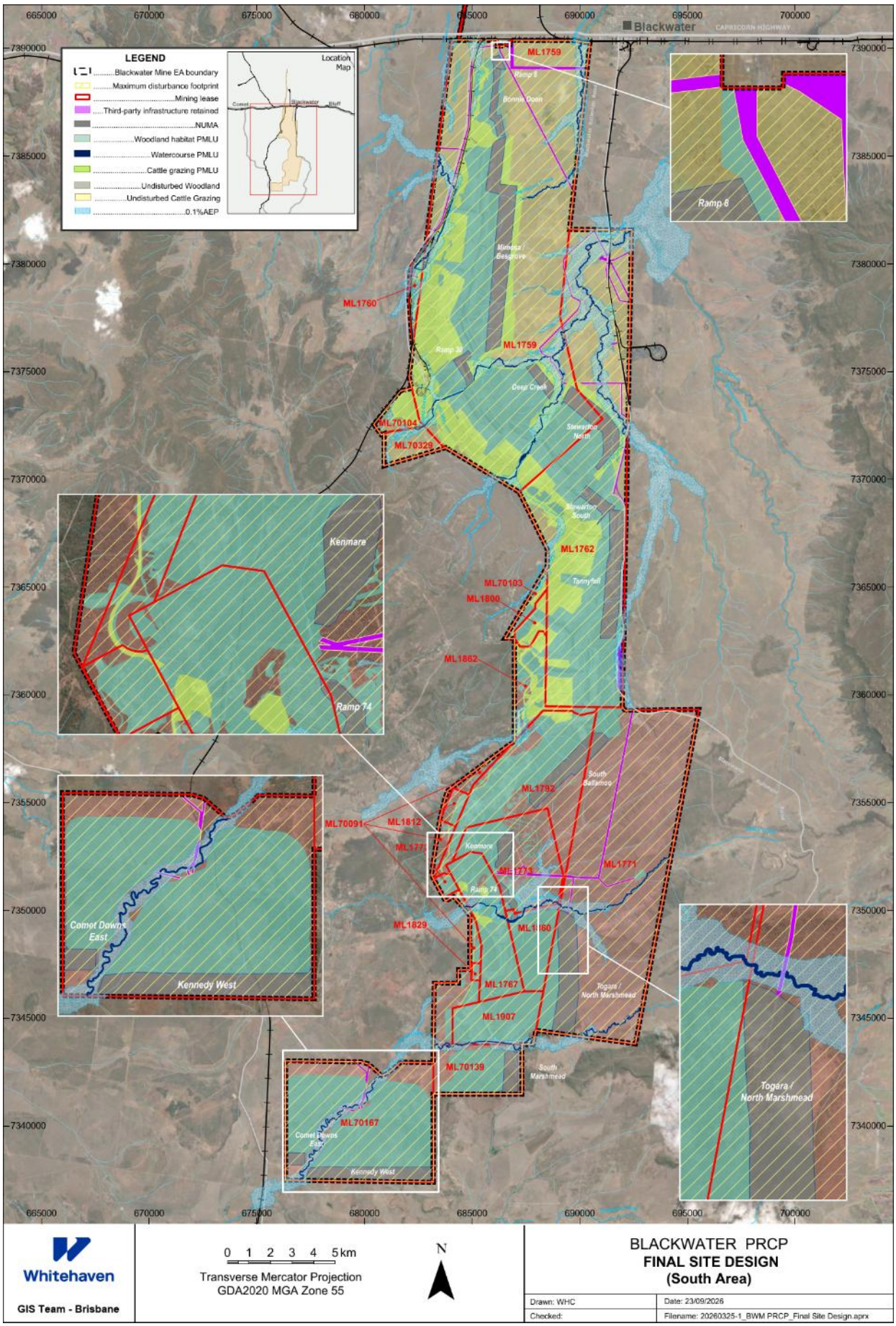


FIGURE 9-2 BWM NUMA AND PMLU AREAS (SOUTH)

9.2 MONITORING AND MANAGEMENT

A residual void monitoring program will be implemented post-closure, consistent with the site's overall rehabilitation monitoring framework.

Table 9-1 summarises the residual void monitoring program for Improvement Area (IA) 1 and IA 2 under the PRCP Schedule. The program is structured to demonstrate progressive achievement of the PRCP Management Milestones (MM):

- MM1 (structural stability);
- MM2 (cover system);
- MM3 (surface requirements); and
- MM4 (sufficient improvement).

Monitoring activities are designed to verify post-closure performance against model predictions, confirm compliance with these milestone criteria, and provide data to support adaptive management and certification by an appropriately qualified person (AQP).

TABLE 9-1 RESIDUAL VOIDS MONITORING PROGRAM

Monitoring Element	Description	Relevant PRCP Milestone(s)
Void water levels	• Automated or manual dip readings and groundwater bores to confirm modelled water balance and hydraulic sink behaviour. • Monitoring will verify predicted trends and confirm the void acts as a groundwater sink post-closure. • Data should be reviewed quarterly by the environmental team and certified by an AQP.	MM4.5-MM4.6
Water quality	• Periodic sampling and laboratory analysis to track salinity, pH, metals, major ions and other parameters relevant to closure performance and environmental harm criteria. • Results compared against model predictions and closure performance targets. • Bi-annual monitoring during the initial decade post-closure, then annual.	MM4.5-MM4.6
Slope and wall stability	• Visual inspections to confirm structural stability, erosion or slumping, and compliance with design FoS. • Inspections undertaken annually and after major rainfall events by a geotechnical engineer or AQP.	MM1.6-MM1.7
Cover Systems	• Periodic visual inspections to confirm differential settlement is not leading to erosion or impacting cover functionality. • Inspections undertaken annually and after major rainfall events by an AQP. • Periodic water level survey to verify minimum 1 m depth is maintained where water is used as a cover.	MM2.1 – MM2.2

Monitoring Element	Description	Relevant PRCP Milestone(s)
Safety bunds, fencing and signage	• Periodic inspection of bunds, fencing and safety signage to confirm integrity and continued effectiveness of exclusion controls in accordance with Australian Standards. • Includes annual maintenance and post-storm verification.	MM3.1-MM3.2, MM1.5 – 1.6 and MM4.4
Wildlife use and safety	• Visual and photographic monitoring to identify fauna interaction or hazard potential and guide mitigation measures. • Findings inform adaptive controls to ensure the NUMA remains safe to humans and fauna.	MM4.4
Adaptive management	• Engineering interventions-bench reshaping, erosion control, drainage improvements-plus model recalibration and revision of closure performance criteria or safety controls if monitoring shows deviation from predictions. • Actions should be implemented under AQP direction.	MM4.5-MM4.7
Certification and review	• All monitoring and inspection outcomes reviewed by an AQP to certify achievement of MM1-MM3 and confirm compliance with PRCP Schedule requirements.	MM4.8

If monitoring results show deviations from predicted trends (e.g. unexpected groundwater mounding, water quality degradation, wall instability, etc.), the following adaptive management responses may be considered:

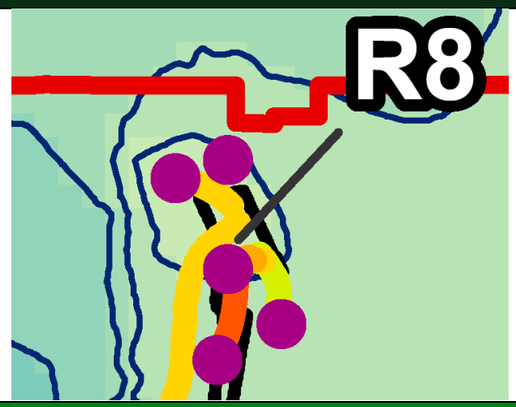
- Engineering interventions (e.g. bench reshaping, additional erosion control);
- Update of predictive models or assumptions;
- Recalibration of closure performance criteria; and
- Revision of exclusion or safety controls.

9.3 RESIDUAL VOID OVERVIEW TABLES

Table 9-2 through Table 9-16 summarise the results of the modelling and design work detailed in the above sections for the relevant residual voids at BWM. It contains the following information:

- Pit design parameters – Section 3;
- Hydrogeology and particle tracking – Section 4;
- Flooding risk – Section 5;
- Residual void lake water balance – Section 6;
- Geotechnical stability – Section 7; and
- Residual void lake geochemistry and limnology – Section 8.

TABLE 9-2 RAMP 8 SUMMARY TABLE

<table>
<tr><th colspan="6">Ramp 8</th></tr>
<tr><th colspan="6">Overview</th></tr>
<tr><th>End of Mining Cross-Section</th><th colspan="3">Final Landform Design</th><th colspan="2">Particle Tracking</th></tr>
<tr><td>N/A</td><td colspan="3">
</td><td colspan="2">
</td></tr>
<tr><th colspan="3">Design Parameters</th><th colspan="3">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th colspan="2">Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 650 m
Max. Width: 360 m
Max. Depth: 66 m
Surface area: 26 ha</td><td>Void crest/Spill Level: 188 mAHD
Indicative void floor: 109 mAHD</td><td>Highwall: ~84%
Low wall: ~51%</td><td>Natural: 33.7 ha
Spoil: 22.0 ha
Rehabilitated Spoil: 21.8 ha
<u>Total: 77.5 ha</u></td><td colspan="2">Spoil: +0.35 ML/day
Tailings: 0.0 ML/day
Natural Geology: +0.02 ML/day
Total GW Inflow: +0.37 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="3">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td colspan="2" rowspan="2">50° Ave Wall Angle:
• Average: 104 m;
• Range: 95-113 m; and
• 90%< 111 m.

60° Ave Wall Angle:
• Average: 99 m;
• Range: 91-96 m; and
• 90%< 94 m.</td><td>Mean: 146.5 mAHD
Max.: 148.7 mAHD</td><td>200 years</td><td>Groundwater sink</td><td>Min. Freeboard: 39.3 m
Does not spill</td></tr>
<tr><th>Post-Mining Flooding Risk</th><th colspan="3">Residual Void Lake Geochemistry</th></tr>
<tr><td>Outside 0.1% AEP design and PMF events.</td><td colspan="3">Near-neutral pH throughout.
Strongly hypersaline after ~200 years with a final TDS of 127 g/L after 935 years.
High concentrations of major ions, silicon and manganese.
Large amounts of precipitated mineral phases (dolomite, ferrihydrite, gypsum, chalcedony).
No observed geochemical equilibrium.</td></tr>
</table>

TABLE 9-3 BONNIE DOON SUMMARY TABLE

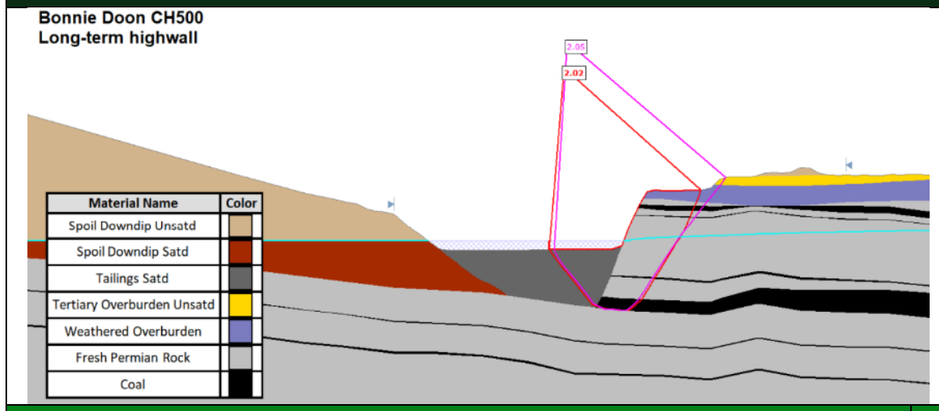
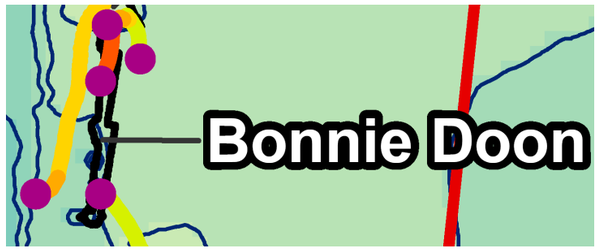
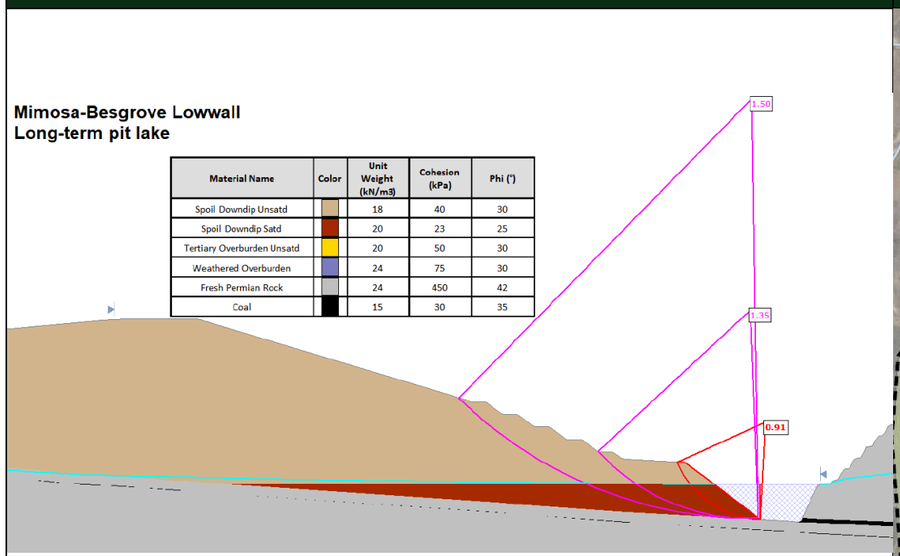
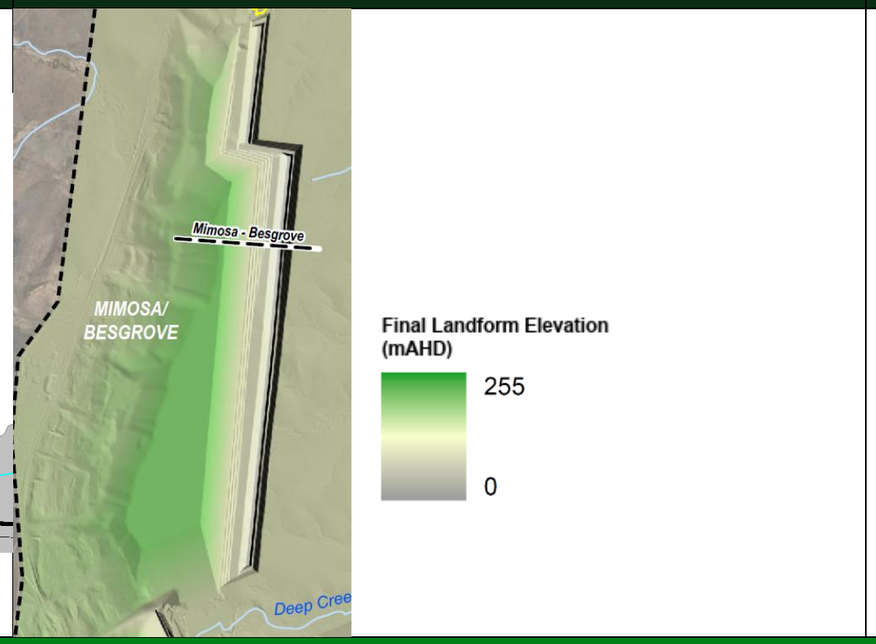
Bonnie Doon					
Overview					
End of Mining Cross-Section		**Final Landform Design**		**Particle Tracking**	
					
Design Parameters			**Hydrology**		
Indicative Dimensions	**Elevation**	**NUMA Slope Grades (overall)**	**Catchment Area**	**Equilibrium GW Inflow Rates**	
Max. Length: 3,000 m Max. Width: 250 m Max. Depth: 26 m Surface area: 105 ha	Void crest/Spill Level: 188 mAHD Indicative void floor: 150 mAHD	Highwall: 74% Low wall: ~55%	Natural: 98.1 ha Spoil: 84.1ha Rehabilitated Spoil: 184.4 ha Total: 366.6 ha	Spoil: -0.12 ML/day Tailings: -0.01 ML/day Natural Geology: -0.01 ML/day Total GW Inflow: -0.14 ML/day	
Geotechnical Stability			**Water Balance**		
Set-back Distance from Highwall/Endwalls			**Equilibrium Water Level**	**Time to Equilibrium Level**	**Outflows**
FoS: 2.02 Set-back from wall toe to FoS>1.5: Crest			Cycles between dry and a maximum of: 159.8 mAHD	150 years	Groundwater Source Min. Freeboard: 28.2 m
			Post-Mining Flooding Risk	**Residual Void Lake Geochemistry**	
			Outside 0.1% AEP design and PMF events.	Weakly alkaline pH (~8) throughout. No hypersalinity due to net groundwater outflow. Low concentrations of solutes and no values outside groundwater trigger levels. Negligible amounts of precipitated mineral phases. Geochemical equilibrium established almost immediately.	

