Blackwater North Extension Project

Groundwater Impact Assessment

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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Whitehaven Blackwater Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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Appendices

Appendix A- 80th Percentile Summary Statistics and Comparison to Guideline Values (BWM EA Bores)

Appendix B Groundwater Modelling Technical Report

Acronyms and Abbreviations

ADWG	Australian Drinking Water Guidelines
ATP	Authority to Prospect
BoM	Bureau of Meteorology
BMA	BM Alliance Coal Operations Pty Ltd
BWM	Blackwater Mine
CHPP	Coal Handling and Preparation Plant
CRD	Cumulative Rainfall Departure
CSG	Coal Seam Gas
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEHP	Department of Environment and Heritage Protection
DES	Department of Environment and Science
DETSI	Department of Environment, Tourism, Science and Innovation
DRDMW	Department of Regional Development, Manufacturing and Water
EA	Environmental Authority
EP Act	Environmental Protection Act 1994
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EV	Environmental Value
GDE	Groundwater Dependent Ecosystems
GMA	Groundwater Management Area
GWDB	Registered Groundwater Bore Database
HES	High Ecological Significance
IESC	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Development
MNES	Matter of National Environmental Significance
NGIS	National Groundwater Information System
NHMRC	National Health and Medical Research Council
RCM	Rangal Coal Measures
ROM	Run of Mine
SILO	Scientific Information for Landowners
SLR	SLR Consulting Australia Pty Ltd
TDS	Total Dissolved Solids
TLF	Train Loadout Facilities
TSF	Tailings Storage Facility
UWIR	Underground Water Impact Report
VWP	Vibrating Wire Piezometer
Water Act	*Water Act 2000*



WQO	Water Quality Objective
WRP	Water Resource Plan

1.0 Introduction

1.1 Overview

SLR Consulting Australia Pty Ltd (SLR) was engaged by Whitehaven Blackwater Pty Ltd (Whitehaven) to assess the potential impacts of the proposed Blackwater Mine - North Extension Project (the Project) on groundwater values.

The assessment has been prepared to support the assessment of the Project under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and to support an application to amend the existing Environmental Authority (EA) for the Blackwater Mine (BWM) under the Queensland *Environmental Protection Act 1994* (EP Act).

The scope of this study is to:

- Describe the existing hydrogeological environment of the Project area and surrounds.
- Assess the potential impacts of the proposed extension of open cut mining on the groundwater system.
- Propose measures to manage or mitigate impacts on groundwater environmental values.

The study area for the purpose of this assessment is shown on **Figure 1-1** and is defined as the extent of the groundwater model domain (refer to **Section 6.0** for a description and extent), which includes the Project area and surrounds. The scope of this groundwater impact assessment is focused on the open cut mining operations proposed within the Project area, with cumulative impacts considered from other mines in the study area.

1.2 Project Background

The BWM is located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (**Figure 1-1**).

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, Environmental Authority (EA) EPML00717813, granted under the EP Act.

The BWM is approved to produce up to approximately 19 million tonnes per annum of (Mtpa) of Run-of-Mine (RoM) coal equating to approximately 16 Mtpa of product coal. The BWM strike length includes mining occurring in a number of separate and/or adjoining pits (**Figure 1-2**). Existing infrastructure is located primarily on ML1760 and includes a Train Load-out Facility (TLF) and coal stockpiles, RoM stockpiles, Coal Handling and Preparation Plant (CHPP), water management infrastructure and supporting infrastructure (i.e., roads, powerlines, laydown areas, workshop and administration areas).

The EA applies to the following Mining Leases (MLs) (**Figure 1-2**):

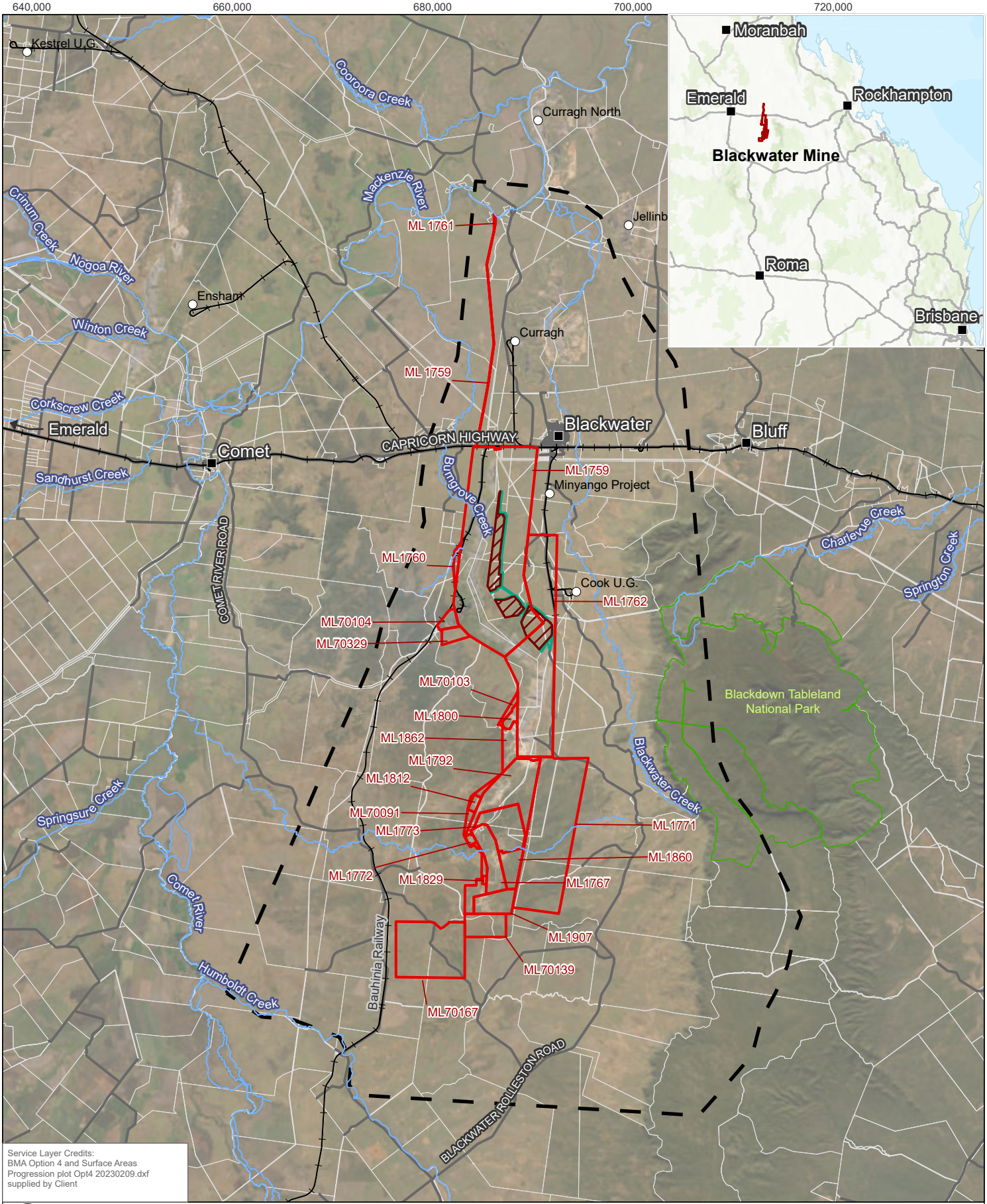
- ML1759
- ML1760
- ML1761
- ML1762
- ML1767
- ML70329
- ML1771
- ML1772
- ML1829
- ML1860
- ML1862
- ML1773
- ML1792
- ML1800
- ML1812
- ML1907
- ML70091
- ML70103
- ML70104
- ML70139
- ML70167

Whitehaven Blackwater seeks relevant State and Federal approvals to extend the current mining operation through the Blackwater North Extension Project (the Project). The Project would extend the mining area of the existing BWM to within Surface Area (SA)10 on ML1759 and SA7 on ML1762 (**Figure 1-2** and **Figure 1-3**). Importantly, the Project should be viewed in the context that it is an extension and continuation of ongoing mining operations on a portion of the significantly larger BWM mining operation.

The key elements of the Project include, but are not limited to, the following:

- extension of open cut operations into SA 7 on ML1762 and SA 10 on ML1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 Mt (approximately) of ROM coal;
- continued extraction of up to 19 Mtpa of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation activities of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.

SA7 on ML1762 and SA10 on ML1759 cover a total area of approximately 9,010 hectares (ha). The extent of the proposed Project open cut mining area and out of pit disturbance areas is approximately 2,317 ha of additional disturbance.



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:500,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

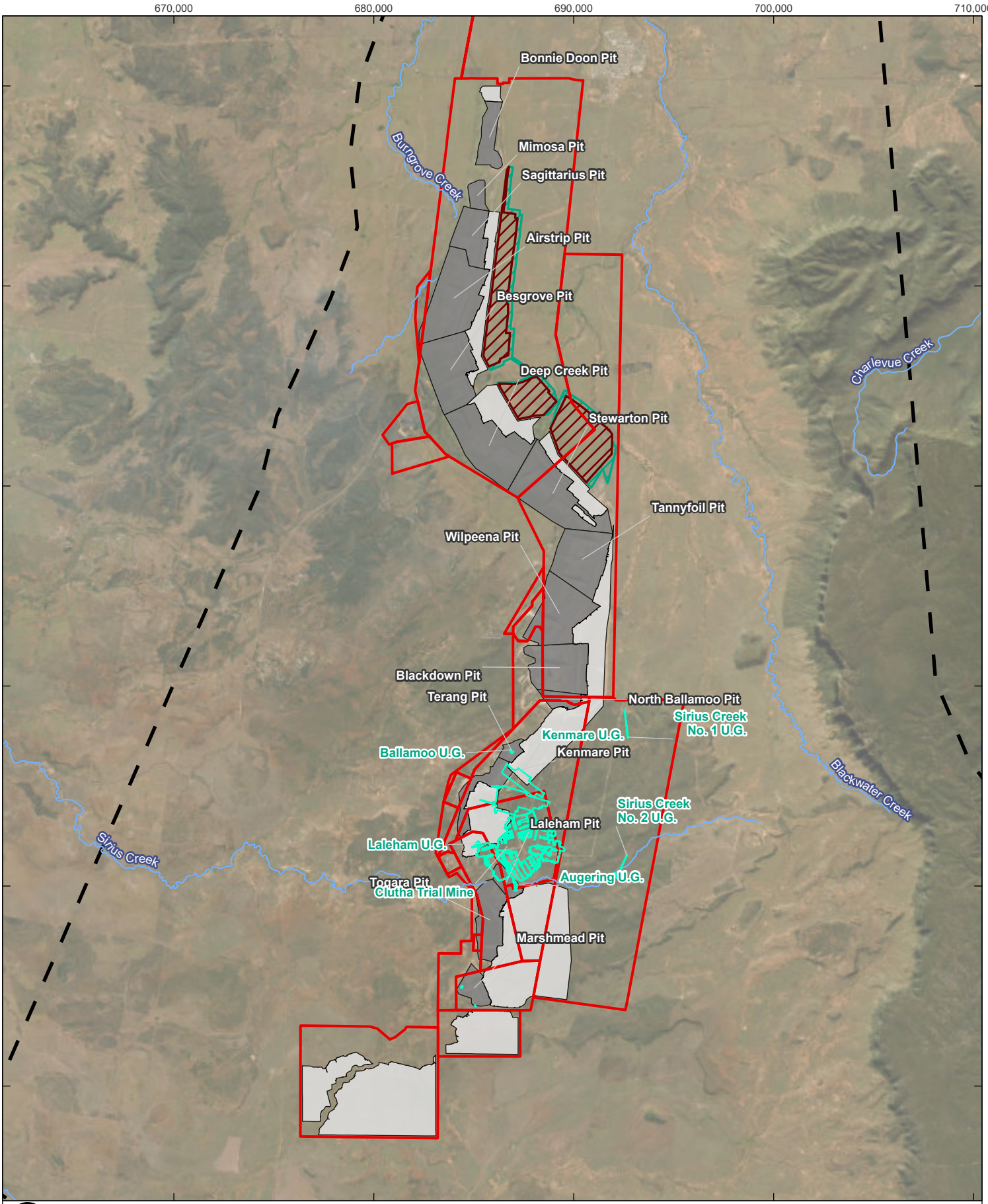
PROJECT LOCATION

SLR

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FIGURE 1-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F01_01_Project Location



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Watercourse
- Historical Underground Mine
- BWM Mining Lease
- GIA Study Area
- Future Pit Extent
- Historical Pit Extent
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT

GROUNDWATER ASSESSMENT

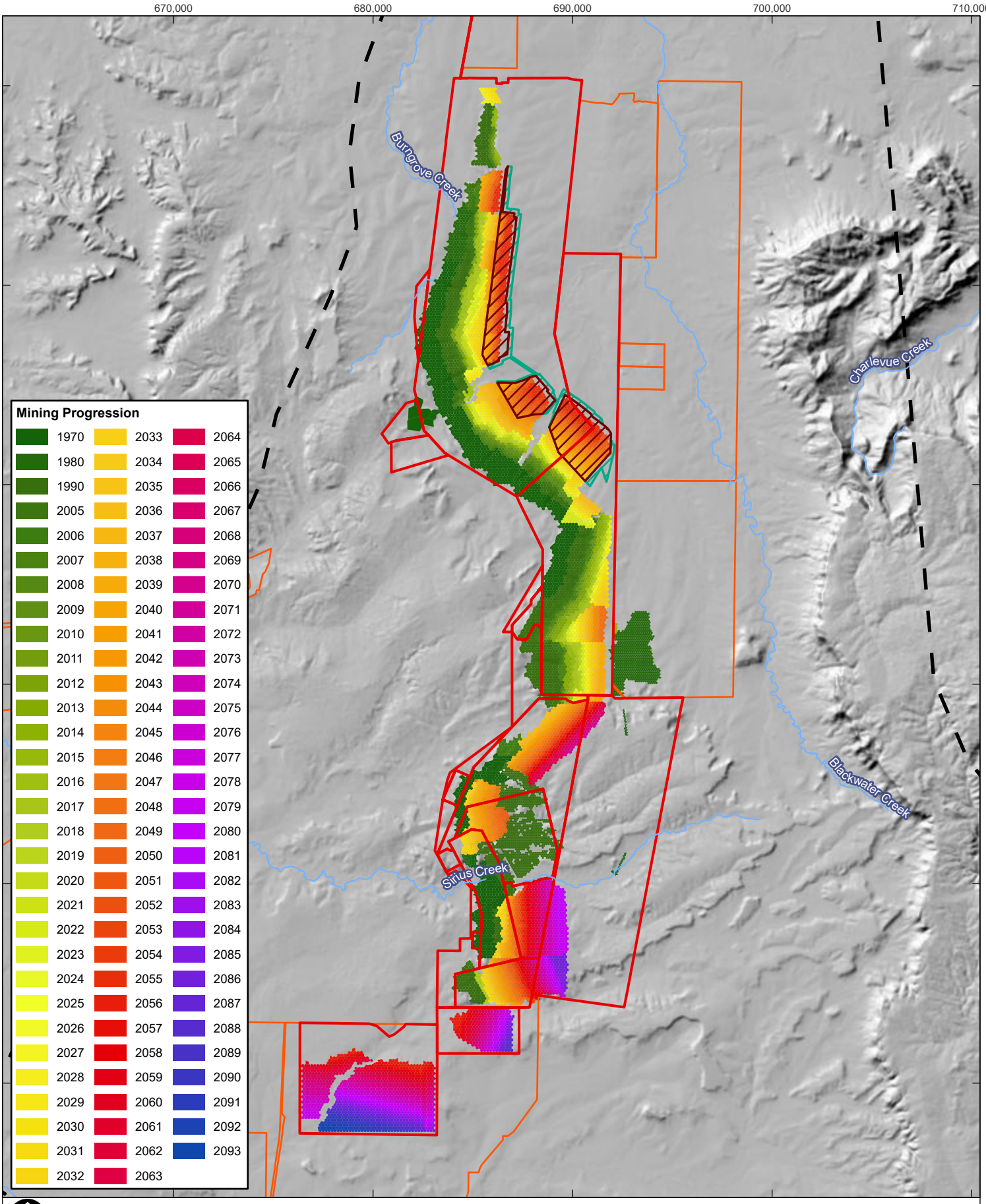
BWM MINING AREAS

SLR

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FIGURE 1-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F01_02_BWM_Mining_Areas


670,000
680,000
690,000
700,000
710,000
7,390,000
7,380,000
7,370,000
7,360,000
7,350,000
7,340,000
Burngrove Creek
Charlevue Creek
Blackwater Creek
Sirius Creek
Mining Progression
1970 1980 1990 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032
2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063
2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093
0 2.5 5 km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:250,000 at A4
Project Number: 640.031809.00001
Date Drawn: 08-Apr-2026
Drawn by: RB
LEGEND
Watercourse
BWM Mining Lease
Mining Lease
Proposed Open Cut Extension
Proposed Infrastructure Area
GIA Study Area
BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT
PROJECT INDICATIVE MINING PROGRESSION
SLR
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.
FIGURE 1-3
Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F01_03_Mining Progression

1.3 Study Objectives

This groundwater assessment was undertaken in accordance with the Queensland government requirements under Chapter 3 of the *Water Act 2000* (Qld) (Water Act), the EP Act and the Commonwealth government requirements under the EPBC Act, (specifically the Water Trigger, refer to **Section 2.1.1**).

To achieve regulatory requirements the groundwater assessment includes:

- A description of the existing hydrogeological environment.
- An assessment of the potential impacts of mining on the groundwater environment.
- Proposed management and mitigation measures.

In compiling these elements of the groundwater assessment, the scope of work detailed in this report was to:

- Summarise the relevant Queensland and Commonwealth environmental regulatory framework.
- Review relevant groundwater, geotechnical and environmental reports to characterise the geological and hydrogeological setting of the Project.
- Review publicly available hydrogeological data such as the Queensland Government's spatial data system (Queensland Globe) and the Bureau of Meteorology's (BoM) National Groundwater Information System (NGIS).
- Characterise the existing groundwater resources, including properties and quality.
- Conceptualise the groundwater regime of the Project area and study area.
- Assess the potential interaction between surface water and groundwater.
- Construct and calibrate a numerical groundwater flow model suitable for the assessment of potential impacts of the Project, in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).
- Perform predictive modelling for the scale and extent of mining impacts upon groundwater levels, groundwater quality and groundwater users at various stages during mine operations and post-mining.
- Perform predictive modelling of the cumulative impacts of the Project and surrounding mines.
- Assess the extent of groundwater impacts to groundwater users and environmental values due to the Project, including through long-term impacts on regional groundwater interception, groundwater drawdown, incidental water impact and post mining equilibrium.
- Document any groundwater dependent ecosystems (GDEs) in the vicinity of the Project that could be impacted by the Project resulting from short and/or long-term changes in the quantity and quality of groundwater.
- Assess potential third-party impacts (i.e. privately-owned bores) as a result of changes to the regional groundwater system due to the Project.
- Develop reasonable and practicable mitigation and management strategies where potential adverse impacts are identified.
- Outline proposed groundwater monitoring network and groundwater management.

2.0 Legislative Requirements and Relevant Guidelines

2.1 Legislation

Relevant legislation in relation to taking or interfering with groundwater resources in the study area is as follows:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Queensland *Water Act 2000* (Water Act):
  - Water Plan (Fitzroy Basin) 2011.
- Queensland *Environmental Protection Act 1994* (EP Act):
  - *Environmental Protection Regulation 2019*
  - *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water and Wetland Biodiversity).

The following sections summarise Commonwealth and Queensland groundwater legislation and policy relevant to the Project.

2.1.1 Commonwealth Environment Protection and Biodiversity Act 1999

The EPBC Act is administered by the Department of Climate Change, Energy, the Environment and Water (DCCEEW). The EPBC Act is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES). Under the EPBC Act, potentially significant impacts on groundwater resources are included where they pertain to a coal seam gas (CSG) or large coal mine development, known as the 'water trigger'.

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) is a statutory committee established under the EPBC Act that provides scientific advice to the Commonwealth Environment Minister and relevant State ministers. Guidelines have been developed in order to assist the IESC in reviewing CSG or large coal mining development proposals that are likely to have significant impacts on water resources. This includes completion of an independent peer review of numerical groundwater modelling in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). The IESC information requirements checklist is presented in **Table 2-1**, with details on where aspects have been addressed and documented within the report.

Table 2-1 IESC Information Requirements Checklist

Assessment Aspect and Checklist Item	Report Section Addressed
Description of the proposed project	
General	
Provide a regional overview of the proposed project area, including a description of the geological basin, coal resource, surface water catchments, groundwater systems, water-dependent assets (including terrestrial and aquatic GDEs), and past, present and reasonably foreseeable coal mining and CSG developments.	**Section 1.2**
Describe the proposal's location, purpose, scale, duration and disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	
Assess the frequency (and time lags, if any), location, volume and direction of interactions between water resources, including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.	
Regulatory Context	
Describe the statutory context, including information on the proposal's status within the regulatory assessment process and any applicable water management policies or regulations.	**Section 2.0**
Describe how potentially impacted water resources are currently being regulated under state or Commonwealth law, including whether there are any applicable standard conditions.	
Describe existing water quality guidelines, environmental flow objectives and other requirements (e.g., water planning rules) for the surface water catchments and groundwater basins within which the development proposal is based.	
Describe public health, recreation, amenity, Indigenous, tourism and/or agricultural values for each water resource, and the plans relevant to their management and protection.	
Groundwater Context	
Describe and map the geology at an appropriate level of horizontal and vertical resolution, including: • definition of the geological sequence(s) in the area, with names and descriptions of the formations and accompanying surface geology, cross-sections and any relevant field data • identification of hydrogeological sequences and characteristics.	**Sections 4.0** and **5.0**
Define and describe or characterise significant geological structures (e.g., faults, folds, intrusives) and associated fracturing in the area and their influence on groundwater – particularly groundwater flow, discharge or recharge. • Provide geological maps appropriately annotated with symbols that denote fault type, throw and the parts of sequences the faults intersect or displace (e.g., Murray and Power 2021). • Include discussion of how the faults potentially influence regional-scale groundwater conditions.	
Describe the likely recharge, discharge and flow pathways for all hydrogeological units likely to be impacted by the proposed development.	

Assessment Aspect and Checklist Item	Report Section Addressed
• Identify current stressors, including impacts from any currently approved projects.	
Describe the existing water quality of all aquifers in the project area. • Where groundwater is to be used for a given purpose such as irrigation, compare the data with relevant guideline values (ANZG 2018) and regional and local water quality objectives.	
Environmental impact assessment	
General	
Describe the intensity, duration, magnitude, timing and geographic extent of each potential impact, specifying the impact's significance and consequences, especially on the environmental condition and human values of each water resource.	**Sections 7.1**, **7.2**, **7.3** and **7.4**
For proposed expansions or modifications, distinguish potential impacts from those of the existing project, and include the likely contribution of the proposed expansion to potential cumulative impacts.	
Assess the significance of each impact with reference to the range of system behaviour found under pre-development conditions and natural environmental and climatic variability.	
Risk-based assessment	
Identify and assess all potential environmental risks to water resources and water-related assets, and their possible impacts. In selecting a risk-assessment approach, consideration should be given to the complexity of the project and the probability and potential consequences of the project's impacts.	**Section 7.6**
Describe the consultation with relevant stakeholders and regulators about the likely risks to water resources and water-related assets. This initial engagement should include agreement about the nature of the action, which assets (including water resources) may be impacted, and the likely sources of impacts and the receptors that may be affected.	N/A
The risk assessment should include a systematic and evidence-based assessment of: • the sources of environmental impacts in the project area • the exposure pathways by which impacts may be transferred from these sources to water resources (receptors), presented as one or more IPDs based on ecohydrological conceptualisation • the likely response of each receptor, especially when the impact(s) may be severe and likely to cause irreversible damage (posing a high risk) • 'hot spots', or areas in the project area (e.g., where vulnerable receptors occur close to impact sources) where risks are especially high • 'hot moments', or periods during and after the project (e.g., when activities are likely to generate major impact) when risks are especially high.	**Section 6.9**
Specify where and how each risk can be avoided or mitigated (or, as a last resort, requires appropriate offsets and/or a conservation payment), and: • provide evidence (preferably from equivalent activities and regions) for the feasibility and effectiveness of mitigation or offset methods	**Section 8.0**

Assessment Aspect and Checklist Item	Report Section Addressed
• describe how monitoring will be able to demonstrate the effectiveness of the mitigation measures.	
Describe the risks of potential cumulative impacts of all past, present and reasonably foreseeable actions and activities that are likely to impact on water resources, including from multiple stressors arising from the proposed action.	**Sections 7.1**, **7.2**, **7.3** and **7.4**
Specify all sources of uncertainty in the assessments of each risk and describe how information has been and will be collected to reduce this uncertainty.	See Groundwater Modelling Technical Report (**Appendix B**)
Investigate relevant context for the risk assessment, such as bioregional assessments, Commonwealth and state water resource plans (e.g., Murray-Darling Basin Plan, Hunter River Salinity Trading Scheme) and state processes such as those that apply in the Surat Cumulative Management Area and the Commonwealth's Joint Industry Framework on Coal Seam Gas.	**Sections 2.0** and **7.6**
Assess residual risks remaining after the implementation of the proposed mitigation and management options, to determine whether these effectively reduce risks to an acceptable level based on the identified environmental objectives.	**Sections 7.6** and **8.0**
Groundwater	
Undertake groundwater modelling in accordance with the *Australian groundwater modelling guidelines* (Barnett et al. 2012), including independent peer review.	**Section 6.0** and Groundwater Modelling Technical Report (**Appendix B**)
Describe each hydrogeological unit as incorporated in the groundwater model, including the thickness, storage and hydraulic characteristics, and hydraulic linkages between units, if any.	
Describe the existing recharge/discharge pathways of the units and the changes that are predicted to occur upon commencement, throughout, and after completion of the proposed project.	
Select and justify appropriate boundary conditions across the model domain to enable a comparison of groundwater model outputs to seasonal field observations.	
Where possible, calibration should incorporate measurements of both potentiometric head (or pressure) and flux, such as measured mine inflows or measured discharges to streams or springs.	
Undertake sensitivity analysis of boundary conditions and hydraulic and storage parameters, and justify the conditions applied in the final groundwater model. Where the interaction between surface water and groundwater is important, parameters describing their connectivity, such as riverbed conductance, should be assessed.	
Assess the potential impacts of the proposal, including how impacts are predicted to change over time and any residual long-term impacts. Consider and describe: • any hydrogeological units that will be directly or indirectly dewatered or depressurised (including lateral effects), interactions between water resources (inter-aquifer connectivity), and connectivity with sea water	

Assessment Aspect and Checklist Item	Report Section Addressed
• the magnitude, extent and change over time of drawdown/mounding, including the time for post-development equilibrium to be reached • the extent of impacts on surface water/groundwater connectivity, water-dependent assets, flow direction and surface topography, including resultant impacts on the groundwater balance • the potential range of drawdown at each affected bore, and clearly articulate the spatial and temporal scales of impacts on other water users • the potential impacts on hydraulic and storage properties of hydrogeological units, including changes in storage, potential for physical transmission of water within and between units, and estimates of likelihood of leakage of contaminants through hydrogeological units • the possible fracturing of and other damage to confining layers.	
Undertake an uncertainty analysis of key predictive outputs (i.e., quantities of interest as per Peeters and Middlemis, 2023).	
For each relevant hydrogeological unit, describe the proportional increase in groundwater use and impacts as a consequence of the proposed project, including an assessment of any consequential increase in demand for groundwater from towns or other industries resulting from associated population or economic growth due to the proposal.	
Closure, rehabilitation and post-development final landforms and voids	
Describe the timing and processes planned for cessation of operations and the closure of the development, particularly any risks of impacts on water-dependent assets that may arise during this phase (e.g., when dismantling and removing infrastructure). Explain how such risks will be avoided or mitigated.	Addressed in a separate PRCP report to be prepared for the Project
If appropriate, qualitatively describe the various final landform options that were considered and their likely legacy impacts on water resources. This context will be useful for justifying the choice of the proposed final landform and how it avoids or mitigates risks of legacy impacts on water resources.	
Ideally, describe how land disturbed by mining activities will be progressively rehabilitated to a safe and stable landform that does not cause environmental harm to water resources and is able to sustain one or more approved post-mining land uses (PMLUs). Give details of the consultation with regulators and the community about the intended PMLUs, the targets associated with their achievement, and how achievement of these targets may be hampered by, for example, site geology and climatic extremes.	
If requested by regulators, specify and justify the methods and techniques that will be used to achieve particular rehabilitation targets and milestones. Explain how these methods may be constrained by project-specific features (e.g., topography, climate, geology and hydrology).	
If appropriate, describe how the effectiveness of the proposed rehabilitation methods and techniques for protecting or restoring water resources will be monitored, and present details (e.g., parameters, sampling frequency) of a monitoring program for demonstrating successful achievement of the targeted PMLUs across the project area after mining or CSG extraction has finished. These monitoring programs should be linked to explicit milestones for completion of progressive stages of rehabilitation, and should include appropriate baseline data against which to judge the effectiveness of the rehabilitation.	

Assessment Aspect and Checklist Item	Report Section Addressed
Describe the final landform and any voids that may remain after closure, and specify the predicted legacy impacts that may persist, such as ongoing effects on surface water and groundwater movements and water quality, erosion and sedimentation, and habitat fragmentation of water-dependent species and communities. Evaluate the adequacy of the modelling underlying these predictions, especially all sources of uncertainty.	
Assess qualitatively the likely long-term risks of impacts on water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider: • stability (e.g., resistance to erosion and slumping), soil geochemistry and quality (relevant for post-closure establishment of vegetation) and the likely effects of the final landform on long-term surface water and groundwater behaviour (e.g., fluxes and runoff) and on water quality, including salinity, pH, toxicity and concentrations of contaminants • geochemistry and its potential effects on seepage through waste rock (e.g., fully or partially refilled voids, remnant rock dumps) and on the quality of water exiting from mine adits and other post-closure sources • groundwater behaviour and rate and depths of water table recovery, including timeframe and final levels of stabilisation • available measures (and their likely effectiveness and feasibility) to avoid or mitigate legacy impacts from the final landform and any voids on water resources and water-dependent assets.	
Baseline data	
For groundwaters, surface waters and ecological water-dependent assets that have been identified in the risk-based assessment, present data that are sufficient to establish pre-development (baseline) conditions and that have been collected at an appropriate sampling frequency and spatial coverage of monitoring sites, ideally over a period sufficiently long to characterise the impacts of climatic variability.	**Section 5.1** and **5.3**
Groundwater	
Provide data from surveyed boreholes to demonstrate the varying depths of the hydrogeological units and associated standing water levels or potentiometric heads, including directions of groundwater flow, contour maps and hydrographs.	**Section 5.0**
Present information from site-specific studies (e.g., geophysical, coring/wireline logging) to characterise the local stress regime and fault structure (e.g., damage zone size, open/closed along fault plane, presence of clay/shale smear, fault jogs or splays).	
Provide site-specific values for hydraulic parameters (e.g., vertical and horizontal hydraulic conductivity and specific yield or specific storage characteristics, including the data from which these parameters were derived) for each relevant hydrogeological unit. In situ observations of these parameters should be sufficient to characterise the heterogeneity of these properties for modelling.	
Provide hydrochemical characterisation (e.g., acidity/alkalinity, electrical conductivity, metals and major ions) and a suitable suite of environmental tracers (e.g., heat; stable isotopes of water; tritium, helium, strontium isotopes) (e.g., Kurukulasuriya et al. 2022; OWS 2020) commensurate with the risks of the proposed development to water resources and water-dependent assets.	

Assessment Aspect and Checklist Item	Report Section Addressed
Provide sufficient data on physical aquifer parameters and hydrogeochemistry to establish pre-development conditions, including fluctuations in groundwater levels at time intervals relevant to aquifer processes. This should include time-series data for water levels and water quality that represent seasonal and climatic cycles.	
Provide long-term groundwater monitoring data, including a comprehensive assessment of all relevant chemical parameters to inform changes in groundwater quality and detect potential contamination events.	
Monitoring and management	
Describe the rationale for selected monitoring parameters and their sampling duration, frequency and methods, including the use of satellite or aerial imagery to identify and monitor large-scale impacts. Target monitoring programs to address key areas of uncertainty, especially for valued assets and water resources that are at greater risk of impacts from the proposed development.	**Section 8.0**
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy guidelines (ANZG 2018) and relevant legislated state protocols (e.g., Queensland Government 2018).	
Identify and justify monitoring sites representative of the diversity of potentially affected water-dependent assets and the nature and scale of potential impacts. Match suitably replicated control and reference sites (BACI design, Downes et al. 2002) to enable detection and monitoring of potential impacts.	
Describe the processes employed to determine impact thresholds for water-dependent assets (e.g., threshold at which a significant impact on an asset may occur).	
Describe proposed mitigation and management actions, and their adequacy, for each significant impact identified, including any proposed mitigation or offset measures for long-term impacts post mining.	
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts, and provide evidence of the likely success of these measures (e.g., case studies).	
Propose adaptive management measures and management responses, giving details of trigger action response plans (TARPs) for valued assets and water resources that are at greater risk of impacts from the proposed development.	
Groundwater	
Describe a robust groundwater monitoring program using dedicated groundwater monitoring bores – including nested arrays where there may be connectivity between hydrogeological units – and targeting specific aquifers, providing information on the groundwater regime and on recharge and discharge processes and identifying changes in quantities and quality of groundwater over time.	**Section 8.0**
Where reinjection schemes are proposed to manage wastewater (e.g., managed aquifer recharge), the monitoring program should include components specifically targeted at identifying any potential impacts from this management action.	N/A
Cumulative impacts	

Assessment Aspect and Checklist Item	Report Section Addressed
Assess the condition and likely responses of all water-dependent assets and water resources likely to be cumulatively impacted by the proposed development combined with all developments (past, present and/or reasonably foreseeable) and other water-intensive activities.	**Sections 6.6.2.2**, **7.1**, **7.2** and **7.3**
Assess the cumulative impacts on potentially affected water-dependent assets and water resources, considering: • the full extent of potential impacts from the proposed project (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts) • all stages of the development, including exploration, operations and post-closure/rehabilitation • the likely spatial magnitude and timeframe over which cumulative impacts will occur (ensuring that the analysis has sufficiently broad geographic and temporal boundaries to include all potentially significant impacts) • opportunities to work with other water users to avoid or mitigate potential cumulative impacts to meet specified environmental objectives.	

2.1.2 Queensland Water Act 2000

The Water Act, supported by the subordinate *Water Regulation 2016*, is the primary legislation regulating groundwater resources in Queensland. The purpose of the Water Act is to advance sustainable management and efficient use of water resources by establishing a system for planning, allocation and use of water.

The statutory right of a tenure holder to take or interfere with underground water is granted as part of the ML approval under the *Mineral Resources Act 1989* (Qld) (MR Act), if the taking or interference with that water is necessarily and unavoidably obtained in the process of extracting the mineral resource. This water is termed ‘associated water’. In developing the Project, Whitehaven is proposing to exercise its underground water rights as part of planned mining activities. Chapter 3 of the Water Act then deals with the management of water related impacts resulting from such an exercise of underground water rights, including where the exercise of underground water rights had happened prior to the commencement of the Water Legislation Amendment Act 2016 per s1283 of the Water Act 2000 (Qld). As this occurred on ML1759 and ML1762 (per correspondence to the Department of Environment and Heritage Protection (DEHP) (now the Department of Environment, Tourism, Science and Innovation [DETSI]) on 3 March 2017), no additional water licence or Underground Water Impact Report (UWIR) is required to be prepared for the Project.