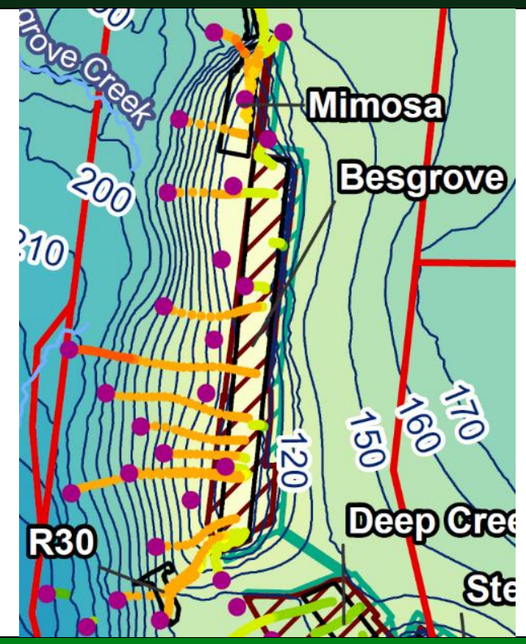
TABLE 9-4 MIMOSA/BESGROVE SUMMARY TABLE

Mimosa/Besgrove		
Overview		
End of Mining Cross-Section	**Final Landform Design**	**Particle Tracking**



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (°)
Spoil Downdip Unsatd		18	40	30
Spoil Downdip Satd		20	23	25
Tertiary Overburden Unsatd		20	50	30
Weathered Overburden		24	75	30
Fresh Permian Rock		24	450	42
Coal		15	30	35





Design Parameters			Hydrology	
Indicative Dimensions	**Elevation**	**NUMA Slope Grades (overall)**	**Catchment Area**	**Equilibrium GW Inflow Rates**
Max. Length: 10,100 m Max. Width: 650 m Max. Depth: 176 m Surface area: 701 ha	Void crest/Spill Level: 200 mAHD Indicative void floor: 24 mAHD	Highwall: ~90% Low wall: ~32%	Natural: 39.1 ha Spoil: 596.5 ha Rehabilitated Spoil: 622.4 ha Total: 1,258 ha	Spoil: +2.38 ML/day Tailings: 0 ML/day Natural Geology: +0.02 ML/day Total GW Inflow: +2.40 ML/day

Geotechnical Stability		Water Balance			
Set-back Distance from Highwall/Endwalls		**Equilibrium Water Level**	**Time to Equilibrium Level**	**Outflows**	
		Mean: 83.7 mAHD Max.: 88.1 mAHD	200 years	Groundwater sink	Min. Freeboard: 111.9 m Does not spill
		Post-Mining Flooding Risk	**Residual Void Lake Geochemistry & Limnology**		
50° Ave Wall Angle: • Average: 180 m; • Range: 120-248 m; and • 90%< 236 m.	60° Ave Wall Angle: • Average: 176 m; • Range: 102-249 m; and • 90%< 236 m.	Outside 0.1% AEP design and PMF events.	Near-neutral pH throughout. Predicted to become hypersaline after ~200 years with a final TDS of 174 g/L after 967 years. Elevated concentrations of major ions, arsenic, chromium, antimony, silicon and manganese. Large amounts of precipitated mineral phases (gypsum, dolomite, lepidocrocite, pyrolusite, barite, diaspore). No observed geochemical equilibrium. With regards to limnology, thermal stratification is the dominant control on water column structure, with surface heating generating strong seasonal density contrasts and recurring summer stratification followed by winter overturn (monomictic behaviour). Salinity stratification is not sustained, as seasonal mixing produces largely uniform salinity profiles despite ongoing salinity increases. Consequently, density stratification is primarily thermally driven, with salinity contributing to density gradients where present and progressively reinforcing stratification over time rather than forming persistent chemical layering.		

TABLE 9-5 DEEP CREEK SUMMARY TABLE

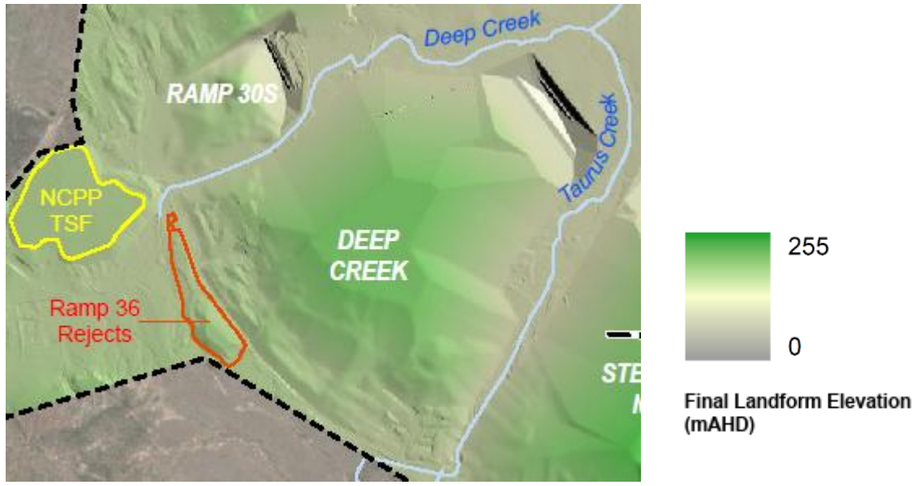
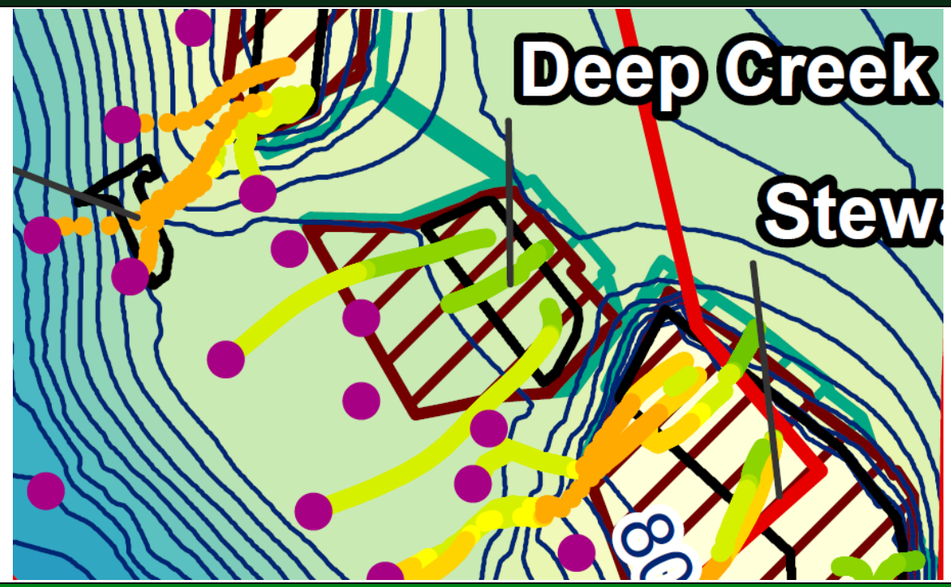
<table>
<tr><th colspan="6">Deep Creek</th></tr>
<tr><th colspan="6">Overview</th></tr>
<tr><th>End of Mining Cross-Section</th><th colspan="3">Final Landform Design</th><th colspan="2">Particle Tracking</th></tr>
<tr><td>N/A</td><td colspan="3">
</td><td colspan="2">
</td></tr>
<tr><th colspan="3">Design Parameters</th><th colspan="3">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th colspan="2">Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 1,600 m
Max. Width: 600 m
Max. Depth: 150 m
Surface area: 102 ha</td><td>Void crest/Spill Level: 202 mAHD
Indicative void floor: 52 mAHD</td><td>Highwall: ~93%
Low wall: ~51%</td><td>Natural: 0.0 ha
Spoil: 52.9 ha
Rehabilitated Spoil: 167.3 ha
<u>Total: 220.2 ha</u></td><td colspan="2">Spoil: +0.79 ML/day
Tailings: 0.0 ML/day
Natural Geology: 0.0 ML/day
Total GW Inflow: +0.79 ML/day</td></tr>
<tr><th colspan="2">Geotechnical Stability</th><th colspan="4">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td>50° Ave Wall Angle:
• Average: 146 m;
• Range: 121-171 m; and
• 90%< 169 m.</td><td>60° Ave Wall Angle:
• Average: 136 m;
• Range: 98-180 m; and
• 90%< 175 m.</td><td>Mean: 134.5 mAHD
Max.: 137.1 mAHD</td><td>300 years</td><td>Groundwater sink</td><td>Min. Freeboard: 64.9 m
Does not spill</td></tr>
<tr><td colspan="2" rowspan="2"></td><th>Post-Mining Flooding Risk</th><th colspan="3">Residual Void Lake Geochemistry</th></tr>
<tr><td>Outside 0.1% AEP event
Partially within PMF extent
(Taurus Creek)</td><td colspan="3">Initially weakly alkaline pH, becoming progressively neutral over time.
Becomes hypersaline after ~300 years with a final TDS of 129 g/L after 935 years.
High concentrations of major ions, silicon, chromium, nickel, antimony and zinc.
Large amounts of precipitated mineral phases (gypsum, dolomite, lepidocrocite, pyrolusite, barite, diaspore).
No observed geochemical equilibrium.</td></tr>
</table>

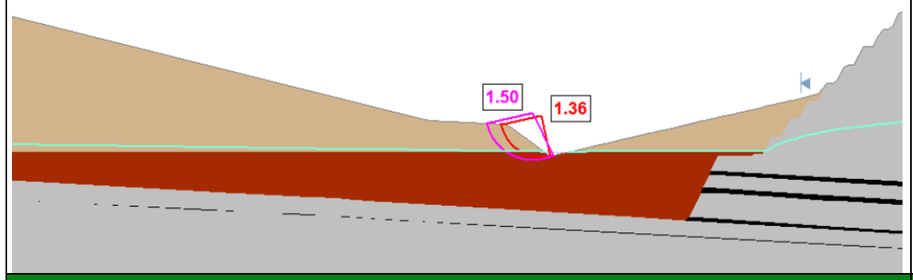
TABLE 9-6 STEWARTON NORTH SUMMARY TABLE

Stewarton North

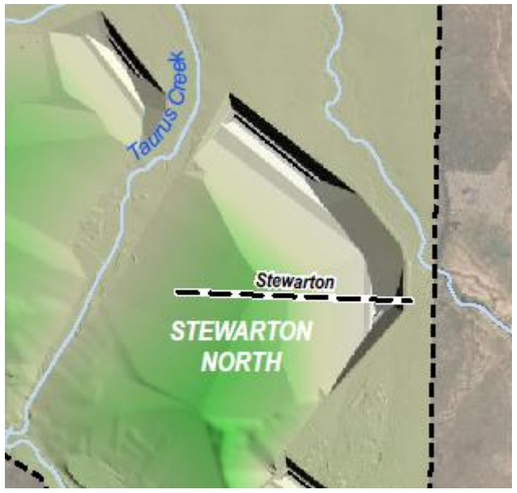
Overview

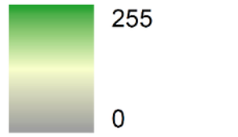
End of Mining Cross-Section

Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (°)
Spoil Downdip Unsatd		18	40	30
Spoil Downdip Satd		20	23	25
Tertiary Overburden Unsatd		20	50	30
Weathered Overburden		24	75	30
Fresh Permian Rock		24	450	42
Coal		15	30	35



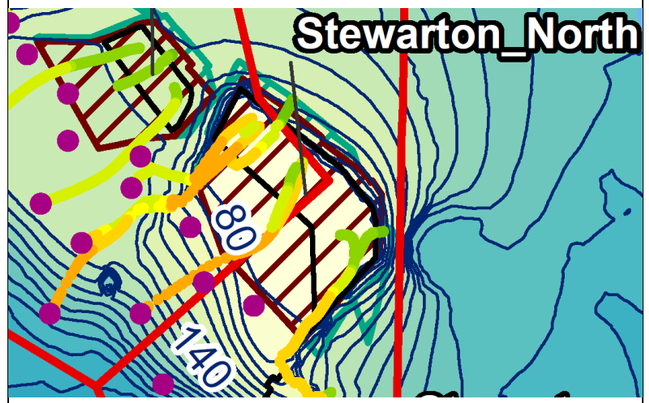
Final Landform Design





Final Landform Elevation (mAHD)

Particle Tracking



Design Parameters

Indicative Dimensions	Elevation	NUMA Slope Grades (overall)
Max. Length: 3,700 m Max. Width: 800 m Max. Depth: 208 m Surface area: 334 ha	Void crest/Spill Level: 204 mAHD Indicative void floor: -4 mAHD	Highwall: ~97% Low wall: ~36%

Hydrology

Catchment Area	Equilibrium GW Inflow Rates
Natural: 0.0 ha Spoil: 195.2 ha Rehabilitated Spoil: 678.1 ha Total: 873.3 ha	Spoil: +1.23 ML/day Tailings: 0.0 ML/day Natural Geology: +0.05 ML/day Total GW Inflow: +1.28 ML/day

Geotechnical Stability

Set-back Distance from Highwall/Endwalls	
50° Ave Wall Angle: • Average: 207 m; • Range: 107-295 m; and • 90%< 290 m.	60° Ave Wall Angle: • Average: 201 m; • Range: 89-298 m; and • 90%< 293 m.

Water Balance

Equilibrium Water Level	Time to Equilibrium Level	Outflows	
Mean: 74.0 mAHD Max.: 78.5 mAHD	200 years	Groundwater sink	Min. Freeboard: 125.5 m Does not spill

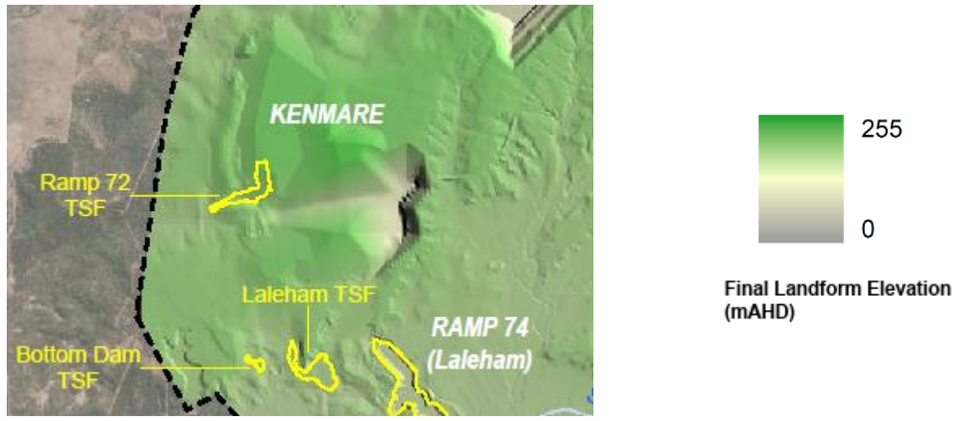
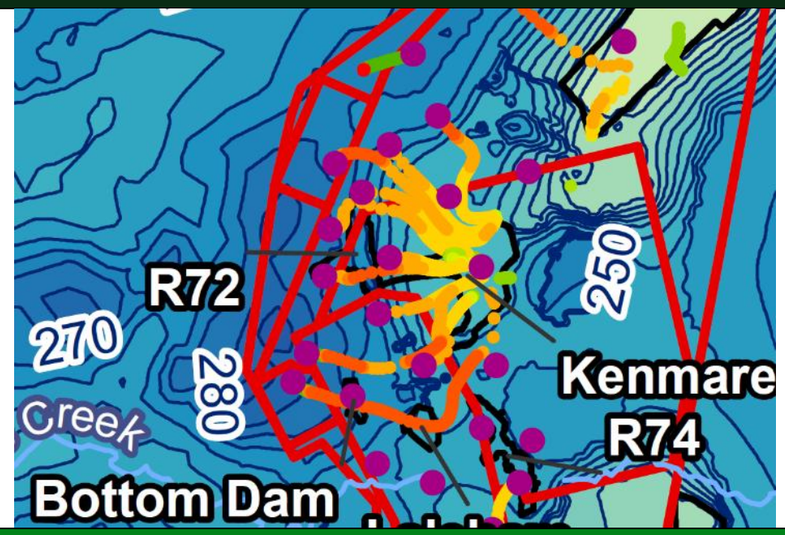
Post-Mining Flooding Risk	Residual Void Lake Geochemistry
Outside 0.1% AEP design and PMF events.	N/A

TABLE 9-7 STEWARTON SOUTH SUMMARY TABLE

<table>
<tr><th colspan="5">Stewarton South</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><th>End of Mining Cross-Section</th><th colspan="2">Final Landform Design</th><th colspan="2">Particle Tracking</th></tr>
<tr><td>N/A</td><td colspan="2">
</td><td colspan="2">
</td></tr>
<tr><th colspan="3">Design Parameters</th><th colspan="2">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th>Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 1,400 m
Max. Width: 500 m
Max. Depth: 140 m
Surface area: 93 ha</td><td>Void crest/Spill Level: 232 mAHD
Indicative void floor: 92 mAHD</td><td>Highwall: ~87%
Low wall: ~34%</td><td>Natural: 0.0 ha
Spoil: 50.9 ha
Rehabilitated Spoil: 150.3 ha
<u>Total: 201.2 ha</u></td><td>Spoil: -0.05 ML/day
Tailings: 0.0 ML/day
Natural Geology: 0.0 ML/day
Total GW Inflow: -0.05 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="2">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td colspan="2" rowspan="2">50° Ave Wall Angle:
• Average: 146 m;
• Range: 113-157 m; and
• 90%< 157 m.