2.1.2.1 Management Framework Relevant to the Project

Water resources within the Project area are managed under the *Water Act 2000* (Qld) through statutory water plans and supporting implementation instruments. The Water Plan (Fitzroy Basin) 2011 provides primary framework for the sustainable management of surface water, overland flow and groundwater resources across the majority of the Project area. The water plan establishes outcomes, objectives and performance indicators, and defines Groundwater Management Areas (GMAs) and their component groundwater units .

The Water Plan is implemented through water management protocols, and where applicable residual resource operation plans, in accordance with the *Water Regulation 2016*. These instruments set out the operational rules for water access, allocation and use, including

requirements for authorisation to take non-associated groundwater from regulated GMAs and groundwater units. Permitted purposes for taking non-associated groundwater are defined under the relevant water plan, the *Water Regulation 2016* or applicable local water management policies.

Surface water resources within the Project area fall within the Water Plan (Fitzroy Basin) 2011, Upper Mackenzie River catchment.

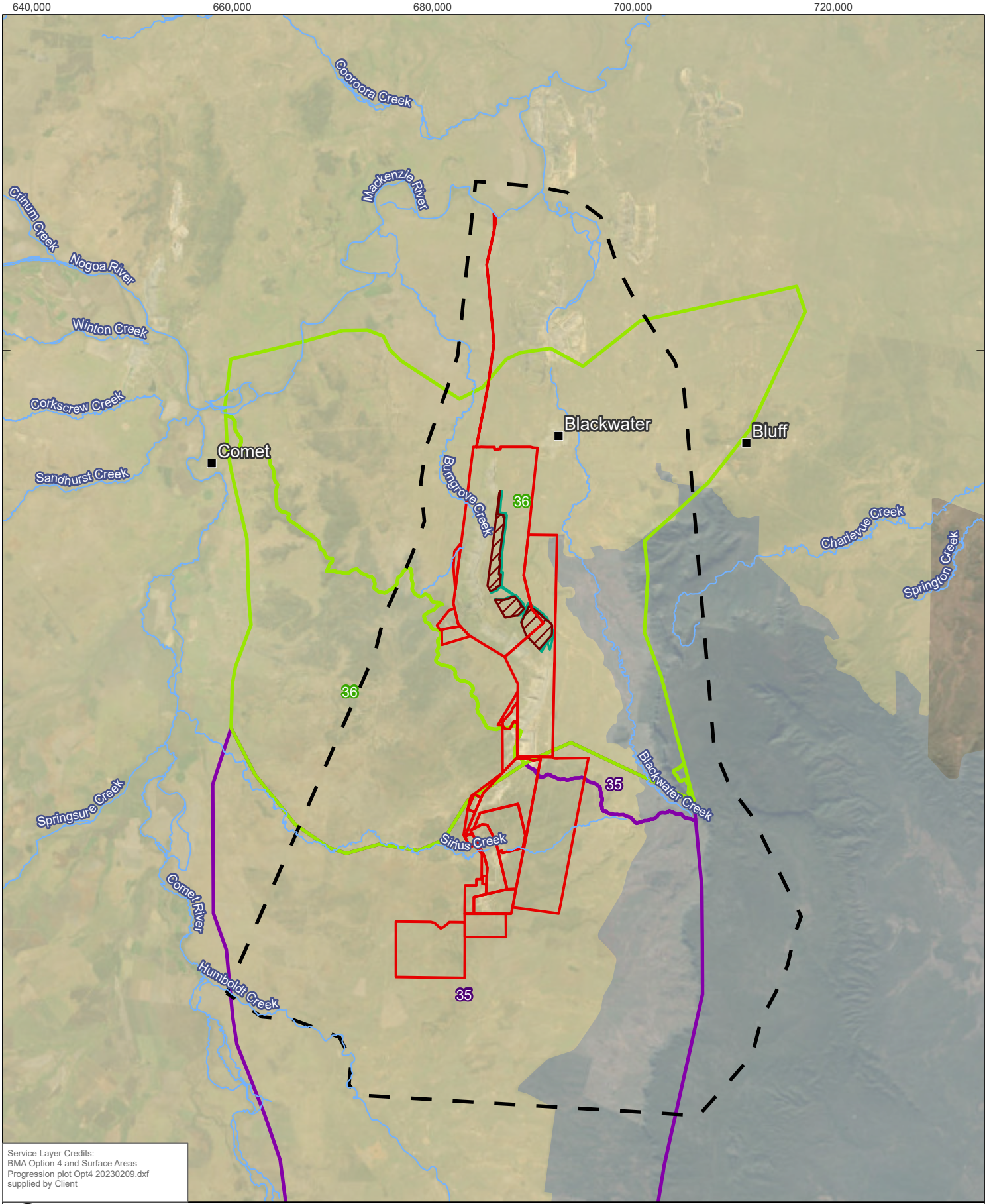
The *Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017* (GABORA) applies to groundwater resources outside the Fitzroy Basin plan area. The BWM MLs are predominantly located within the Fitzroy Basin plan area, however a small portion of ML 1762 (but not within the Project area) intersects the GABORA water plan area. Groundwater resources within that area are therefore subject to the provisions of the GABORA water plan, while the remainer of the BWM MLs are regulated under the Water Plan (Fitzroy Basin) 2011.

As part of the Project, Whitehaven is proposing to continue to exercise underground water rights during the period in which resource activities will be carried out within ML1759 and ML1762. The Project will affect groundwater within the Highlands GMA under the Water Plan (Fitzroy Basin) 2011, as shown on **Figure 2-1**. This relates to both Groundwater Unit 1 (containing aquifers of the Quaternary alluvium) and Groundwater Unit 2 (sub-artesian aquifers).

2.1.2.2 Water Act Declared Watercourses and Drainage

The Water Act includes criteria for determining watercourses that require authorisation under the Water Act to take water, interfere with the flow of water, take quarry material or excavate and place fill in a watercourse. The Water Act also includes criteria for drainage features that may require authorisation to take or interfere with overland flow. In the vicinity of the Project area, Blackwater Creek, the lower part of Taurus Creek and Sagittarius Creek, and Burngrove Creek are defined as a watercourse under the Water Act criteria, and several small tributaries of these watercourses that traverse the Project area are defined as drainage features.

These watercourses and drainage features may be relevant to the groundwater assessment for the Project if there is a component of surface water-groundwater interaction associated with them.



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:500,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MANAGEMENT AREAS AND CHEMISTRY ZONES

SLR

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FIGURE 2-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F02_01_Groundwater Management Areas and Chemistry Zones

2.1.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The EPP Water and Wetland Biodiversity aims to achieve objectives set out by the EP Act, and is applicable to all Queensland waters. Environmental values (EVs) and water quality objectives (WQOs) are determined for Queensland waters, in alignment with the EPP Water and Wetland Biodiversity.

EPP Water and Wetland Biodiversity provides a framework to achieve the water and wetland objectives that are set out by the EP Act through:

- Identifying environmental values and management goals for Queensland waters.
- Providing state water quality guidelines and WQOs to enhance or protect the environmental values.
- Providing a framework for making consistent, equitable and informed decisions.
- Monitoring and reporting on the condition of Queensland waters.

Groundwater resources within the vicinity of the Project are scheduled under the EPP Water and Wetland Biodiversity as Schedule 1 Plan WQ1310 Groundwaters. The Project falls under groundwater chemistry Zone 36 of this Plan. The legislated EVs for these groundwaters are:

- Biological integrity of aquatic ecosystems.
- Human use EVs:
    - Suitability of water supply for irrigation.
    - Farm water supply/use.
    - Stock watering.
    - Drinking water supply.
    - Industrial use.
    - Cultural and spiritual values.

The EPP Water and Wetland Biodiversity also provides limited water quality objectives for underground aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs provided in the EPP Water and Wetland Biodiversity are classified by groundwater depth and regional chemistry zone.

Surface water resources within the vicinity of the Project study area are scheduled under the EPP Water and Wetland Biodiversity as:

- Waters of the Mackenzie southern tributaries of the Upper Mackenzie Sub-basin (WQ1304).
- Waters of the Comet River eastern tributaries of the Comet River Sub-basin (WQ1307).

The legislated EVs for these surface waters are:

- Biological integrity of aquatic ecosystems.
- Human use EVs:
    - Suitability of water supply for irrigation (not for WQ1304).
    - Farm water supply/use.
    - Stock watering.



- Human consumption.
- Primary recreation.
- Secondary recreation.
- Visual recreation.
- Drinking water supply.
- Industrial water supply.
- Cultural and spiritual values.

The surface water WQOs for the Waters of the Mackenzie southern tributaries of the Upper Mackenzie Sub-basin (WQ1304) may be relevant to the groundwater assessment for the Project if there is a component of surface water-groundwater interaction associated with them.

2.1.4 Environmental Authority

Under the EP Act, an environmental assessment is required as part of the application for an Environmental Authority (EA), or the application for an amendment to an existing EA, to undertake an environmentally relevant activity. The process assesses the potential environmental impacts of the Project, and how impacts should be avoided, minimised and managed. DETSI is responsible for the administration and delivery of applications for an EA, and amendment applications. The current operations are approved under EA EPML00717813.

2.2 Relevant Guidelines

There are several available guidelines designed to assist proponents to meet the relevant legislative requirements to complete a groundwater assessment for coal mining proposals such as the Project. These guidelines are:

- IESC (2024). *Information guidelines for proponents preparing coal seam gas and large coal mining development proposals* – EPBC Act.
- IESC (2024). *Information Guidelines Explanatory Note: Using impact pathway diagrams based on ecohydrological conceptualisation in environmental impact assessment.* Commonwealth of Australia.
- Murray, T.A. and Power, W.L. (2021). *Information Guidelines Explanatory Note: Characterisation and modelling of geological fault zones*. Commonwealth of Australia. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of Agriculture, Water and the Environment, Commonwealth of Australia.
- Peeters LJM and Middlemis H (2023). *Information Guidelines Explanatory Note: Uncertainty analysis for groundwater modelling, A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of Climate Change, Energy, the Environment and Water*, Commonwealth of Australia.
- Doody, T.M., Hancock, P.J. & Pritchard, J.L. (2019). *Information Guidelines Explanatory Note. Assessing groundwater-dependent ecosystems* – EPBC Act.
- Barnett et al., (2012). *Australian Groundwater Modelling Guidelines.* Waterlines report. National Water Commission, Canberra.

3.0 Existing Conditions

3.1 Climate

The climate of the study area is sub-humid/sub-tropical, with a distinct wet and dry season. Historical climate data was obtained for the period from January 1970 to July 2025 from the Scientific Information for Landowners (SILO) database (Queensland Government, 2025). Data from the BWM weather station is limited to a relatively short record of rainfall data. Therefore, the SILO climate record for grid point data located at latitude -23.70, and longitude 148.85, which lies within the EA Boundary, is used to understand long-term climate trends. Rainfall data from the BWM site weather station is available from January 2016 to January 2025. A comparison between monthly rainfall, as recorded at the BWM site weather station, and monthly rainfall from the SILO climate record is presented on **Figure 3-1** for the most recent year of available data. The two data sets generally correlate well over the overlapping period, which justifies using the SILO climate record data to understand long-term climate trends and the climate input for the Project groundwater modelling (**Section 6.0**).

Long-term average monthly rainfall, Morton's areal actual evapotranspiration and Class A Pan evaporation from SILO is presented in **Table 3-1**. The study area is characterised by a long-term average rainfall of approximately 549 mm per year, with wetter conditions during the summer months of December, January and February and relatively dry conditions during the remainder of the year. As shown in **Figure 3-2** average monthly evaporation and evapotranspiration exceed rainfall in all months. Within the study area, the highest rate of evapotranspiration occurs along creek lines, where the water table is closer to ground surface and deeper-rooted vegetation is present.

To place rainfall over the years into an historical context, cumulative rainfall departure (CRD) was calculated for the period of January 1970 to July 2025 (**Figure 3-3**). This is a summation of the monthly departures of rainfall from the long-term average monthly rainfall. A rising slope in the CRD plot indicates periods of rainfall above the long-term average, as is the case from March 2022 to December 2022, whereas a falling slope indicates periods when rainfall is below the long-term average (e.g. February 2018 to September 2021). Rainfall volumes over the more recent period of the record (i.e. December 2022 to July 2025) have been predominantly average, as is indicated by the roughly horizontal trend in the CRD (**Figure 3-3**).

In addition, the CRD is used to assess the recharge of groundwater via rainfall. Where observed groundwater level trends mimic the pattern of the CRD curve, it is considered that natural fluctuations in the groundwater table can result from temporal changes in rainfall recharge to groundwater systems. Typically, changes in groundwater elevation can reflect the deviation between the long-term monthly (or yearly) average rainfall, and the actual rainfall, as illustrated by the CRD. The CRD and observed groundwater levels are discussed as a means to characterise climatic conditions within the assessment of groundwater levels (see **Section 5**).



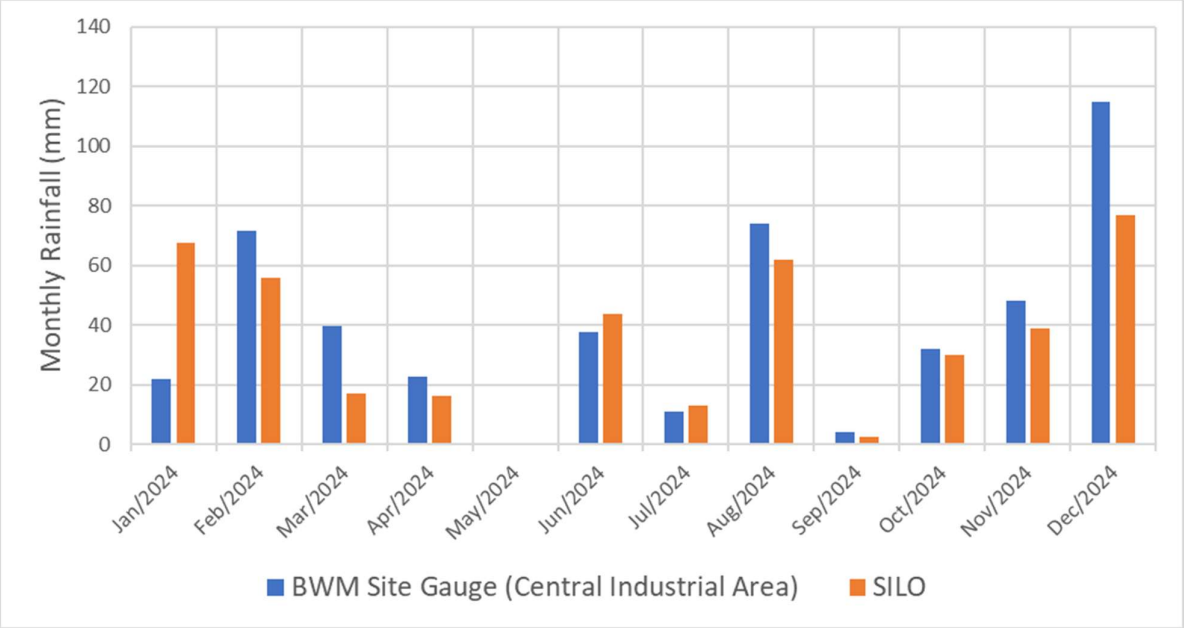


Figure 3-1 Monthly Rainfall at the BWM Site Station and SILO Data Location (2024)

Table 3-1 Total Monthly Rainfall, Evaporation and Evapotranspiration (January 1970 to July 2025)

Average Total Monthly[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)	88	74	49	29	32	23	22	17	24	45	62	84	549
Evaporation (class A Pan) (mm)	229	186	189	148	114	91	98	130	171	213	225	241	2036
Evapotranspiration (Morton's areal actual) (mm)	134	113	106	68	43	31	35	52	71	98	115	134	999

1 SILO (Queensland Government, 2025)

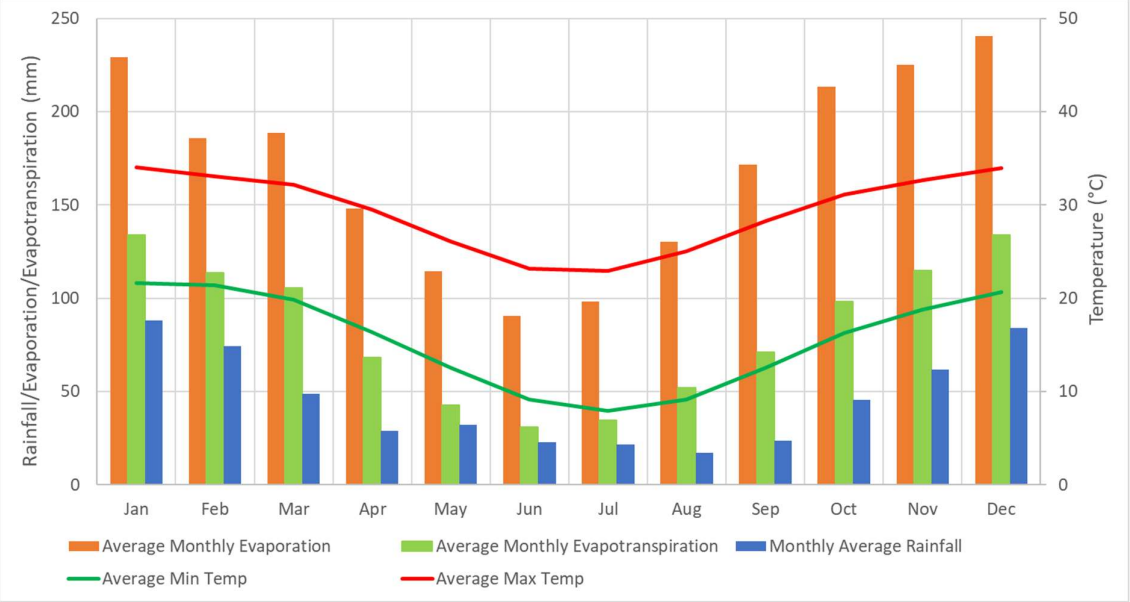


Figure 3-2 Average Monthly Evaporation, Evapotranspiration, Rainfall and Temperature (January 1970 to July 2025)

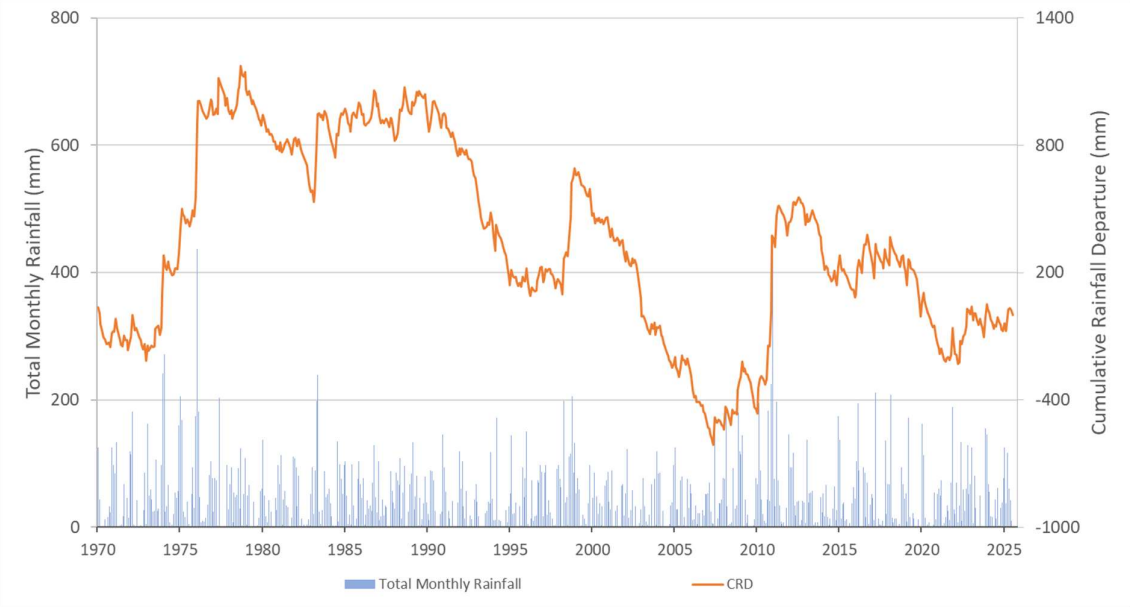


Figure 3-3 Cumulative Rainfall Departure and Total Monthly Rainfall

3.2 Topography and Drainage

The study area topography is relatively flat, with elevations of 280 mAHD in the south to around 150 mAHD in the north, at an average gradient of between 1:100 and 1:240. To the south of BWM, there are hills with elevations around 350 mAHD, which form the catchment divide between the Mackenzie and the Comet sub-catchments (**Figure 3-5**).

Approximately 10 to 15 km to the east of BWM, toward the eastern boundary of the study area, there is an outcrop of the Clematis Group sandstone, which reaches an elevation up to 750 mAHD.

BWM is located across two surface sub-catchments of the Water Plan (Fitzroy Basin) 2011:

- The Upper Mackenzie sub-catchment, which is located within the northern portion of BWM.
- The Comet sub-catchment, which is located within the southern portion of BWM.

The surface drainage comprises several ephemeral creeks that are tributaries of the Mackenzie and Comet Rivers. Creeks that flow in the Upper Mackenzie sub-catchment drain from south to north towards the Mackenzie River, whilst creeks that flow in the Comet sub-catchment drain from east to west towards the Comet River. The Project area is located in the Mackenzie sub-catchment and the most prominent drainage feature in the area is Blackwater Creek.

The ephemeral creeks have intermittent flow and typically contain water after high intensity rainfall events (AGE, 2003). **Figure 3-4** shows the average daily water level measurements in Blackwater Creek (Blackwater Creek D/S monitoring point as shown on **Figure 3-5**) compared to the daily rainfall (SILO climate record, refer to **Section 3.1**)**.** After large rainfall events, generally considered to exceed approximately 30 mm/day, the creek records flow. The flows subsequently recede during drier periods.

Groundwater interaction with ephemeral creeks is considered unlikely within the study area for the alluvium and underlying Regolith. Groundwater and surface water interaction is discussed in more detail in **Section 5.6.2**.

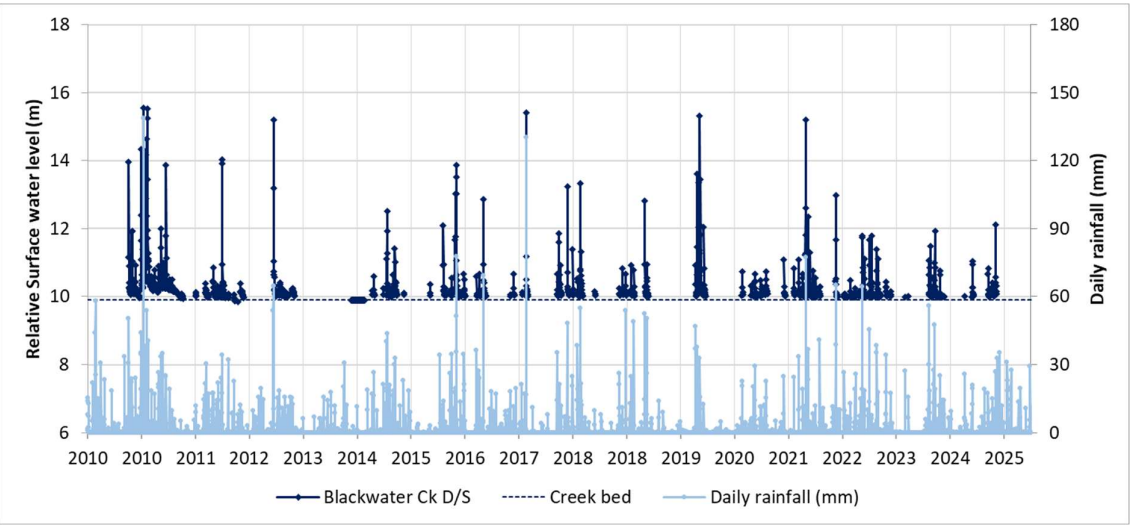
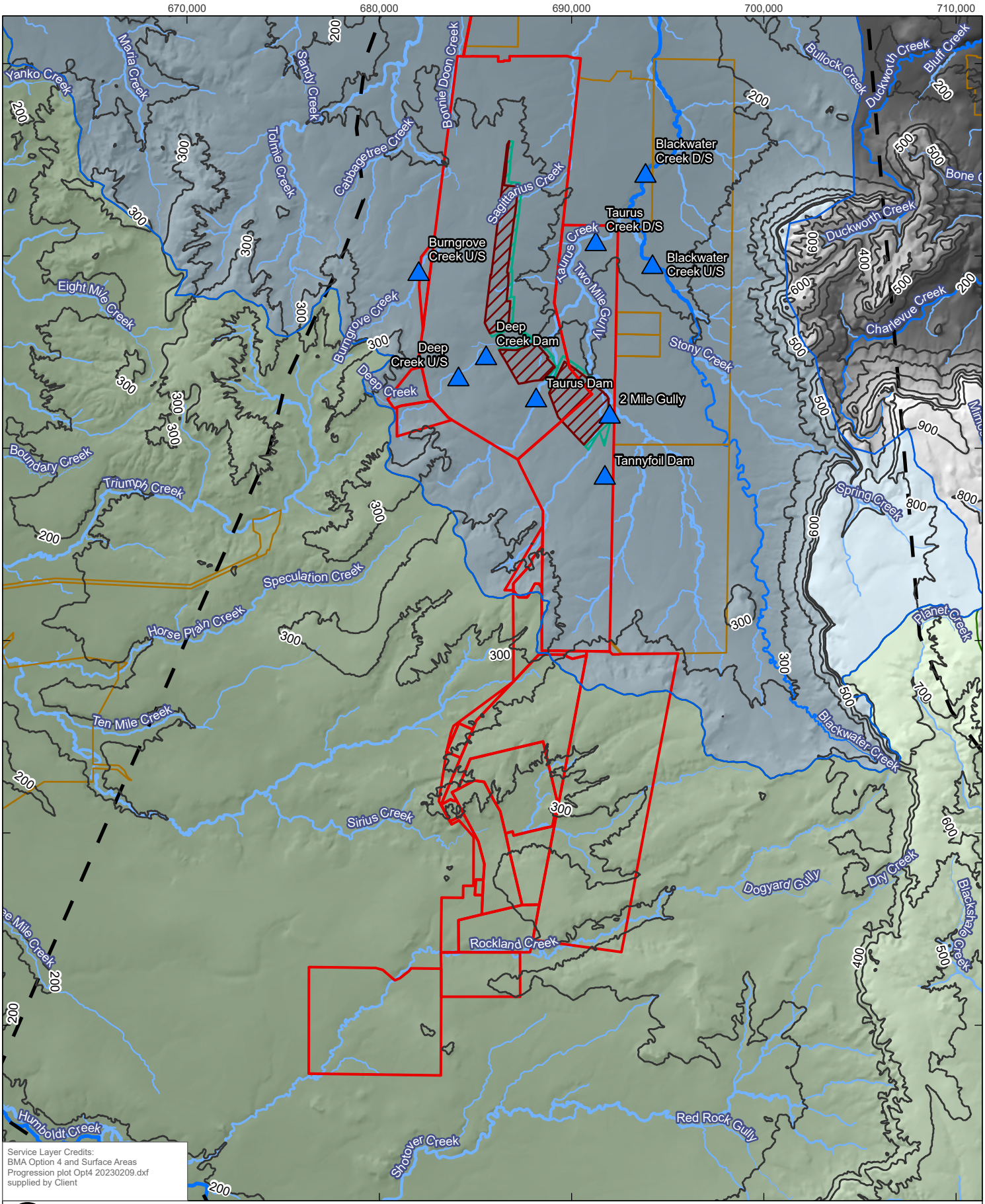


Figure 3-4 Average Daily Water Levels in Blackwater Creek D/S plotted against Daily Rainfall



BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

TOPOGRAPHY, DRAINAGE AND WATER PLANS

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:260,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
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FIGURE 3-5

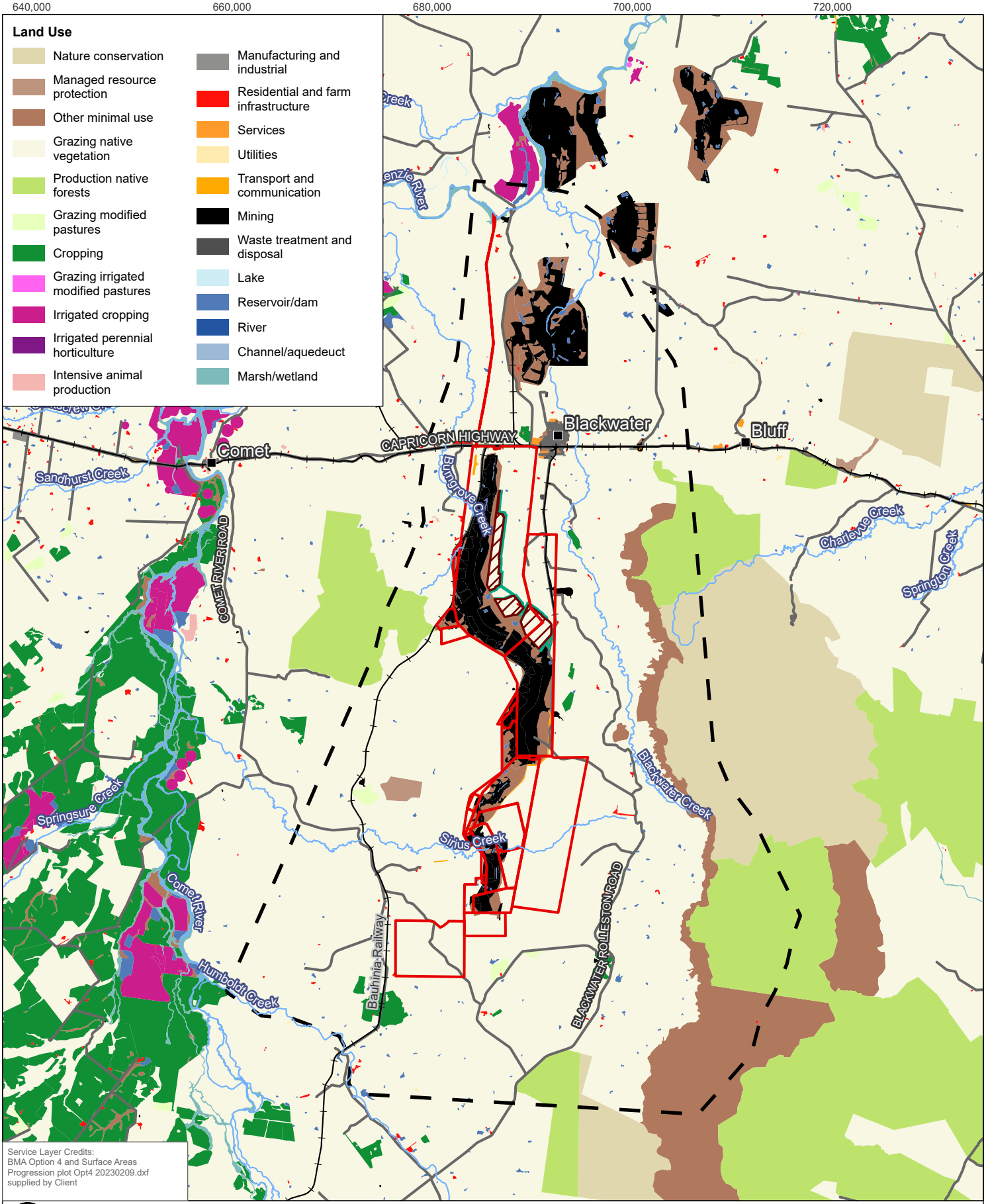
Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F03_05_Topography, Drainage and Water Plans

3.3 Land Use

Land use in the study area (**Figure 3-6**) is predominately coal mining, CSG exploration, and agriculture in the form of cattle grazing. These land uses are discussed in the sections below.

3.3.1 Agriculture

The mapped land use in the study area and surrounds is shown on **Figure 3-6.** The predominant agricultural use is grazing, with a few scattered small cropping areas. No intense agricultural uses were mapped. Agricultural use within the Project area is predominantly “grazing native vegetation”.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:500,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- City/Town
- Watercourse
- Railway
- Road
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

SURROUNDING LAND USES

SLR

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FIGURE 3-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F03_06_Surrounding Land Uses

3.3.2 Mining

The Project lies within an existing mining precinct with several coal mines operating nearby. **Table 3-2** lists operating mines, advanced projects and mines in care and maintenance within 50 km of the study area. Operating mines and advanced projects which are located within 50 km from the Project are shown on **Figure 3-7.** Mines that have been included in the cumulative impact assessment are discussed in more detail in **Section 3.3.2.1** to **3.3.2.3**.

3.3.2.1 Cook Colliery

Cook Colliery adjoins the Project and is an underground mine owned by QCoal following its acquisition from Bounty Mining in 2020. The underground metallurgical mine had been in care and maintenance since December 2019 until its return to operational status in February 2022. Cook Colliery went back into care and maintenance in November 2025.

The mine is located to the east of BWM. When the mine was operational, mining took place within the Argo coal seams of the Rangal Coal Measures (RCM). The Argo average thickness is 4.5 m although is variable ranging from 0.5 m to 10 m due to faulting. The depth of the Argo Seam varies from 150–170 m in the western areas to 270–290 m depth in the seam split zone. Cook Colliery was placed under ‘care and maintenance’ following partial water inundation in March 2017 that flooded some sections of the underground workings. Following the flooding event, a change was adopted and Cook Colliery operated as a Bord and Pillar mine. Underground workings occurred within 500 m of open-cut BWM workings.

3.3.2.2 Minyango Mine

The Minyango Mine, owned by Constellation Mining, also adjoins the Project and is a proposed underground mine located on ML80173. The Minyango Project Approvals proposed to extract coal from the Aries and Pollux coal seams of the RCM and is anticipated to have a peak production of 9 Mtpa of ROM coal and a mine life of approximately 25 years (AGE, 2013). At present, the Minyango Mine is not in operation.