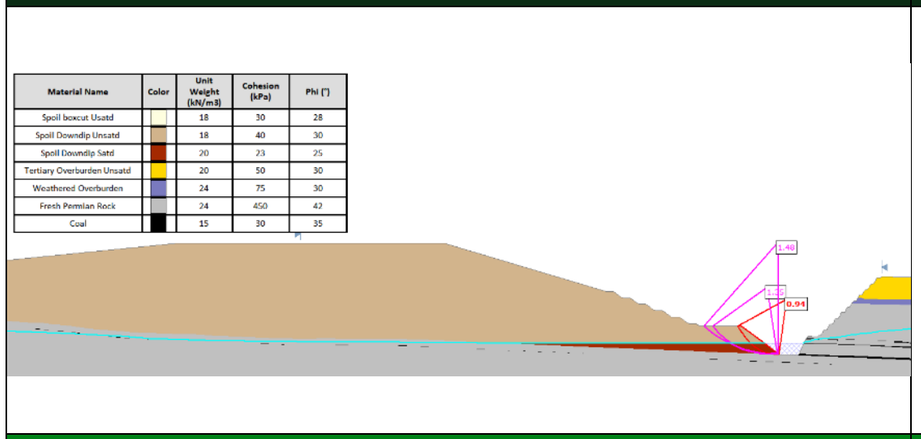
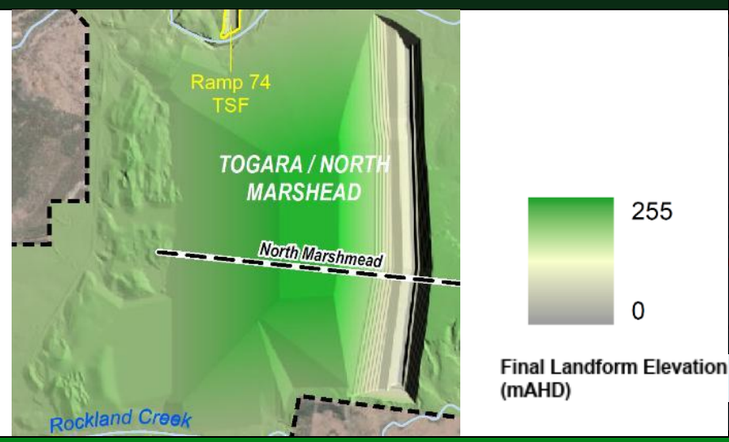
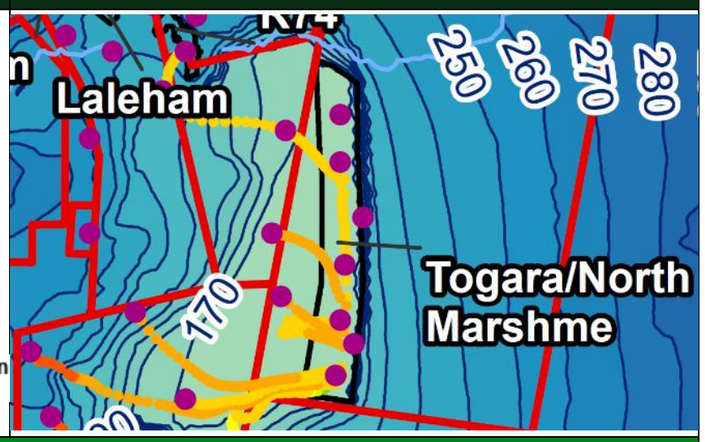
60° Ave Wall Angle:
• Average: 124 m;
• Range: 98-142 m; and
• 90%< 138 m.</td><td>Mean: 103.9 mAHD
Max.: 115.5 mAHD</td><td>100 years</td><td>Groundwater source</td><td>Min. Freeboard: 116.5 m
Does not spill</td></tr>
<tr><th>Post-Mining Flooding Risk</th><th colspan="2">Residual Void Lake Geochemistry</th></tr>
<tr><td>Outside 0.1% AEP design and PMF events.</td><td colspan="2">N/A</td></tr>
</table>

TABLE 9-8 KENMARE SUMMARY TABLE

<table>
<tr><th colspan="6">Kenmare</th></tr>
<tr><th colspan="6">Overview</th></tr>
<tr><th>End of Mining Cross-Section</th><th colspan="3">Final Landform Design</th><th colspan="2">Particle Tracking</th></tr>
<tr><td>N/A</td><td colspan="3">
</td><td colspan="2">
</td></tr>
<tr><th colspan="3">Design Parameters</th><th colspan="3">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th colspan="2">Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 1,800 m
Max. Width: 500 m
Max. Depth: 122 m
Surface area: 85 ha</td><td>Void crest/Spill Level: 297 mAHD
Indicative void floor: 175 mAHD</td><td>Highwall: ~36%
Low wall: ~31%</td><td>Natural: 0.0 ha
Spoil: 146.1 ha
Rehabilitated Spoil: 236.0 ha
<u>Total: 382.1 ha</u></td><td colspan="2">Spoil: +0.49 ML/day
Tailings: 0.0 ML/day
Natural Geology: 0.0 ML/day
Total GW Inflow: +0.49 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="3">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td colspan="2" rowspan="2">50° Ave Wall Angle:
• Average: 186 m;
• Range: 169-198 m; and
• 90%< 195 m.

60° Ave Wall Angle:
• Average: 163 m;
• Range: 147-175 m; and
• 90%< 173 m.</td><td>Mean: 218 mAHD
Max.: 221.5 mAHD</td><td>150 years</td><td>Groundwater sink</td><td>Min. Freeboard: 75.5 m
Does not spill</td></tr>
<tr><th>Post-Mining Flooding Risk</th><th colspan="3">Residual Void Lake Geochemistry</th></tr>
<tr><td colspan="2">Outside 0.1% AEP design and PMF events.</td><td colspan="3">Near-neutral pH throughout.
Becomes hypersaline after ~100 years with a final TDS of 81 g/L after 929 years.
High concentrations of major ions, silicon and manganese.
Large amounts of precipitated mineral phases (dolomite, gypsum, chalcedony).
No observed geochemical equilibrium.</td></tr>
</table>

TABLE 9-9 TOGARA/NORTH MARSHMEAD SUMMARY TABLE

<table>
<tr><th colspan="6">Togara/North Marshmead</th></tr>
<tr><th colspan="6">Overview</th></tr>
<tr><th colspan="2">End of Mining Cross-Section</th><th colspan="2">Final Landform Design</th><th colspan="2">Particle Tracking</th></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td></tr>
<tr><th colspan="3">Design Parameters</th><th colspan="3">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th colspan="2">Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 5,500 m
Max. Width: 850 m
Max. Depth: 202 m
Surface area: 511 ha</td><td>Void crest/Spill Level: 271 mAHD
Indicative void floor: 69 mAHD</td><td>Highwall: ~90%
Low wall: ~36%</td><td>Natural: 7.4 ha
Spoil: 458.0 ha
Rehabilitated Spoil: 249.1 ha
<u>Total: 714.5 ha</u></td><td colspan="2">Spoil: +3.29 ML/day
Tailings: 0.0 ML/day
Natural Geology: +0.03 ML/day
Total GW Inflow: +3.3302 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="3">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td colspan="2" rowspan="2">50° Ave Wall Angle:
• Average: 298 m;
• Range: 186-389 m; and
• 90%< 367 m.

60° Ave Wall Angle:
• Average: 299 m;
• Range: 193-392 m; and
• 90%< 369 m.</td><td>Mean: 165.7 mAHD
Max.: 167.7 mAHD</td><td>300 years</td><td>Groundwater sink</td><td>Min. Freeboard: 103.3 m
Does not spill</td></tr>
<tr><th>Post-Mining Flooding Risk</th><th colspan="3">Residual Void Lake Geochemistry</th></tr>
<tr><td colspan="2">Outside 0.1% AEP design and PMF events.</td><td colspan="3">Near-neutral pH throughout.
Strongly hypersaline after ~900 years with a final TDS of 104 g/L after 914 years.
High concentrations of major ions, silicon and manganese.
Large amounts of precipitated mineral phases (ferrihydrite, barite, gypsum, chalcedony).
No observed geochemical equilibrium.</td></tr>
</table>

TABLE 9-10 SOUTH MARSHMEAD SUMMARY TABLE

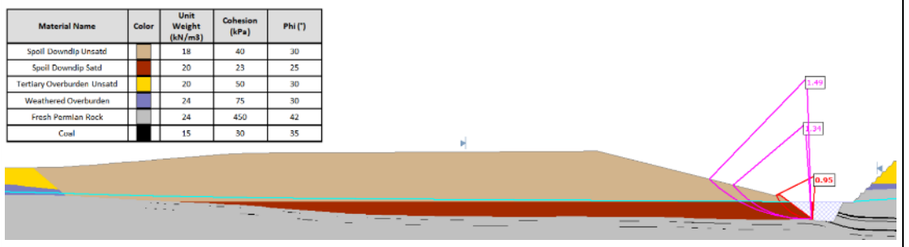
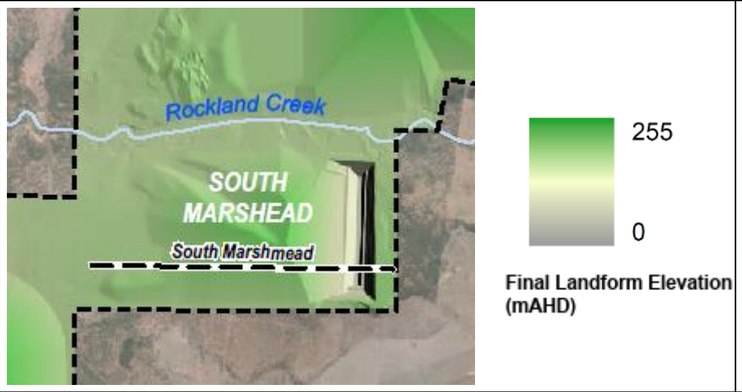
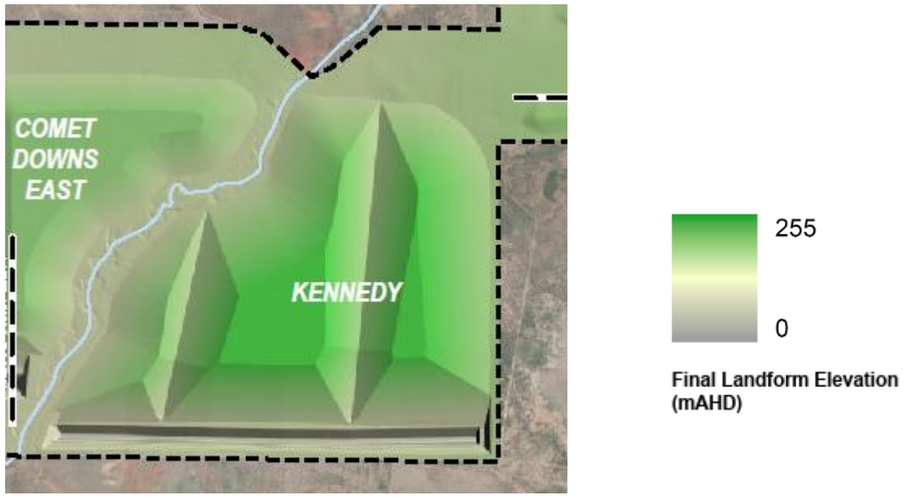
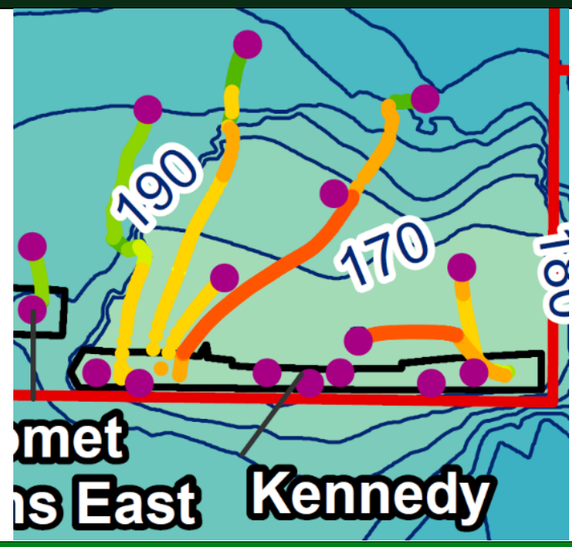
<table>
<tr><th colspan="5">South Marshmead</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><th colspan="2">End of Mining Cross-Section</th><th colspan="2">Final Landform Design</th><th>Particle Tracking</th></tr>
<tr>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td>
</td>
</tr>
<tr><th colspan="3">Design Parameters</th><th colspan="2">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th>Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 1,800 m
Max. Width: 650 m
Max. Depth: 162 m
Surface area: 123 ha</td><td>Void crest/Spill Level: 270 mAHD
Indicative void floor: 108 mAHD</td><td>Highwall: ~95%
Low wall: ~40%</td><td>Natural: 0.0 ha
Spoil: 119.4 ha
Rehabilitated Spoil: 80.3 ha
<u>Total: 199.7 ha</u></td><td>Spoil: +0.89 ML/day
Tailings: 0.0 ML/day
Natural Geology: 0.0 ML/day
Total GW Inflow: +0.89 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="2">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td>50° Ave Wall Angle:
• Average: 232 m;
• Range: 194-273 m; and
• 90%< 267 m.</td><td>60° Ave Wall Angle:
• Average: 213 m;
• Range: 167-253 m; and
• 90%< 249 m.</td><td>Mean: 171.1 mAHD
Max.: 174 mAHD</td><td>300 years</td><td>Groundwater sink</td><td>Min. Freeboard: 96 m
Does not spill</td></tr>
<tr><td colspan="2"></td><th>Post-Mining Flooding Risk</th><th colspan="2">Residual Void Lake Geochemistry</th></tr>
<tr><td colspan="2"></td><td>Outside 0.1% AEP design and PMF events.</td><td colspan="2">N/A</td></tr>
</table>

TABLE 9-11 KENNEDY SUMMARY TABLE

<table>
<tr><th colspan="6">Kennedy</th></tr>
<tr><th colspan="6">Overview</th></tr>
<tr><th>End of Mining Cross-Section</th><th colspan="3">Final Landform Design</th><th colspan="2">Particle Tracking</th></tr>
<tr><td>N/A</td><td colspan="3">
</td><td colspan="2">
</td></tr>
<tr><th colspan="3">Design Parameters</th><th colspan="3">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th colspan="2">Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 5,700 m
Max. Width: 700 m
Max. Depth: 122 m
Surface area: 357 ha</td><td>Void crest/Spill Level: 221 mAHD
Indicative void floor: 99 mAHD</td><td>Highwall: ~102%
Low wall: ~36%</td><td>Natural: 0.0 ha
Spoil: 188.6 ha
Rehabilitated Spoil: 481.1 ha
<u>Total: 669.7 ha</u></td><td colspan="2">Spoil: +2.31 ML/day
Tailings: 0 ML/day
Natural Geology: +0.04 ML/day
Total GW Inflow: +2.36 ML/day</td></tr>
<tr><th colspan="2">Geotechnical Stability</th><th colspan="4">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td colspan="2" rowspan="2">50° Ave Wall Angle:
• Average: 149 m;
• Range: 125-195 m; and
• 90%< 173 m.

60° Ave Wall Angle:
• Average: 129 m;
• Range: 110-183 m; and
• 90%< 144 m.</td><td>Mean: 166.4 mAHD
Max.: 168.8 mAHD</td><td>400 years</td><td>Groundwater sink</td><td>Min. Freeboard: 52.2 m
Does not spill</td></tr>
<tr><th>Post-Mining Flooding Risk</th><th colspan="3">Residual Void Lake Geochemistry</th></tr>
<tr><td colspan="2">Outside 0.1% AEP design and PMF events.</td><td colspan="3">N/A</td></tr>
</table>

TABLE 9-12 COMET DOWNS EAST SUMMARY TABLE

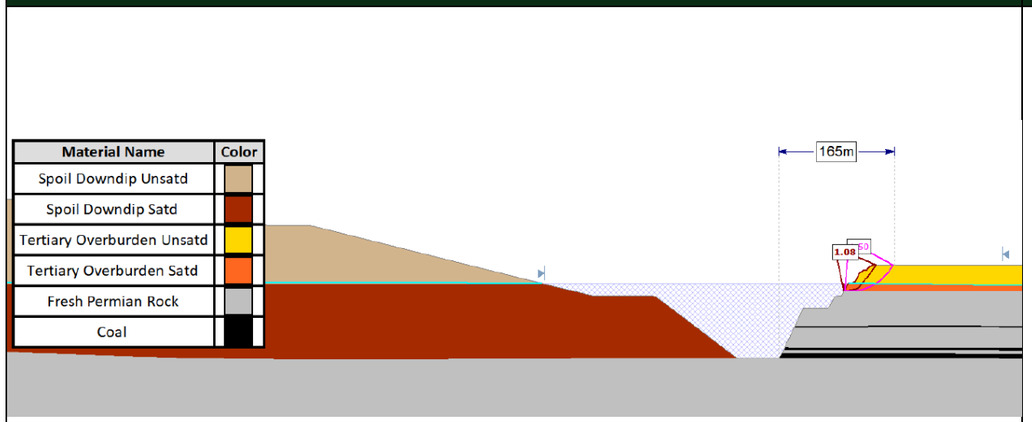
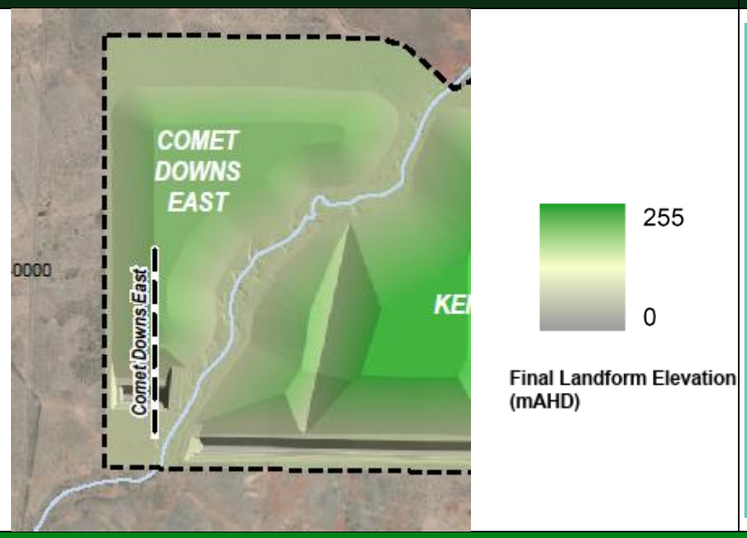
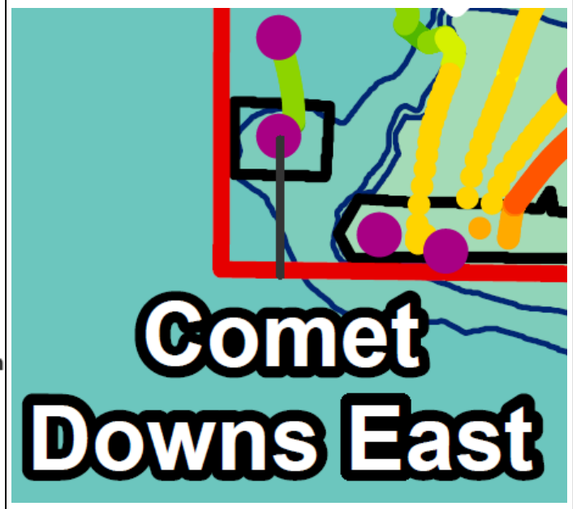
Comet Downs East					
Overview					
End of Mining Cross-Section		**Final Landform Design**		**Particle Tracking**	
					
Design Parameters			**Hydrology**		
Indicative Dimensions	**Elevation**	**NUMA Slope Grades (overall)**	**Catchment Area**		**Equilibrium GW Inflow Rates**
Max. Length: 800 m Max. Width: 570 m Max. Depth: 132 m Surface area: 49 ha	Void crest/Spill Level: 222 mAHD Indicative void floor: 90 mAHD	Highwall: ~98% Low wall: ~36%	Natural: 8.9 ha Spoil: 27.7 ha Rehabilitated Spoil: 69.4 ha Total: 106.0 ha		Spoil: +0.85 ML/day Tailings: 0.0 ML/day Natural Geology: +0.10 ML/day Total GW Inflow: +0.94 ML/day
Geotechnical Stability			**Water Balance**		
Set-back Distance from Highwall/Endwalls			**Equilibrium Water Level**	**Time to Equilibrium Level**	**Outflows**
FoS: 1.08 Set-back from wall toe to FoS>1.5: 165 m			Mean: 191.2 mAHD Max.: 193 mAHD	450 years	Groundwater sink Min. Freeboard: 29 m Does not spill
			Post-Mining Flooding Risk	**Residual Void Lake Geochemistry**	
			Outside 0.1% AEP design and PMF events.	Near-neutral pH throughout. Strongly hypersaline after ~900 years with a final TDS of 104 g/L after 921 years. High concentrations of major ions, silicon and manganese. Large amounts of precipitated mineral phases (ferrihydrite, barite, gypsum, chalcedony). No observed geochemical equilibrium.	

TABLE 9-13 RAMP 74 SUMMARY TABLE

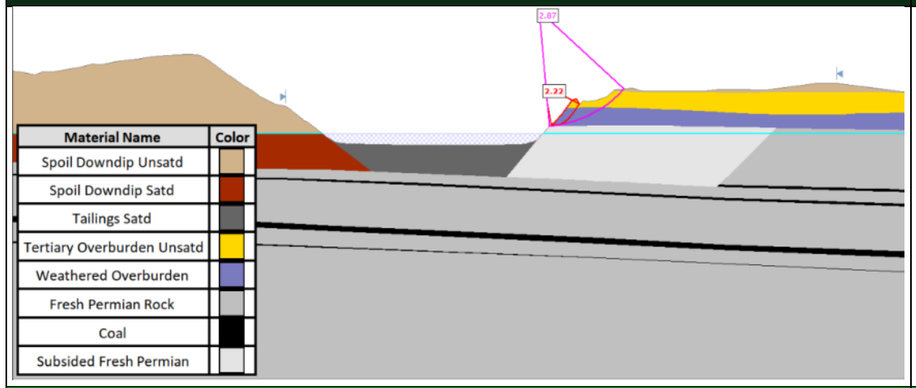
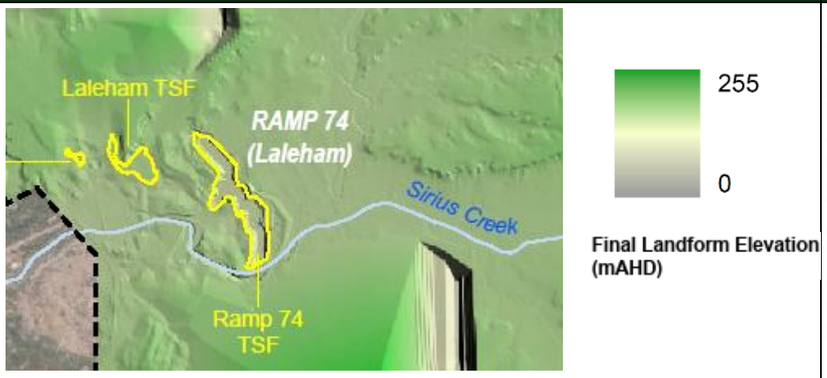
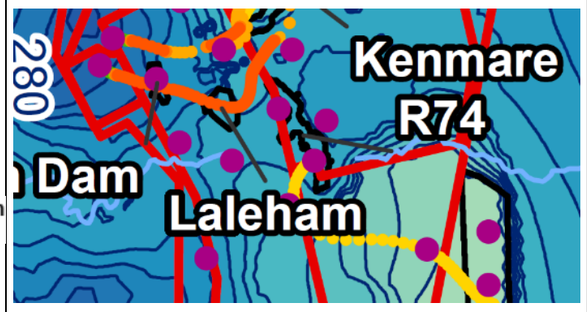
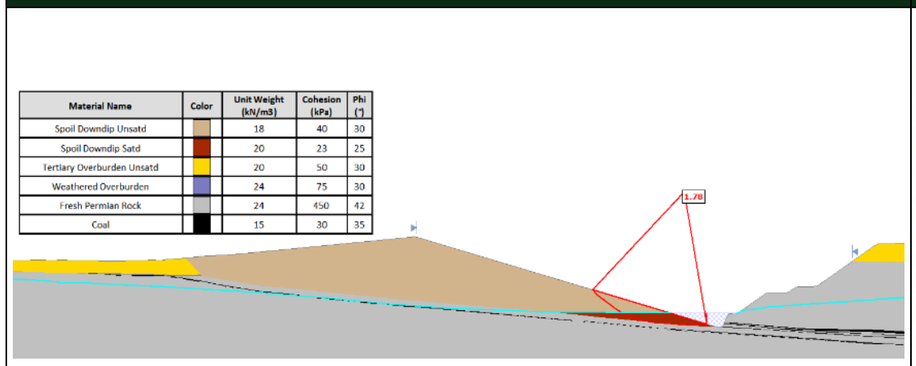
<table>
<tr><th colspan="5">Ramp 74</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><th colspan="2">End of Mining Cross-Section</th><th colspan="2">Final Landform Design</th><th>Particle Tracking</th></tr>
<tr>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td>
</td>
</tr>
<tr><th colspan="3">Design Parameters</th><th colspan="2">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th>Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 2,000 m
Max. Width: 300 m
Max. Depth: 32 m
Surface area: 59 ha</td><td>Void crest/Spill Level: 266 mAHD
Indicative void floor: 234 mAHD</td><td>Highwall: ~67%
Low wall: ~58%</td><td>Natural: 10.1 ha
Spoil: 58.3 ha
Rehabilitated Spoil: 112.9 ha
<u>Total: 181.3 ha</u></td><td>Spoil: -2.33 ML/day
Tailings: -0.01 ML/day
Natural Geology: +0.01 ML/day
Total GW Inflow: -2.32 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="2">Water Balance</th></tr>
<tr><th colspan="3">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td colspan="3" rowspan="3">FoS: 2.22
Set-back from wall toe to FoS> 1.5: Crest</td><td>Cycles between dry and a maximum of: 244.3 mAHD</td><td>100 years</td><td>Groundwater source</td><td>Min. Freeboard: 21.7 m
Does not spill</td></tr>
<tr><th>Post-Mining Flooding Risk</th><th colspan="3">Residual Void Lake Geochemistry</th></tr>
<tr><td>Outside 0.1% AEP event
Inside PMF extents (Sirius Creek)</td><td colspan="3">Near-neutral pH throughout.
Low salinity throughout with a final TDS of 113 mg/L after 1,000 years due to net groundwater outflow.
Low concentrations of major ions, silicon and manganese.
Negligible amounts of precipitated mineral phases.
Geochemical equilibrium established almost immediately.</td></tr>
</table>

TABLE 9-14 SOUTH BALLAMOO SUMMARY TABLE

<table>
<tr><th colspan="5">South Ballamoo</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><th colspan="2">End of Mining Cross-Section</th><th colspan="2">Final Landform Design</th><th>Particle Tracking</th></tr>
<tr>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td>
</td>
</tr>
<tr><th colspan="3">Design Parameters</th><th colspan="2">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th>Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 4,600 m
Max. Width: 1,100 m
Max. Depth: 206 m
Surface area: 350 ha</td><td>Void crest/Spill Level: 290 mAHD
Indicative void floor: 84 mAHD</td><td>Highwall: ~53%
Low wall: ~31%</td><td>Natural: 0.0 ha
Spoil: 365.0 ha
Rehabilitated Spoil: 267.4 ha
<u>Total: 632.4 ha</u></td><td>Spoil: +1.83 ML/day
Tailings: 0.0 ML/day
Natural Geology: +0.03 ML/day
Total GW Inflow: +1.83 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="2">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td colspan="2" rowspan="2">50° Ave Wall Angle:
• Average: 356 m;
• Range: 277-434 m; and
• 90%< 423 m.

60° Ave Wall Angle:
• Average: 359 m;
• Range: 277-438 m; and
• 90%< 427 m.</td><td>Mean: 141.5 mAHD
Max.: 144.3 mAHD</td><td>300 years</td><td>Groundwater sink</td><td>Min. Freeboard: 145.7 m
Does not spill</td></tr>
<tr><th>Post-Mining Flooding Risk</th><th colspan="2">Residual Void Lake Geochemistry & Limnology</th></tr>
<tr><td colspan="2">Outside 0.1% AEP design and PMF events.</td><td colspan="2">N/A</td></tr>
</table>

TABLE 9-15 TANNYFOIL SUMMARY TABLE

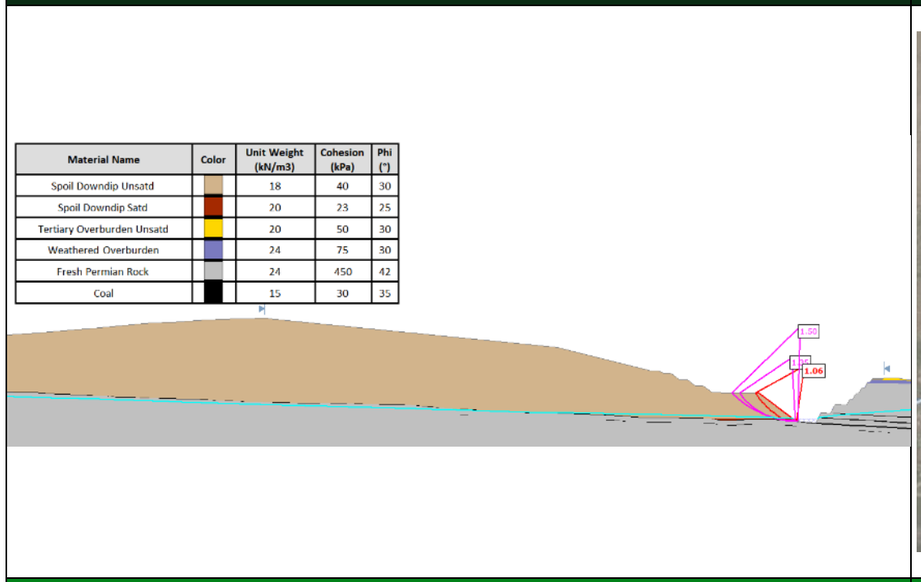
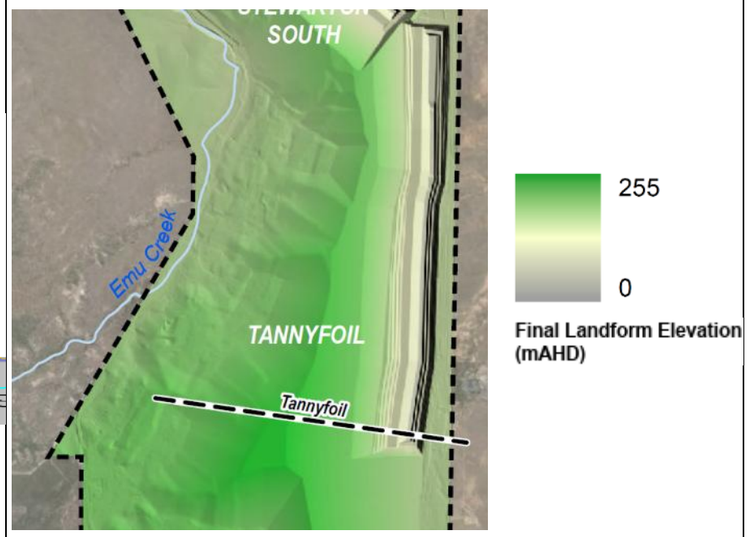
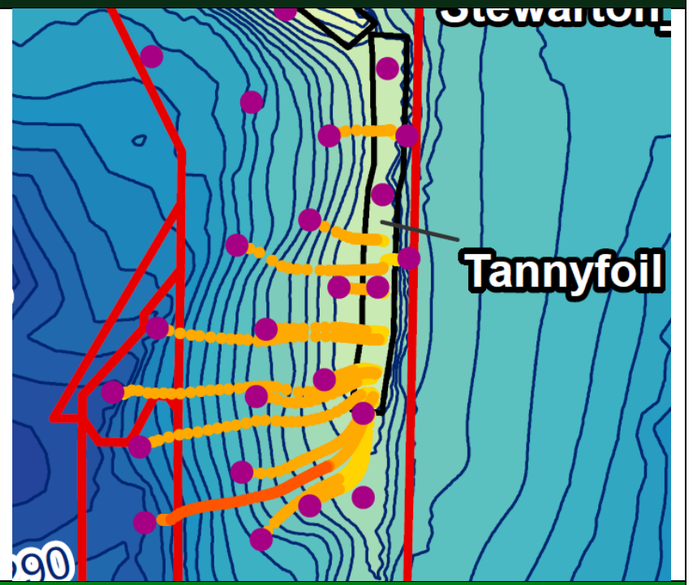
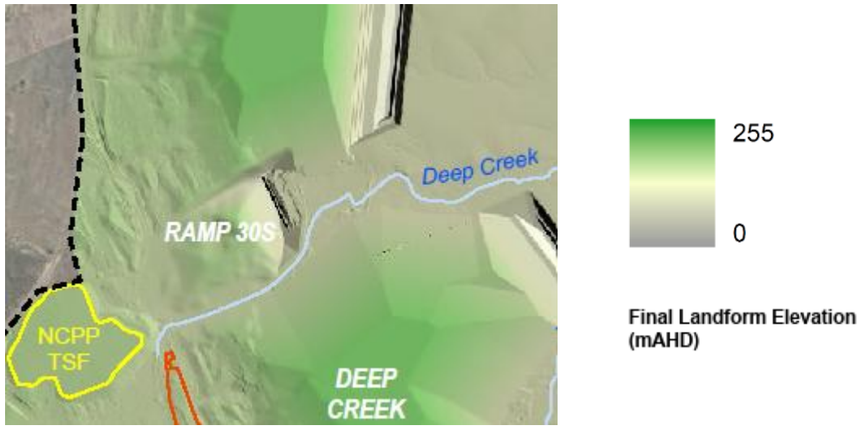
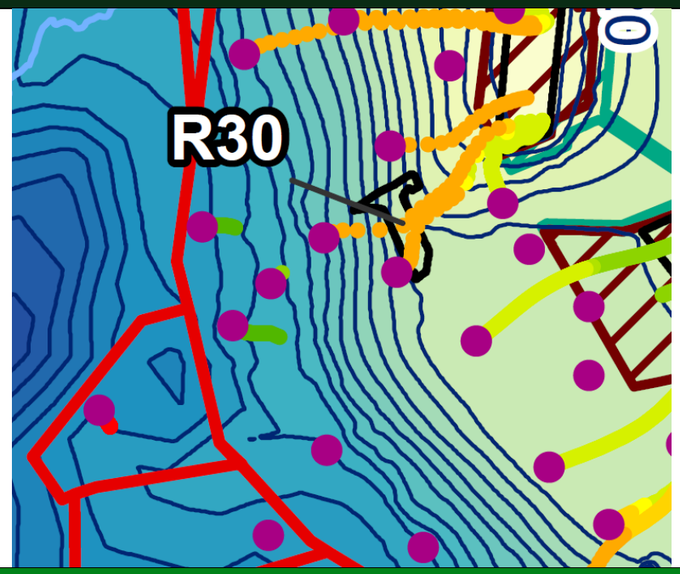
<table>
<tr><th colspan="5">Tannyfoil</th></tr>
<tr><th colspan="5">Overview</th></tr>
<tr><th colspan="2">End of Mining Cross-Section</th><th colspan="2">Final Landform Design</th><th>Particle Tracking</th></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td>
</td></tr>
<tr><th colspan="3">Design Parameters</th><th colspan="2">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th>Catchment Area</th><th>Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 6,000 m
Max. Width: 630 m
Max. Depth: 122 m
Surface area: 400 ha</td><td>Void crest/Spill Level: 237 mAHD
Indicative void floor: 115 mAHD</td><td>Highwall: 74%
Low wall: ~34%</td><td>Natural: 0 ha
Spoil: 388.1 ha
Rehabilitated Spoil: 458.6 ha
<u>Total: 846.7 ha</u></td><td>Spoil: +1.51 ML/day
Tailings: 0.0 ML/day
Natural Geology: +0.02 ML/day
Total GW Inflow: +1.52 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="3">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td>50° Ave Wall Angle:
• Average: 148 m;
• Range: 122-166 m; and
• 90%< 163 m.</td><td>60° Ave Wall Angle:
• Average: 129 m;
• Range: 99-161 m; and
• 90%< 153 m.</td><td>Mean: 144.7 mAHD
Max.: 148.3 mAHD</td><td>250 years</td><td>Groundwater sink</td><td>Min. Freeboard: 88.7 m
Does not spill</td></tr>
<tr><td colspan="2"></td><th>Post-Mining Flooding Risk</th><th colspan="3">Residual Void Lake Geochemistry</th></tr>
<tr><td colspan="2"></td><td>Outside 0.1% AEP design and PMF events.</td><td colspan="3">N/A</td></tr>
</table>