3.3.2.3 Curragh Mines

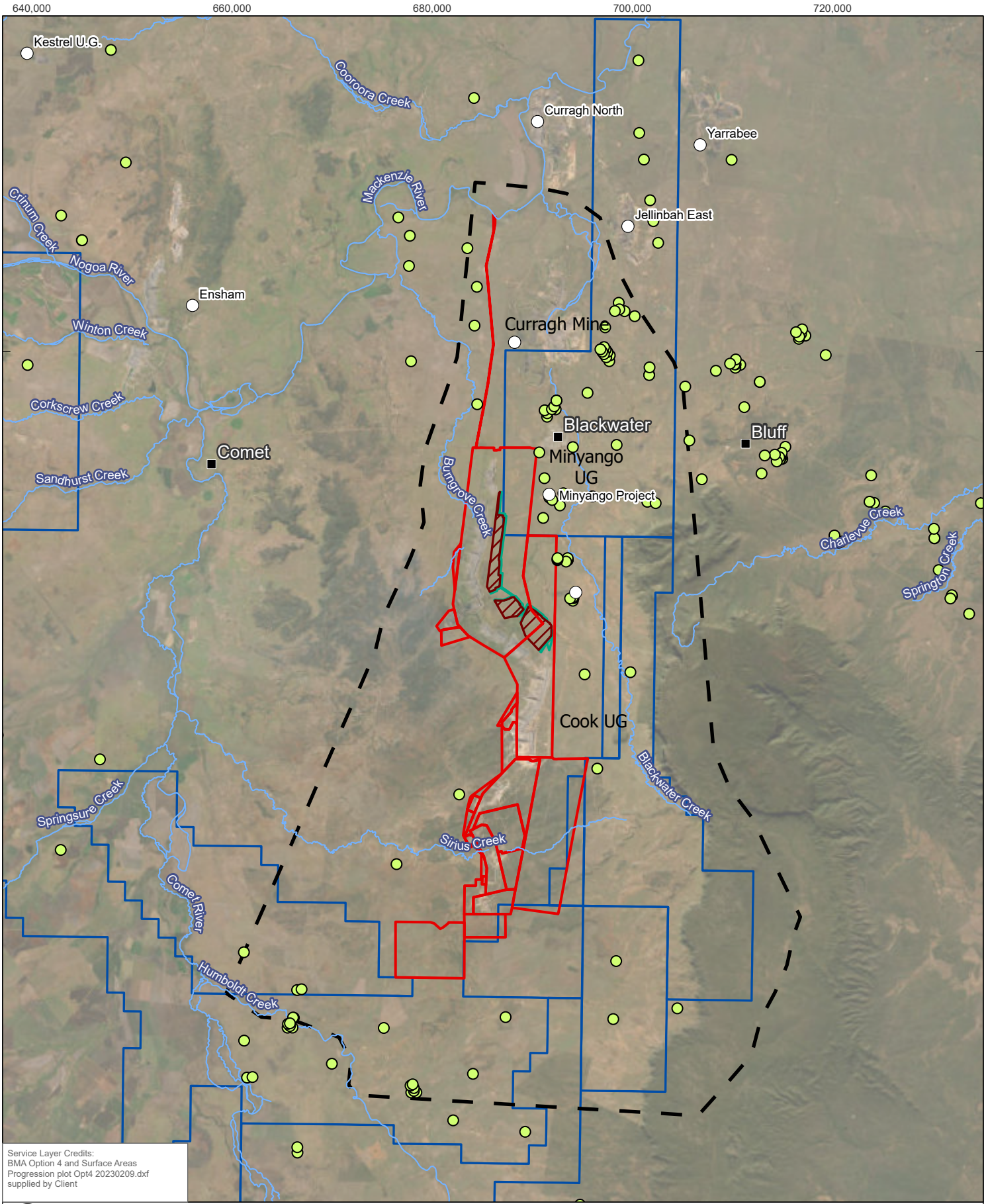
Coronado currently operates the Curragh coal mine complex, which is located adjacent to the Project and approximately 8 km north of Blackwater Township. The complex comprises two open cut mines (Curragh North and Curragh South) and an underground mine (Mammoth Underground). The open cut operations began in 1983, extracting coal from the Aries, Pisces, Castor and Pollux coal seams of the RCM, while the underground mine started in 2024.

Table 3-2 Current Mining Operations and Advanced Projects within 50 km of the Project

Mine	Status	Type	Planned Start	Planned End	Distance from Project (km)	Target Coal	Surface Water Catchment
Curragh South, Curragh North*	Operating	Open cut	1983	2046	20	Rangal Coal Measures	Upper Mackenzie
Mammoth Underground Mine	Operating	Underground	2024	2046	20	Rangal Coal Measures	Upper Mackenzie
Bluff Coal Mine	Care and Maintenance	Open cut	2013	2031	30	Rangal Coal Measures	Lower Mackenzie
Jellinbah Coal Mine	Operating	Open cut	1989	Unknown	35	Rangal Coal Measures	Upper Mackenzie
Ensham Mine	Operating	Open cut and Underground	1993	2037	40	Rangal Coal Measures	Nogoa
Yarrabee Coal Mine	Operating	Open cut	1982	Unknown	45	Rangal Coal Measures	Upper Mackenzie
Springsure Creek Coal Mine	Advanced Project	Underground	Unknown	Unknown	50	Rangal Coal Measures	Comet
Minyango Coal Project*	Advanced Project	Underground	2015 (yet to commence)	2040	Adjoining	Rangal Coal Measures	Upper Mackenzie
Comet Ridge Project	Advanced Project	Open cut	Unknown	Unknown	16	Rangal Coal Measures	Comet
Cook Colliery*	Care and Maintenance	Underground	1973	2025	Adjoining	Rangal Coal Measures	Upper Mackenzie

* mine included in the cumulative impact assessment (calibration and/or prediction phase).





BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

SURROUNDING MINES

Coordinate System:	GDA2020 MGA Zone 55
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Date Drawn:	08-Apr-2026
Drawn by:	AS

SLR

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FIGURE 3-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F03_07_Surrounding Mines

3.3.3 Petroleum

Currently, there are no active CSG fields within 30 km of the Project. **Table 3-3** lists the Authority to Prospect (ATP) within a 10 km buffer of ML1759 and ML1762. These ATPs have the potential to be developed into CSG extraction leases in the future, however, given there are no licences or firm plans in place to extract gas, CSG activities were not included in this study's cumulative impact assessment. **Figure 3-7** shows the regional ATPs and CSG wells (exploration only). No CSG extraction or monitoring bores were identified within 20 km of the BWM mining lease area.

Table 3-3 Exploration Permits within 10 km of ML1759 and ML1762

Allocation Type	Permit Number	Purpose	Expiry Date	Holder
Authority to Prospect	ATP 1025	Petroleum	2033	BOW CSG PTY LTD
Authority to Prospect	ATP 2063	Petroleum	2027	COMET RIDGE MAHALO FAR EAST PTY LTD
Authority to Prospect	ATP 2072	Petroleum	2030	COMET RIDGE MAHALO FAR EAST PTY LTD

4.0 Geology

The Project is located in the Bowen Basin, which is one of five major foreland sedimentary basins which were formed along the eastern side of Australia during the Permian geologic period. The Bowen Basin is the largest productive coal basin in Australia. The north-south oriented Bowen Basin stretches from Townsville in the north, to the Queensland-New South Wales border in the south.

The stratigraphic sequence of the study area is presented in **Table 4-1**. From youngest to oldest, the stratigraphic sequence across the study area comprises of unconsolidated Quaternary aged sediments unconformably overlying consolidated Permian and Triassic aged sequences (**Figure 4-1**). The Permian and Triassic strata form regular layered fluvio-deltaic sedimentary sequences, while the Quaternary sediments are more complex and irregular. The coal deposits extracted from BWM are found within the RCM, which is the uppermost Permian unit (**Figure 4-2**). Tertiary aged basalts, in the form of remnant lava flows, are found to the south but are not present in the study area.

The RCM at BWM outcrop in the western portion of the pits and dip down to the east of the pits. In the Project area, the strike is along the north-south direction. West of the pits is an anticline structure, which means that further west, the coal seams dip to the west (**Figure 4-2**).

The surface geology of the study area is dominated by the outcropping Rangal Coal Measures to the west of BWM and the overlying Rewan Group in the east of the BWM (**Figure 4-1**). Overlying these basal units, Tertiary Sediments and Quaternary alluvium are present as cover. At the eastern extents of the study area, the Clematis Group outcrops with a dramatic change in topography associated with the comparatively weathering resistant sandstones of that geologic unit.

Figure 4-3 shows an east to west geological cross section through the Project area. For the location of the cross section refer to **Figure 4-2** (Cross Section A-A). Note the depth extent of the Fair Hill Formation to the west is unknown, and not relevant to this assessment.

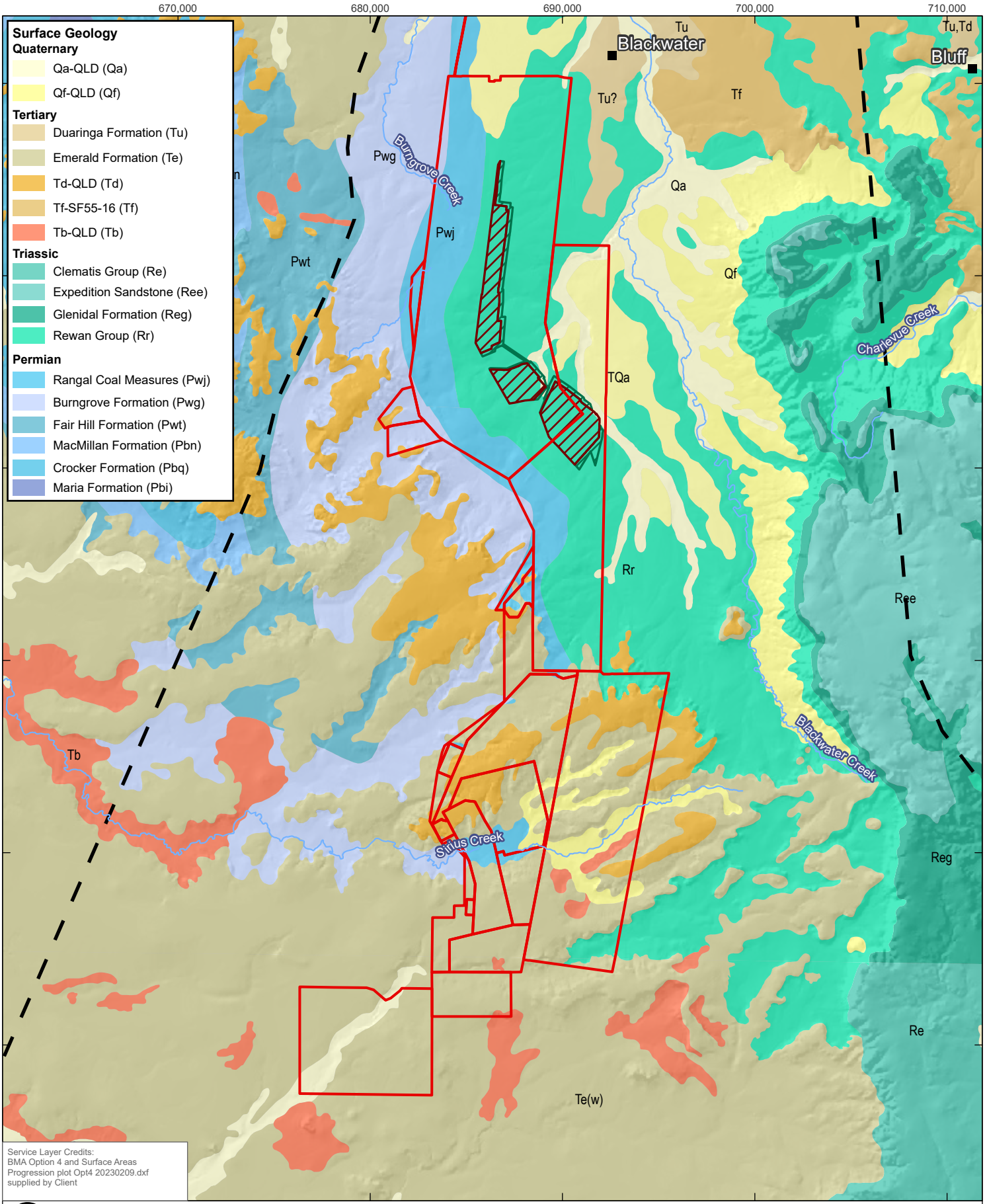
Each of the main stratigraphic units, relevant to the Project, is discussed in **Section 4.1** to **Section 4.5**, and details on the structural geology is provided in **Section 4.7**.

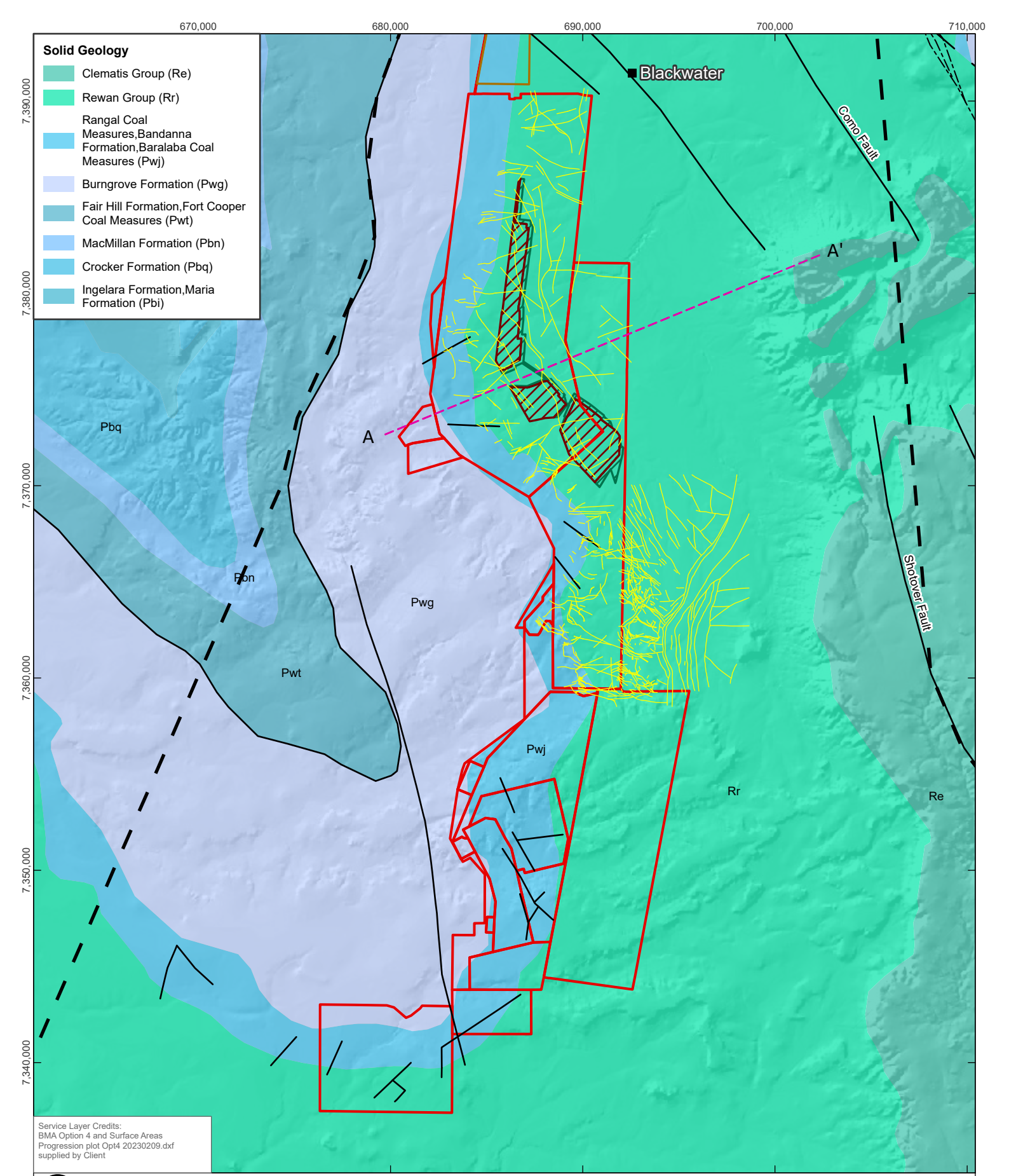
Table 4-1 Summary of Stratigraphy in the Study Area

Age	Unit	Thickness (m)	Description
Quaternary	Alluvium	0.5–12	Alluvium - silt, clay, sand and gravel.
Tertiary	Basalt	30	Weathered basalt soils, residual basalt. Moderately weathered and fresh basalt. Does not outcrop.
	Sediments	30	Clays, sandstones, sands, gravels, often poorly consolidated (Tu, Te(w), Tf and TQa). Regional mapping shows highly weathered Tertiary Sediments display some areas of duricrust (Td) and partially cemented fanglomerate (Tf).
Triassic	Clematis Sandstone	100–800	Weathering resistant medium to coarse grained quartzose to sublabile and micaceous sandstone, siltstone, mudstone and conglomerate.
	Rewan Group	50–300	Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate (at base); deposited in a fluvial-lacustrine environment. Occur 2 m to 6 m above the Aries seam.

Age	Unit	Thickness (m)	Description
Permian	Rangal Coal Measures	100	Feldspathic and lithic sandstone, carbonaceous mudstone, siltstone, tuff and coal seams. Coal seams include the Aries, Castor, Pollux and Orion and Pisces seams. The Pollux and Orion seams commonly coalesce into a single seam, which is referred as the Argo seam.
	Burngrove Formation	170	Sandstones, siltstones and mudstones, and banded coal seams frequently interbedded with tuff and tuffaceous mudstones - coal seams include the Virgo and Leo seams.

Source AGE (2008), AGE (2013) and EMM (2019).


670,000
680,000
690,000
700,000
710,000
7,390,000
7,380,000
7,370,000
7,360,000
7,350,000
7,340,000
Surface Geology
Quaternary
Qa-QLD (Qa)
Qf-QLD (Qf)
Tertiary
Duaringa Formation (Tu)
Emerald Formation (Te)
Td-QLD (Td)
Tf-SF55-16 (Tf)
Tb-QLD (Tb)
Triassic
Clematis Group (Re)
Expedition Sandstone (Ree)
Glenidal Formation (Reg)
Rewan Group (Rr)
Permian
Rangal Coal Measures (Pwj)
Burngrove Formation (Pwg)
Fair Hill Formation (Pwt)
MacMillan Formation (Pbn)
Crocker Formation (Pbq)
Maria Formation (Pbi)
Blackwater
Bluff
Tu
Tu?
Tf
Tu,Td
Pwg
Burngrove Creek
Pwj
Pwt
Qa
Qf
Charlevue Creek
TQa
Rr
Ree
Blackwater Creek
Tb
Sirius Creek
Reg
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Te(w)
Service Layer Credits:
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Progression plot Opt4 20230209.dxf
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0
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LEGEND
City/Town
Watercourse
GIA Study Area
BWM Mining Lease
Proposed Open Cut Extension
Proposed Infrastructure Area
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:260,000 at A4
Project Number: 640.031809.00001
Date Drawn: 08-Apr-2026
Drawn by: AS
BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT
SURFACE GEOLOGY
SLR
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FIGURE 4-1
Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F04_01_Surface Geology



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
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BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

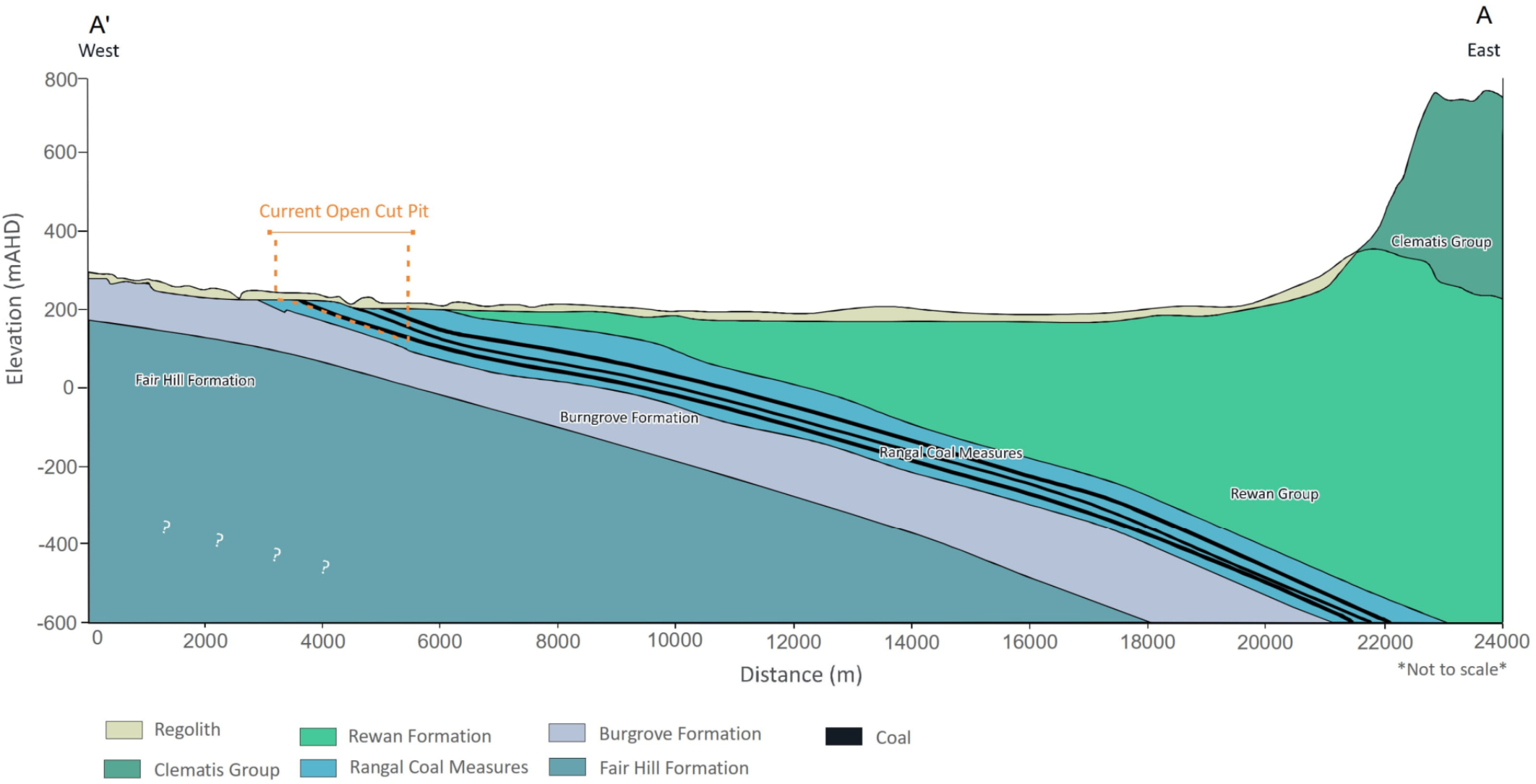
SOLID GEOLOGY

SLR

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FIGURE 4-2

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Date Drawn: 26-Nov-2023

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

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GEOLOGICAL CROSS SECTION ACROSS THE STUDY AREA

FIGURE 4-3

Path: H:\Projects-SLR\620-BNE\620-BNE\620.014601.00001 Blackwater NEP\08 GIS\BWM NEP Pro\BWM NEP Pro.aprx\620014601_GW_F04_3_Geological Cross Section

4.1 Quaternary Sediments

The Quaternary alluvial sediments unconformably overlie the Triassic Rewan Group and Rangal Coal Measures. The unit consists of a thin surficial cover of generally unconsolidated clays, silts, sands and gravels associated with floodplains of the major drainage channels, primarily Blackwater Creek. Drilling data from within the study area shows that the alluvial sequence varies from approximately 0.5 to 16 m thick.

Recent drilling at BWM has shown that alluvium associated with the creeks, is not always present and extents are limited. In 2020, four bores were attempted to be installed into the alluvium near north BWM (Taurus Creek, Sagittarius Creek and Two Mile Gully), however only one drillhole at Taurus Creek found sufficient alluvial sediments which was completed as a dry bore (AGE, 2020). In 2021 another bore targeted the alluvium at Sagittarius Creek, however upon drilling, the alluvial sediments were again deemed insufficient at the site, so the bore was installed into the underlying Rewan Group instead (HydroFS, 2021). Based on these investigations, it is considered that the extent of the alluvium within the study area is likely smaller than mapped on the regional surface geology map (**Figure 4-1**).

4.2 Tertiary Sediments and Basalt

Tertiary Sediments and basalts unconformably overlay the Triassic and Permian units. The unit consists primarily of unconsolidated/weathered Tertiary Sediments and weathered claystone, siltstone and sandstones. The unit varies in thickness, typically ranging from 5 to 50 m with a maximum thickness of 115 m, typically thicker to the south. To the south and southwest of the study area, basalt flows are present (**Figure 4-1**). The basalts have been described as having varying degrees of weathering and thickness, from moderately weathered thin flows (intersected in ML 70167 the Humboldt area – see **Figure 1-1**) to thicker and more fresh flows (intersected slightly further north in ML 70139 in the South Marshmead area – see **Figure 1-1**). The basalt flows vary in thickness ranging from 10 to 42 m (AGE, 2003). The basalt occurs in the study area (groundwater model domain), but not in the Project area, and hence is not discussed in detail in the subsequent conceptualisation.

4.3 Triassic Clematis Group

The Clematis Group unconformably overlies the Rewan Group and outcrops on the eastern margins of the study area, where it forms an elevated plateau and escarpment (**Figure 4-2**).

The unit is comprised of weathering resistant medium to coarse grained quartzose to sublabile and micaceous sandstone, siltstone, mudstone and conglomerate. In the study area, the Clematis Group is made up of the Glenidal Formation and Expedition Sandstone members which are estimated to form an average thickness in the range of 100 to 800 m (Geoscience Australia, 2021).

4.4 Triassic Rewan Group

The Rewan Group overlies the Rangal Coal Measures and occurs as in-fill material, thickening to the east with the dip of the coal measures and thin to the west where the coal measures occur at outcrop (**Figure 4-3**). Where present, the Rewan Group has a distinct greenish tint (non-marine deposits containing glauconite) in colour and is composed of siltstone and mudstone, with interbeds of lithic and volcanic sandstones.

Based on exploration drill holes and groundwater bore holes in the study area, the Rewan Group is comprised of siltstone and mudstone, with interbeds of lithic and volcanic sandstones and is of variable thickness ranging between 50 and 300 m.

4.5 Rangal Coal Measures

The RCM underlie the Rewan Group and outcrop to the west of the mine (**Figure 4-3**). This unit consists of interbedded sandstone, siltstone, mudstone, and coal with tuff (towards the base) and has a thickness of up to 100 m in the study area. The three main economic coal seams are the Aries, Castor and Pollux Seam. This naming convention applied regionally. For operational reasons, the coal seams follow a different naming convention at BWM: Aries Seam is referred to as the Top Seam, the Castor Seam is referred to as the Middle Seam and the Pollux Seam is referred to as the Lower Seam.

The splitting and occurrence of seams is shown in **Figure 4-4**. The principal coal seams in the BWM area in descending order are the Top Seam (also known as TFULL), Middle Seam (MFULL) and Middle split (MB), Lower Seam (LFULL) and Lower split (L01). Minor seams include the Upper Top (UT), Top Rider (TR), Middle Rider (MR) and Lower and Upper Rider (LUR) seams.

The Pollux and Orion seams create the thick Argo seam (CD) in the southern portion of the BWM. To the north, the Orion and Pollux Seams coalesce into the Lower (LFULL) Seam. This seam splits into the lower split (L01) and the Middle seam (MFULL). Between the Deep Creek/Wilpeena and Blackwater pit areas the Middle Seam coalesces with the Aries and Castor Seams.

4.6 Burngrove Formation

The Burngrove Formation is comprised of mudstone, siltstone, sandstone, coal and tuff. The RCM conformably overlie the coal bearing Burngrove Formation. The Burngrove Formation is considered the basement formation for this assessment.

4.7 Structural Geology

The structural geology in the region is characterised by gently folded consolidated sediments and a major north to north-west striking fault system which forms the Jellinbah thrust fault (AGE, 2013). A series of easterly dipping thrust faults occur parallel to the Jellinbah thrust, including the Shotover Fault (occurring to the east of the study area where the Clematis Group outcrops) and the Como Fault that runs through the Curragh Mine (**Figure 4-5**) (Mallet et al., 1985). Regionally the structure is defined as a faulted monoclinal limb (AGE, 2013).

The strata in the vicinity of the BWM are heavily influenced by a series of easterly dipping north to northwest striking faults (AGE, 2008). The Shotover Fault is of major importance as there is a displacement of up to 3,000 m (AGE, 2013). Locally, thrust faulting that occurs within the BWM may be attributed to thrusts occurring in the footwall of the Shotover Fault. Local structure is influenced by strike slip movement of basement rocks. Local fault displacement is reported to be less than five meters on average but can reach up to 20 m (AGE, 2008). **Figure 4-5** shows the numerous local faults mapped within the study area. The local faults were mapped by historical tenement holders (BM Alliance Coal Operations Pty Ltd [BMA]) and the regional faults were sourced from the public database (Qld Government, 2004).

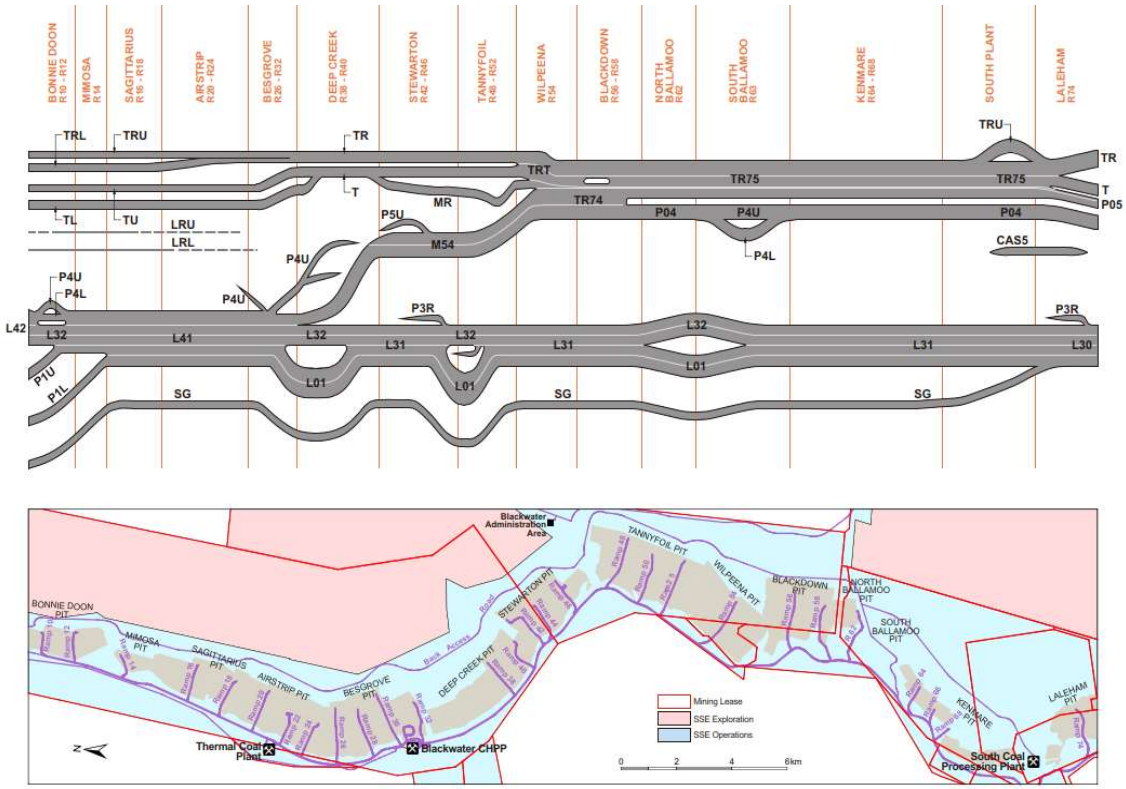
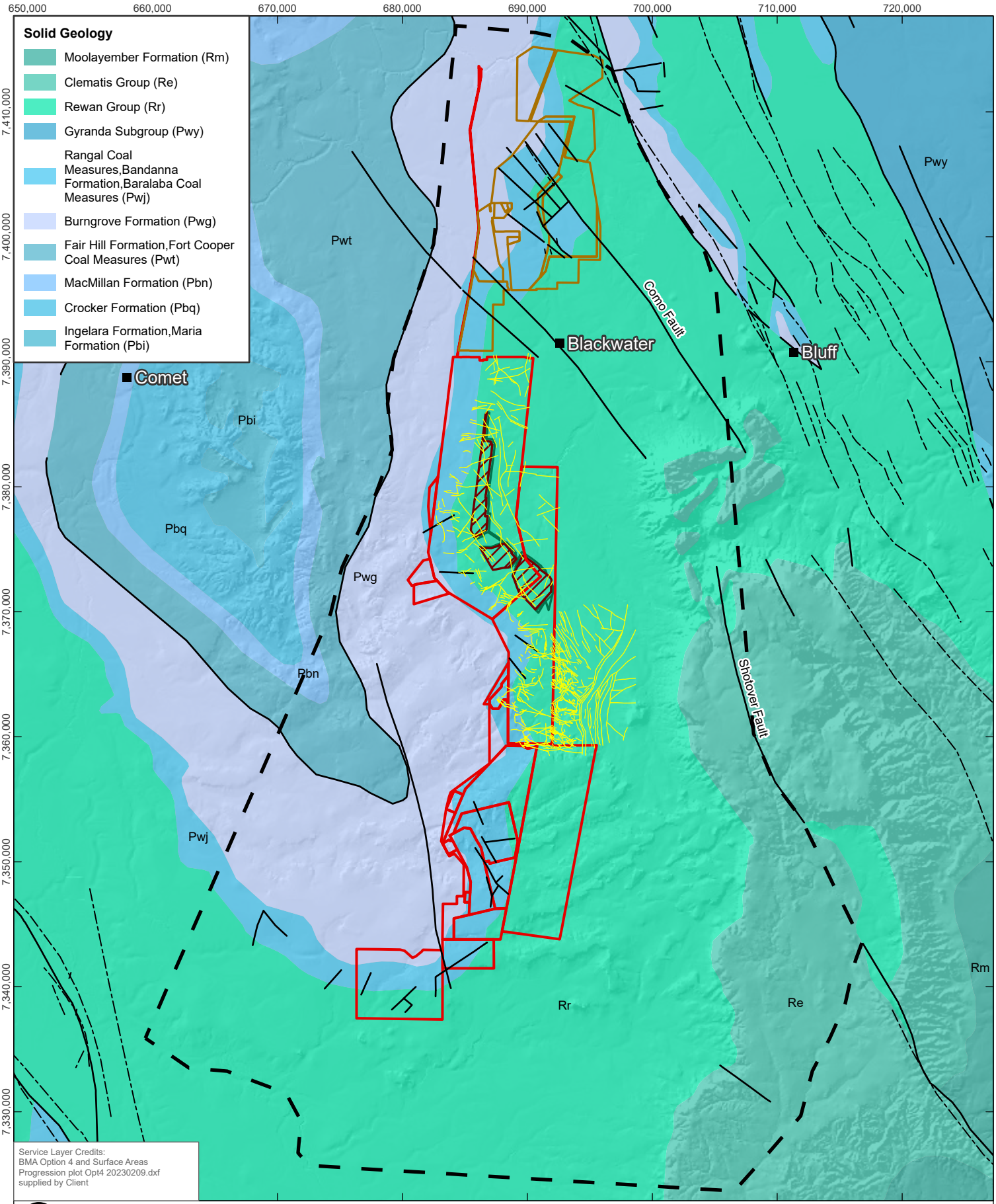


Figure 4-4 Schematic Seam Stratigraphy and Split Diagram (BMA, 2014)



Service Layer Credits:
BMA Option 4 and Surface Areas Progression plot Opt4 20230209.dxf supplied by Client

0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- City/Town
- Local Fault
- Basin Scale Fault (1995)
- Basin Scale Fault
- BWM Mining Lease
- Mining Lease
- GIA Study Area
- Proposed Open Cut Area
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

LOCAL AND REGIONAL FAULTS

SLR

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FIGURE 4-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F04_05_Model Faults

5.0 Hydrogeology

This section discusses each of the hydrogeological units relevant to the Project, describing groundwater hydrology (groundwater occurrence, hydraulic gradients, recharge and discharge), hydraulic properties, groundwater quality, and groundwater use and management. The conceptual hydrogeological model for the study area, refined with the most recent groundwater monitoring dataset with a focus on the Project, is summarised in **Section 5.6**.

The local hydrostratigraphic units are described below, from the shallowest (Alluvium) to the deepest (Burngrove Formation):

- **Alluvium** - Alluvial deposits are associated with local creeks. In recent years, the alluvium local to the study area has been found dry.
- **Tertiary Sediments and Basalt** - Unconsolidated surface layer of weathered rock (also referred to as regolith) which may provide a preferential flow pathway for groundwater if levels exceed the base of weathering.
- **Clematis Group** - Outcrops on the eastern margins of the study area, where it forms an elevated plateau. The unit is comprised of weathering resistant medium to coarse grained quartzose to sublabile and micaceous sandstone, siltstone, mudstone and conglomerate.
- **Rewan Group** - A regional scale aquitard comprising mudstones interbedded with siltstone and fine to medium grained labile sandstone. However, permeability testing indicates hydraulic conductivity values may be higher in the upper weathered zone of the unit.
- **Rangal Coal Measures (RCM)** - Previous investigations (EMM, 2021) identified this formation as a regional aquifer. Groundwater flow is primarily within the coal seams (via interconnected cleats and fractures), which are confined by low permeability overburden and interburden that essentially form aquitards. The coal measures are highly faulted resulting in “compartmentalisation” with coal seams juxtaposed against lower permeability interburden. Recharge to this unit occurs via direct infiltration where the unit outcrops or sub-crops.
- **Burngrove Formation** - Outcrops to the west of BWM and dips east below the RCM. It is largely regarded an aquitard comprising interbedded siltstone, carbonaceous and tuffaceous shales, mudstone, and thin coal seams. However, several landholder bores are apparently screened within this formation locally (assuming the registered bore database aquifer attribution is correct) suggesting it includes permeable horizons that can support low yields. This formation is considered the basement for the purposes of this assessment.

5.1 Groundwater Monitoring

Figure 5-1 to **Figure 5-8** and **Table 5-1** to **Table 5-8** show the BWM groundwater monitoring network bores for which data is available for this assessment. Data used for this assessment has been collected from 144 monitoring bores and four Vibrating Wire Piezometers (VWPs). The period for which groundwater quality and groundwater level data is available from these bores is also listed in the tables below.

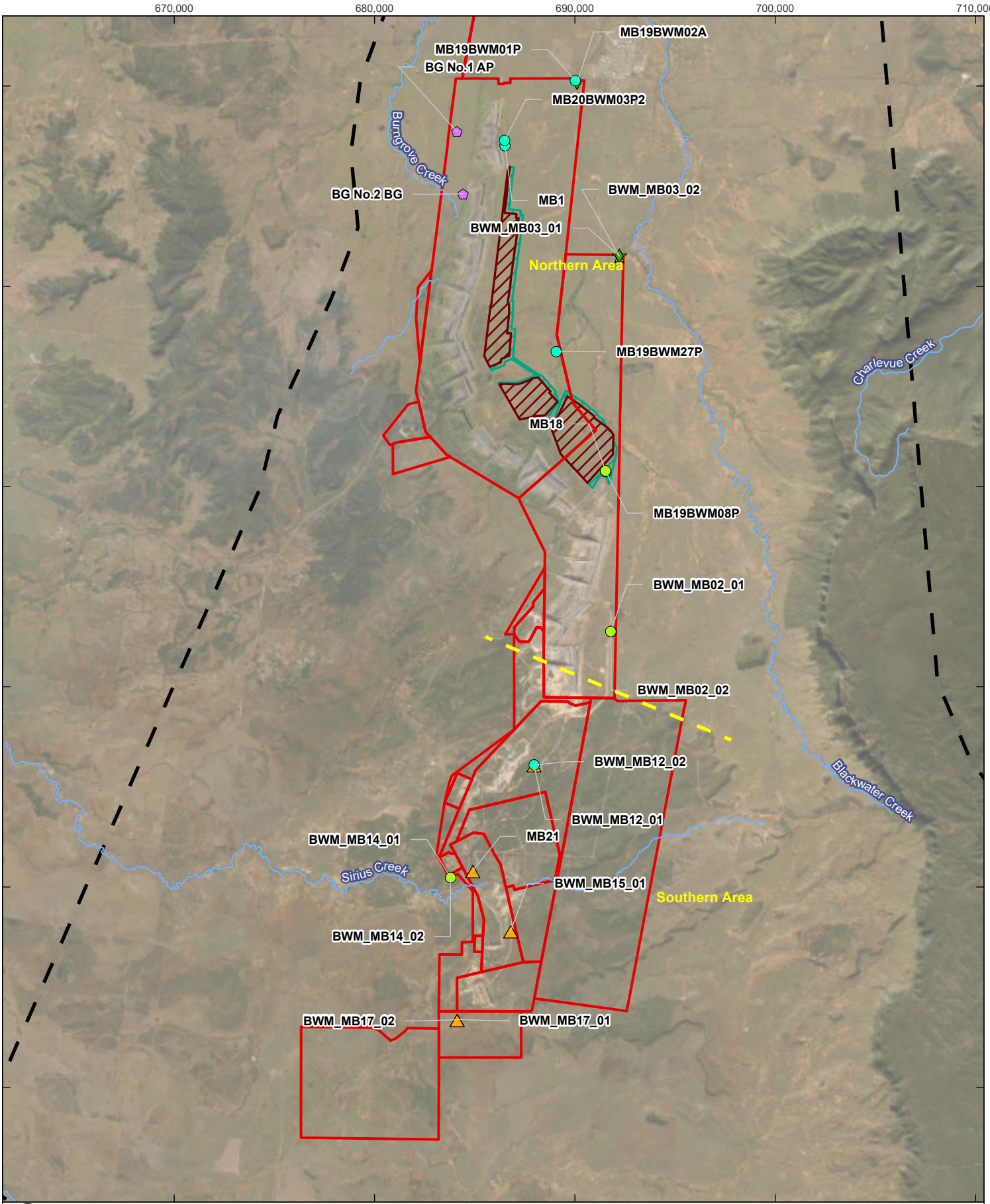
5.1.1 BWM EA Monitoring Bores

There is a total of 21 EA monitoring bores across BWM. Details of these bores are shown in **Table 5-1** with their locality shown in **Figure 5-1**.

Table 5-1 EA Monitoring Bores

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
BWM_MB03_01	692223	7381510	181.98	12	8 - 11	Alluvium	BWM South	Active (dry)	26/11/2024	26/11/2024	-	-
BWM_MB12_01	687961	7356102	332.79	24	16-22	Tertiary	BWM South	Active (dry)	30/05/2022	30/01/2025	-	-
BWM_MB15_01	686794	7347807	321.39	16.43	10.43 - 16.43	Tertiary	BWM South	Active	22/05/2022	4/03/2025	23/08/2023	4/03/2025
BWM_MB17_01	684127	7343376	262.29	18	12 - 18	Tertiary Basalt	BWM South	Active (dry)	22/08/2022	4/03/2025	-	-
BWM_MB17_02	684119	7343373	262.38	29	22 - 28	Tertiary	BWM South	Active	22/08/2022	4/03/2025	25/08/2023	4/03/2025
MB21	684905	7350813	264.23	31	25 - 31	Tertiary Sediments	BWM South	Active	31/08/2009	4/03/2025	31/08/2009	4/03/2025
MB19BWM02A	690112	7390183	168.87	15	12 - 15	Weathered Rewan	BWM North	Active	17/12/2019	5/03/2025	30/06/2020	5/03/2025
BWM_MB03_02	692220	7381519	182.13	42	35 - 41	Rewan	BWM South	Active	21/08/2023	26/11/2024	21/08/2023	8/03/2025
BWM_MB02_01	691791	7362760	259.73	28.4	22.3 - 28.3	RCM (OB)	BWM North	Active	16/08/2023	28/01/2025	16/08/2023	8/03/2025
MB18	691528	7370782	221.41	40.6	37.6 - 40.6	RCM (Sandstone OB)	BWM North	Active	1/09/2009	8/03/2025	1/09/2009	8/03/2025
BWM_MB14_01	683797	7350477	267.75	25	18 - 24	RCM (IB)	BWM South	Active	28/01/2023	4/03/2025	14/06/2022	4/03/2025
BWM_MB14_02	683798	7350466	267.74	152	144 - 150	RCM (Sandstone OB)	BWM South	Active	21/04/2022	4/03/2025	14/06/2022	4/03/2025
MB1	686514	7387022	201.16	60	54 - 60	RCM (Aries)	BWM North	Active	1/09/2009	3/03/2025	1/09/2009	3/03/2025
MB19BWM01P	690024	7390277	168.58	171	168 - 171	RCM (Aries)	BWM North	Active	17/12/2019	26/11/2024	15/06/2020	26/11/2024
MB19BWM27P	689070	7376739	197.35	189	180 - 189	RCM (Aries & siltstone)	BWM North	Active	19/12/2019	6/03/2025	30/06/2020	6/03/2025
MB20BWM03P2	686490	7387289	199.62	109	98 - 107	(RCM, Castor and Pollux)	BWM North	Active	25/02/2021	3/03/2025	10/02/2021	3/03/2025
BWM_MB02_02	691803	7362756	259.85	153.5	144 - 150	RCM (Castor)	BWM North	Active	16/08/2023	31/01/2025	29/09/2020	8/03/2025
MB19BWM08P	691544	7370740	221.67	190	184 - 190	RCM (Aries Seam & Siltstone)	BWM North	Active	29/06/2020	25/11/2024	30/06/2020	8/03/2025
BWM_MB12_02	687969	7356097	333.56	159	155 - 158	RCM (Castor)	BWM South	Active	30/05/2022	30/01/2025	17/08/2023	8/03/2025
BG No.1 AP	684107	7387742	200.46	72.9	63.6 - 72.9	Burngrove	BWM North	Active	19/01/2012	5/03/2025	28/12/2011	5/03/2025
BG No. 2 BG	684414	7384622	211.79	38.5	32.3 - 38.5	Burngrove	BWM North	Active	19/01/2012	5/03/2025	28/12/2011	5/03/2025

O/I = overburden/interburden
1 Coordinates GDA 2020 Zone 55



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Alluvium
- Tertiary
- Rewan
- RCM (Coal)
- RCM Overburden/Interburden
- Burngrove

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- BWM EA BORES

SLR

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FIGURE 5-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_01_Groundwater Monitoring Network (BWM EA Bores)

5.1.2 BWM Non-EA Monitoring Bores

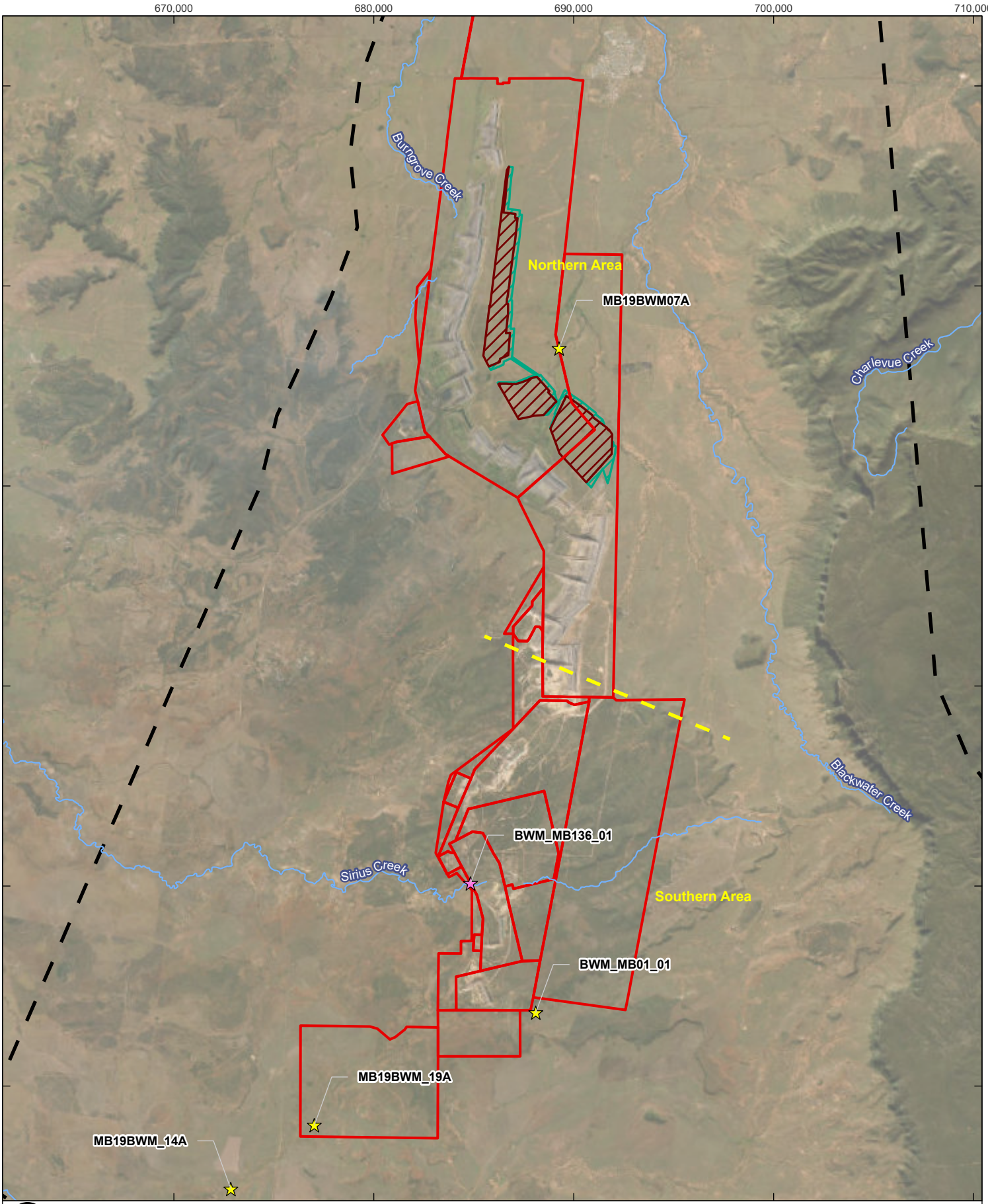
5.1.2.1 Quaternary Sediments

The BWM non-EA groundwater monitoring network for the alluvium is shown in **Table 5-2** and **Figure 5-2**. The monitoring network comprises a total of six monitoring bores (one of which is a current EA listed bore and describe above), installed at depths ranging from 7 to 16 metres below ground level (mBGL), with available data between 2019 and 2025. All excluding one, which was located to the south of the BWM operations, are observed to be dry.

Table 5-2 Quaternary Sediments Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
MB19BWM07A	689271	7376875	196.5	7	4 - 7	Alluvium	BWM North	Active (dry)	18/12/2019	22/06/2023	30/06/2020	22/06/2023
BWM_MB01_01	688102	7343664	271.04	16	10 - 16	Alluvium	BWM South	Active	17/03/2023	20/11/2024	17/03/2023	20/07/2023
MB19BWM_14A	672849	7334846	205.84	7.5	6 - 7	Alluvium	BWM South	Active (dry)	4/08/2022	27/06/2023	-	-
MB19BWM_19A	677022	7338038	224.72	14.5	9 - 12	Alluvium	BWM South	Active (dry)	4/08/2022	27/06/2023	-	-
BWM_MB136_01	684837	7350128	256.26	8.3	4.0 - 7.0	Alluvium/ Burngrove	BWM South	Active (dry)	18/10/2024	31/01/2025	-	-

1 Coordinates GDA 2020 Zone 55



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Alluvium
- Alluvium/ Burngrove

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- QUATERNARY SEDIMENTS

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FIGURE 5-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_02_Groundwater Monitoring Network (Quaternary Sediments)

5.1.2.2 Tertiary Sediments and Basalt

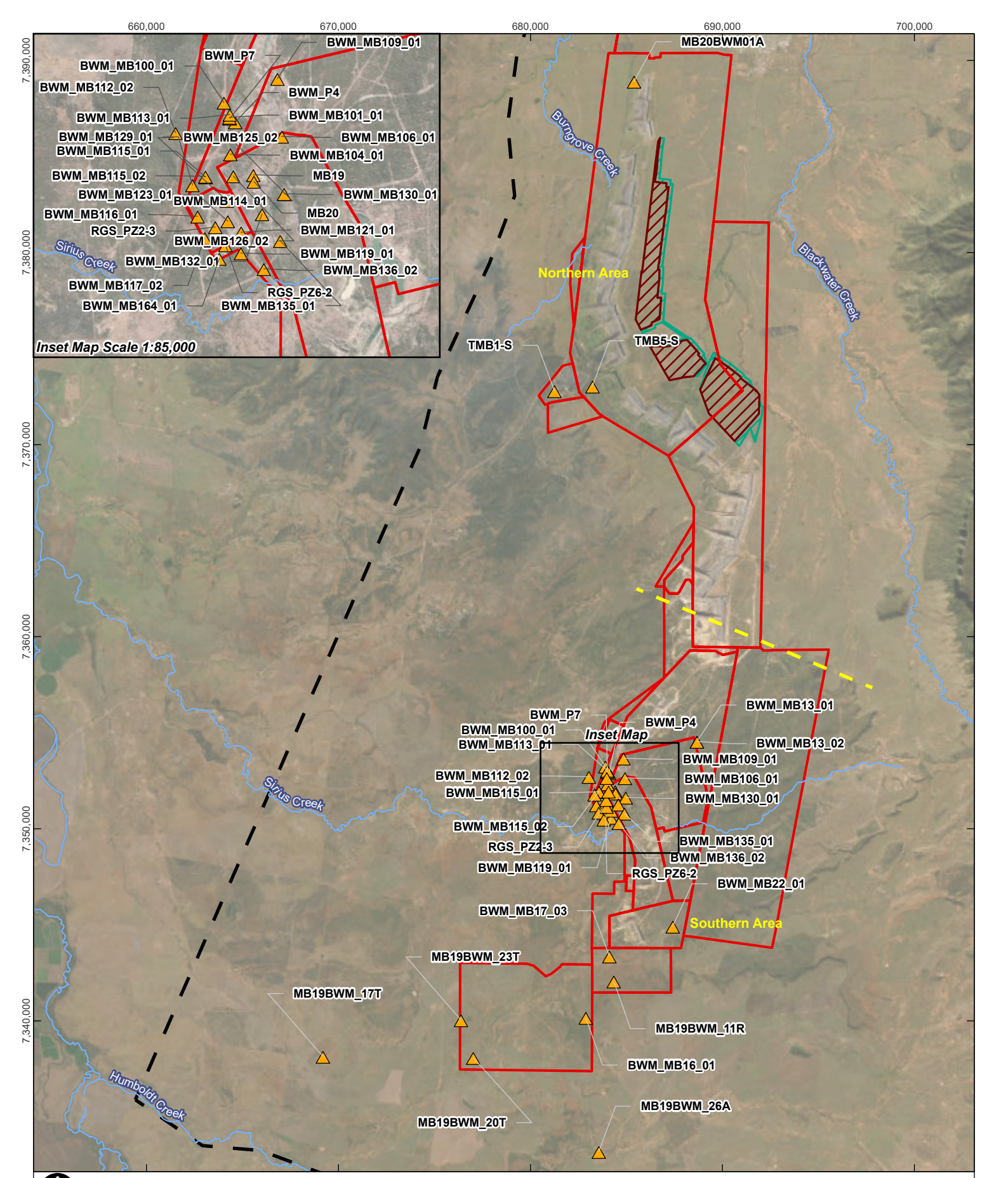
The BWM non-EA groundwater monitoring network for the Tertiary Sediments and Basalt is shown in **Table 5-3** and **Figure 5-3**. This network includes a total of 7 monitoring bores, of which five are current EA listed bores (**Table 5-1** and excluded here), installed at depths ranging from 4.5 to 56 mBGL, with available data between 2009 and 2025. Of these, 24 bores are currently dry.

Table 5-3 Tertiary Sediments and Basalt Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
MB20BWM01A	685396	7388908	187.76	9.5	6.5 - 9.5	Tertiary	BWM North	Active	21/06/2023	30/01/2025	-	-
TMB5-S	683230	7373039	239.06	15	12 - 15	Tertiary	BWM North	Active	17/01/2024	27/11/2024	27/11/2024	27/11/2024
TMB1-S	681249	7372800	259.53	16	13 - 16	Tertiary	BWM North	Active	18/01/2024	29/11/2024	29/11/2024	29/11/2024
BWM_MB13_01	688667	7354548	301.14	4.5	2.5 - 4.5	Tertiary	BWM South	Active (dry)	23/08/2022	29/01/2025	-	-
BWM_MB13_02	688672	7354546	300.53*	22	16 - 22	Tertiary	BWM South	Active (dry)	21/08/2022	29/01/2025	-	-
BWM_MB16_01	682882	7340174	283.63	56	49 - 55	Tertiary	BWM South	Active	19/08/2022	20/11/2024	-	-
BWM_MB17_03	684111	7343371	262.46	46	40 - 46	Tertiary	BWM South	Active	22/08/2022	25/09/2024	-	-
BWM_MB22_01	687412	7344924	286.17	26.5	21 - 26.5	Basalt	BWM South	Active	17/03/2023	20/11/2024	17/03/2023	17/03/2023
BWM_P4	684098	7352908	284.44	15.5	12.5 - 15.5	Tertiary (clay)	BWM South	Active	26/01/2023	10/09/2024	26/01/2023	28/09/2023
BWM_P7	684002	7352973	284.95	15.5	12.4 - 15.4	Tertiary (clay)	BWM South	Active	26/01/2023	10/09/2024	26/01/2023	28/09/2023
MB19	684418	7351975	310.7	19.7	13.7 - 19.7	Tertiary	BWM South	Unknown	31/08/2009	31/01/2025	31/08/2009	30/05/2012
MB19BWM_11R	684338	7342067	290.92	41.4	35.43 - 41.43	Tertiary (Basalt)	BWM South	Active (dry)	2/02/2023	27/06/2023	-	-
MB19BWM_17T	669191	7338149	226.31	32.5	26 - 32	Tertiary	BWM South	Active (dry)	6/11/2022	27/06/2023	-	-
MB19BWM_20T	677019	7338087	224.5	30.5	24 - 30	Tertiary (Sandstone with minor basalt)	BWM South	Active (dry)	20/09/2022	27/06/2023	-	-
MB19BWM_23T	676379	7340051	238.87	43.5	36.26 - 42.26	Tertiary	BWM South	Active (dry)	19/08/2022	27/06/2023	-	-
MB19BWM_26A	683558	7333194	226.86	15.5	9 - 15	Tertiary	BWM South	Active	26/05/2022	20/11/2024	-	-
MB20	684428	7351856	311.58	31.6	25.6 - 31.6	Tertiary	BWM South	Active (dry)	20/10/2009	31/01/2025	27/07/2009	11/02/2021
RGS_PZ2-3	683745	7351052	285.56	10.5	6 - 10.5	Tertiary	BWM South	Active	29/01/2023	11/06/2024	29/01/2023	26/09/2023
RGS_PZ6-2	683925	7350731	276.64	6.5	3.5 - 6.5	Tertiary Clays (fractured zone)	BWM South	Active	30/01/2023	12/06/2024	30/01/2023	29/09/2023
BWM_MB100_01	683897	7353255	304.36	17.5	10.5 - 16.5	Tertiary	BWM South	Active (dry)	23/08/2022	15/10/2024	-	-
BWM_MB101_01	683996	7352990	285	28	19 - 28	Tertiary (Clays, weathered sandstone)	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB104_01	684011	7352341	309.2	20	13.5 - 19.5	Tertiary	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB106_01	684923	7352654	307.81	32.5	26 - 32	Tertiary	BWM South	Active	15/10/2024	15/10/2024	-	-
BWM_MB109_01	684845	7353676	316.31	36	29.5 - 35.5	Tertiary	BWM South	Active (dry)	22/10/2024	22/10/2024	-	-
BWM_MB112_02	683041	7352718	269.92	21.4	15 - 21	Tertiary	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB113_01	684003	7353042	285.51	13.5	7 - 10	Tertiary	BWM South	Active	15/10/2024	15/10/2024	-	-
BWM_MB114_01	683973	7352659	295.95	20.4	12.3 - 16.3	Tertiary	BWM South	Active	15/10/2024	15/10/2024	-	-
BWM_MB115_01	683572	7351933	310.44	12	8.5 - 11.5	Tertiary	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB115_02	683570	7351947	310.48	25.3	18.5 - 24.5	Tertiary	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB116_01	683431	7351240	304.83	12.9	9.4 - 12.4	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB117_02	683557	7350857	302.84	29.5	21.9 - 27.9	Tertiary	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB119_01	684198	7350590	281.36	19	15.5 - 18.5	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB121_01	684202	7350959	307.11	18.5	10.5 - 16.5	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB123_01	683965	7351157	307.03	8.8	5.2 - 8.2	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB125_02	683948	7351517	307.97	42.5	36 - 42	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB126_02	684063	7351953	312.14	32.5	26 - 32	Tertiary	BWM South	Active	8/11/2024	8/11/2024	-	-

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
BWM_MB129_01	683340	7351795	306.52	20.4	14 - 20	Tertiary	BWM South	Active (dry)	5/11/2024	5/11/2024	-	-
BWM_MB130_01	684963	7351640	281.62	18	14.0 - 17.0	Tertiary into RCM OB	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB132_01	684573	7351281	288.66	19	12.5 - 18.5	Tertiary	BWM South	Active (dry)	22/10/2024	22/10/2024	-	-
BWM_MB135_01	684895	7350808	263.75	12	6.5 - 9.5	Tertiary	BWM South	Active (dry)	18/10/2024	18/10/2024	-	-
BWM_MB136_02	684603	7350311	255.41	21.5	15.0 - 21.0	Tertiary	BWM South	Active	18/10/2024	18/10/2024	-	-
BWM_MB164_01	683816	7350493	269.25	15.3	8.5 - 14.5	Tertiary (Silty clay)	BWM South	Active	16/10/2024	16/10/2024	-	-

OB = Overburden
1 Coordinates GDA 2020 Zone 55
* Ground Level



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Tertiary

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- TERTIARY

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FIGURE 5-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_03_Groundwater Monitoring Network (Tertiary)

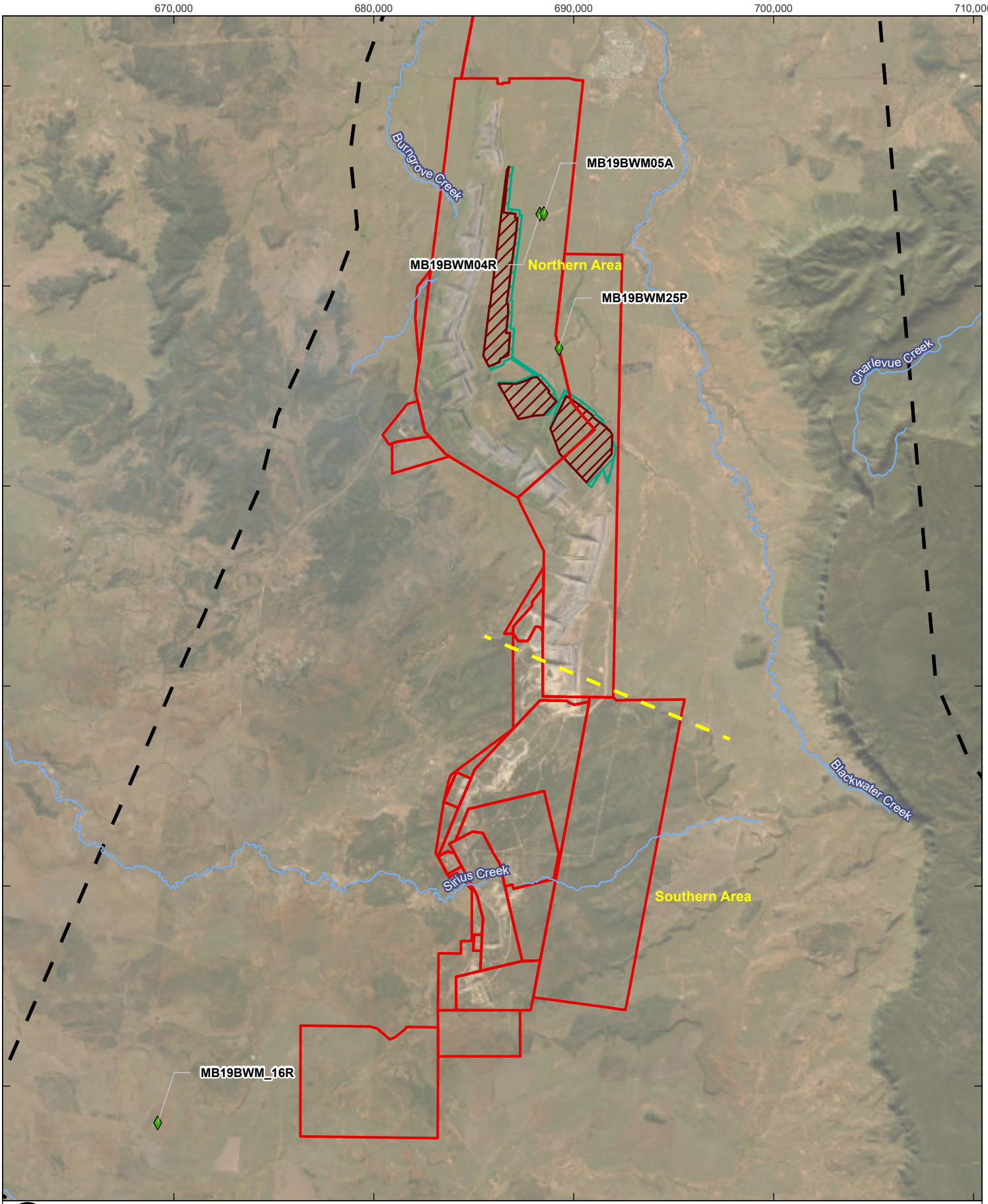
5.1.2.3 Triassic Rewan Group

The BWM non-EA groundwater monitoring network for the Triassic Rewan Group includes a total of four monitoring bores, one of which is currently dry. Bores are installed at depths ranging from 15 to 95 mBGL, with available data between 2023 and 2025. Bore details and their locality are shown in **Table 5-4** and **Figure 5-4** respectively.

Table 5-4 Triassic Rewan Group Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
MB19BWM04R	688307	7383595	200.9	80	71 - 80	Rewan	BWM North	Active	30/06/2020	21/06/2023	30/06/2020	26/09/2023
MB19BWM05A	688507	7383623	199.57	15	9 - 15	Weathered Rewan	BWM North	Active (dry)[2]	18/12/2019	21/06/2023	30/06/2020	21/06/2023
MB19BWM25P	689262	7376881	196.42	20	17 - 20	Rewan	BWM North	Active	1/07/2020	22/06/2023	30/06/2020	26/09/2023
MB19BWM_16R	669188	7338156	226.26	95	87 - 93	Rewan	BWM South	Active	6/11/2022	19/11/2024	31/01/2023	12/09/2023

1 Coordinates GDA 2020 Zone 55
2 bore forms part of the groundwater network and is currently monitored, however, it is currently dry



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Rewan
- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH PROJECT EIS
GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- REWAN GROUP

SLR

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FIGURE 5-4

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_04_Groundwater Monitoring Network (Rewan Group)

5.1.2.4 Rangal Coal Measures

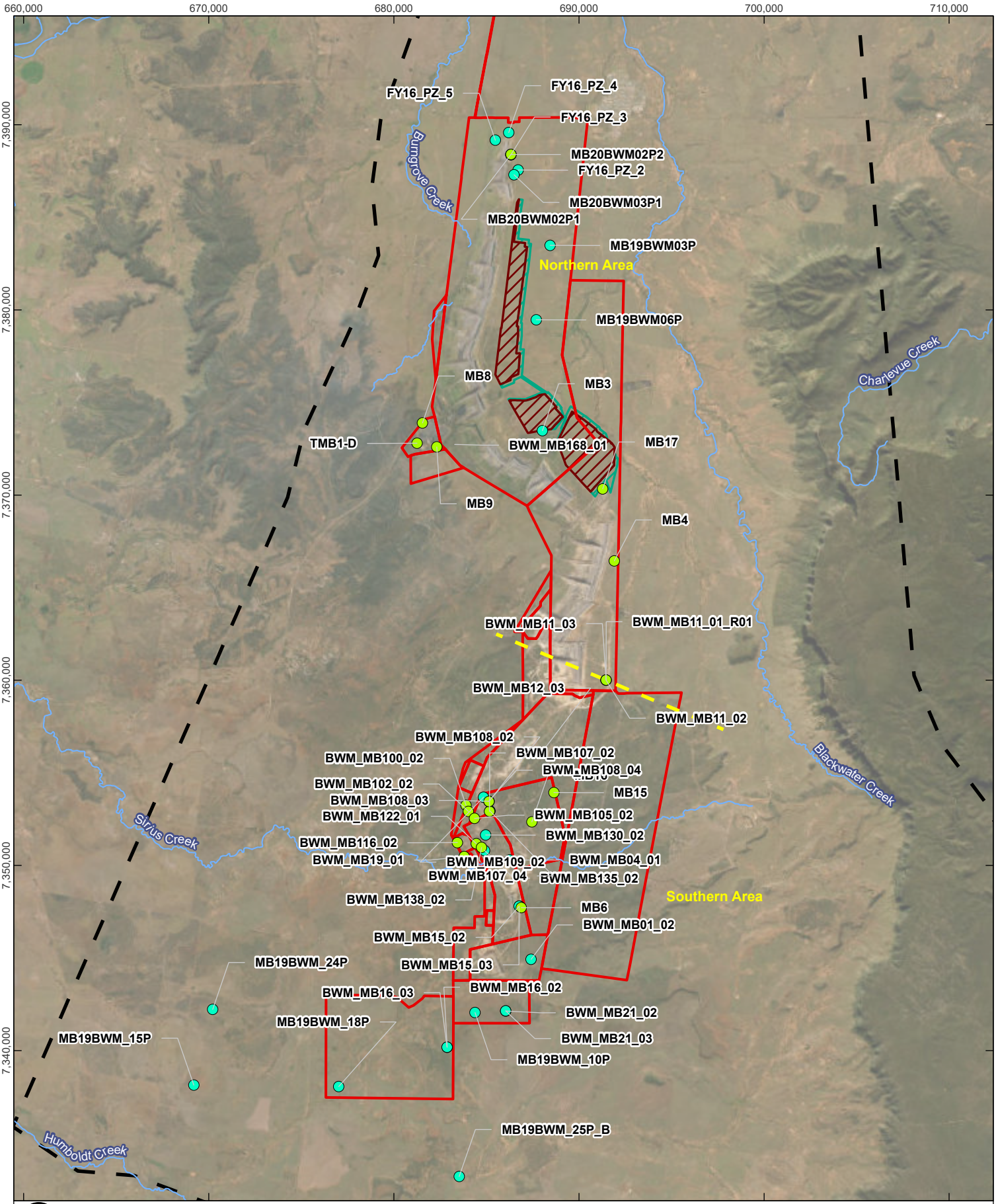
BWM non-EA groundwater monitoring bores targeting the Rangal Coal Measures are shown in **Table 5-5** and **Figure 5-5** and comprises a total of 51 monitoring bores. The bores are installed at depths ranging from 17 to 231.5 mBGL, with available data between 2009 and 2025, and six observed as dry.