TABLE 9-16 RAMP 30 SUMMARY TABLE

<table>
<tr><th colspan="6">Ramp 30</th></tr>
<tr><th colspan="6">Overview</th></tr>
<tr><th>End of Mining Cross-Section</th><th colspan="3">Final Landform Design</th><th colspan="2">Particle Tracking</th></tr>
<tr><td>N/A</td><td colspan="3">
</td><td colspan="2">
</td></tr>
<tr><th colspan="3">Design Parameters</th><th colspan="3">Hydrology</th></tr>
<tr><th>Indicative Dimensions</th><th>Elevation</th><th>NUMA Slope Grades (overall)</th><th colspan="2">Catchment Area</th><th>Equilibrium GW Inflow Rates</th></tr>
<tr><td>Max. Length: 1,200 m
Max. Width: 300 m
Max. Depth: 78 m
Surface area: 64 ha</td><td>Void crest/Spill Level: 217 mAHD
Indicative void floor: 139 mAHD</td><td>Highwall: ~67%
Low wall: ~32%</td><td colspan="2">Natural: 0.0 ha
Spoil: 24.1 ha
Rehabilitated Spoil: 149.2 ha
<u>Total: 173.3 ha</u></td><td>Spoil: -0.21 ML/day
Tailings: 0.0 ML/day
Natural Geology: 0.0 ML/day
Total GW Inflow: -0.21 ML/day</td></tr>
<tr><th colspan="3">Geotechnical Stability</th><th colspan="3">Water Balance</th></tr>
<tr><th colspan="2">Set-back Distance from Highwall/Endwalls</th><th>Equilibrium Water Level</th><th>Time to Equilibrium Level</th><th colspan="2">Outflows</th></tr>
<tr><td colspan="2" rowspan="2">50° Ave Wall Angle:
• Average: 100 m; and
• Range: 89-107 m.

60° Ave Wall Angle:
• Average: 83 m; and
• Range: 76-88 m.</td><td>Cycles between dry and a maximum of: 162.6 mAHD</td><td>150 years</td><td>Groundwater source</td><td>Min. Freeboard: 54.4m
Does not spill</td></tr>
<tr><td></td><td>Post-Mining Flooding Risk</td><td colspan="2">Residual Void Lake Geochemistry</td></tr>
<tr><td colspan="2"></td><td>Outside 0.1% AEP design and PMF events.</td><td colspan="2">Near-neutral pH throughout.
Low salinity throughout with a final TDS of 133 mg/L after 997 years due to net groundwater outflow.
Low concentrations of major ions, metals and metalloids.
Negligible amounts of precipitated mineral phases.
Geochemical equilibrium established almost immediately.</td></tr>
</table>

10. DISCUSSION

This section summarises the findings across all assessments. It identifies key risks, uncertainties and implications for closure and residual risk management.

The modelling and evaluations presented in this VCP demonstrate that the final landform will be safe, stable and non-polluting under the proposed closure configuration:

- Water balance and groundwater modelling show that the overall final landform, including spoil dumps and residual voids, will function as a terminal groundwater sink and are not predicted to overtop in any modelled scenario:
  - Four residual voids (Stewarton South, Ramp 30, Ramp 74 and Bonnie Doon) have net outward groundwater fluxes. However, the predicted lake elevations in these residual voids are higher than the lakes that form in neighbouring voids, resulting in a hydraulic gradient which drives outflows from these higher elevation lakes towards the lower elevation neighbouring void lakes rather than away from the voids;
- Water quality modelling using PHREEQC indicates that Mimosa/Besgrove, Ramp 8, Deep Creek, Kenmare, Togara/North Marshmead and Comet Downs East residual void lakes are predicted to experience progressive increases in salinity, with TDS and major ions increasing over time with no indication of stabilisation:
  - These void lakes show consistent evaporative concentration of solutes. This is consistent with the water balance and groundwater modelling results; they are predominantly terminal systems within the broader void network, resulting in retention of solutes over time; and
  - Although increasing salinity of the void lakes presents ecological limitations, the void lakes remain hydrologically contained within the mine footprint and are not expected to affect surrounding groundwater or surface-water systems;
- Water quality modelling by PHREEQC indicates that Bonnie Doon, Ramp 30 and Ramp 74 residual void lakes will maintain low to moderate salinity and stable water quality conditions over the long term:
  - This reflects their net groundwater outflows (toward neighbouring residual voids), which removes water and solutes from the system during the simulation, preventing evapoconcentration of solutes; and
  - These voids show no persistent increases in TDS or major ions, with concentrations remaining stable or fluctuating in response to climatic cycles rather than accumulating over time;
- Limnological modelling indicates that residual void lakes will exhibit persistent thermal stratification with seasonal overturn (monomictic behaviour), rather than permanent or meromictic conditions:
  - Thermal stratification develops each summer and breaks down during winter mixing, providing regular turnover of the water column and limiting long-term isolation of deep waters;

  - Salinity increases progressively over time due to evaporative concentration and groundwater inputs; however, seasonal mixing results in largely uniform salinity profiles, and sustained salinity stratification is not predicted;
  - As a result, density stratification is primarily controlled by temperature, with salinity contributing locally to density gradients but not forming stable, long-term chemical layering; and
  - Overall, stratification strength may increase over time as salinity accumulates, but the system continues to undergo seasonal mixing, and long-term stabilisation beyond the modelled period remains uncertain;
- Geotechnical assessments confirm that the final void slopes achieve the required Factors of Safety for closure stability; and
- Flood modelling indicates the final landform design, inclusive of permanent creek diversions, will provide protection for the residual voids from the 0.1% AEP flood event.

10.1 RISK AND UNCERTAINTY

While the assessment outcomes in this VCP support the long-term stability and containment of the residual voids, some level of uncertainty remains due to the nature of predictive modelling and future climate conditions. Key sources of uncertainty include:

- Climate variability and change, particularly the timing and intensity of rainfall and evaporation under different SSP scenarios;
- Catchment hydrology assumptions, including long-term performance of rehabilitated surfaces and erosion control measures;
- Void water quality evolution, especially under progressively increasing salinity and density stratification conditions in terminal pit lakes; and
- Material properties, such as variability in spoil geochemistry or uncharacterised lithologies within final wall exposures.

To manage these uncertainties, adaptive management strategies will be implemented as part of residual risk management. These may include long-term monitoring of water levels, salinity trends and slope stability, along with predefined trigger levels and response actions. The residual void management approach will be reviewed periodically and refined based on updated monitoring data or changes in closure assumptions.

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APPENDIX A ANNUAL VOID WATER QUALITY MODELLING RESULTS

The following figures (Figure A-1 to Figure A-18) to show annual timestep results, by parameter, for the nine residual void pit lakes modelled using PHREEQC. These results represent the simulation with active geochemical controls (Section 8.1.3.3).

As discussed in Section 4.1.2, the Boonie Doon, Ramp 30 and Ramp 74 residual voids have predicted net outflow fluxes. These residual voids are predicted to lose void water to adjacent voids via the natural geology between the voids. Each of these voids have predicted lake elevations higher than the neighbouring voids, resulting in a hydraulic gradient between the voids that drives this outwards flux to its neighbouring void. As such, they behave as flow through systems and do not demonstrate cumulative and concentrating characteristics. The nine modelled residual voids and the abbreviations used in the charts are listed in Table A-1

TABLE A-1 MODELLED RESIDUAL VOID ABBREVIATIONS

Modelled Residual Void	Abbreviation
Ramp 8	R8
Bonnie Doon	BD
Mimosa/Besgrove	MB
Ramp 30	R30
Deep Creek	DC
Kenmare	KEN
Ramp 74	R74
Togara/North Marshmead	TNM
Comet Downs East	CDE