Table 5-5 Rangal Coal Measures Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
FY16_PZ_2	686714	7387555	200.03	104.7	100.7 - 103.7	Pollux	BWM North	Active	26/11/2020	21/06/2023	26/11/2020	27/09/2023
FY16_PZ_3	686322	7388372	193.48	82.5	72.5 - 81.5	Pollux	BWM North	Active	25/11/2020	30/01/2025	23/03/2021	21/06/2023
FY16_PZ_4	686206	7389577	191	54	50 - 53	Pollux	BWM North	Active	25/11/2020	30/01/2025	25/11/2020	27/09/2023
FY16_PZ_5	685482	7389168	186.97	53.5	49.5 - 52.5	Pollux	BWM North	Active	25/11/2020	30/01/2025	25/11/2020	27/09/2023
MB19BWM03P	688442	7383483	199.39	231.5	222.5 - 231.5	Aries & Siltstone	BWM North	Active	30/06/2020	21/06/2023	30/06/2020	26/09/2023
MB19BWM06P	687694	7379464	209.64	186	180 - 186	Siltstone & Aries	BWM North	Active	30/06/2020	21/06/2023	30/06/2020	21/06/2023
MB20BWM02P1	686325	7388395	192.86	36	30 - 36	IB (Sandstone)	BWM North	Active	24/03/2021	30/01/2025	24/03/2021	21/06/2023
MB20BWM02P2	686321	7388395	192.92	66	60 - 66	Castor	BWM North	Active	25/02/2021	30/01/2025	25/02/2021	27/09/2023
MB20BWM03P1	686489	7387296	199.44	86	80 - 86	Castor	BWM North	Active	24/03/2021	30/01/2025	10/02/2021	27/09/2023
MB3	688026	7373479	219.99	78.2	73.6 - 78.2	Aries	BWM North	Active	1/09/2009	6/11/2022	12/01/2010	15/05/2023
MB8	681544	7373895	271.76*	17	14 - 17	OB/IB?	BWM North	Unknown	1/09/2009	14/06/2024	1/09/2009	29/11/2023
MB9	682318	7372602	249.08	18	15 - 18	OB/IB?	BWM North	Active	1/09/2009	22/11/2024	1/09/2009	22/11/2024
TMB1-D	681252	7372802	259.56	36	31 - 36	IB	BWM North	Active	18/01/2024	29/11/2024	29/11/2024	29/11/2024
BWM_MB11_01_R01	691464	7360014	300.66	90.4	85 - 88	OB	BWM Central	Active	2/05/2022	22/01/2024	-	-
BWM_MB11_02	691466	7360007	300.85	115.25	112.25 -115.25	Castor	BWM Central	Active	4/05/2022	23/01/2025	23/01/2025	23/01/2025
BWM_MB11_03	691459	7360009	300.62	136.2	121.2 - 127.2	Pollux	BWM Central	Active	29/04/2022	23/01/2025	23/01/2025	23/01/2025
MB17	691280	7370333	227.2	67	-	OB (Sandstone)	BWM Central	Decommissioned	1/09/2009	26/02/2020	1/09/2009	26/02/2020
MB4	691908	7366445	250.25	49.8 (52)	Unknown	OB (Sandstone)	BWM Central	Decommissioned	31/08/2009	28/11/2019	31/08/2009	28/11/2019
BWM_MB01_02	687411	7344932	286.32	128	120 - 122	Castor	BWM South	Active	17/02/2023	20/11/2024	18/02/2023	16/08/2023
BWM_MB04_01	686247	7350296	259.3*	28.5	22 - 28	Castor	BWM South	Unknown	29/01/2023	12/06/2024	29/01/2023	28/09/2023
BWM_MB12_03	687977	7356091	334.03	180	172.72-178.28	Pollux	BWM South	Active	24/05/2022	29/01/2025	-	-
BWM_MB15_02	686779	7347804	321.21	126	114 - 120	Pollux	BWM South	Active	22/05/2022	24/01/2025	24/01/2025	24/01/2025
BWM_MB15_03	686768	7347802	320.93	84.9	78.9 - 84.9	Castor	BWM South	Active	22/05/2022	24/01/2024	24/01/2025	24/01/2025
BWM_MB16_02	682883	7340184	283.25	86	79 - 85	Castor	BWM South	Active	19/08/2022	20/11/2024	-	-
BWM_MB16_03	682875	7340188	283.29	113	106.5 - 112.5	Pollux	BWM South	Active	27/11/2022	20/11/2024	31/01/2023	12/09/2023
BWM_MB168_01	683280	7372735	241.21	26.5	20 - 26	Coal		Active	-	-	-	-
BWM_MB19_01	683803	7350482	267.87	42	34 - 40	OB	BWM South	Active	18/03/2023	24/05/2023	18/03/2023	24/05/2023
BWM_MB21_02	686043	7342140	305.08	129.4	123 - 129	Aries	BWM South	Active	6/03/2023	21/11/2024	3/03/2023	3/03/2023
BWM_MB21_03	686041	7342148	305.1	163.9	153 - 159	Pollux	BWM South	Active	6/03/2023	21/11/2024	2/03/2023	2/03/2023
MB15	688648	7353936	296.89	140	None, open borehole 51.8-140	Coal in Laleham UG area (EMM, 2021)	BWM South	Decommissioned	20/10/2009	17/08/2022	20/10/2009	18/02/2023
MB16	687458	7352353	281.51	109	None, open borehole 23.6-109	OB in Kenmare UG goaf area (EMM, 2021)	BWM South	Decommissioned	20/10/2009	6/11/2022	20/10/2009	18/02/2023
MB19BWM_10P	684383	7342058	291.38	103	96.5-102.5	Aries	BWM South	Active	28/02/2023	21/11/2024	28/02/2023	15/05/2023
MB19BWM_15P	669194	7338140	226.52	140	131.7 - 137.7	Aries	BWM South	Active	1/10/2022	11/12/2023	31/01/2023	12/09/2023
MB19BWM_18P	677019	7338061	224.57	85	78.5 - 84.5	Aries	BWM South	Active	31/07/2022	11/12/2023	1/02/2023	12/09/2023
MB19BWM_24P	670211	7342228	229.43	68.5	62 - 68	Aries	BWM South	Active	1/02/2023	19/11/2024	1/02/2023	12/09/2023
MB19BWM_25P_B	683532	7333206	227	133.5	127 - 133	Aries	BWM South	Active	11/06/2022	12/12/2023	31/01/2023	7/09/2023

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
MB6	686881	7347723	320.21	19.36 (49.7)	12.6 - 26.5	OB	BWM South	Unknown	31/08/2009	6/11/2022	31/08/2009	6/11/2022
BWM_MB122_01	684453	7351176	317.52	39.5	35 - 38	OB	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB130_02	684959	7351646	281.68	29.5	23.0 - 29.0	Pollux	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB135_02	684899	7350805	263.92	33	17.0 - 23.0	Aries	BWM South	Active	18/10/2024	18/10/2024	-	-
BWM_MB138_02	684736	7350972	276.26	26	19.5 - 25.5	IB	BWM South	Active	19/10/2024	19/10/2024	-	-
BWM_MB100_02	683897	7353250	304.38	38.5	31.5 - 37.5	IB	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB102_02	684026	7352919	284.31	46	39 - 45	IB	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB105_02	684356	7352543	308.04	20.4	14 - 20	Weathered OB	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB107_02	685169	7352920	314.82	34.5	29.5 - 32.5	Weathered OB	BWM South	Active (dry)	20/10/2024	20/10/2024	-	-
BWM_MB107_04	685192	7352941	315.81	87	80.5 - 86.5	Weathered RCM (Pollux 32/31/L01 seam)	BWM South	Active	20/10/2024	20/10/2024	-	-
BWM_MB108_02	685140	7353456	314.71	33	27 - 33	Weathered OB	BWM South	Active (dry)	20/10/2024	20/10/2024	-	-
BWM_MB108_03	685137	7353463	314.67	59.5	47.35 - 59.35	Aries	BWM South	Active (dry)	20/10/2024	20/10/2024	-	-
BWM_MB108_04	685132	7353470	314.72	89	80 - 86	Pollux	BWM South	Active	20/10/2024	20/10/2024	-	-
BWM_MB109_02	684843	7353684	316.18	77	65 - 71	Pollux	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB116_02	683430	7351232	304.88	24.5	18.8 - 22.8	Weathered OB	BWM South	Active	16/10/2024	16/10/2024	-	-

OB = Overburden, IB = Interburden
1 Coordinates GDA 2020 Zone 55
* Ground Level



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:270,000 at A4
Project Number:	640.031809.00001
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Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- RCM (Coal)
- RCM Overburden/Interburden

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- RANGAL COAL MEASURES

SLR

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FIGURE 5-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_05_Groundwater Monitoring Network (Rangal Coal Measures)

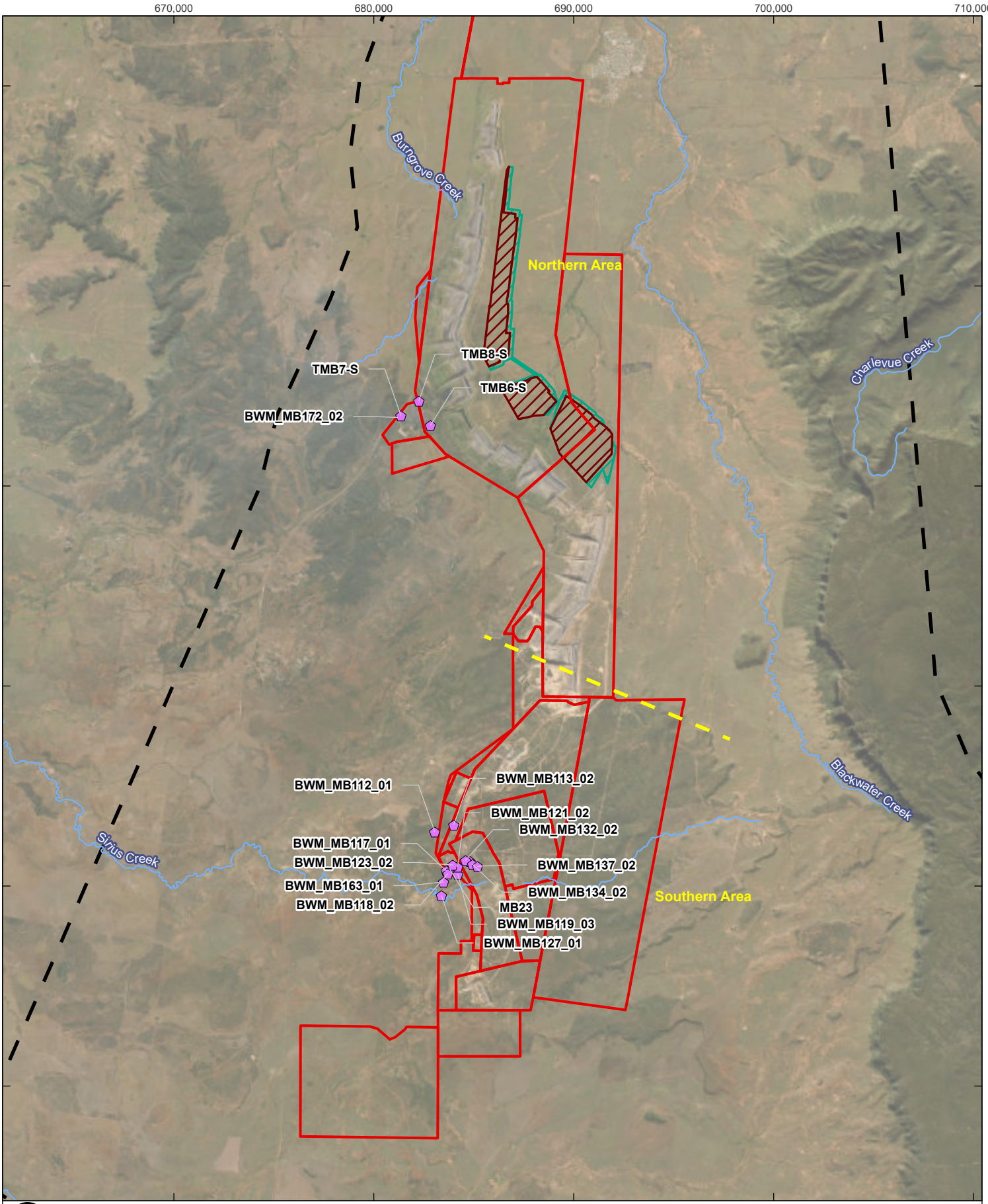
5.1.2.5 Burngrove Formation

The BWM non-EA groundwater monitoring network for the Burngrove Formation is shown in **Table 5-6** and **Figure 5-6**. The network consists of a total of 18 monitoring bores. The bores are installed at depths ranging from 8 to 72.9 mBGL, with available data between 2012 and 2025, with five observed as dry.

Table 5-6 Burngrove Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
BWM_MB172_02	681182.8	7373429	270.3	59.5	49.5-58.5	Burngrove	BWM North	Active	-	-	-	-
MB23	683792	7350850	278.95	24	18 - 24	Burngrove	BWM South	Active	27/01/2023	14/08/2024	27/01/2023	27/09/2023
TMB6-S	682831	7373037	242.09	10	8 - 10	Burngrove (weathered mudstone)	BWM North	Active	17/01/2024	30/11/2024	30/11/2024	30/11/2024
TMB7-S	681355	7373520	263.51	10	7 - 10	Weathered Burngrove	BWM North	Active	18/01/2024	14/06/2024	-	-
TMB8-S	682255	7374259	257.4	36	30 - 36	Burngrove	BWM North	Active	18/01/2024	27/11/2024	27/11/2024	27/11/2024
BWM_MB112_01	683043	7352714	270.06	12.5	9 - 12	Burngrove	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB113_02	683999	7353052	285.64	30.5	20 - 29	Burngrove (Mudstone and siltstone)	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB117_01	683622	7350774	302.25	39.3	32.8 - 38.8	Burngrove (sandstone)	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB118_02	683708	7350621	278.28	28	21.5 - 27.5	Burngrove (sandstone)	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB119_03	684197	7350597	281.48	29.3	25.8 - 28.8	Burngrove (sandstone)	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB121_02	684196	7350960	307.29	32.5	23 - 32	Burngrove (sandstone)	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB123_02	683946	7351056	303.87	30	23 - 29	Burngrove (sandstone)	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB127_01	683379	7349529	248.26	11.5	7.9 - 10.9	Burngrove (sandstone)	BWM South	Active (dry)	5/11/2024	5/11/2024	-	-
BWM_MB131_02	684803	7351242	279.25	23	14.5 - 20.5	Burngrove (sandstone)	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB132_02	684591	7351283	288.83	29.5	23.0 - 29.0	Burngrove (sandstone)	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB134_02	684943	7351085	277.8	39.5	36.0 - 39.0	Burngrove (sandstone)	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB137_02	685185	7350987	280.35	30	23.5 - 29.5	Burngrove	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB163_01	683486	7350205	257.4	8	3 - 6	Weathered Burngrove	BWM South	Active (dry)	5/11/2024	5/11/2024	-	-

O/I = overburden/interburden
1 Coordinates GDA 2020 Zone 55
* Ground Level



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
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Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Burngrove
- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- BURNGROVE FORMATION

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FIGURE 5-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_06_Groundwater Monitoring Network (Burngrove Formation)

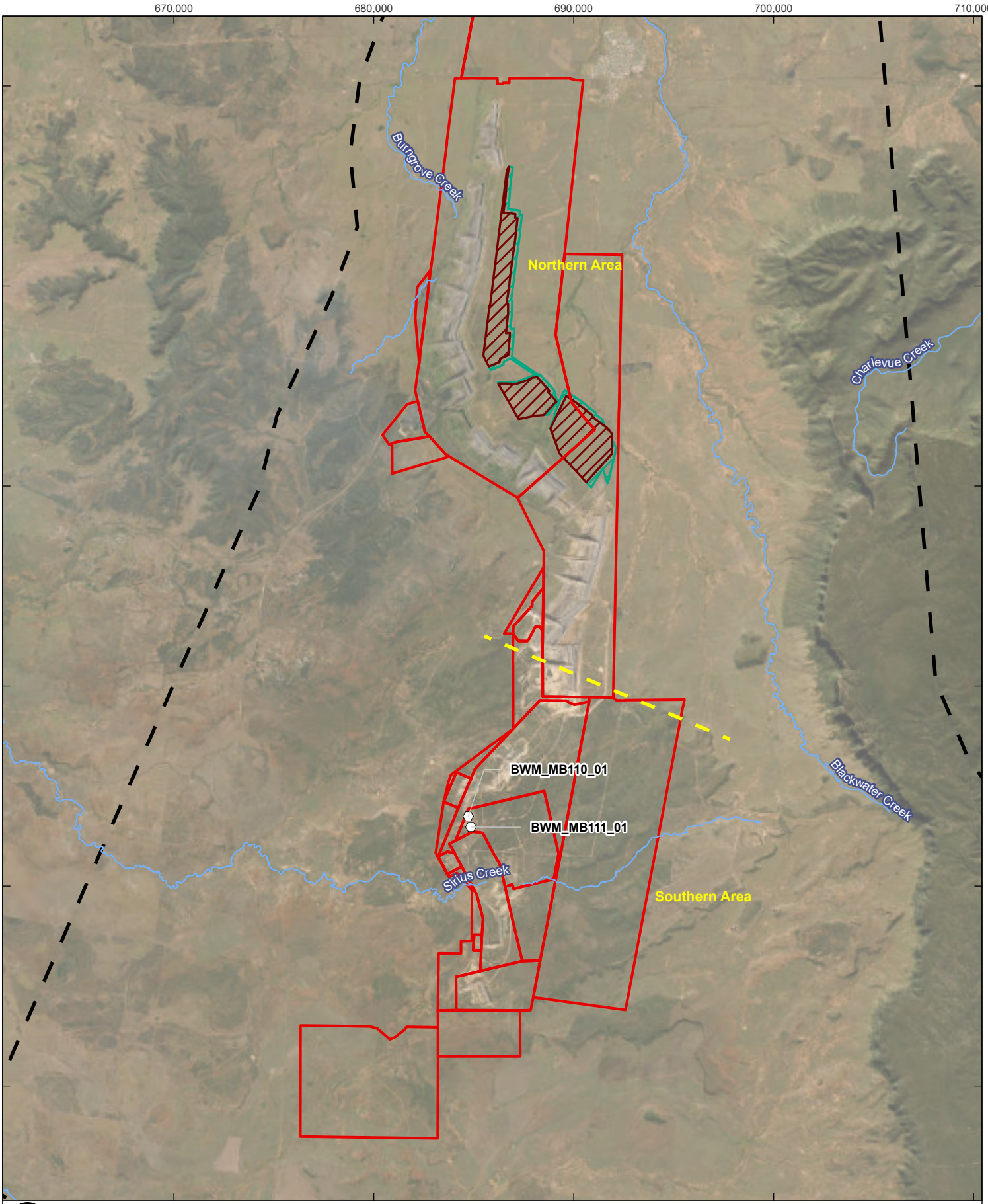
5.1.2.6 Spoil

Groundwater monitoring bores targeting spoil are shown in **Table 5-7** and **Figure 5-7** and include a total of two bores (one of which is dry), installed at depths ranging from 26 to 35.5 mBGL, with available data in 2024.

Table 5-7 Spoil Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
BWM_MB110_01	684722	7353488	288.47	36	26 - 32	Mine spoil (tailings)	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB111_01	684855	7352949	304.65	39	26.5 - 35.5	Mine spoil (tailings)	BWM South	Active (dry)	22/10/2024	22/10/2024	-	-

1 Coordinates GDA 2020 Zone 55
* Ground Level



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Spoil
- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- SPOIL

SLR

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FIGURE 5-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_07_Groundwater Monitoring Network (Spoil)

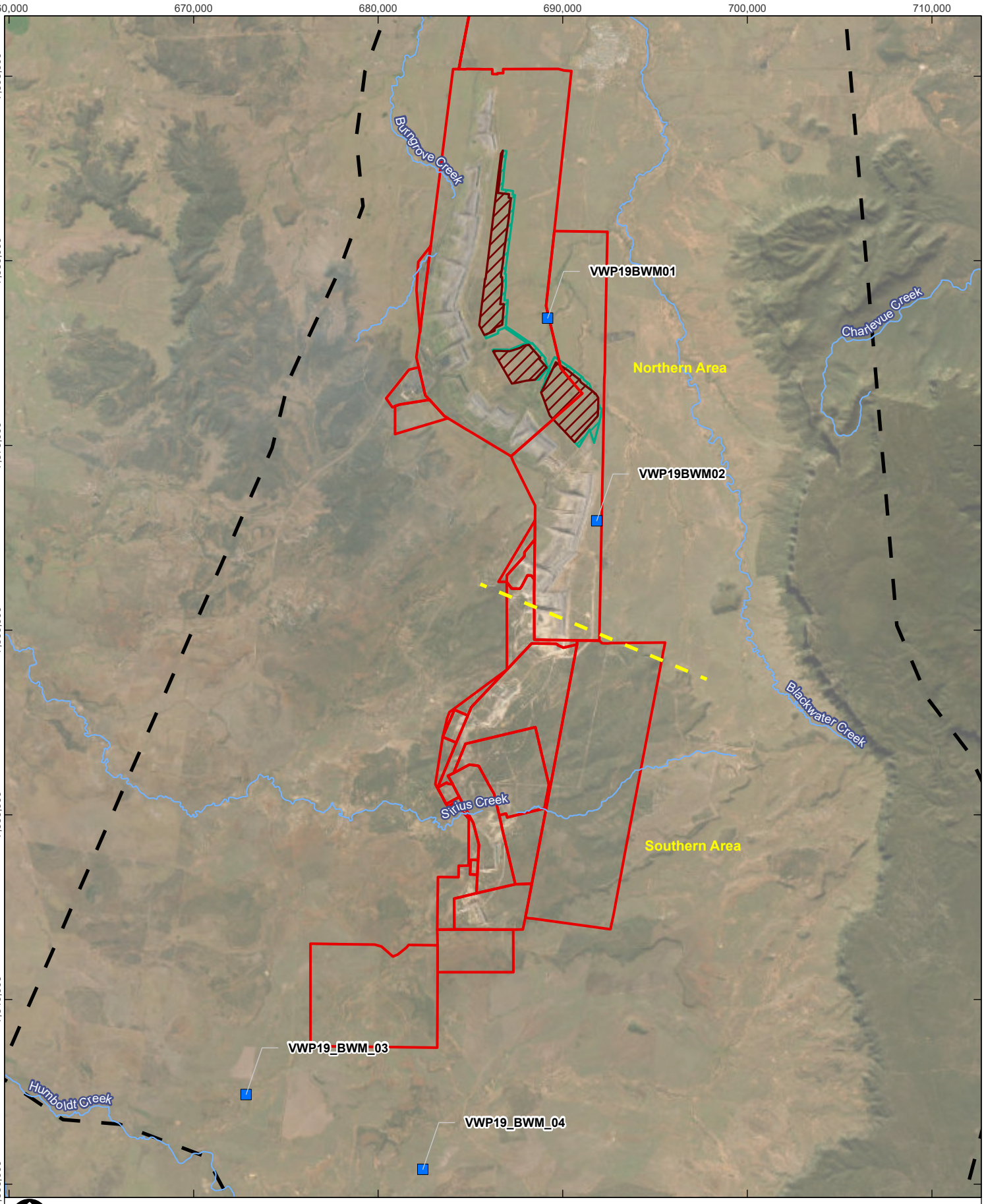
5.1.2.7 Vibrating Wire Piezometers

Four Vibrating Wire Piezometers (VWPs) are installed at BWM, two of which are located in the north and two in the south of BWM. Details for the VWPs, including the sensor depths, are provided in **Table 5-8** with their locality shown in **Figure 5-8**.

Table 5-8 Vibrating Wire Piezometers

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Sensor Depths (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
VWP19BWM01	689179	7376894	198	271.5	46 / 104 / 125 / 154 / 186	RCM OB / RCM OB / Aries / RCM IB / Pollux	BWM North	Unknown[2]	22/12/2019	22/11/2022	-	-
VWP19BWM02	691840	7365921	249	174	87.5 / 101 / 112 / 127 / 149	RCM OB / Aries / Castor / Pollux / Orion	BWM North	Unknown	22/04/2020	22/07/2022	-	-
VWP19_BWM_03	672843	7334855	206.57	190.75	40 / 100 / 155.5 / 160 / 182.5	Rewan / RCM OB / Aries / Castor / Argo	BWM South	Active	15/08/2022	15/02/2024	-	-
VWP19_BWM_04	682417	7330805	226.16	190.75	42 / 88 / 112.5 / 143.5 / 153.5	Rewan / Rewan/ Aries / Castor / Argo	BWM South	Active	15/09/2022	15/02/2024	-	-

1 Coordinates GDA 2020 Zone 55
2 status unknown as not currently monitored, and not located in recent survey and may or ma not still be in existence



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:270,000 at A4
Project Number:	640.031809.00001
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LEGEND

Groundwater Monitoring Location

- VWP

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- VIBRATING WIRE PIEZOMETERS

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FIGURE 5-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_08_Groundwater Monitoring Network (Vibrating Wire Piezometers)

5.2 Hydraulic Properties

Hydraulic properties of hydraulic conductivity and storativity have been measured by various techniques at different locations in the vicinity of BWM. Results can differ depending on the techniques employed. Falling head or slug tests are at best an approximation of hydraulic conductivity and provide an estimate generally within one order of magnitude. Packer testing conducted during drilling programs is considered a more reliable measure of hydraulic conductivity, providing an estimate over the interval tested. Test pumping is the most reliable method of measuring hydraulic conductivity and has the advantage of identifying recharge or barrier boundaries if they are present. In addition, if during test pumping drawdown is measured in observation bores, the aquifer storativity can be calculated.

Within the study area, the coal seams are the main groundwater bearing units within the Permian sequences, with low hydraulic conductivity interburden generally confining the individual seams. Sedimentary consolidation processes cause the coal seams to display dual porosity characteristics, with a primary matrix porosity and a secondary (dominant) porosity provided by diagenic fractures (joints and cleats). Hydraulic conductivity of the coal decreases with depth due to increasing overburden pressure reducing the aperture of fractures.

5.2.1 Northern Area

In the BWM Northern Area, two field hydraulic testing campaigns were recently undertaken (AGE, 2020 and HydroFS, 2021). The results for estimated hydraulic conductivities from slug tests are presented in **Table 5-9**. Results for the Rewan Group show higher hydraulic conductivities in the shallowed weathered zone, and lower hydraulic conductivity in the deeper part of the unit considered more representative of the true formation. The results for the RCM are predominantly representative of coal (Aries Coal Seam). One test was taken at a zone with coal and interburden present. The geometric mean of the coal hydraulic conductivity is estimated at 0.003 m/day, however the results span over three orders of magnitude (0.00003 m/day to 0.056 m/day). The locations of the bores tested in these campaigns are shown on **Figure 5-9**.

Table 5-9 Blackwater Northern Area Slug Test Results

Bore	Aquifer Unit	Bore Depth (m)	Hydraulic Conductivity (m/day)	Source
Rewan Group				
MB19BWM02A	Siltstone (Weathered Rewan)	15	0.39	AGE, 2020
MB19BWM25P	Sandstone (Weathered Rewan)	20	0.002	AGE, 2020
MB19BWM04R	Sandstone (Rewan)	80	0.0008	AGE, 2020
Rangal Coal Measures				
MB20BWM02P2	Permian (coal)	66	0.00028	HydroFS, 2021
MB20BWM03P1	Permian (coal and sandstone interburden)	86	0.056	HydroFS, 2021
MB20BWM03P2	Permian (coal)	109	0.015	HydroFS, 2021
MB19BWM01P	Aries Coal Seam	171	0.033	AGE, 2020



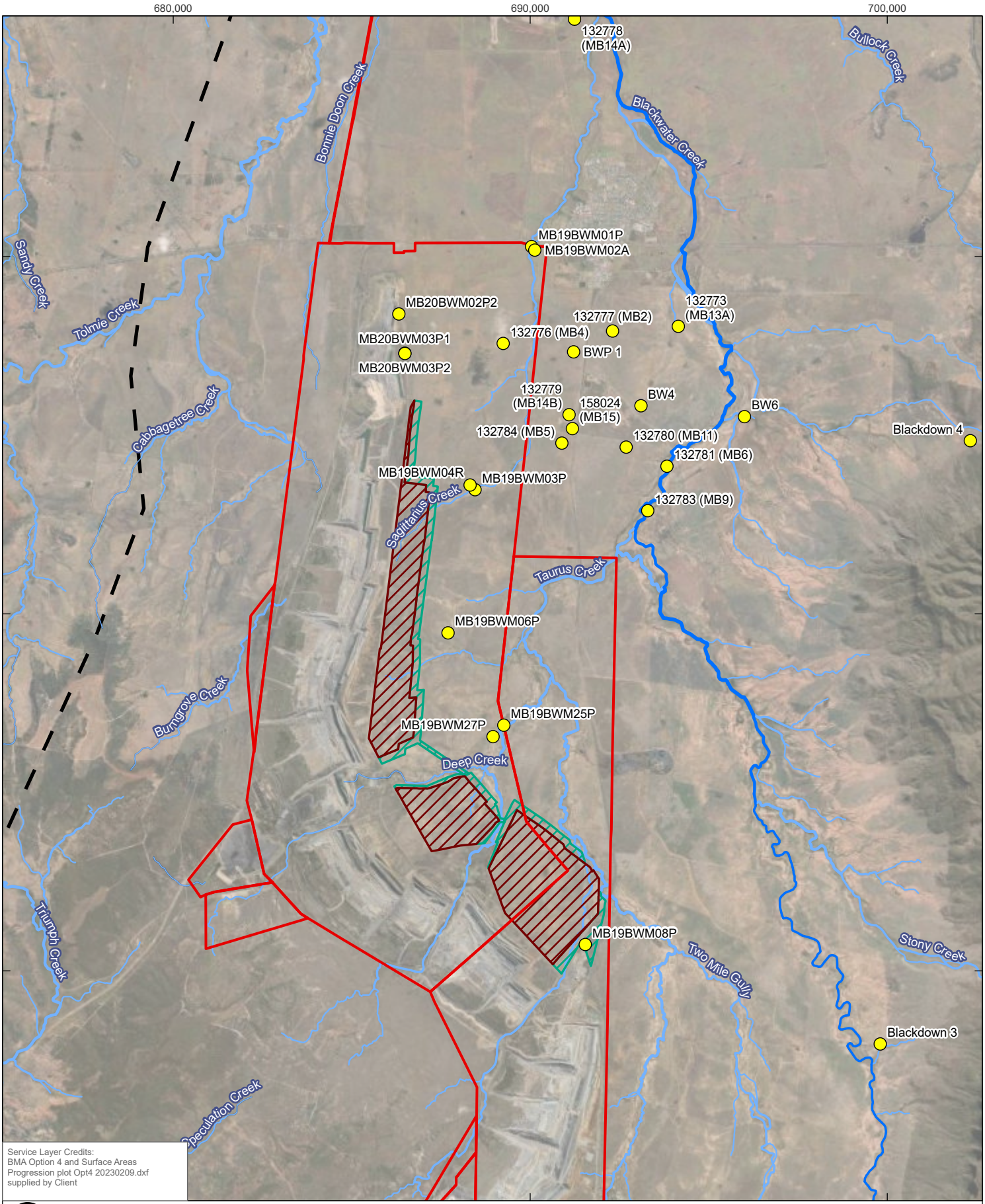
Bore	Aquifer Unit	Bore Depth (m)	Hydraulic Conductivity (m/day)	Source
MB19BWM06P	Aries Coal Seam	186	0.00007	AGE, 2020
MB19BWM27P	Aries Coal Seam	189	0.027	AGE, 2020
MB19BWM08P	Aries Coal Seam	198	0.024	AGE, 2020
MB19BWM03P	Aries Coal Seam	231.5	0.00003	AGE, 2020

Falling-head tests were undertaken on several monitoring bores within ML80173 as part of the proposed Minyango Project (AGE, 2013). The hydraulic conductivity derived from the falling-head tests are summarized in **Table 5-10**. The Blackwater Creek alluvium has the highest estimated hydraulic conductivity of 0.4 m/day, with the Rewan Group estimated hydraulic conductivity ranging over two orders of magnitude between 0.00015 and 0.055 m/day. The measured hydraulic conductivity of one sample from the Aries Seam was 0.003 m/day which is within the range of results obtained for the Rewan Group. The locations of the tested bores are shown on **Figure 5-9**.

Table 5-10 Minyango Falling-Head Tests

Bore	Unit	Bore Depth (m)	Hydraulic Conductivity (m/day)
132783 (MB9)	Blackwater Creek Alluvium	13	0.4
132776 (MB4)	Rewan Group	33	0.015
132784 (MB5)	Rewan Group	47	0.00015
132781 (MB6)	Rewan Group	41	0.0075
132780 (MB11)	Rewan Group	53	0.055
132773 (MB13A)	Rewan Group	16	0.01
132778 (MB14A)	Rewan Group	35	0.0058
132779 (MB14B)	Rewan Group	23	0.0008
158024 (MB15)	Rewan Group	23	0.055
132777 (MB2)	Aries Seam	226	0.003

In addition, several campaigns of drill stem testing of the coal seams within the north and centre of Blackwater have previously been undertaken. Aquifer parameters derived from drill stem tests are summarised in **Table 5-11** (EMM, 2019). The locations of the tested bores are shown on **Figure 5-9.**



Service Layer Credits:
BMA Option 4 and Surface Areas Progression plot Opt4 20230209.dxf supplied by Client

0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:140,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Hydraulic Testing Location
- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

HYDRAULIC TESTING DATA LOCATIONS

SLR

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FIGURE 5-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_09_Hydraulic Testing Data Locations

Table 5-11 Drill stem Test Results (EMM, 2019)

Bore	Coal Seam	Test Depth (m)	Hydraulic Conductivity (m/day)
Blackdown 3	Aries/Castor	574	0.00014
	Virgo	657	0.000017
	Leo/Aquarius	713	0.000017
Blackdown 4	Aries	861	0.000058
	Castor	873	0.000042
BW6	Aries	348–355	0.00019
BW4	Pollux	222–235	0.081
BWP 1	Aries	252–258	0.149
	Castor	265–270	0.094
	Pollux	280=–288	0.032

5.2.2 Southern Area

A series of test pumping programs have been previously undertaken on the coal bearing strata in the South Blackwater area. **Table 5-12** shows the resulting estimated hydraulic parameters including hydraulic conductivity and storativity, collated from these investigations (EMM, 2019).

Table 5-12 Hydraulic Parameters (South Blackwater Area)

Area	Method	Unit	Hydraulic Conductivity (m/day)	Storativity
Kennedy Pit Area	Pumping Test	Argo Seam	3.2 to 8.1	$1.3x10^{-4}$ to $3.4x10^{-4}$
		Aries and Castor Seam	5	$1.3x10^{-4}$ to $3.4x10^{-4}$
		Fresh overburden and interburden	0.75 to 1.75	$3.5x10^{-5}$ to $9.1x10^{-5}$
		Overburden – Weathered and Tertiary	0.7	$3.0x10^{-3}$
		Floor Strata	0.05	$3.5x10^{-5}$ to $9.1x10^{-5}$
Kennedy Pit Area	Pumping Test	Pollux/Argo Seam	6.4	-
Laleham Pit Area	Unknown	Argo Seam	1.3 to 1.9	$1.0x10^{-4}$
South Marshmead	Unknown	Argo Seam	1.5	-

Test pumping conducted by AGC in 1990 was undertaken over 48 hours at a rate of 2.3 L/s with water levels recorded in several observation bores. Drawdown was observed in all bores with the furthest located 820 m from the pumping bore, recording a maximum drawdown of 0.15 m (EMM, 2019).

AGE (2003) conducted test pumping of the Pollux/Argo seam within the Kennedy pit area. The test pumping program was conducted at a rate of 1.5 L/s for 72 hours. The recorded drawdown after 72 hours of pumping was 2.11 m and 0.855 m at distances of 612 m and 1,150 m respectively. Analysis of the test pumping data indicated a hydraulic conductivity of 6 m/day. The exact location of the pumping bore is not known.

Douglas and Partners (1997) reported the hydraulic parameters for the Argo Seam within the Laleham and South Marshmead pit area. The type of testing and location of the test bores are not reported.

5.2.3 Faults

The mapped local faults (**Figure 4-5**) show a displacement of a maximum of 5 m (EMM, 2021). Site specific testing of the faults has not been undertaken to derive hydraulic properties of the fault zones or assess whether the faults act as conduits or barrier to groundwater flow. However, they are anticipated to act more as barriers than conduits because the faults compartmentalise the coal seam geology and Permian groundwater flow is dominated by water movement within these seams.

As identified by Jourde *et al*. (2002), faulting can result in higher permeabilities within strata parallel with the fault plane, and lower permeabilities within strata perpendicular to the fault plane. However, this can also be dependent on whether faults are currently active (Paul *et al.*, 2009). Faulting has been inactive within the Bowen Basin for over 140 million years (Clark *et al.*, 2011), indicating that the fault zones are less likely to act as conduits to flow; this relates to filling of the fractured pore spaces over time through hydrothermal alteration and mineralisation (Uysal *et al.*, 2000). Drill core logs from the Bowen Basin generally show that where fractures and faults have been geologically logged, many fractures are “healed” with calcite and siderite. This indicates that although the system contains a fracture network, many of the existing fractures are cemented, which reduces the effective permeability of the fracture when compared to any open fracture network (Uysal,2000).

Based on a detailed literature review of the effect of faulting on groundwater flow, Coffey (2014) has developed a conceptual model for fault zone hydraulic characterisation in the Bowen Basin (**Figure 5-10**), largely based on Jourde *et al.* (2002) and Flodin *et al.* (2001). This conceptualisation provides a means of inferring hydraulic conductivities of the fault core and the fault damage zone from regional hydraulic conductivity, with the fault core typically one to three orders of magnitude lower conductivity than the regional host rock, and the damage zone approximately an order of magnitude higher.

For this assessment, only one major fault, the Shotover Fault, was included in the groundwater model (refer to **Section 6.0**). The Shotover Fault is located approximately 15 km east of the EA boundary, near the eastern edge of the model boundary (**Figure 4-5**). It is an east dipping thrust fault with a displacement of up to 3,000 m (Mallet, 1988). As mentioned above, fault zones within the model boundary are likely to be “healed” with mineralisation, reducing effective permeability. This suggests that the Shotover Fault is more likely to act as a hydraulic barrier. In line with the IESC (2021) Explanatory Note: Characterisation and Modelling of Geological Fault Zones (Murray & Power, 2021), the Shotover Fault has been classified under Scenario A2: a fault acting as a barrier based on conceptual evidence, as no site-specific hydraulic testing has been undertaken. This



classification reflects the current understanding that the fault core has significantly lower hydraulic conductivity than the surrounding host rock, and supports its representation as a no-flow boundary in the groundwater model.

This fault, the Shotover Fault, was included as a no flow boundary, based on the understanding that the fault core has a lower hydraulic conductivity than the host rock.

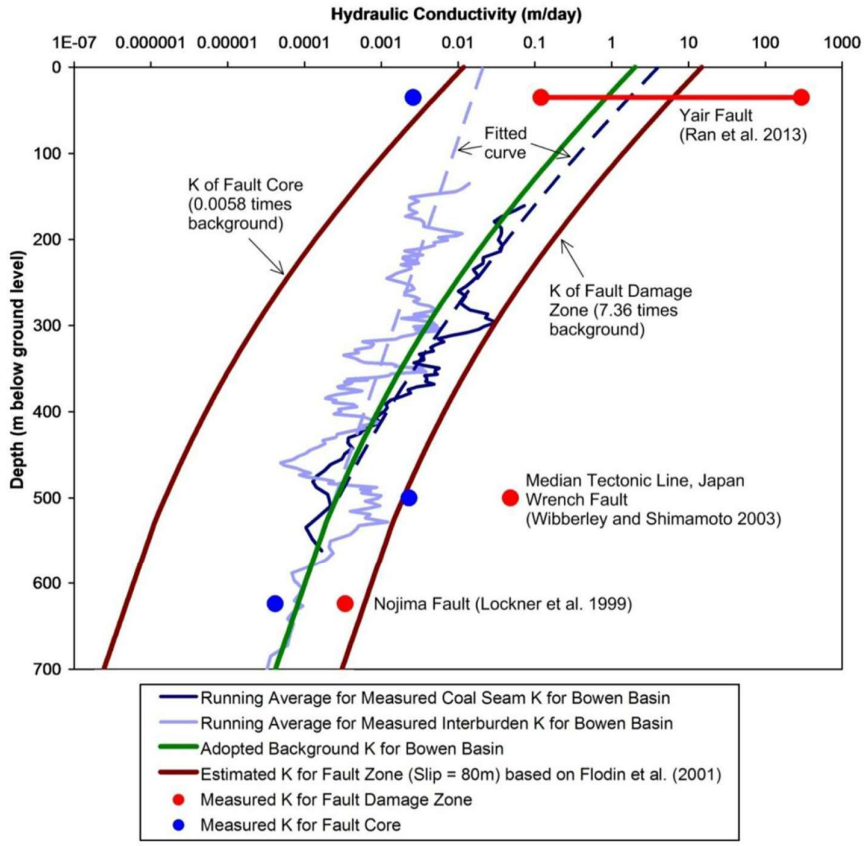


Figure 5-10 Faulting Conceptual Model Developed by Coffey (2014)

5.3 Groundwater Distribution, Flow, Recharge and Discharge

5.3.1 Quaternary Sediments (Alluvium)

Based on recent drilling at BWM, it is considered that the horizontal extent of the Quaternary alluvium within the Study Area is likely smaller than mapped on the regional surface geology map (**Figure 4-1**).

Recent drilling campaigns targeting the alluvium in the north of BWM (2020 and 2021) revealed either an absence of alluvium, and/or dry conditions. In 2020, four bores were planned to be installed into the alluvium at north BWM, however only one of the four locations (bore MB19BWM07A at Taurus Creek) was able to be installed into the alluvium, which was then found to be unsaturated (AGE, 2020). Two bores were planned to be installed into the Two Mile Gully alluvium but did not intersect alluvium and were grouted up. A further two bores targeting the Sagittarius Creek alluvium were attempted to be installed, with one intersecting alluvium (MB19BWM02A) that was found to be unsaturated, and the

other (MB19BWM05A) intersecting possible alluvium or possible Tertiary sediments that were also unsaturated.

These two drillholes in Sagittarius Creek were converted to monitoring bores targeting the shallow weathered Rewan Group instead, where first shallow groundwater was found. Another bore (BWM_MB03_01) installed into the Taurus Creek alluvium, drilled in 2020 (EMM, 2021) has also been dry since installation.

In 2021, during an additional drilling campaign, bore MB20BWM01A initially targeted alluvium (near a small unnamed tributary of Bonnie Doon Creek) but again due to the lack of alluvial sediments at the site, the bore was installed into the water table in the shallow Rewan Group (HydroFS, 2021). In 2023, five additional bores were installed in the alluvium of Rockland Creek (four bores) and Shotover Creek (one bore) in the south of BWM, two of which (MB19BWM_14A and MB19BWM_19A) found the alluvium to be unsaturated.

Drilling results indicate that where the alluvium is present, it is generally dry, with saturated areas found in few locations. There are six active BWM monitoring bores screened in the alluvium that have been considered for this assessment (**Figure 5-2**), however only one is saturated BWM_MB01_01 at Rockland Creek, just outside (approximately 300 metres [m]) the eastern edge of the EA boundary. (**Figure 5-11** and **Figure 5-12**). It is noted however that there is no mapped alluvium in this area, rather the surface geology in the area is mapped as Tertiary sediments. Furthermore, the bore log shows the screened interval to be “clay sand, weathered” indicating that the bore may actually be screened in the Tertiary sediments or weathered Permian, rather than alluvium. The short data record available for this bore shows groundwater level elevation to range between approximately 15 to 16 mBTOC (255 to 256 mAHD) (**Figure 5-11** and **Figure 5-12**). The relatively deep recorded depth to groundwater of approximately 15 m below ground level where alluvial groundwater is encountered indicates a distinct lack of connection with any surface water features, and is also likely beyond the rooting depth of any terrestrial vegetation species.

Due to the general lack of saturated monitoring locations in the alluvium, and the limited period of data available, it is not possible to assess correlation with rainfall (and therefore recharge) based on these bores. However, based on a review of available groundwater level data for the neighbouring Minyango Project that was conducted by AGE (2013), recharge to the alluvium is suggested to be limited. Of the four bores installed into the alluvium at Minyango Project, three were also dry. The only bore that encountered water (Minyango-MB9) revealed a limited saturated thickness of less than 0.8 m, with a depth to water level of 10.8 mBGL. The monitoring data for MB9 showed a steady decline between December 2012 to September 2013, and showed no correlation with rainfall. AGE (2013) determined that, for bore MB9, recharge is likely limited by the surficial clay above alluvium and that the alluvium is likely compartmentalised, with limited connectivity between saturated alluvium areas, separated by clay lenses and outcropping bedrock. Where saturated, the alluvium may facilitate recharge to underlying geological units. Discharge from this aquifer is generally considered to be via evapotranspiration and leakage to underlying aquifers.



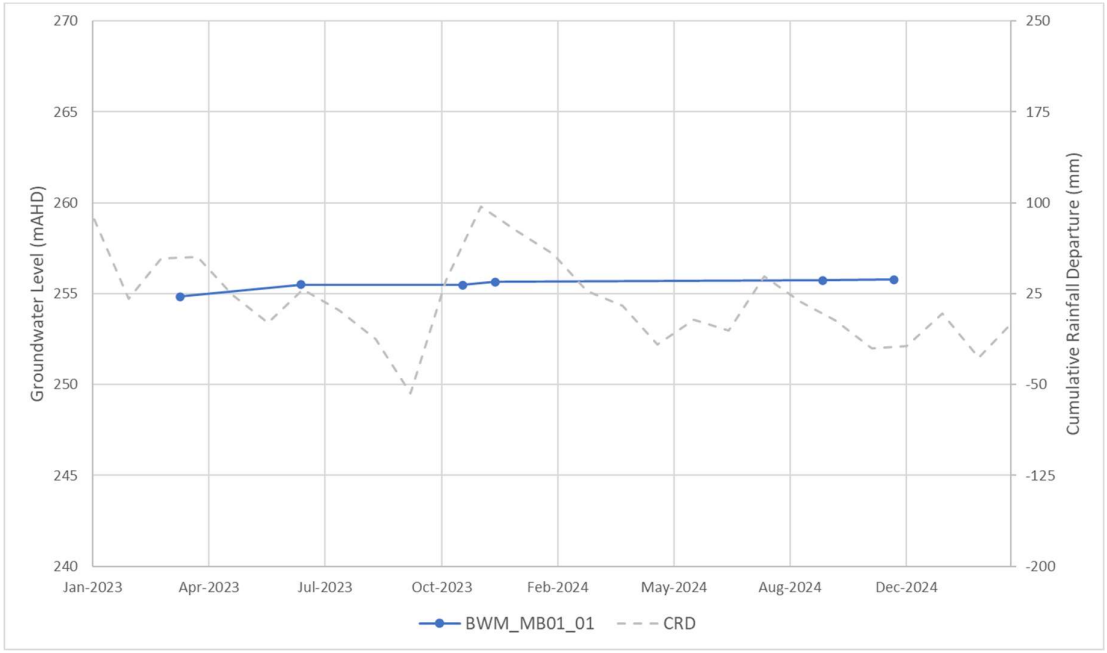


Figure 5-11 Groundwater Level (mAHD) – Alluvium

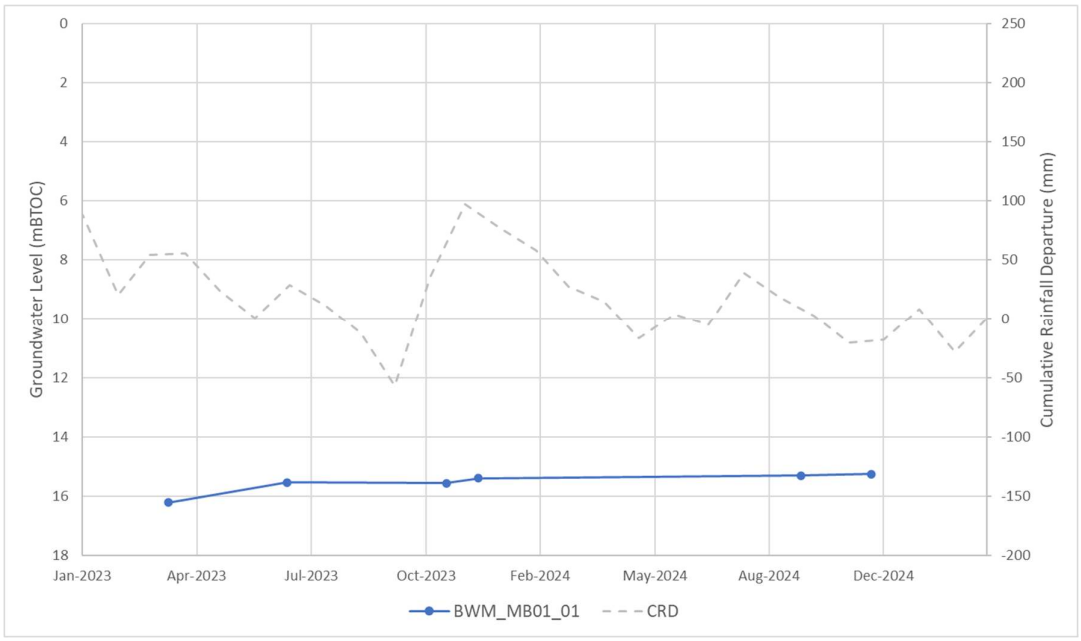


Figure 5-12 Groundwater Level (mBTOC) – Alluvium

Due to the general lack of saturated monitoring locations in the alluvium within the study area, it is not possible to map groundwater contours for this unit, nor is it likely that a widespread flow system in the alluvium exists. However, where saturation does exist, groundwater flow in the alluvium is expected to be controlled by topography and mimic surface water flow directions, with flow towards the north at North Blackwater and towards the southwest at South Blackwater.

5.3.2 Tertiary Sediments

The Tertiary unit forms the surficial (water table) aquifer, where the groundwater table exceeds the base of the unit (that is, in some locations at BWM the Tertiary unit is 'dry' and therefore does not form an aquifer). Groundwater level data for the Tertiary EA listed bores is provided as two separate figures - **Figure 5-13** and **Figure 5-14**, for visualisation purposes due to the elevation difference between the groundwater levels.

Bores BWM_MB12_01 and BWM_MB17_01 are also Tertiary EA listed bores but have been recorded as dry since installation so do not appear on the figures.

Groundwater levels in the Tertiary EA listed bores range from approximately 242 to 306 mAHD and 15 to 20 mBTOC. The longest monitoring record is available from MB21, which shows there has been a steady decrease in groundwater level since 2011, interrupted periodically by relatively short-term responses to large rainfall events. This long-term decline reflects a long-term response following the very high rainfall observed in 2011. Groundwater levels in BWM_MB15_01 and BWM_MB17_02 over the relatively short monitoring period have remained stable, showing no response to rainfall trends or any mine-related influences. This is consistent with the conceptualisation of the Tertiary unit, where recharge from rainfall infiltration is expected to be low due to the presence of surficial clays. Notably, bore BWM_MB15_01 sits at the highest ground elevation of any of the Tertiary EA listed bores and hence has the highest groundwater level elevation of any of the Tertiary EA listed bores, noting that the natural water table elevation typically forms a subdued reflection of topography.

47 bores are screened in the Tertiary Sediments, with MB20BWM01A located in the Northern area, east of the Bonnie Doon Pit and the remaining bores located within the Southern area (**Figure 5-3**). Five of these bores are current EA listed bores.

Northern Area

MB20BWM01A was drilled in 2020 and has remained dry since instillation. In this area the Tertiary Sediments are relatively thin (i.e. less than 15 m thick) and underlain by the Rewan Group (east of the mining area), the Permian units of the RCM (within the mining area) and the Burngrove Formation (west of the mining area). The Tertiary Sediments primarily consist of highly to extremely weathered sandstone and mudstone of the Duaringa Formation and forms the bulk of the Regolith. In the Northern Area, the Tertiary Sediments are expected to be mostly dry, as indicated by recent drilling (AGE, 2020 and HydroFS, 2021) as well as historical observations at Minyango (AGE, 2013). As per the alluvium, recharge is expected to be low due to the presence of surficial clays. Although no groundwater monitoring data is available, groundwater flow in the Tertiary Sediments is expected to mirror topography and flow towards the north.

Southern Area

Based on drilling results, the Tertiary Sediments in the Southern Area are thicker on average than in the Northern Area. In this area they primarily consist of claystone, siltstones, sandstones and interbedded basalt of the Emerald Formation.



Groundwater levels for the three monitoring bores screening the Tertiary Sediments vary from approximately 240 mAHD (BWM_MB17_02) to 305 mAHD (BWM_MB15_01) (**Figure** 5-13 and **Figure 5-14**).

Following the commencement of water level measurement, BWM_MB17_02 and MB21 have seen a very slight albeit relatively steady decrease in water level, while BWM_MB15_01 has remained stable. These trends are intermittently interrupted only by relatively short-term response to large rainfall events. The bores display levels that are consistent with the assumed flow pattern for the regional Tertiary units, following a subdued reflection of topography.

Groundwater quality (**Section 5.4**) is generally saline, which would suggest a low to very low recharge rate for the Tertiary Sediments. However, there is significant variability in salinity levels for some of the identified bores of the Southern Area bores.

Discharge is considered to be primarily through evapotranspiration and leakage to underlying aquifers.

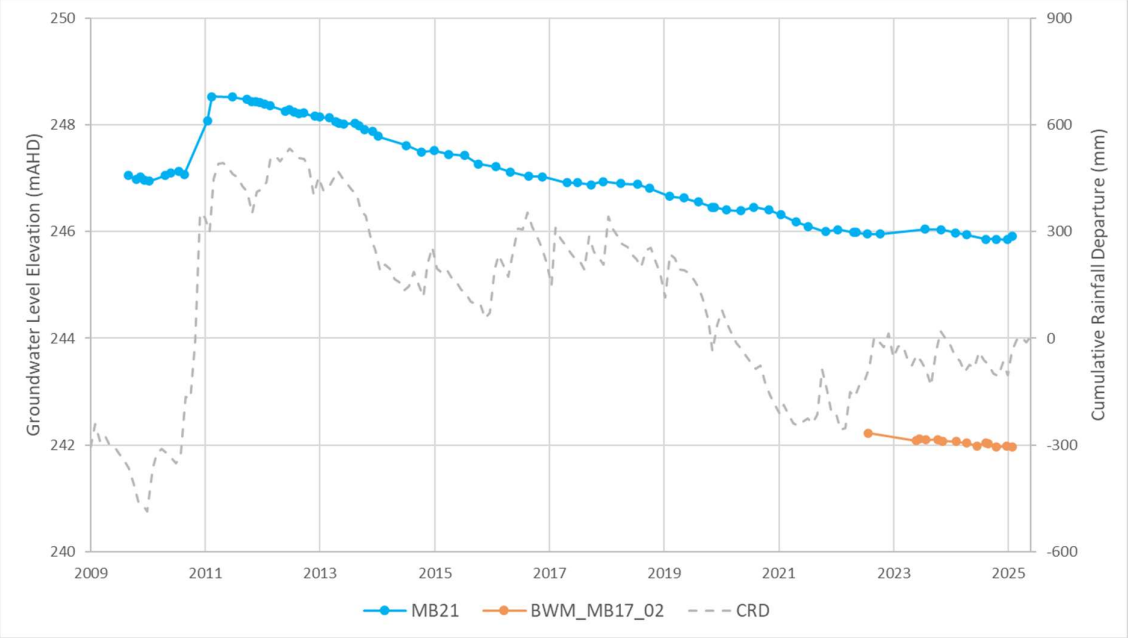


Figure 5-13 Groundwater Levels – Tertiary EA Listed Bores (MB21 and BWM_MB17_02)

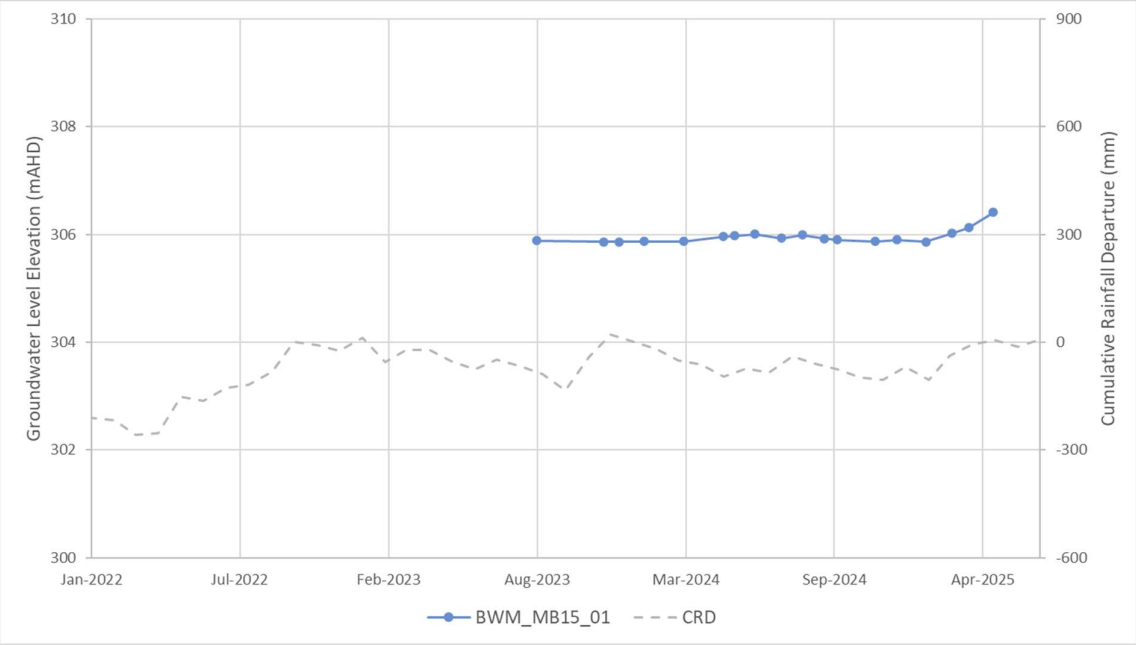


Figure 5-14 Groundwater Levels – Tertiary EA Listed Bores (continued) (BWM_MB15_01)

5.3.3 Clematis Group

The aquifer forming Clematis Group sandstones are distinguished by coarse grain size, with less interbedded shale and siltstone than the non-aquifer forming Clematis Group units. There are no registered bores within the Clematis Group sandstone, as the sandstone outcrops in elevated rugged areas in Arthur's Bluff State Forest, Shotover State Forest and Blackdown Tableland National Park. Claystones of the Rewan Group directly underlie the Clematis Group, forming an aquitard between the Clematis Group and the deeper Rangal Coal Measures.

5.3.4 Rewan Group

Regionally across the Bowen Basin, the Rewan Group is considered an aquitard (DNRM, 2016), given its low yielding nature, with any groundwater having limited potential for beneficial use due to the typically fine-grained, clay-bound nature of the sediments.

Groundwater level data for the two BWM EA listed bores installed into the Rewan Group is provided as (**Figure 5-15**). The monitoring data shows groundwater levels in these bores range between approximately 161 to 170 mAHD.

Both bores show stable groundwater levels with little variation in groundwater level over the monitoring record, approximately 1 m for MB19BWM02A and 0.1 m for BWM_MB03_02. The small 1 m increase occurring in MB19BWM02A between mid-2020 and early 2023 appears to be a subdued response to a relatively sustained period of above average rainfall. MB19BWM02A and BWM_MB03_02 generally show stable water levels over the monitoring record with no response to short term rainfall CRD peaks, indicating a degree of insulation from short term recharge events.

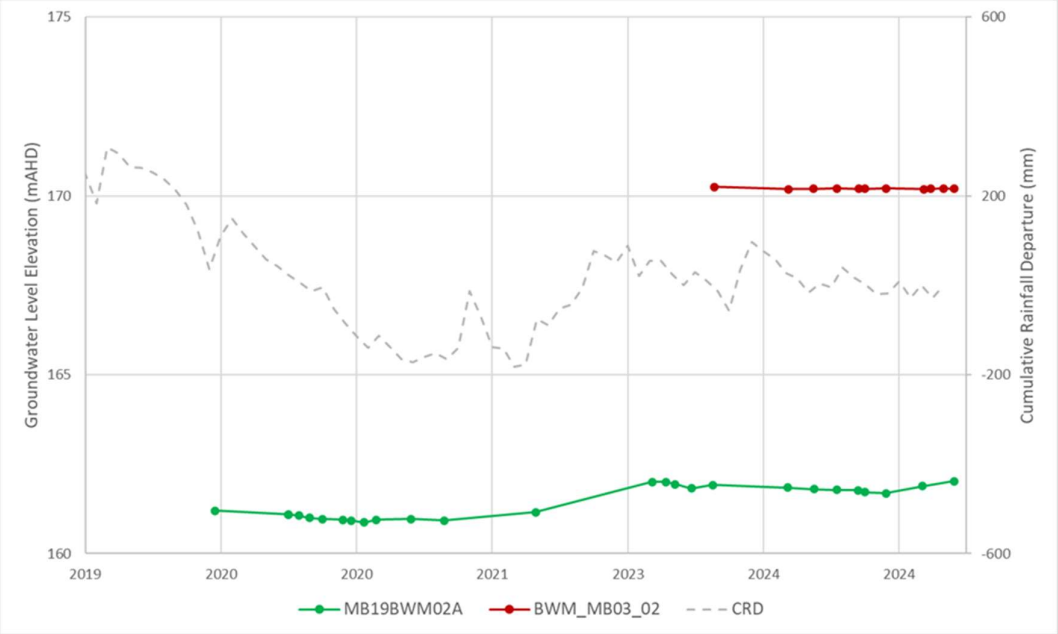


Figure 5-15 Groundwater Levels – Rewan Group

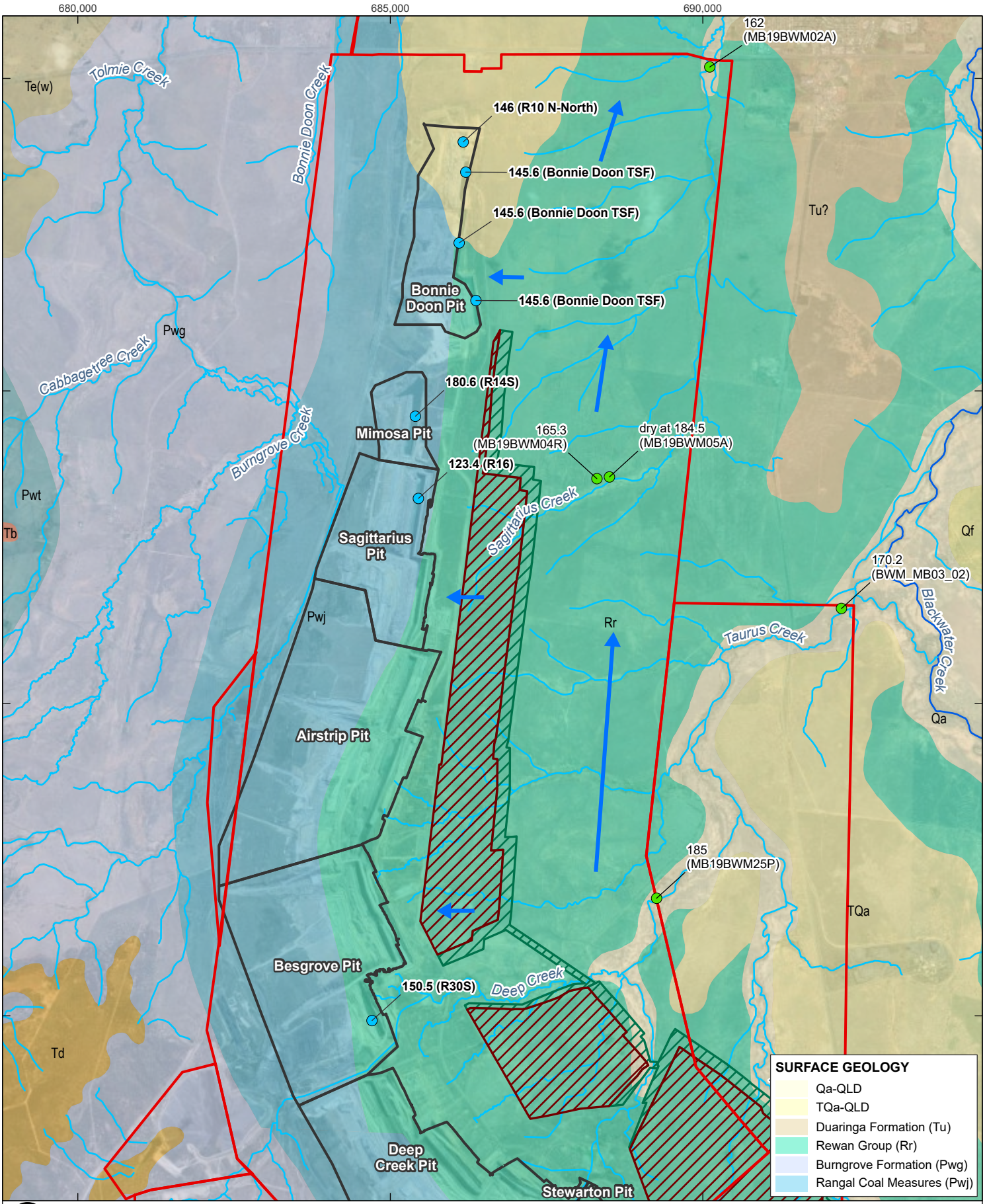
Recharge to the Rewan Group is expected to occur via leakage from the overlying Quaternary and Tertiary units. Recharge rates are likely very low due to the low hydraulic conductivity of the interbedded fine grained clay horizons restricting infiltration. This is

supported by elevated salinity (see **Section 5.4**) which is consistent with high groundwater residence times concentrating salts.

Outflow from this unit is expected to be through lateral flow, with low vertical hydraulic conductivity limiting potential leakage to underlying units. The suggested insulation of this unit from recharge events makes it unlikely that there would be short term (post-rainfall) groundwater pressure increases sufficient as to discharge to surface water features.

Available groundwater levels from the monitoring bores grouped in the northern area indicate a flow toward the north of BWM (i.e. consistent with topographical gradients) and potentially (if the Rewan Group is saturated in this area) also locally towards the pits that report lake levels significantly below the groundwater levels in the nearest bores screened in the Rewan Group (**Figure 5-16**). As shown on **Figure 5-4** there is one bore screened in the Rewan Group in BWM South however, groundwater flow in the southern portion of BWM is also expected to follow topography, with a flow direction towards the south and southwest.





0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:80,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Water Level - mAHD (Pit)
- Bore (Groundwater Level – mAHD)
- Groundwater Flow Direction
- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- Historical Pit Extent
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER FLOW DIRECTION IN THE REWAN GROUP (BWM NORTH)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 5-16

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_16 Groundwater Flow Direction in the Rewan Group (BWM North)

5.3.5 Rangal Coal Measures

The following conceptualisation of groundwater distribution, flow, recharge and outflow for the RCM is discussed separately for the North (**Section 5.3.5.1**) and South (**Section 5.3.5.2**). This division is a reflection of the very large north-south strike length of BWM and fact that, broadly, the Permian groundwater system appears divided across BWM on the basis of the broad scale topographically driven surface water catchments, being the upper Mackenzie River sub-catchment for North and Central BWM and the Comet River sub-catchment for South BWM.

5.3.5.1 BWM North Area

Groundwater level data for the RCM EA listed bores in the BWM North area is shown on **Figure 5-17**. Groundwater levels from these bores range from approximately 143 to 245 mAHD.