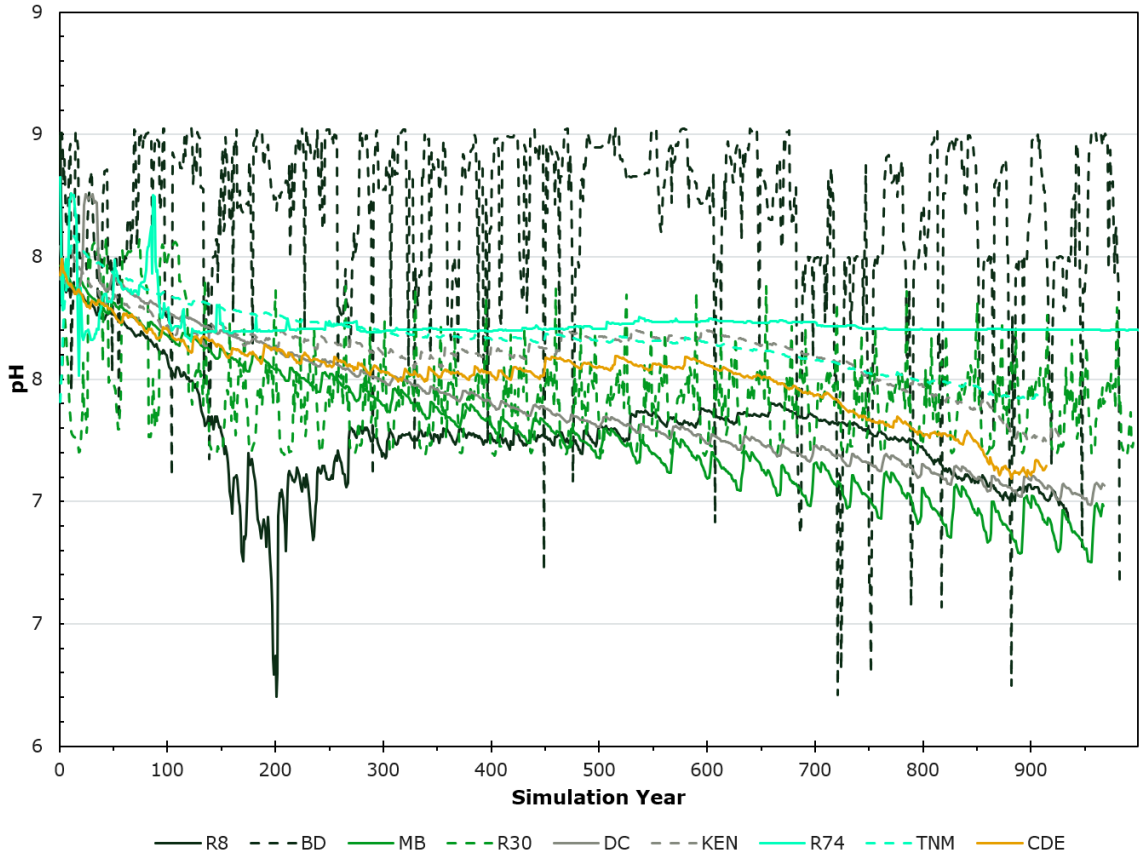


FIGURE A-1 pH

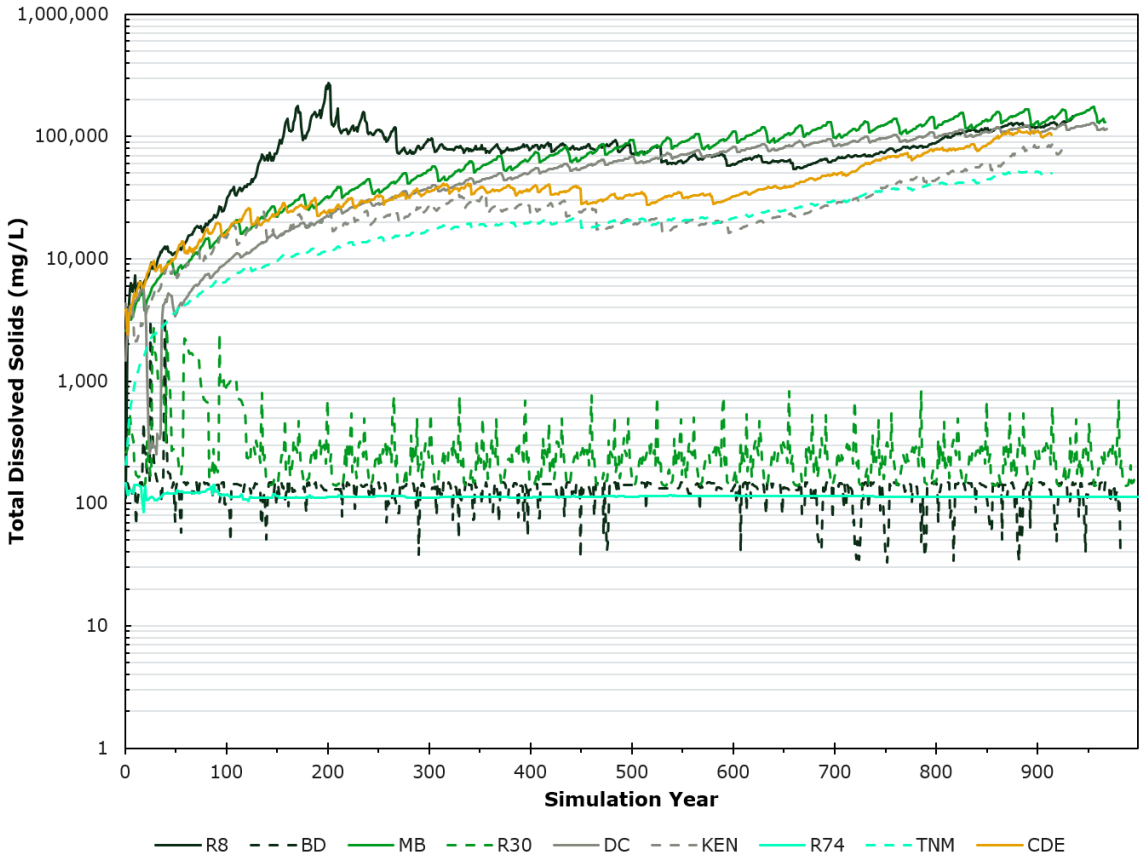


FIGURE A-2 TOTAL DISSOLVED SOLIDS

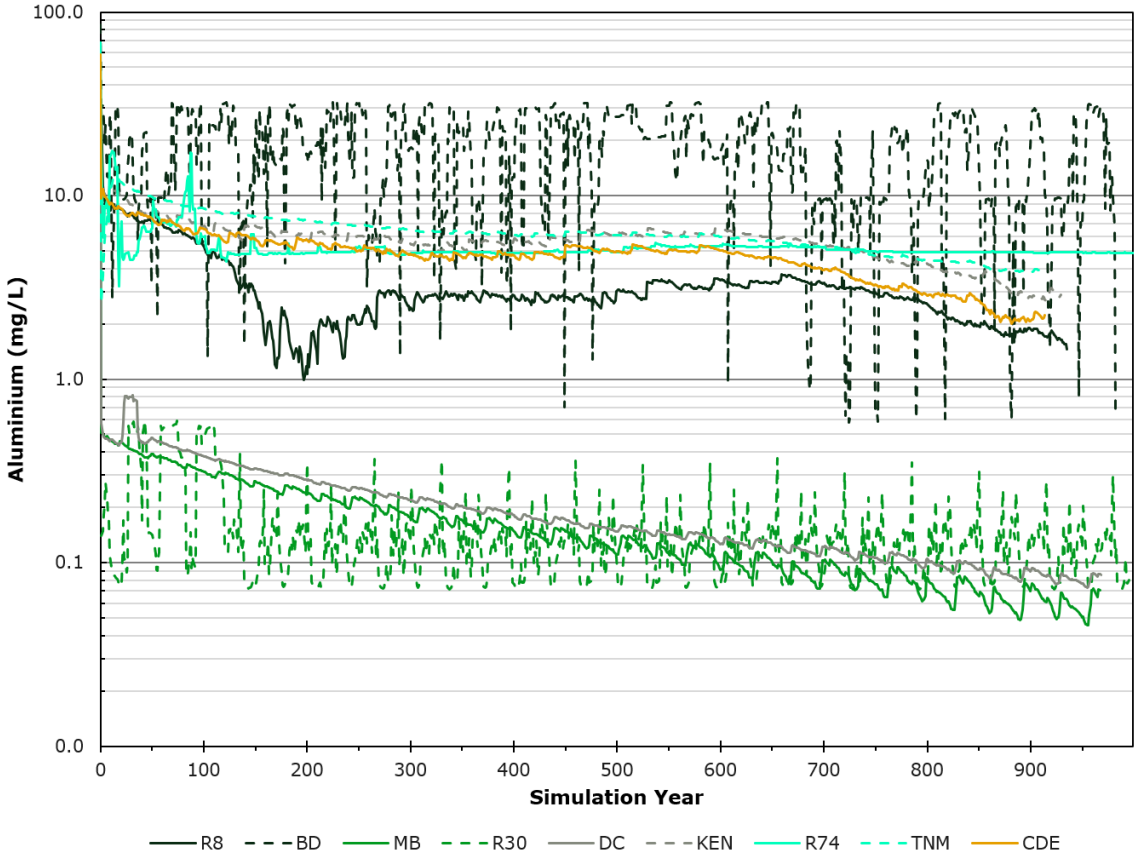


FIGURE A-3 ALUMINIUM

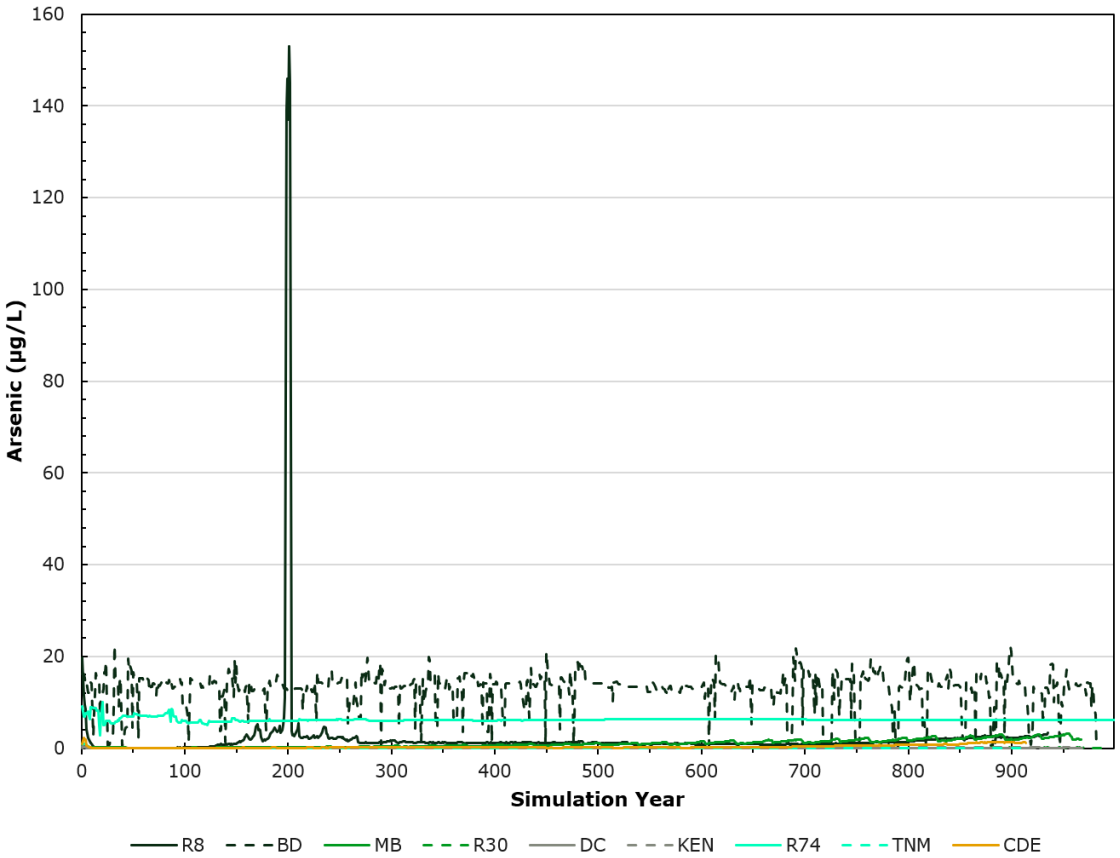


FIGURE A-4 ARSENIC

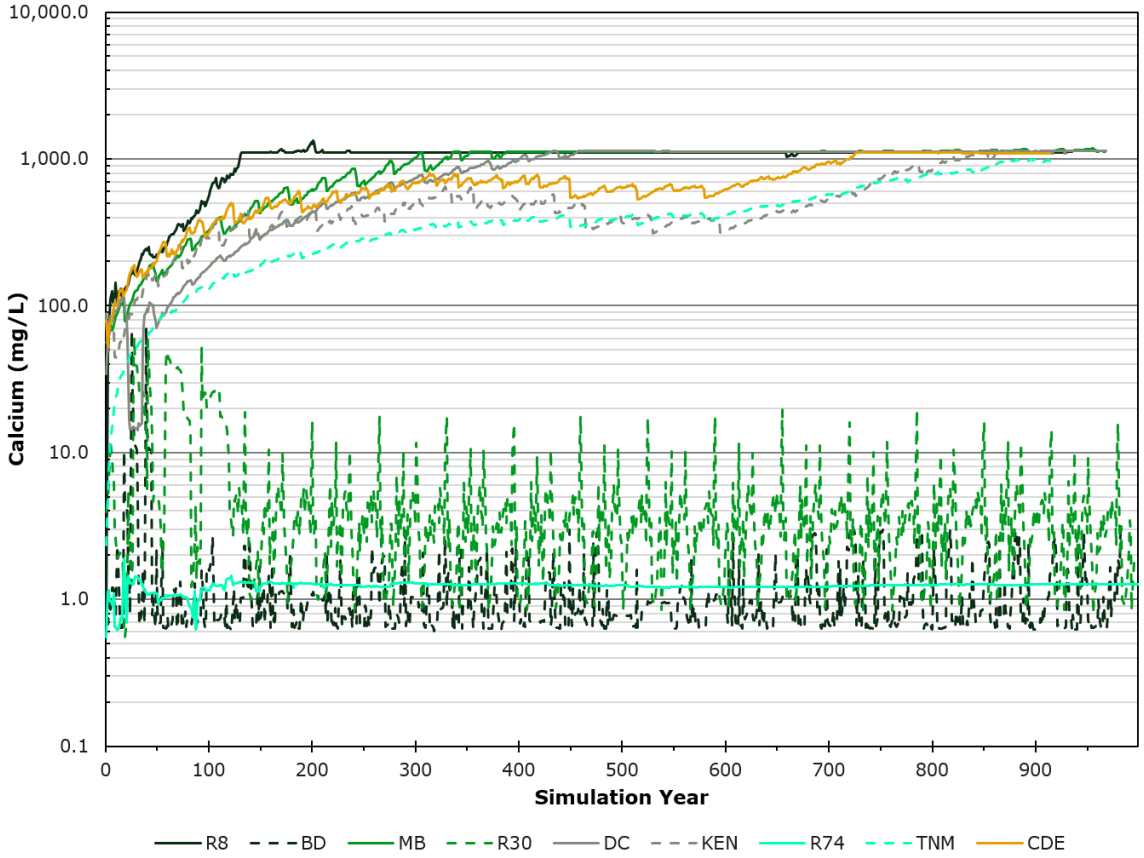


FIGURE A-5 CALCIUM

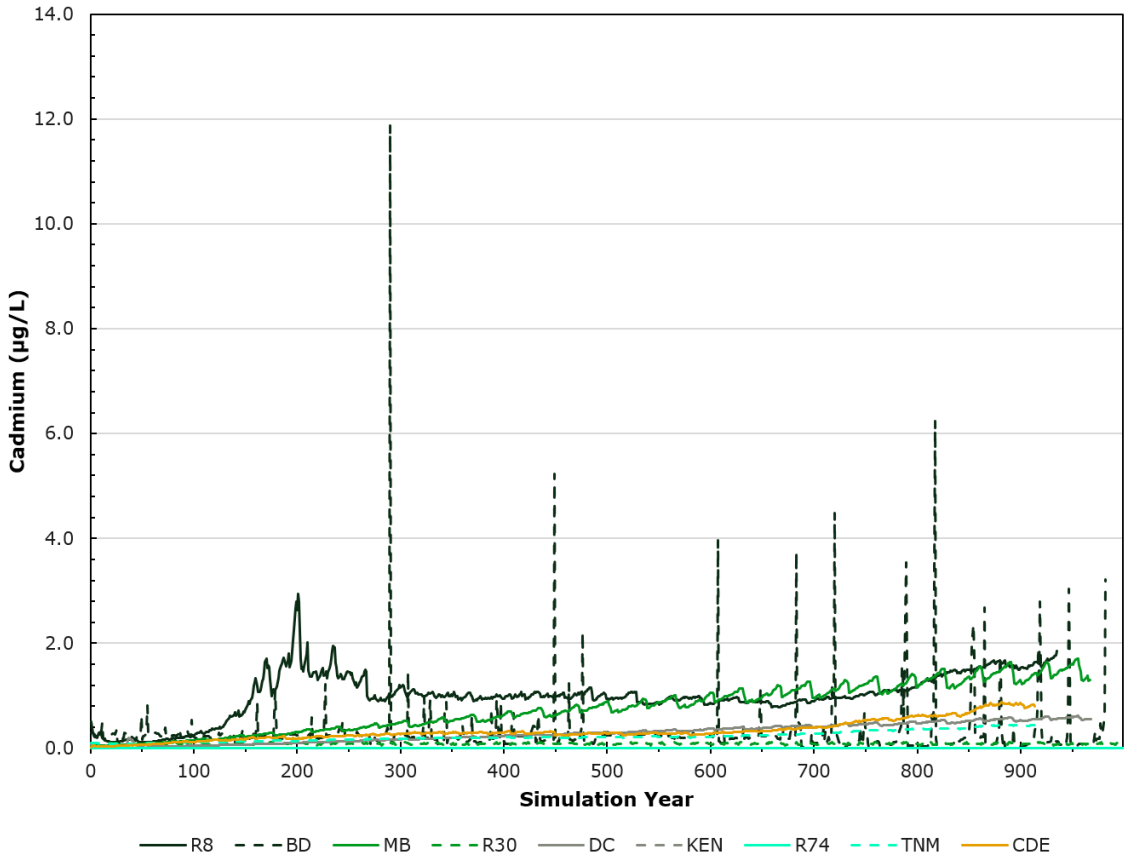


FIGURE A-6 CADMIUM

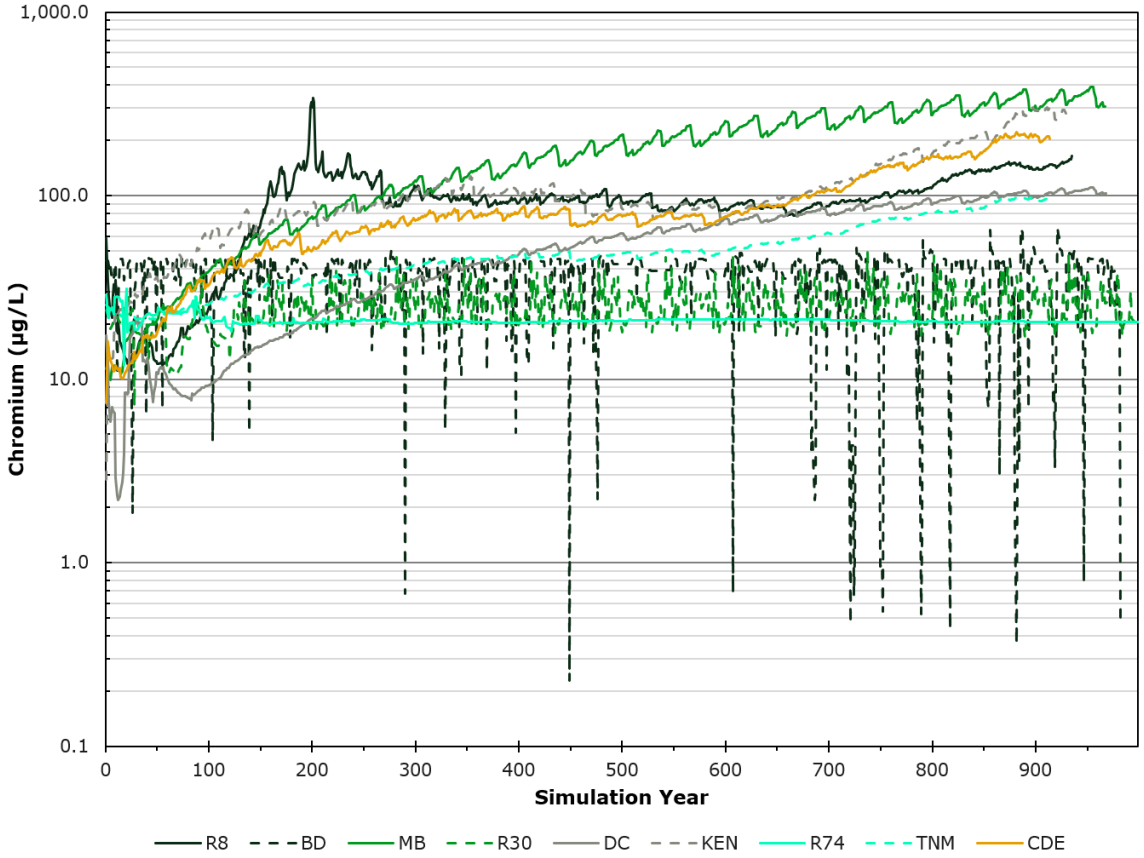


FIGURE A-7 CHROMIUM

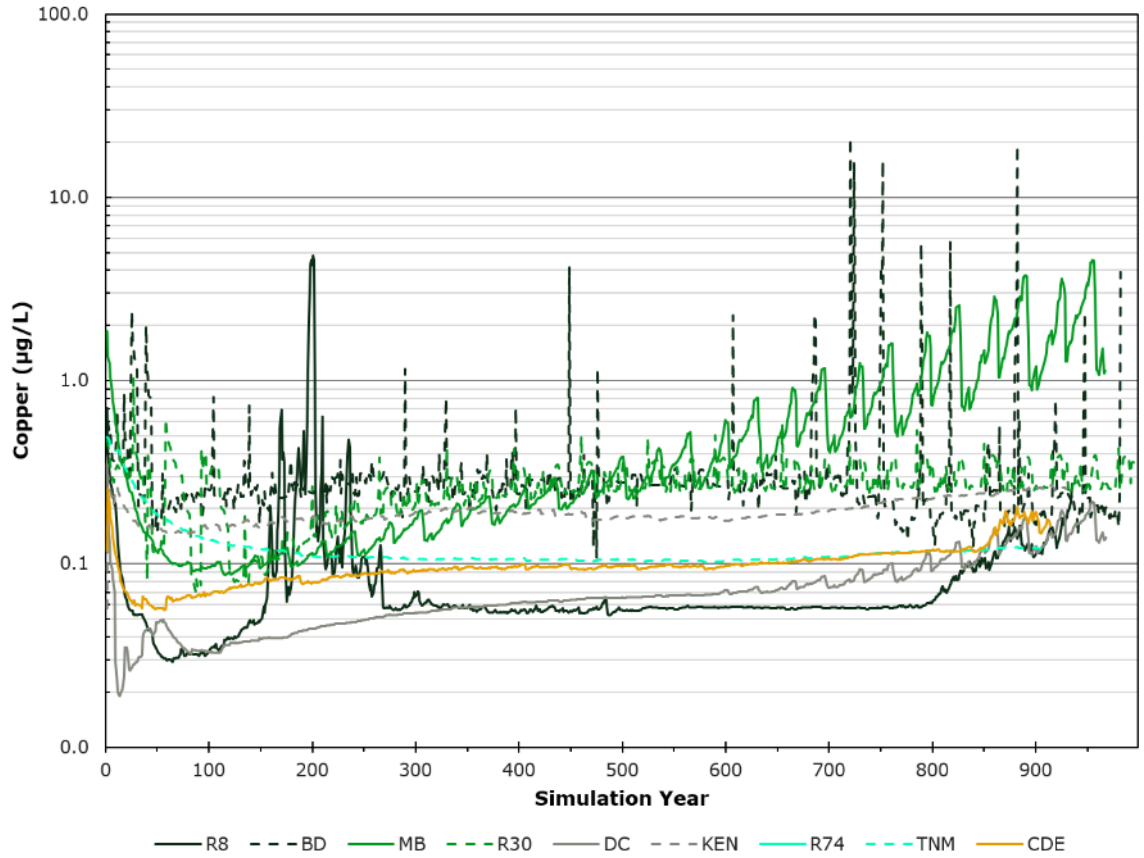


FIGURE A-8 COPPER

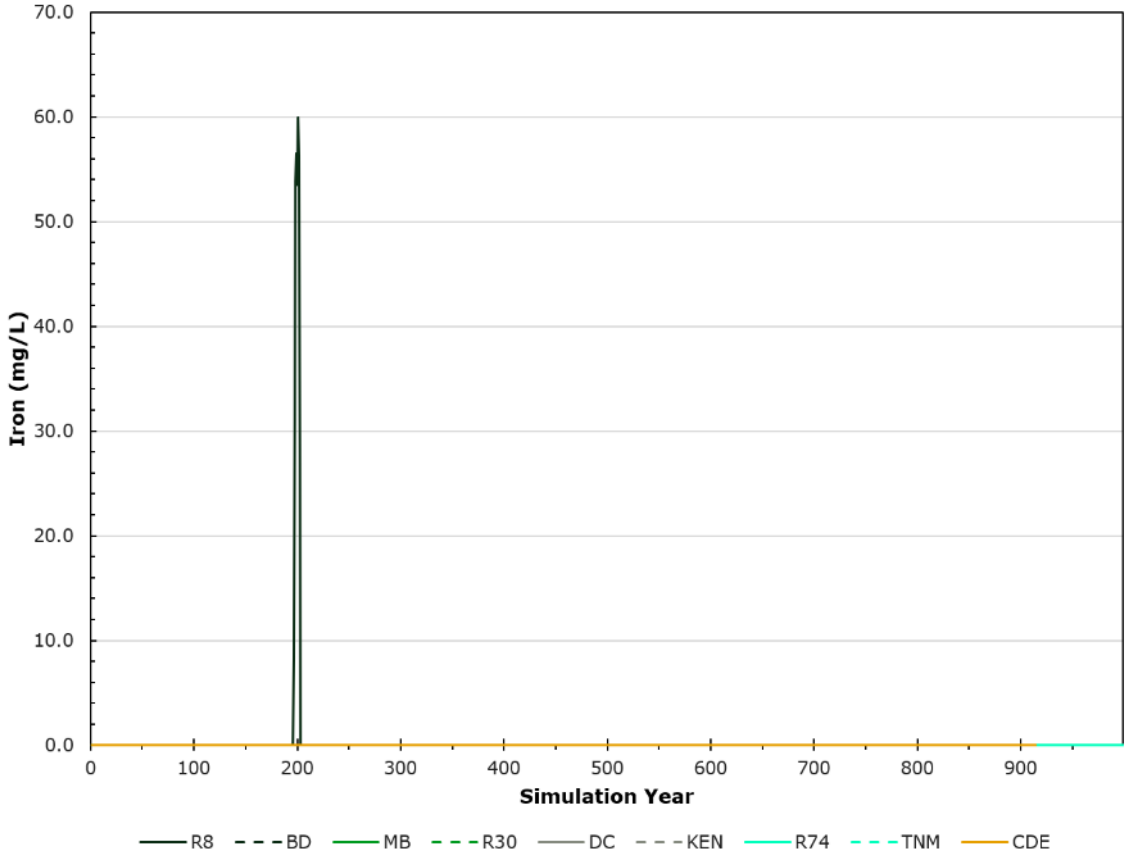


FIGURE A-9 IRON

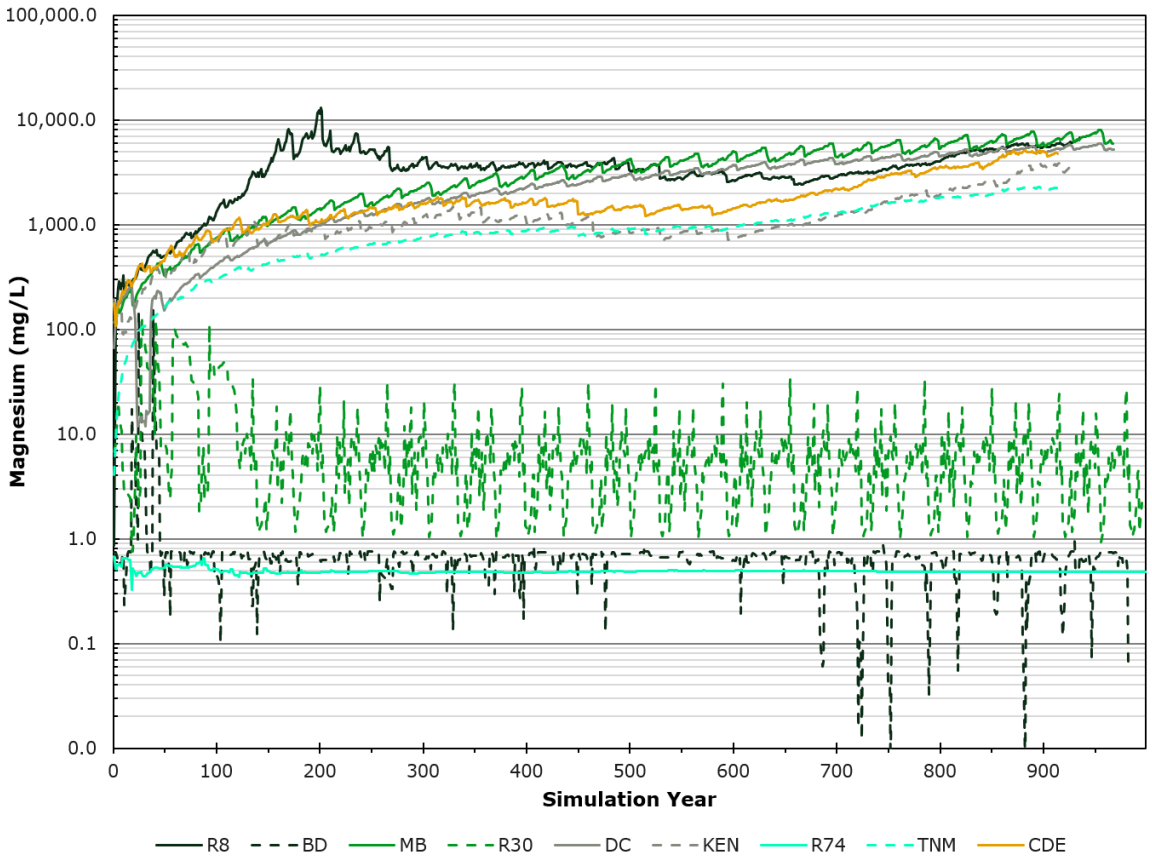


FIGURE A-10MAGNESIUM

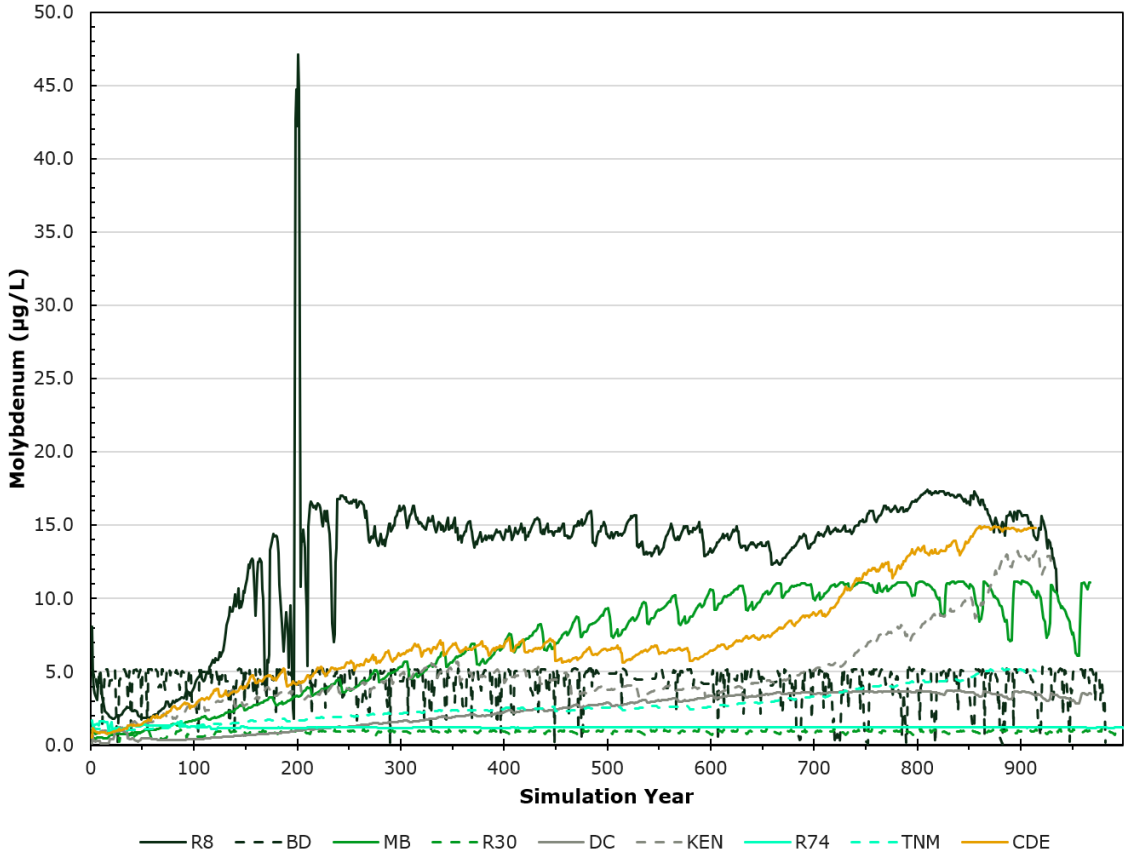


FIGURE A-11 MOLYBDENUM

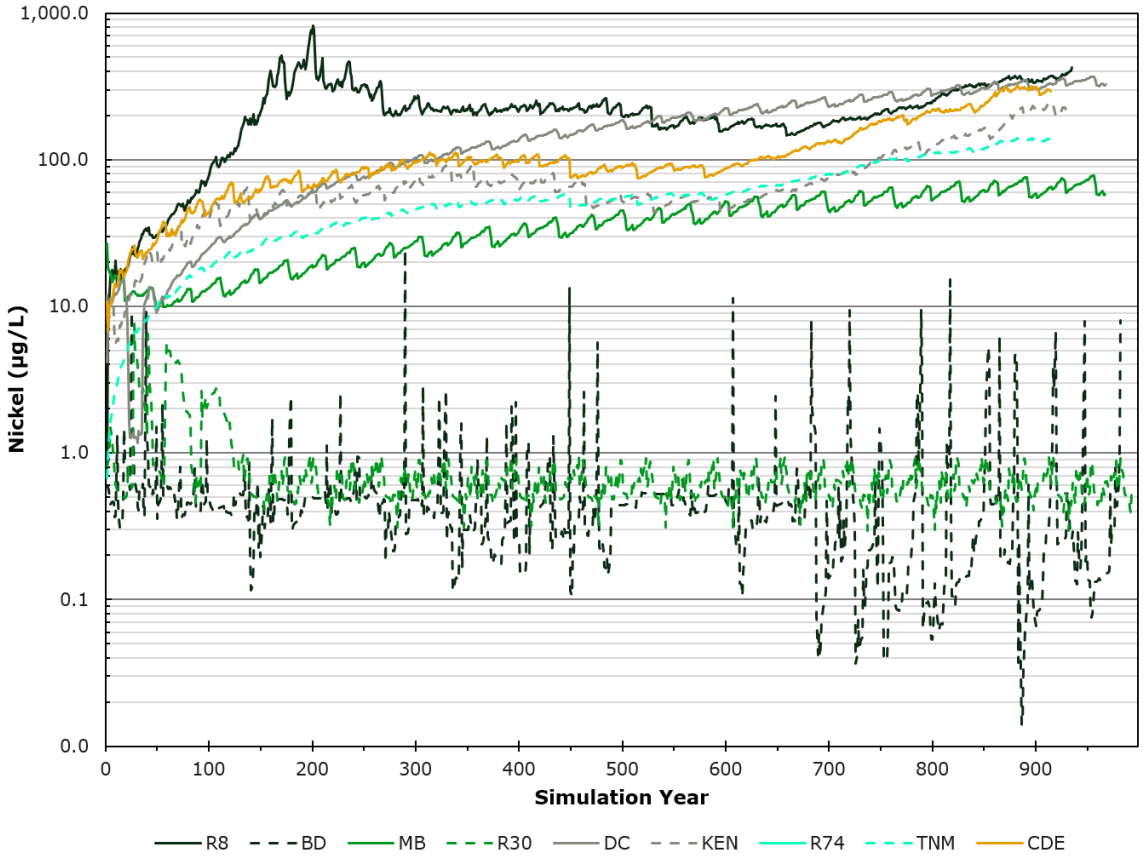


FIGURE A-12 NICKEL

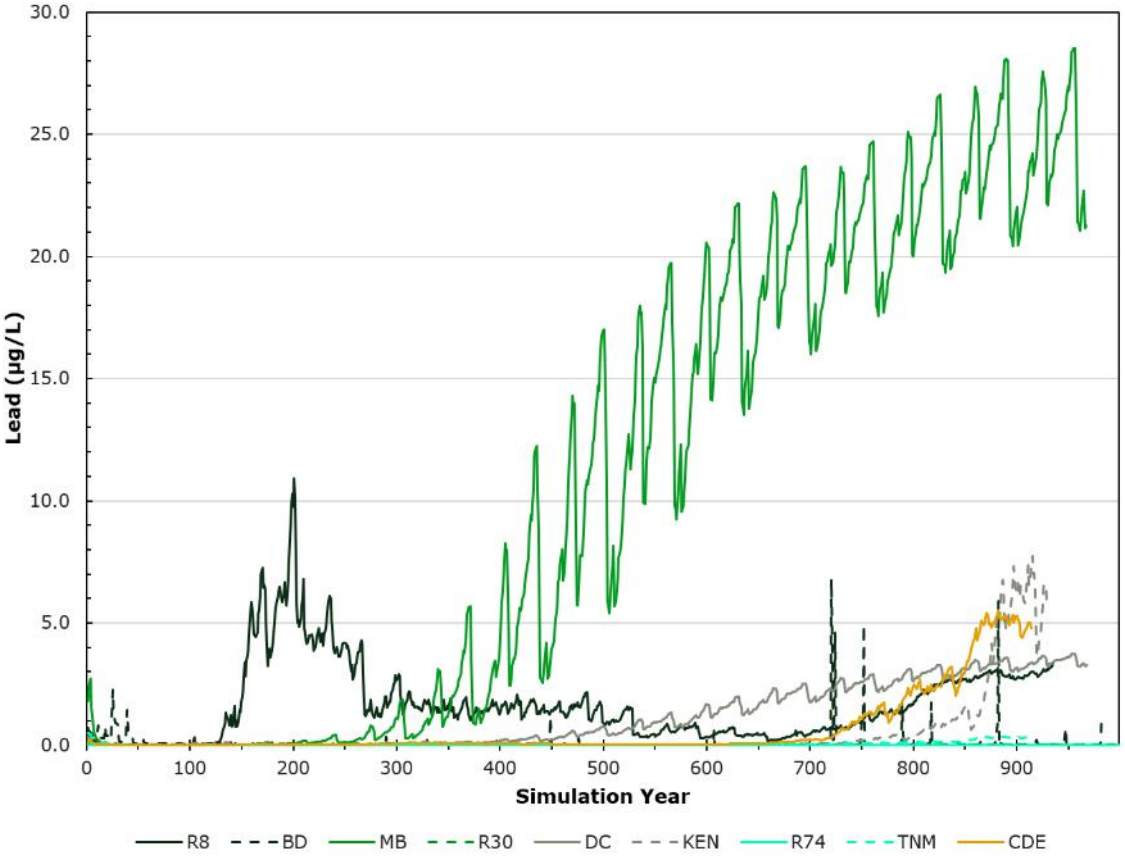


FIGURE A-13 LEAD

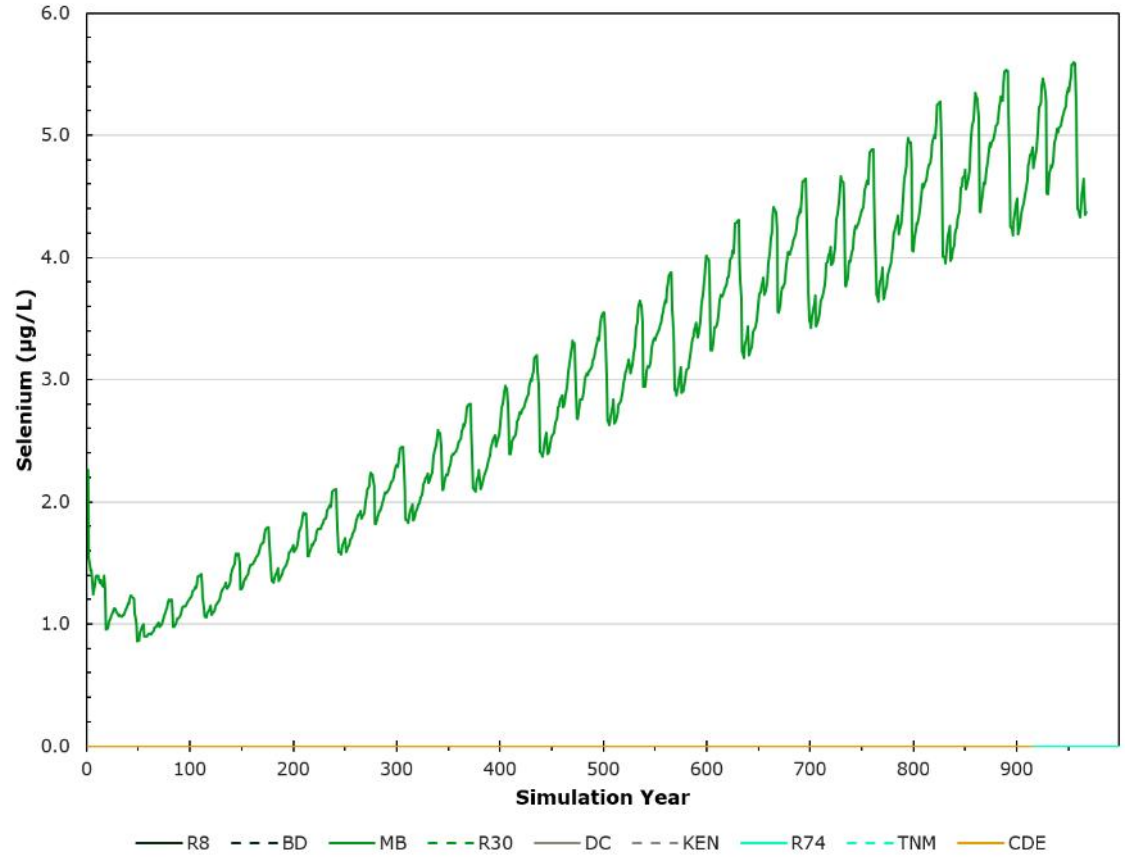


FIGURE A-14 SELENIUM

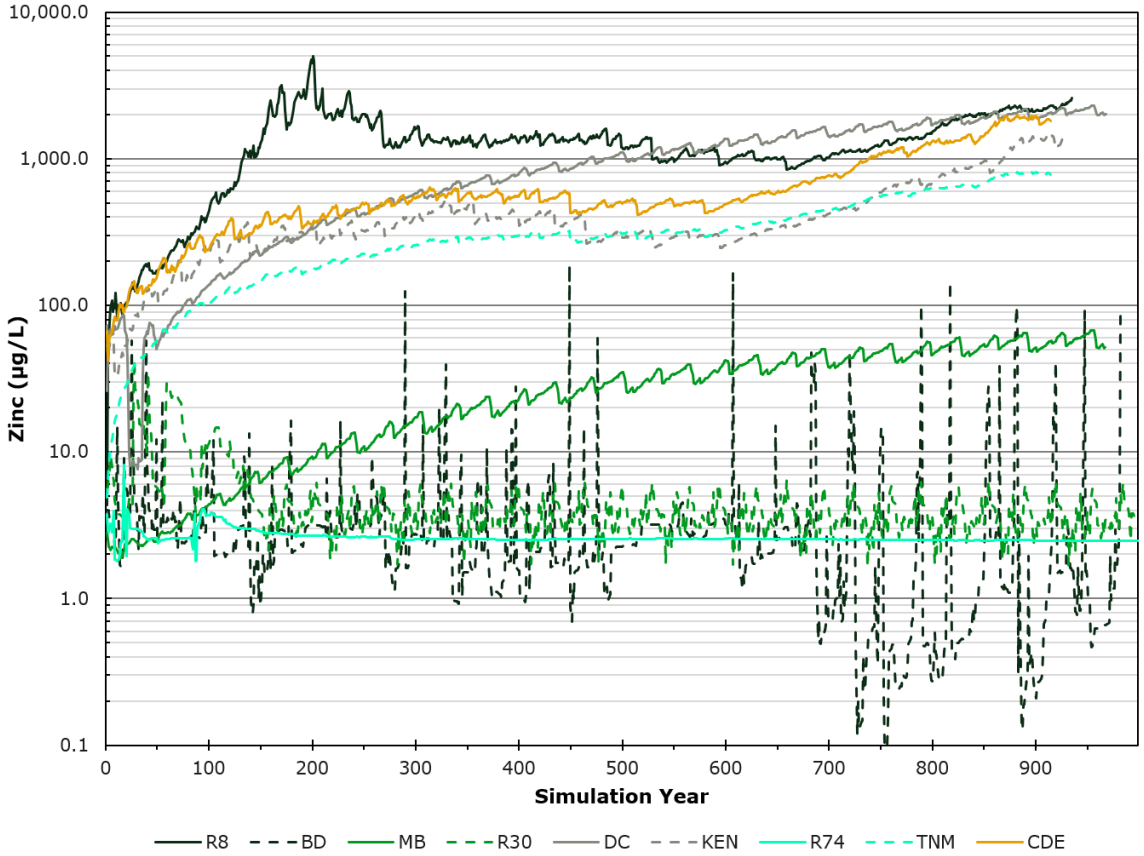