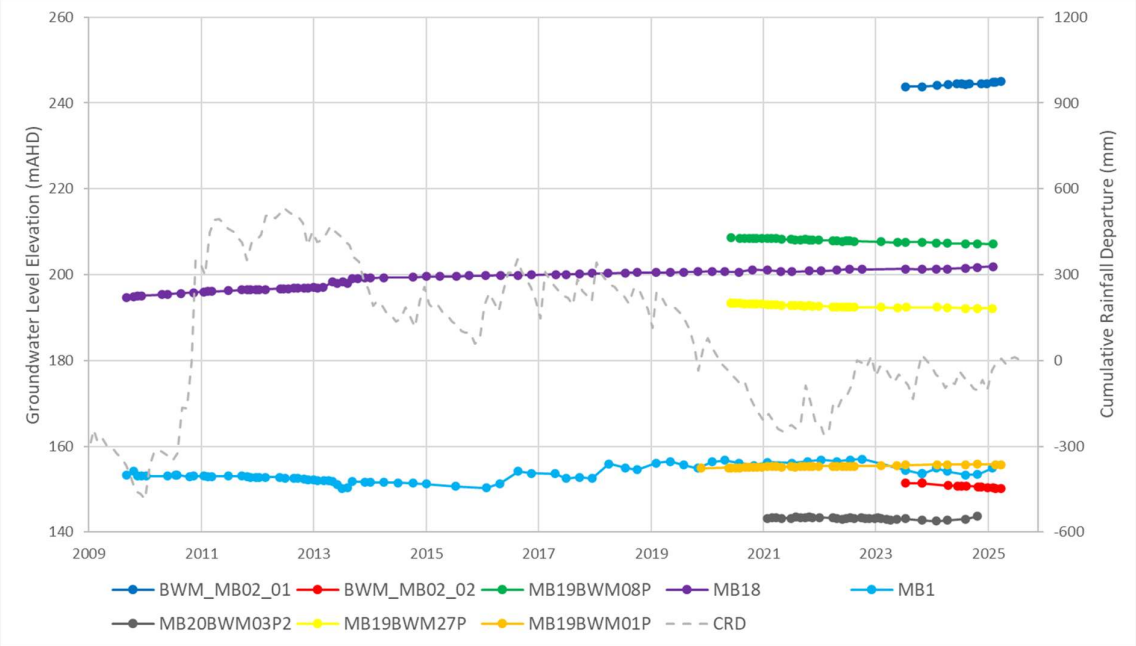


Figure 5-17 Groundwater Levels – Rangal Coal Measures EA Listed Bores (BWM North Area)

A comparison of the groundwater level trends shown against the CRD indicates that the groundwater regime in the RCM is somewhat insulated from short term climatic effects. As shown on **Figure 5-17**, groundwater elevation at MB1 (monitoring the Aries seam, and located approximately 400 m east of the Bonnie Doon highwall), which has the longest monitoring record, gradually but marginally increased between the cessation of Bonnie Doon Pit mining in 2016 and the beginning of 2023, before declining slightly in 2024 but remaining relatively steady thereafter. Given this bore has a groundwater elevation well above the nearby pit water levels, this is considered to be a hydraulic response of the RCM recovering following the removal of dewatering stressors, rather than an indication of recharge from pit lakes. The monitoring record at MB20BWM03P2 (monitoring the Castor/Pollux seams) which also monitors the area of the RCM immediately east of the Bonnie Doon Pit / in-pit Tailings Storage Facility (TSF) area shows relatively stable groundwater levels over its monitoring

record. Groundwater levels here are potentially influenced by the tailings dam design and construction. MB19BWM01P and MB19BWM27P also monitor the Aries seam and show little variation in water level over the monitoring record, with MB19BWM01P steadily increasing approximately 0.8 m and MB19BWM27P steadily declining approximately 1.2 m. Groundwater elevation at MB19BWM27P is notably higher than the other EA listed bores monitoring in the Aries seam (i.e. MB1 and MB19BWM01P), reflective of an overall south to north inferred groundwater flow direction. Groundwater elevation is also lowest at MB20BWM03P2 monitoring the Castor/Pollux seams below the Aries seam, indicating a downwards hydraulic gradient (and flow potential) from the Aries seam to the Castor/Pollux seams.

Of note, BWM_MB02_02 reports the second lowest groundwater levels and given its location between BWM's Blackdown and Wilpeena Pits to the west of the bore, and the Cook Colliery underground mine to the east outside of the BWM mining lease and EA boundary, indicates a drawdown influence from mining activities. Bore MB18, which is screened in the RCM overburden, has the longest monitoring record and shows an overall increasing trend in groundwater level from 2010 to current. MB19BWM08P shows a groundwater level of around 207 mAHD, whereas the groundwater level at adjacent shallower MB18 is around 202 mAHD, indicating an upwards hydraulic gradient from the confined coal seams into the aquitard overburden material. BWM_MB02_02 (Castor Seam) and BWM_MB02_01 (screened in the shallow overburden) show approximately 90 m of head separation, indicating a downwards hydraulic gradient and flow potential.

5.3.5.2 BWM South Area

Groundwater level data for the RCM EA listed bores in the BWM South area is shown on **Figure 5-18**. Groundwater levels from these bores range from approximately 234 to 275 mAHD, and display a relatively stable monitoring record. Likewise with the RCM bores across BWM North, the comparison of the groundwater level trends shown against the CRD indicate that the groundwater regime in the RCM is somewhat insulated from short term climatic effects. BWM_MB12_02 monitors the castor seam and shows little variation in water level over the monitoring record, with approximately 1.9 m increase between 2022 and 2023, and around 0.1 m variation since. BWM_14_01 and BWM_14_02 both monitor the overburden and also show little variation in water level, with both bores steadily increasing approximately 0.3 m over the monitoring record. Notably, BWM_14_01 (shallow overburden) and BWM_14_02 (deep overburden) show approximately 12 m of head separation, indicating a downwards hydraulic gradient.

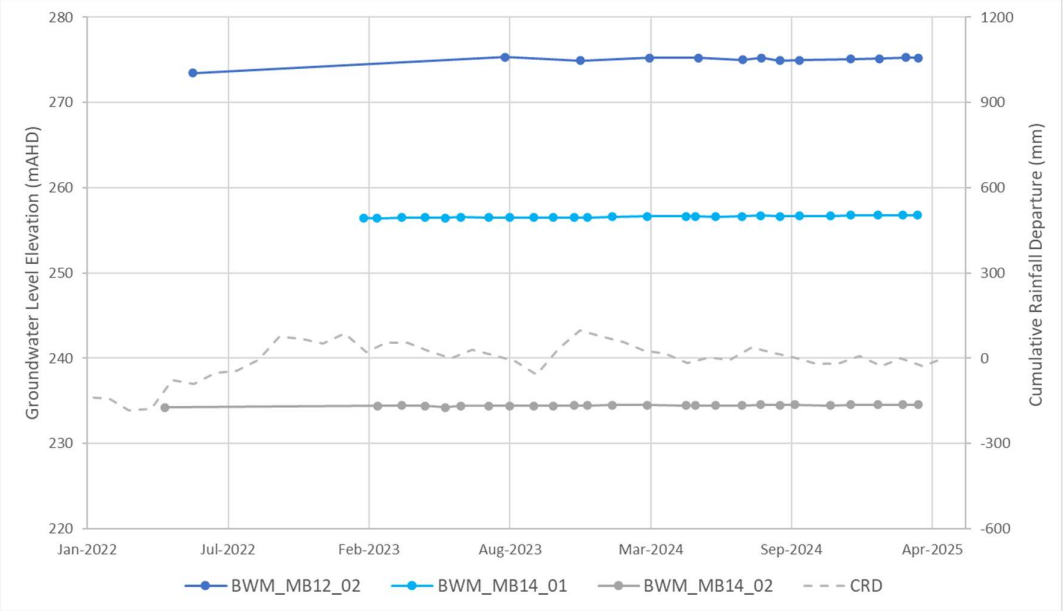


Figure 5-18 Groundwater Level (mAHD) – Rangal Coal Measures (Southern Area)

Available groundwater levels for the now decommissioned bore MB16 are shown in **Figure** 5-19. MB16 is suggested by EMM (2021) to monitor the Aries Seam (or Aries Seam workings) within the extent the historic Laleham Underground Mine, which extracted coal from the Aries to the Pollux Seams (Byrnes Geotechnical, 2024). Groundwater levels at MB16 were approximately 223 mAHD (58 mBGL) prior to 2015, after which a gradual increase in water level occurred to approximately 243 (38 mBGL) mAHD to 2018 before stabilising. This water level increase of approximately 19 m is likely to be related to partial recovery of water in the underground workings (EMM, 2021), i.e. reflooding.

Groundwater levels at MB16 are noted to remain significantly lower in elevation than water storage elevations within the Kenmare pit (287.4 to 276.6 mAHD), suggesting there remains the potential for groundwater movement towards the underground workings from water stored in this pit. The groundwater levels at MB16 are also marginally lower in elevation than the most recent pit lake level recorded within the Ramp 74/Laleham pit (246.4 mAHD), though the difference is relatively small and suggests that the underground workings may have essentially reached close to hydraulic equilibrium with the Ramp 74/Laleham pit.

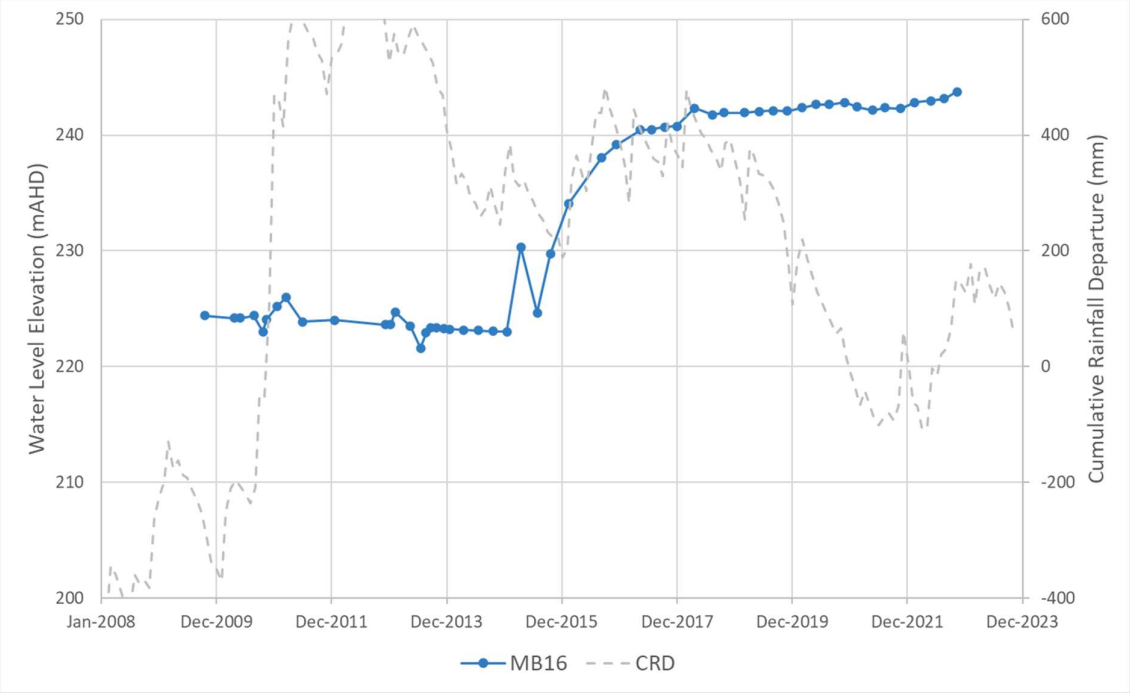


Figure 5-19 MB16 Groundwater Level (mAHD) – (Laleham Underground Mine)

5.3.5.3 Summary

A comparison of groundwater level trends for all BWM bores screened in the RCM coal seams against the CRD indicates that the groundwater regime in the RCM coal seams is somewhat insulated from short term climatic effects, though depth and conductivity of the monitored horizon clearly influences this response. Through hydraulic connection with the mining areas, it is apparent that there is some minor response in regional groundwater levels to mining depressurisation.

Groundwater quality in the RCM coal seams is mostly saline (**Section 5.4**), which suggests long residence times related to low recharge rates and increased water-rock interaction.

Recharge to the coal seams is expected to occur primarily via leakage from the overlying Quaternary and Tertiary units, with greater recharge occurring in areas where the seams subcrop and outcrop. Based on the inferred hydraulic gradients between overburden and coal seams, this is likely limited to the overburden horizons, with coal seam recharge occurring through mine surface water storages where the seams are hydraulically connected to the storages. Outflow from the RCM is considered to be primarily through inflow to active mining areas, within the cone of depression. Where groundwater is not influenced by the cone of depression, outflow will occur downdip following regional flow path to the east.

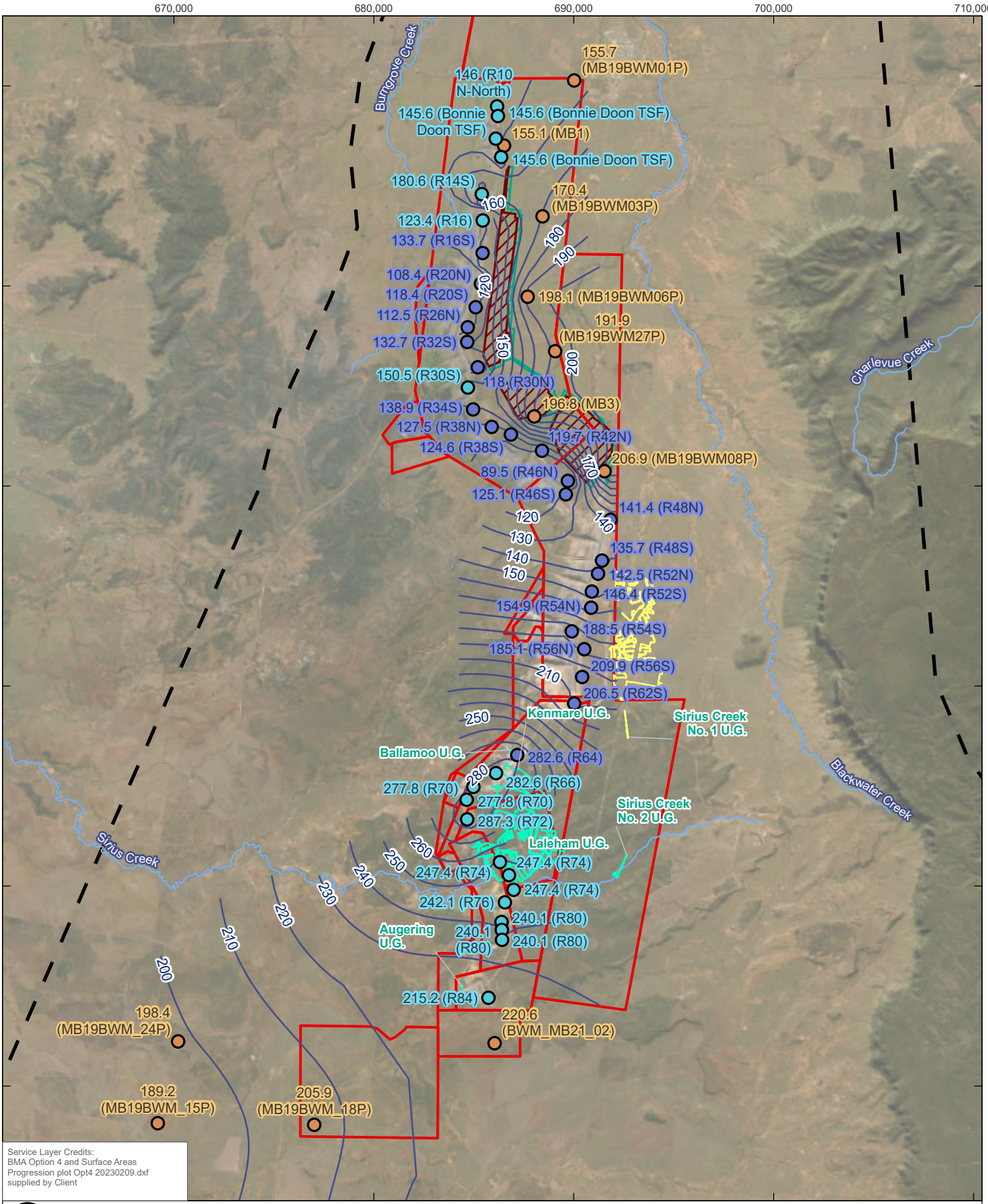
Groundwater level contours for the Aries Seam are shown on **Figure 5-20**. The Aries Seam was selected as it has the highest number of data points and most recent data available for analysis, and it is expected that other coal seams would exhibit similar flow patterns. The contours are based on the most recently available groundwater level measurements from bores screened in the Aries Seam. The most recent available pit water levels are also included in the mapping to assist with the interpretation of RCM groundwater flow direction as it provides an indication of the groundwater level in the RCM directly adjacent to the pit, since there is direct hydraulic connection between the pits and the RCM. Where there are no



in-pit water storages, the base elevation of the pits (based on most recently available LiDAR in February 2024) are also shown as groundwater levels must be below the base of the pits in the case of dry pits, with any groundwater inflow passively managed through evaporation and the use of in pit sumps.

As shown on **Figure 5-20**, the groundwater flow direction in the BWM North area is locally predominantly towards the mine pits, consistent with discharge to the active mine pits. In the southern area of BWM, the flow direction within the Aries Seam is dominated by the local influence of elevated in-pit water storages at Kenmare Pit. In the far south, the potentiometric mapping indicates a groundwater divide present just north of Sirius Creek, consistent with the surface catchment divide, with groundwater flow from northeast to southwest. As mentioned above, it is expected that the lower coal seams would exhibit similar flow patterns, however this does not apply to the Castor, Pollux and Orion seams in the area of the Cook Colliery. In this area the groundwater flow direction in these seams would be dominated by the local influence of dewatering, with the local groundwater flow direction therefore predominantly towards Cook Colliery.





Service Layer Credits:
BMA Option 4 and Surface Areas Progression plot Opt4 20230209.dxf supplied by Client

0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

Elevation (mAHD)

- Base Elevation - mAHD (Pit Ramp)
- Base of Pit - mAHD (Pit)
- Water Level - mAHD (Bore)
- Water Level - mAHD (Pit)
- Groundwater Elevation Contour (mAHD)
- Watercourse
- Current Underground Mine
- Historical Underground Mine
- GIA Study Area
- BWM Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER LEVEL CONTOURS – ARIES SEAM

SLR

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FIGURE 5-20

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_20_GWL Levels Aries Seam

5.3.6 Burngrove Formation

There are two monitoring bores installed in the Burngrove Formation, both are located to the northwest of the Project. **Figure 5-21** show the groundwater levels in these bores, 'BG-1' and 'BG-2'.

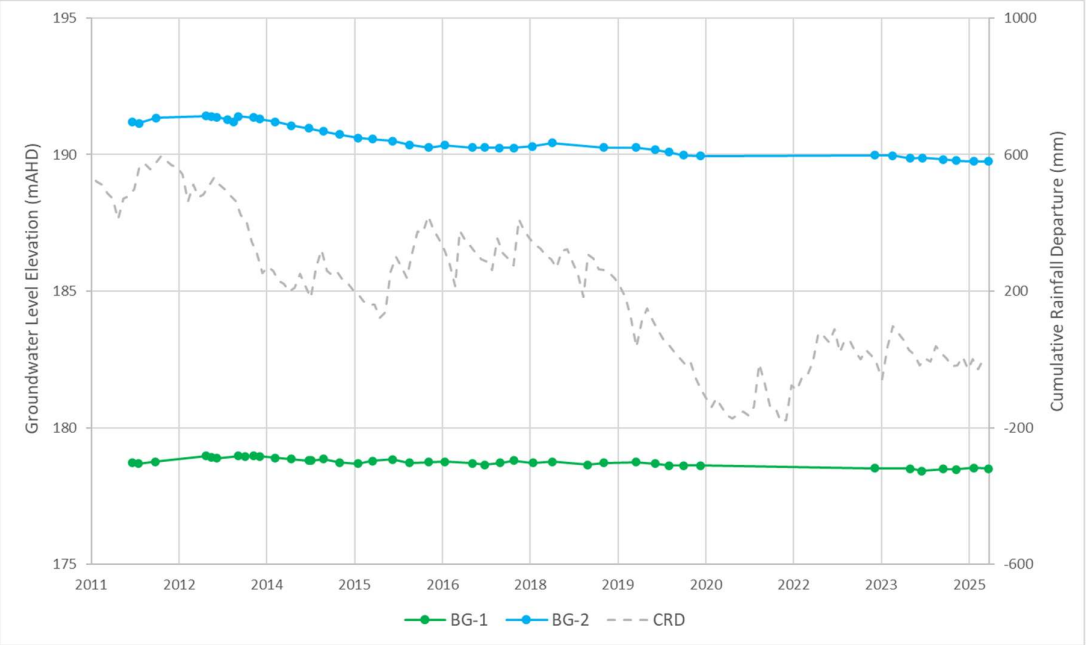
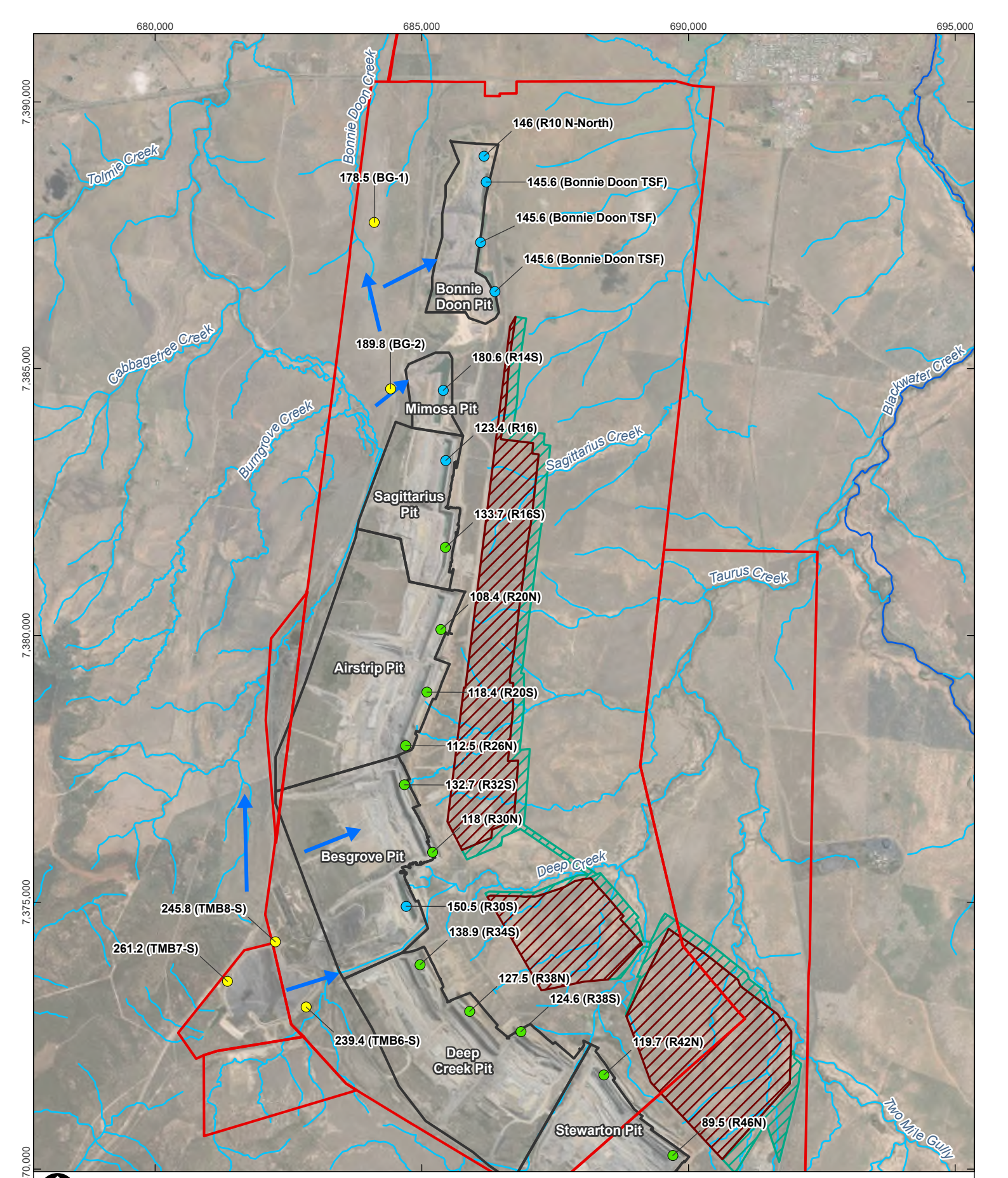


Figure 5-21 Standing Water Level in the Burngrove Formation

The monitoring data shows groundwater levels in these bores range between approximately 178 to 191 mAHD. Both bores show little variation in groundwater level over the monitoring record, approximately 0.5 m for BG-1, and 1 m for BG-2. These variations at both bores are consistent with the overall long-term decline of the CRD over the corresponding monitoring record, with the trend being more pronounced at BG-2. Groundwater levels in these bores do not seem to respond to short term increases in the CRD, suggesting low rates of rainfall-derived recharge in these areas. Recharge to the Burngrove Formation would occur primarily where the formation outcrops along the west of the Project Area (**Figure 4-1**). Outflow from this formation is expected to be through lateral flow in the direction of regional groundwater flow, with some upwards leakage to the depressurised RCM.

The groundwater flow direction at BWM North is inferred to be overall towards the north-northwest consistent with topographical gradients and surface water flow patterns. The local flow direction near the pits is towards the northeast, consistent with the concept of local groundwater discharge to the pits. It is noted that the magnitude of the local hydraulic gradient towards the pits (east-northeast) is much greater than the north-northwest flow component as inferred by the larger head difference between data points over a shorter distance. This indicates that the magnitude of groundwater flow towards the pits is significantly greater than groundwater flow to the north-northwest. In the area of the NCPP, the local flow direction is towards the east, consistent with the drainage line that runs towards Deep Creek. The other bores screened in the Burngrove Formation in BWM South are grouped closely around the Red Dam area and hence are not useful in inferring regional flow direction, however, groundwater flow in the southern portion of BWM is expected to follow topography, with a flow direction towards the south and southwest.



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A4
Project Number:	640.031809.00001
Date Drawn:	15-Feb-2026
Drawn by:	RB

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER FLOW DIRECTION IN THE BURNGROVE FORMATION (BWM NORTH)

SLR

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FIGURE 5-22

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_21_GW Flow Direction in the Burngrove Formation (BWM North)

5.3.7 Vertical Flow between Units

Two VWPs were installed in the BWM North Area, VWP19BWM01 and VWP19BWM02 (AGE, 2020). VWPs are groundwater level (pressure) monitoring infrastructure with multiple sensors installed at different depths allowing for collection of groundwater levels from multiple groundwater bearing zones in a single borehole. From the water pressure at each sensor, potential interactions between the groundwater bearing units can be interpreted. These VWPs are no longer operational, with no recent data available. It is reported that VWP19BWM02 was damaged via blasting, although the timing of this is not confirmed.

VWP19BWM01 is located on ML1759 in the Northern Area, around 4 km east of the closest open-cut pit, which has a water level (or sump level) of 130 mAHD. The water level data for the VWP is presented in **Figure 5-23**, together with the CRD. Since the start of the recording in December 2019, the water levels in all sensors have declined continually. An exception is Sensor VW4 (Interburden 154 mBGL). The water level at that bore followed the shallower sensors (VWP1-3) closely, then increased in water levels, and has been stable at 196 mAHD since 2020. It is unknown whether this reflects the water levels in the interburden or if an instrument error is the cause for the difference in water levels. Furthermore, the Pollux seam monitoring (VW5 Pollux Seam 186 mBGL) shows flat response inconsistent with relative changes in rest of the monitoring profile and this sensor is not considered representative. **Figure 5-23** shows that the Aries Seam (VW3 Aries Seam 125 mBGL) and two vertical locations of the overburden (VW1 Overburden 46 mBGL and VW3 Overburden 104 mBGL) show similar water levels. Higher water level in the stable Aries Seam sensor (VW3 Aries Seam 125 mBGL) data post-2021 indicates that there is an upwards vertical gradient (confined aquifer) in the coal seams. This is consistent with the nested bore data discussed in **Section 5.3.5**. It is unclear if the water levels in the VWP follow a climatic pattern or are influenced by mining.

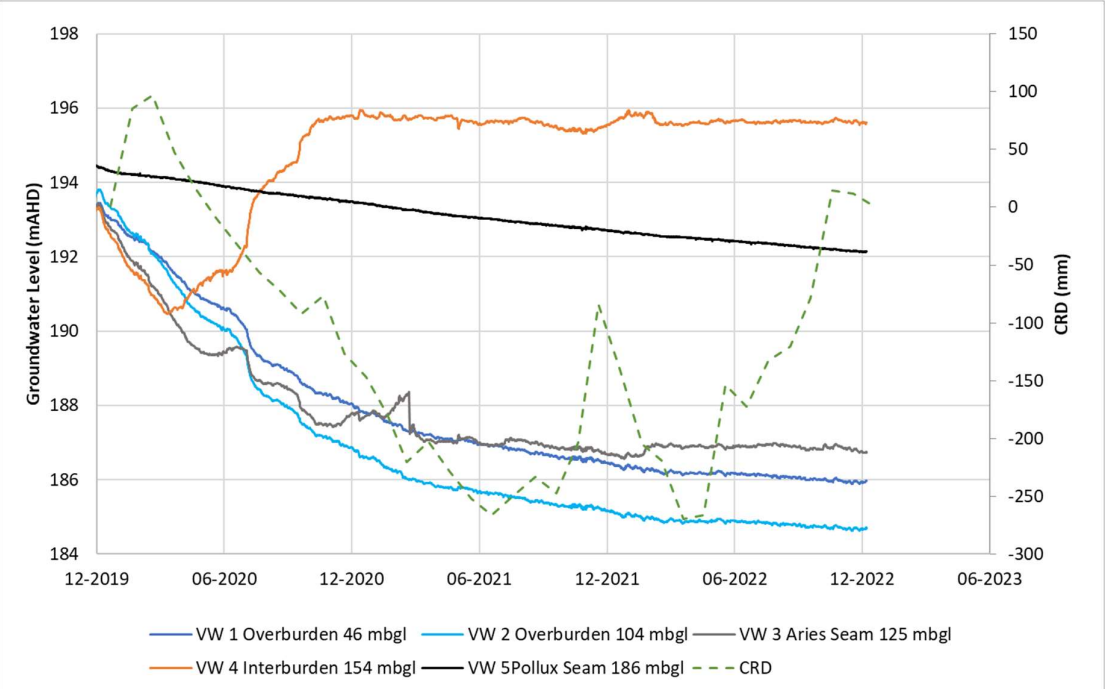


Figure 5-23 Groundwater Levels at VWP19BWM01 and CRD

VWP19BWM02 is located on ML1762 in the Central Area, around 500 m away from the closest pit (Ramp 52N). The water level data for the VWP is presented in **Figure 5-24**, together with the CRD. For this location the overburden (VW1) has a 30 m higher water level than the coal seams, which suggest a downward vertical flow gradient. In late 2022, the water level in all sensors sharply increases before fluctuating until the end of the monitoring record in a consistent pattern across all sensors (**Figure 5-24**). The similarity in responses across many of the sensors, and the timing of these responses broadly in line with when significant rainfall events or changes in mine water management may have occurred, could lead to the conclusion that these changes are climate related. However, standpipe bore MB4, which is located close by and is screened in the same formation, has historically not responded to climatic events, and hence it is more likely that the increase in water levels in late 2022 is related to a sensor error rather than a recharge event at depth.

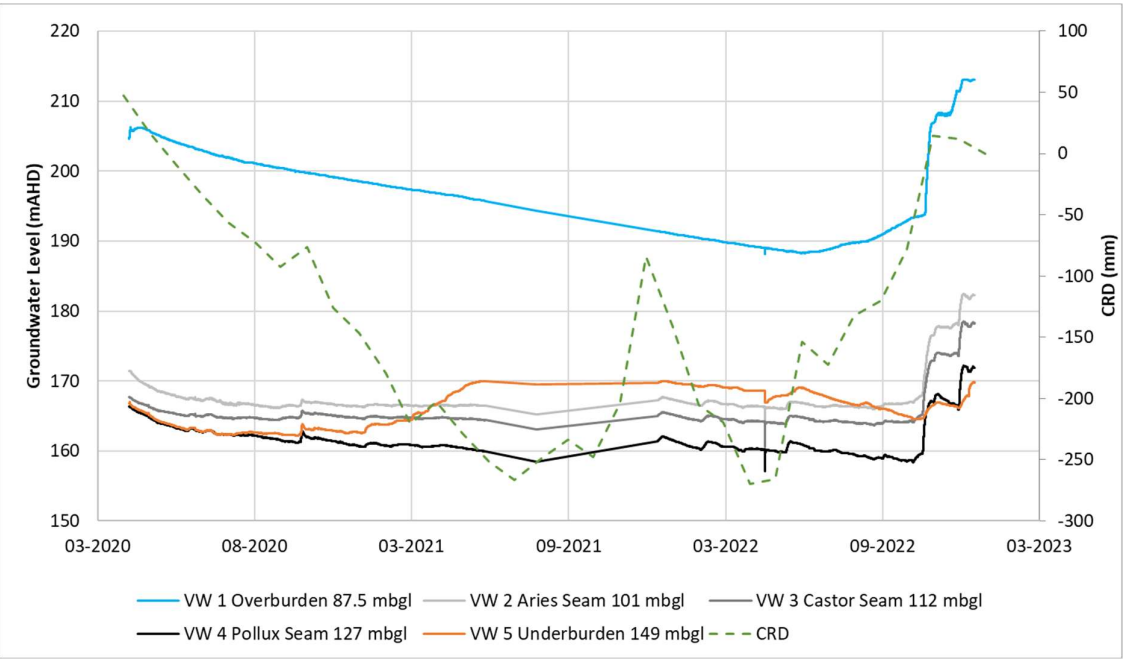


Figure 5-24 Groundwater Level at VWP19BWM02P and CRD

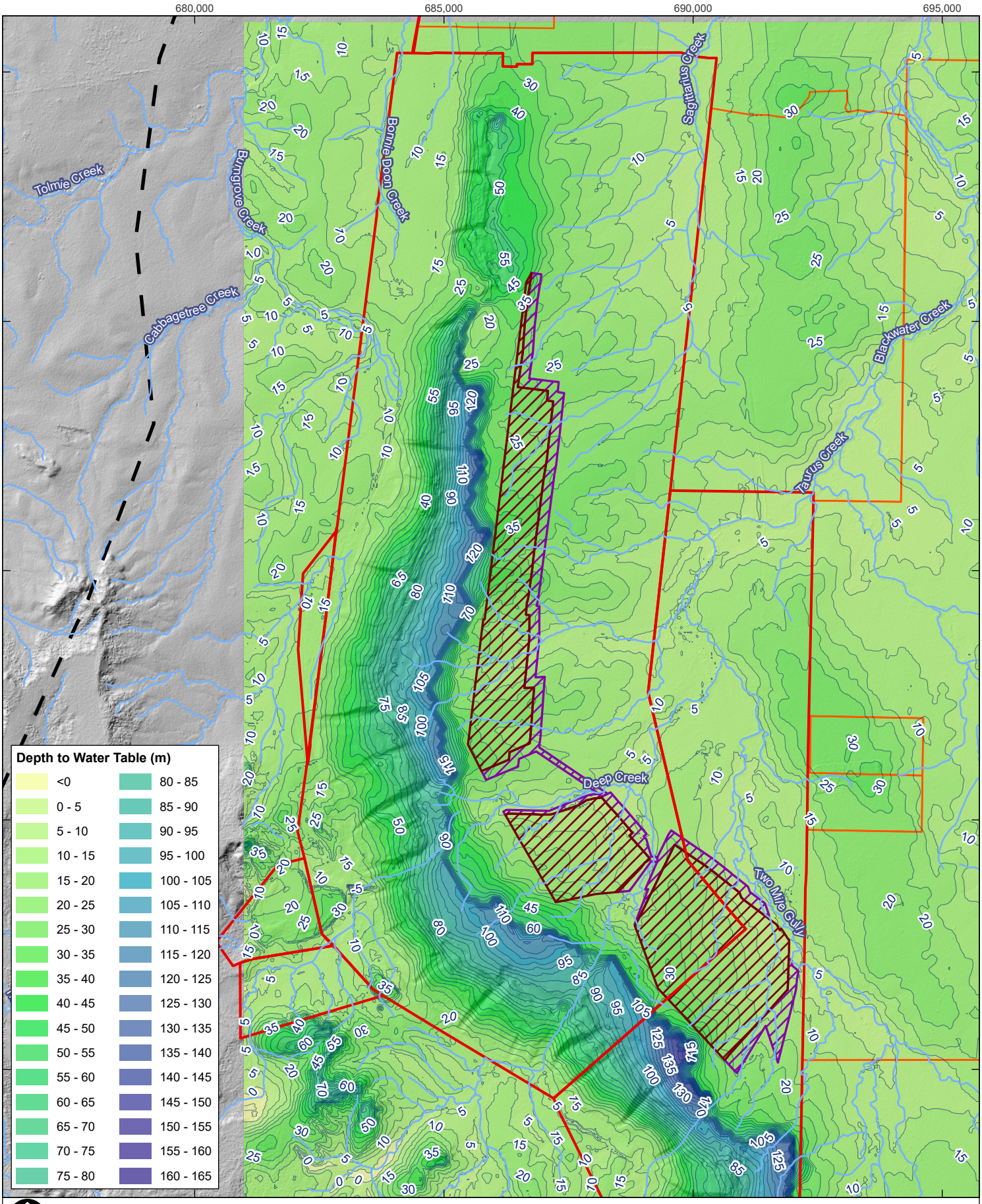
In addition to the VWP data, there are grouped standpipe bores where different levels within the stratigraphy are monitored with screened sections that are offset from one another vertically. These also contribute to the understanding of potential vertical groundwater gradients. Water level observations (most recent available – April 2020 to December 2022) and inferred vertical flow are presented in **Table 5-13**. The shallowest bore for both groups was found dry since installation in 2020 and for all subsequent monthly monitoring rounds. For both groups, the water levels in the Permian Coal Seam bores are higher than in the Rewan Group bores. This indicates that the Rewan Group is acting as a confining unit consistent with it being an aquitard. Groundwater pressure data shows consistent upwards gradient from the coal seams into the Rewan Group.