FIGURE A-15 ZINC

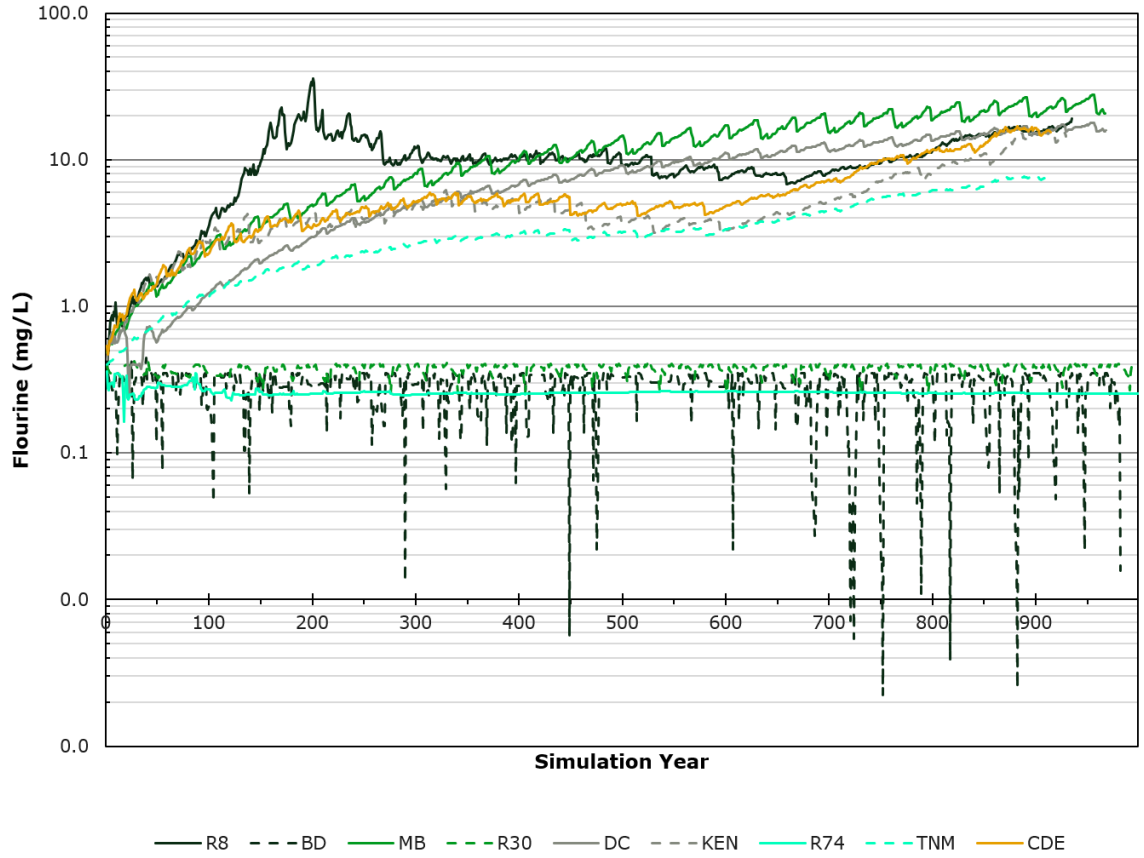


FIGURE A-16 FLUORINE

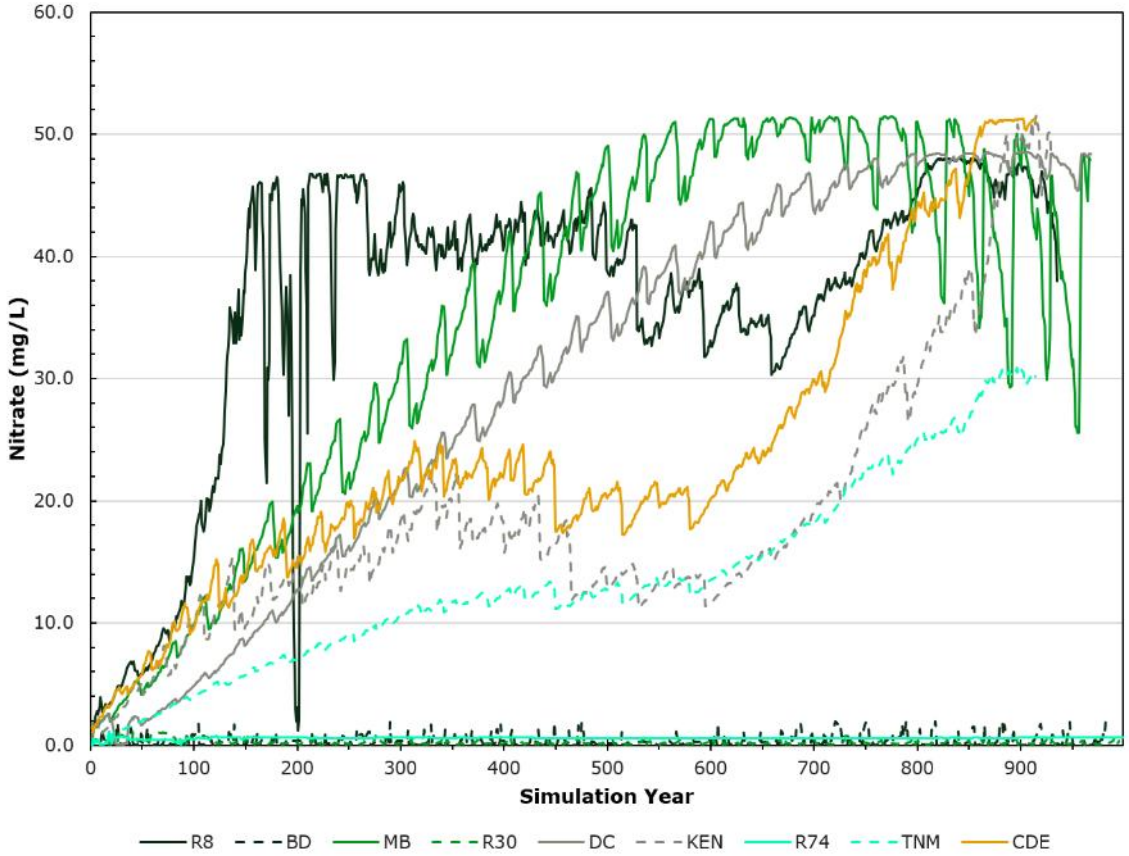


FIGURE A-17 NITRATE

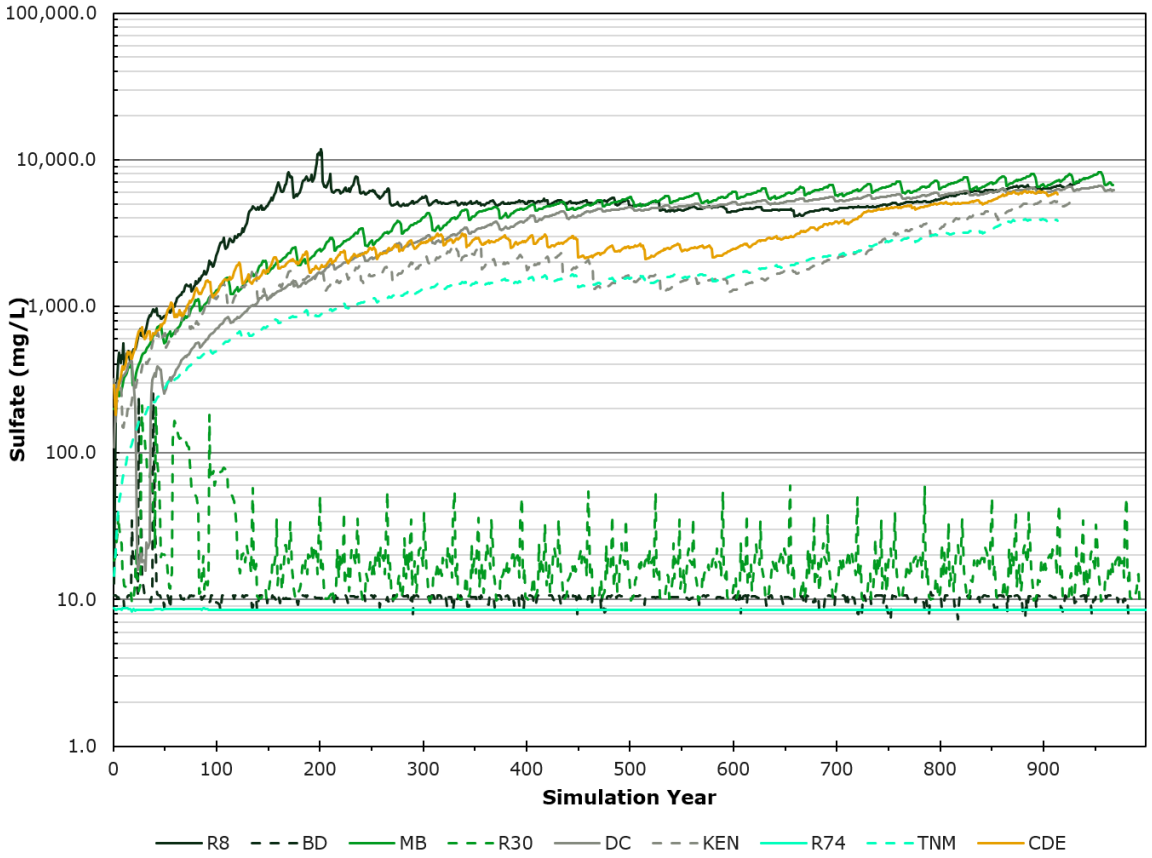


FIGURE A-18 SULFATE

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India
Indonesia
Ireland
Italy
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Malaysia
Mexico
Mozambique
Netherlands
New Zealand
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