Table 5-13 Water Levels at Grouped Standpipe Bores

Group	Bore Name	Formation / Unit	Bore Depth (m)	Water Level (mAHD)
Group 1	MB19BWMB05A	Weathered Rewan	15	Dry
	MB19BWMB04R	Rewan Group	80	166–168
	MB19BWMB03P	Permian Coal Seam	231	172–178
Group 2	MB19BWMB07A	Alluvium	7	Dry
	MB19BWMB25P	Weathered Rewan	20	179–181
	MB19BWMB17P	Permian Coal Seam	189	193–194

5.3.8 Depth to Water Table Mapping

The depth to water table defined in the numerical groundwater model at the end of the calibration period is provided in **Figure 5-25**.



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	15-Apr-2026
Drawn by:	RB

LEGEND

- Depth to Water Table (m)
- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

DEPTH TO WATER TABLE

SLR

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FIGURE 5-25

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_FXX_Depth to Water Table

5.3.9 Groundwater–Surface Water Interactions

Based on the water level data collected to date, and conceptualisations of groundwater flow within the Project area, groundwater interaction with ephemeral creeks is considered to be unlikely. As discussed in **Section 5.3.1**, the extent of alluvium is limited, both horizontally and vertically, suggesting dry conditions for most of that unit and water tables significantly below the creek beds. The Regolith (i.e. weathered Tertiary Sediments and weathered Rewan Group) is also unlikely to host significant groundwater. Where saturated, water levels in the Regolith are several meters below the base of the creek bed (**Section 5.3.4**).

At Blackwater South, intermittent hydraulic connectivity between the Regolith and surface drainages is inferred, however generally, there is no continual baseflow from the groundwater into the creeks given their ephemerality.

There is also the potential for interaction between mine surface water storages such as dams and pits, and the hydrogeological units hydraulically connected to them, as indicated by the inferred groundwater contours (**Figure 5-20**) in the Aries coal seam.



5.4 Groundwater Quality

5.4.1 Groundwater Typing

The proportions of major anions and cations were used to determine the hydrochemical facies of groundwaters sampled at BWM. The anion-cation balance, pH and EC of historical data from BWM monitoring bores is displayed on the Durov diagrams in **Figure 5-26** to **Figure 5-31**. The diagrams are split by aquifer and area, including bores in the alluvium (**Figure 5-26**), Tertiary (**Figure 5-27**), Rewan Group (**Figure 5-28**) and RCM at BWM North (**Figure 5-29**), RCM at BWM South (**Figure 5-30**) and the Burngrove Formation (**Figure 5-31**). There is a high degree of observed variability in groundwater quality between hydrostratigraphic units, and between individual bores within individual hydrostratigraphic units.

Records from alluvium groundwater quality sampling include one bore across three samples (**Figure 5-26**). The data from this bore shows a Na-Cl groundwater type with a neutral pH and variable EC results ranging from 6,900 to 23,800 µS/cm.

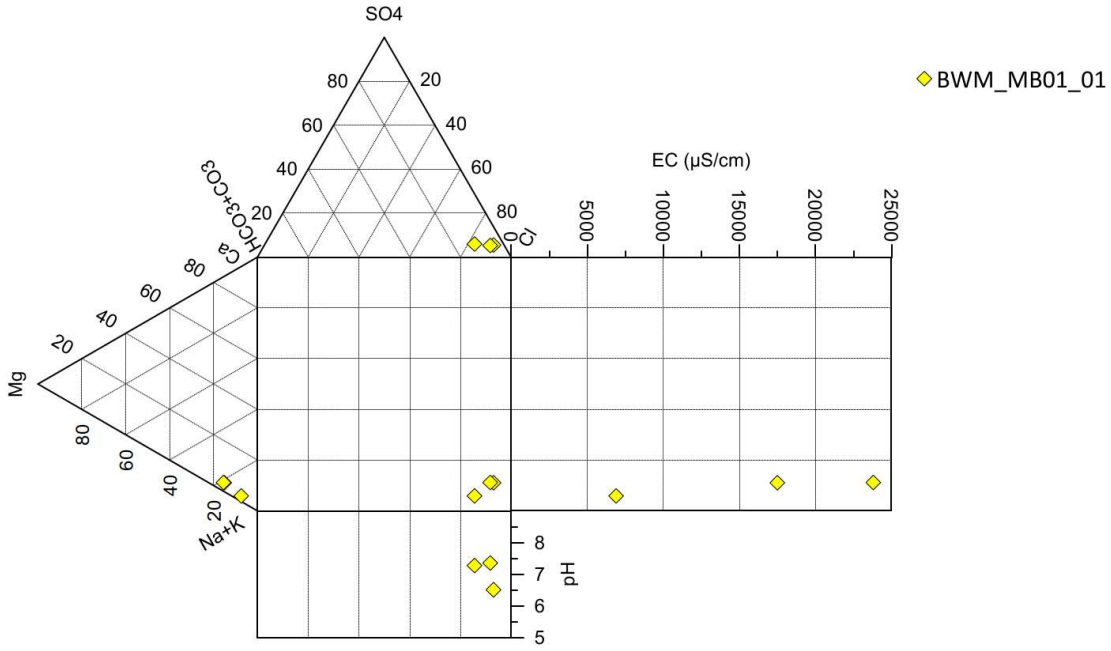


Figure 5-26 Durov Diagram – Alluvium

A Durov diagram for the monitoring bores screened within the Tertiary strata is presented as **Figure 5-27**. The bores are screened within the sediments/weathered strata of the Tertiary and located at BWM South. Bores MB21 and BWM_MB15_01 records a Na-Cl type groundwater, while BWM_MB17_02 records a Na-CO3-HCO3 water type.

The influence of HCO3 on the water chemistry of BWM_MB17_02 records, along with the comparatively fresh EC (500 µS/cm) is suggestive of direct rainfall recharge at this location. This direct recharge may be an influence of infiltration from Rockland Creek, located 150 m north of the bore.

Historical groundwater data from the Tertiary strata bores shows an EC range of from 500 to 16,800 µS/cm with a median of 13,500 µS/cm. pH data ranges from 3.3 to 8.4 with a median of 7.4. Bore BWM_MB15_01 has a notably low pH of 3.3 and relatively saline EC value (6160 µS/cm).

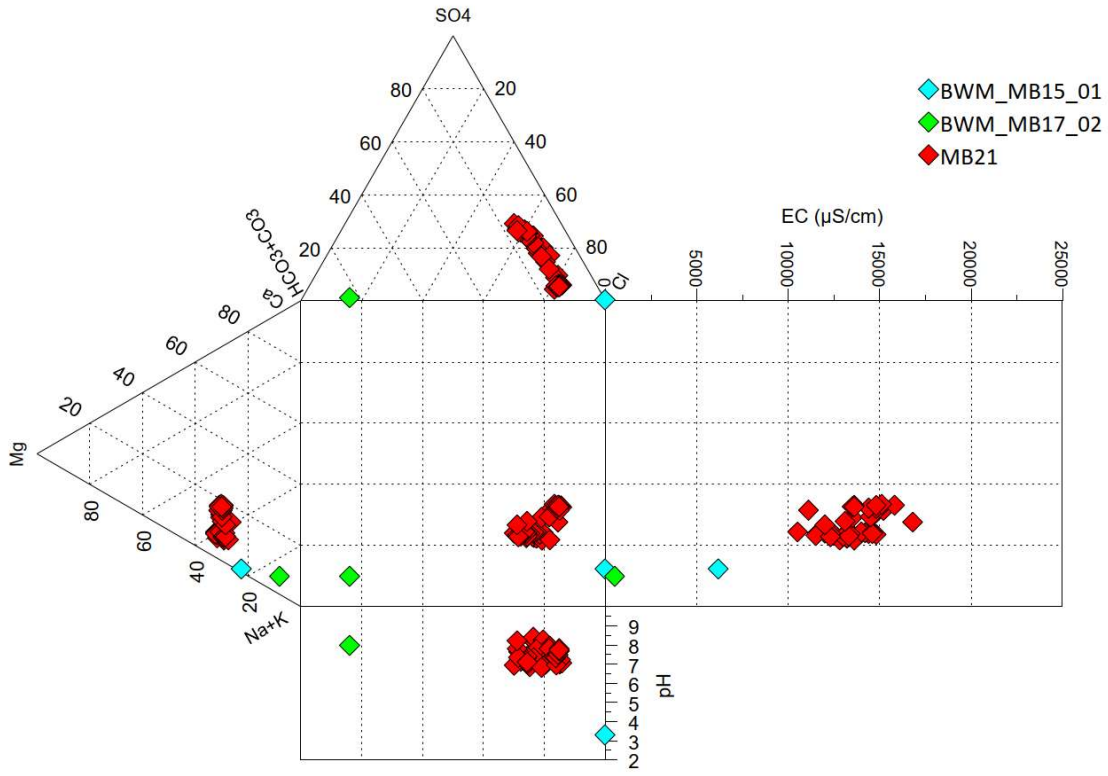


Figure 5-27 Durov Diagram – Tertiary Strata

Bores BWM_MB03_02 and MB19BWM02A are screened within the Rewan Group and record Na-Cl type groundwaters (**Figure 5-28**). Both bores record relatively high EC values ranging approximately 30,500 to 40,000 µS/cm. Recorded pH from bores in the Rewan Group ranges from mildly acidic to mildly alkaline (pH range 6.8 to 7.8), with a median pH of 7.2.

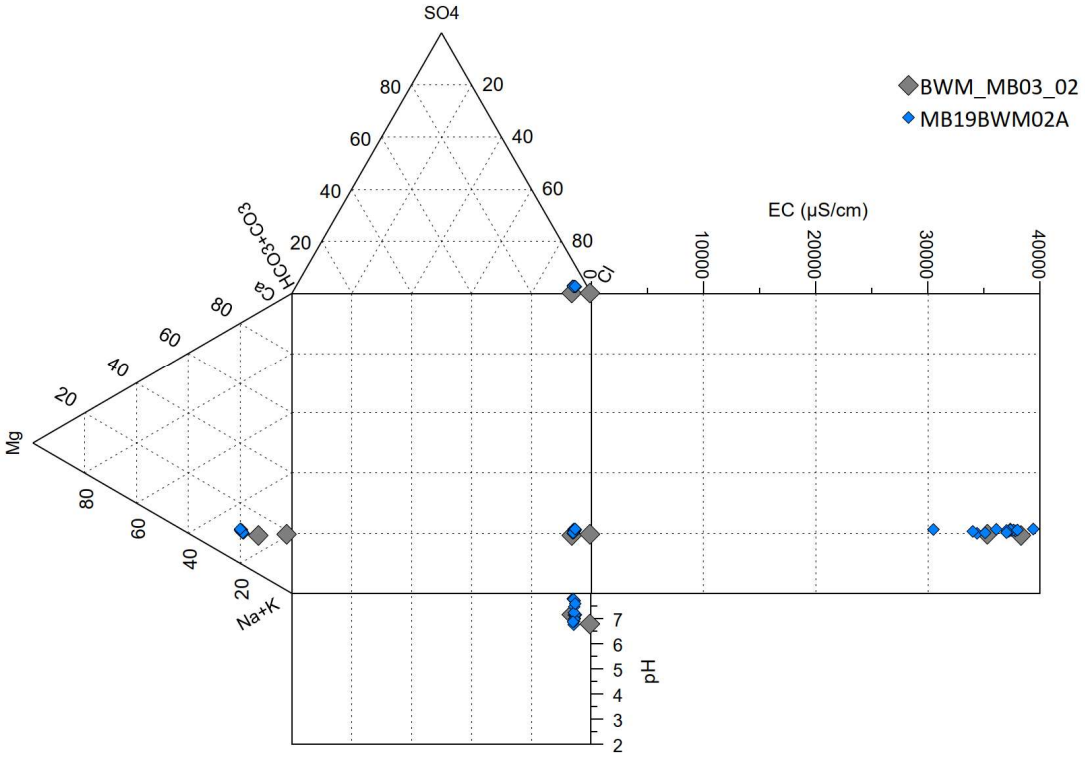


Figure 5-28 Durov Diagram – Rewan Group

The chemical analysis of groundwater from 11 bores targeting the RCM is shown on **Figure** 5-29 to **Figure 5-30**. Results from these bores indicate that groundwater within this unit is generally Na-Cl water type. Exceptions to this are bores BWM_MB02_01, BWM_MB12_02, MB19BWM08P, MB19BWM27P, and BWM_MB14_02. These bores show distinctly different groundwater types, plotting as Na-Cl-HCO3 types.

Groundwater in the RCM generally has a median EC of 17,300 µS/cm, but ranges from 1,870 to 36,900 µS/cm. Recorded pH is generally neutral (median value of 7.7), however the data ranges from values between 6.9 to 11.9. Outliers occur, with high pH (of between 9 and 12) at bores MB19BWM01P and BWM_MB02_02. The elevated pH at these bores is likely unrepresentative of natural conditions and may be due to water interaction with residual cement grout from the bore construction, and they have consequently been removed from the plot.

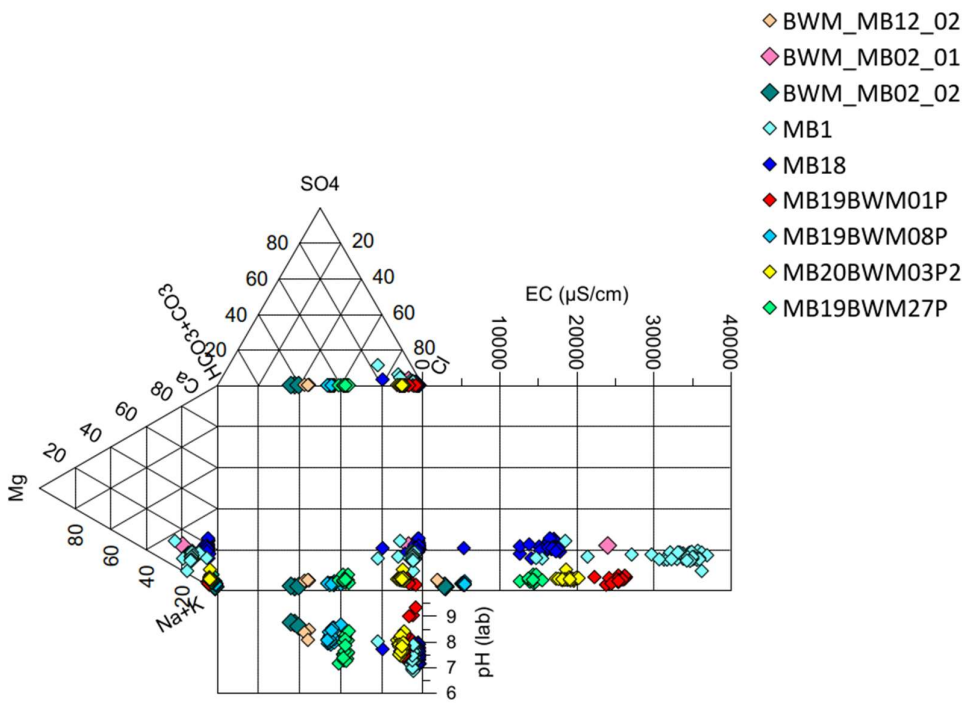


Figure 5-29 Durov Diagram – RCM (North BWM)

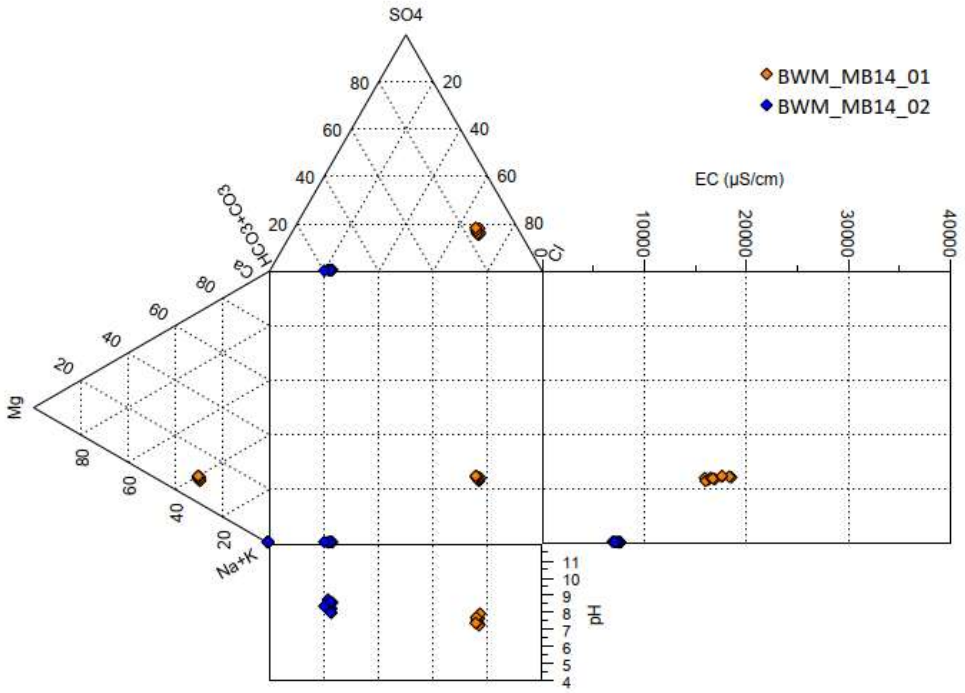


Figure 5-30 Durov Diagram – RCM (South BWM)

Groundwater from two bores screened in the Burngrove Formation record Na-Cl groundwater type (**Figure 5-31**). The results are tightly clustered which suggests that groundwater in the Burngrove Formation has a distinct water chemistry. Groundwater has a median EC of 12,500 µS/cm and ranges from 6,190 to 21,500 µS/cm. pH data shows a range from 7.1 to 8.9, with a median value of 8 indicating the groundwater pH is generally around neutral to slightly alkaline.

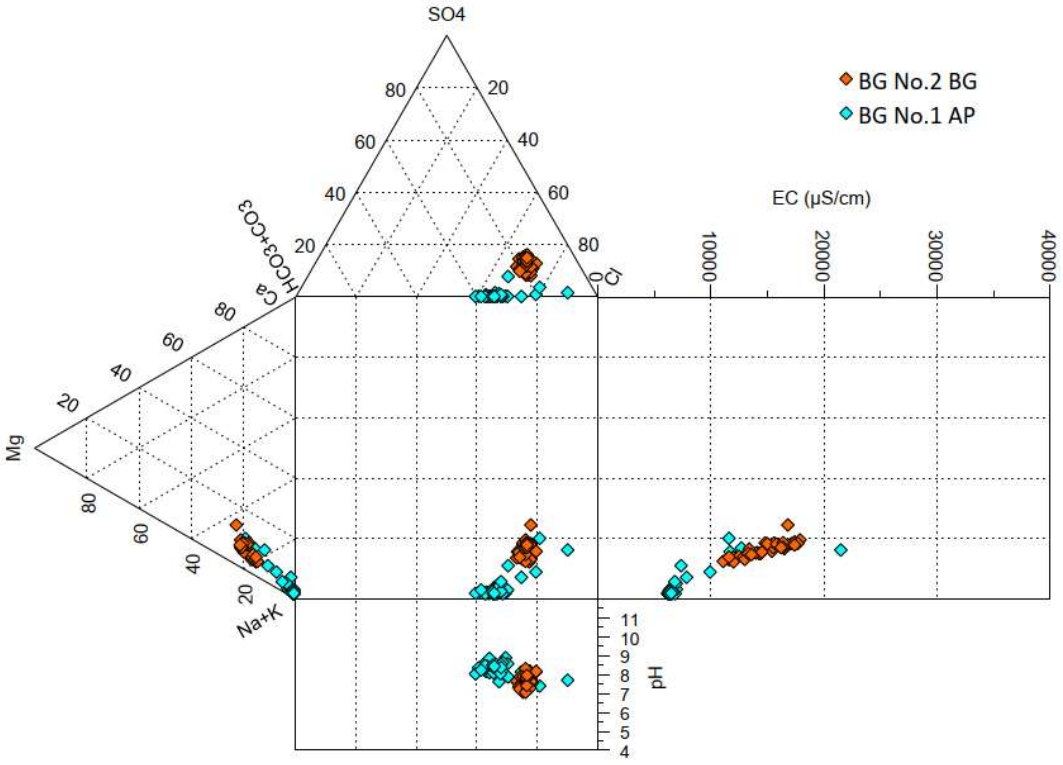


Figure 5-31 Durov Diagram – Burngrove Formation

5.4.2 Salinity

Salinity is a key constraint to water management and groundwater use by receptors and can be described by total dissolved solid (TDS) concentrations. **Figure 5-32** presents the TDS data associated with waters screened in the various hydrostratigraphic units for BWM monitoring bores. Salinity ranges represented on **Figure 5-32** are defined by the Food and Agriculture Organization of the United Nations (FAO, 2013).

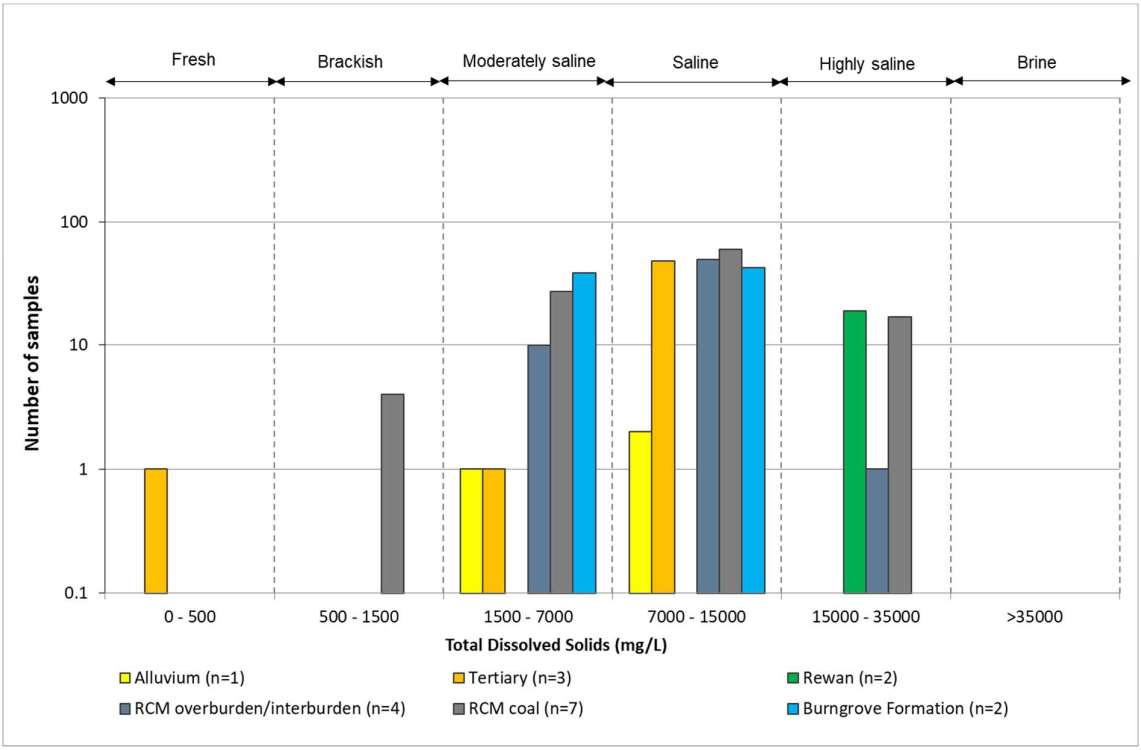
The graph shows that available data from one bore in the alluvium records TDS ranging from moderately saline to saline, with an average TDS of 8,983 mg/L and range between 4,250 mg/L and 11,600 mg/L.

Groundwater in the Tertiary strata ranges from fresh to saline, with an average TDS of 9,427 mg/L and range between 363 and 11,700 mg/L.

In the Rewan Group, groundwater ranges from moderately saline to saline, with an average TDS of 25,126 and range between 19,600 and 30,800 mg/L.

Within the RCM, groundwater ranges from brackish to highly saline, with bores that screen coal seams recording an average TDS of 9,481 and range between 1,000 to 17,000 mg/L, and bores screening interburden/overburden recording average TDS of 10,400 and range between 3,250 to 18,500 mg/L.

In the Burngrove Formation, groundwater ranges from moderately saline to saline, with an average TDS of 6,964 mg/L and range between 3,250 and 14,400 mg/L.



n = number of bores

Figure 5-32 Salinity Ranking by Hydrostratigraphic Unit

5.4.3 Beneficial Groundwater Use

5.4.3.1 Potentially Relevant Environmental Values and Guidelines

BWM lies mainly within the Highlands Groundwater Management Area (GMA) of the Fitzroy Basin under the *Water Plan (Fitzroy Basin) 2011* (**Figure 5-33**). 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 subartesian 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 in the Study Area are also scheduled under the EPP Water and Wetland Biodiversity, as Comet Groundwaters (for the southern part of BWM within the Comet sub-catchment (DEHP, 2011a)) and Mackenzie Groundwaters (for the northern part of BWM within the Upper Mackenzie sub-catchment (DEHP, 2011b)) of the Fitzroy Basin water plan (WQ1310) (**Figure 5-33**). The legislated environmental values (EVs) for these Groundwaters (**Table 5-14**) are:

- Aquatic ecosystems;
- Irrigation;
- Farm supply/use;
- Stock water;
- Primary recreation (Comet Groundwaters only);
- Drinking water;
- Industrial use; and
- Cultural and spiritual values.

Also shown in **Table 5-14** is a comparison of those WQOs that are potentially applicable based on the results of the EMM (2019) bore census (see **Section 5.5**). 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" (***Table 5-14**).

Table 5-14 Environmental Values of Comet and Mackenzie Groundwaters of the Fitzroy Basin

Environmental Values (DEHP, 2011a, 2011b)												
Fitzroy Basin Water Plan (WQ1310) Sub-catchment	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human Consumer	Primary Recreation	Secondary Recreation	Visual Recreation	Drinking water	Industrial use	Cultural and spiritual values
Comet Groundwaters	☑	☑	☑	☑			☑			☑	☑	☑
Mackenzie Groundwaters	☑	☑	☑	☑						☑	☑	☑
Potentially Locally Applicable based on EMM (2019) bore census	☑		☑	☑							☑	

The EPP Water and Wetland Biodiversity provides WQOs for the scheduled EVs in WQ1310. WQOs are long-term goals for water quality management and the purpose of the WQOs is to support and protect EVs. They are numerical concentration levels or narrative



statements of indicators established for receiving waters to support and protect the designated EVs for those waters. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural, economic).

Where groundwater quality analysis results exceed a particular WQO for a particular EV, it is considered indicative that the groundwater may be unsuitable for supporting that particular EV.

The WQ1310 WQOs for groundwater relevant to BWM are shown **Table 5-15**.

Table 5-15 Water Quality Objectives for Fitzroy Sub-basin Environmental Values

Water Quality Indicator	Unit	ADWG Guidelines[1]		Mackenzie River Sub-basin EVs			Comet River Sub-basin EVs		
		ADWG Guidelines Health	ADWG Guidelines Aesthetic	Irrigation[2]	Stock[3]	Aquatic 95%[4]	Irrigation[5]	Stock[6]	Aquatic 95%[4]
pH	-	-	6.5 to 8.5	-	-	6.5 to 8.5	-	-	6.5 to 8.5
TDS	mg/L	-	600		5000[7]	-		5000[7]	-
Chloride	mg/L	-	250	-	-	-	-	-	-
Sodium	mg/L	-	180	-	-	-	-	-	-
Aluminium	mg/L	-	0.2	5	5	0.055	5	5	0.055
Arsenic	mg/L	0.01	-	0.1	0.5	0.024	0.1	0.5	0.024
Beryllium	mg/L	0.06	-	0.1	-	-	0.1	-	-
Boron	mg/L	4	-	0.5	5	-	0.5	5	-
Cadmium	mg/L	0.002	-	0.01	0.01	0.0002	0.01	0.01	0.0002
Chromium	mg/L	0.05	-	0.1	1	0.001	0.1	1	0.001
Cobalt	mg/L	-	-	0.05	1	-	0.05	1	-
Copper	mg/L	2	1	0.2	1[6]	0.0014	0.2	1[6]	0.0014
Fluoride	mg/L	1.5	-	1	2	-	1	2	-
Iron	mg/L	-	0.3	0.2	-	-	0.2	-	-
Lead	mg/L	0.01	-	2	0.1	0.0034	2	0.1	0.0034
Lithium	mg/L	-	-	2.5	-	-	2.5	-	-
Manganese	mg/L	0.5	0.1	0.2	-	1.9	0.2	-	1.9
Mercury	mg/L	0.001	-	0.002	0.002	0.0006	0.002	0.002	0.0006
Molybdenum	mg/L	0.05	-	0.01	0.15	-	0.01	0.15	-
Nickel	mg/L	0.02	-	0.2	1	0.011	0.2	1	0.011
Selenium	mg/L	0.01	-	0.02	0.02	0.005	0.02	0.02	0.005
Silver	mg/L	0.1	-	-	-	0.05	-	-	0.05
Uranium	mg/L	0.02	-	0.01	0.2	-	0.01	0.2	-
Vanadium	mg/L	-	-	0.1	-	-	0.1	-	-
Zinc	mg/L	-	3	2	20	0.008	2	20	0.008

1 NHMRC (2025) Australian Drinking Water Guidelines
2 Table 9 of DEHP (2011b) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives: Irrigation water (Long term value)
3 Table 10 and Table 11 of DEHP (2011b) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives: Stock value)
4 ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% for protection and 99% for bioaccumulating contaminants)
5 Table 9 of DEHP (2011a) Comet River Sub-basin Environmental Values and Water Quality Objectives: Irrigation water (Long term value)
6 Table 10 and Table 11 of DEHP (2011a) Comet River Sub-basin Environmental Values and Water Quality Objectives: Stock value
7 Relevant guideline value for cattle

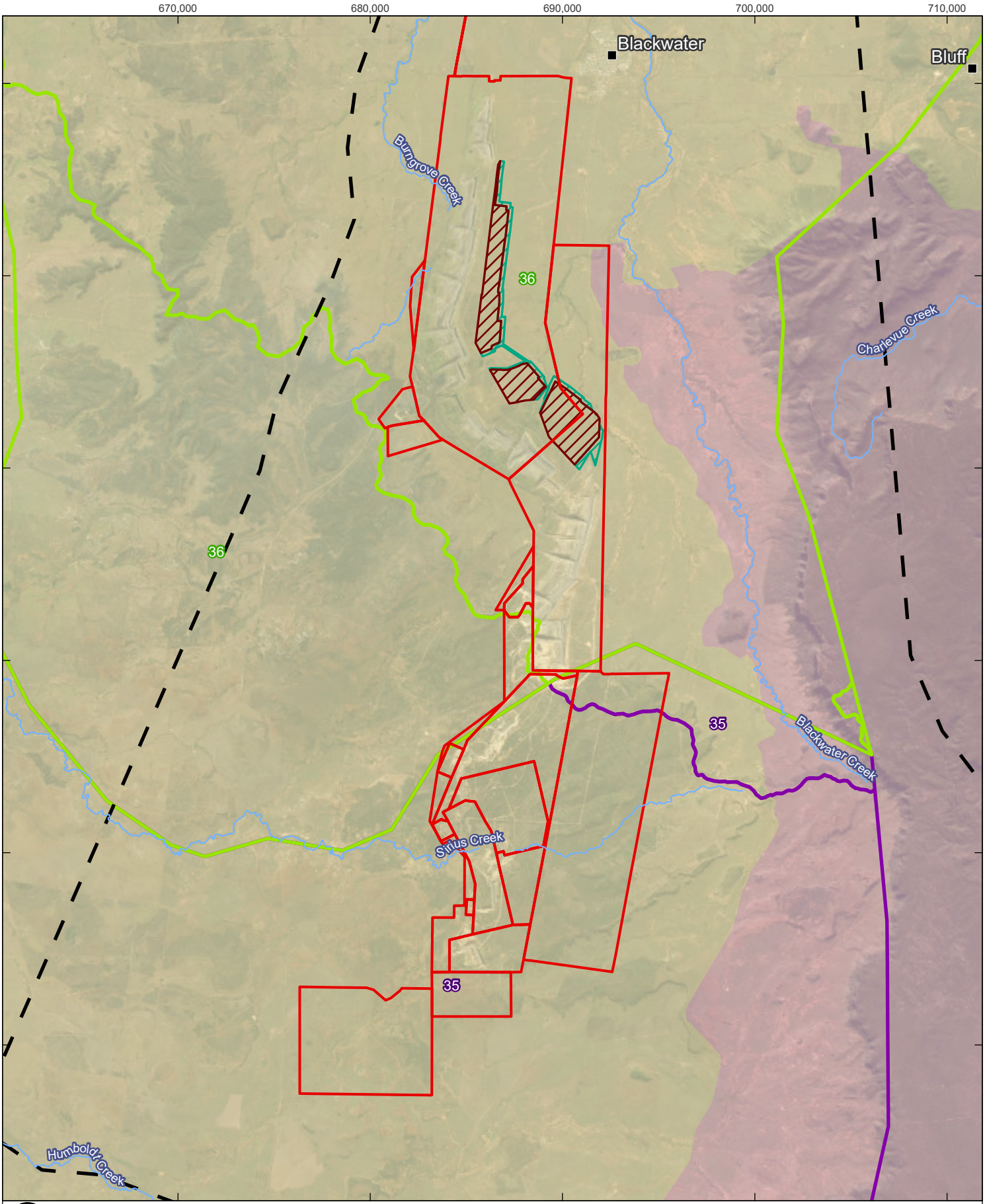


The EPP Water and Wetland Biodiversity also provides limited WQOs specifically for underground aquatic ecosystem protection in the WQ1310 Fitzroy Basin Groundwater Zones (BWM straddles the Mackenzie WQ1304 and Comet River WQ1307 Sub-Basins of the Fitzroy basin, the Project area is within the Mackenzie WQ1304 Sub-Basin). These WQOs vary across the Fitzroy Basin and are defined on the basis of groundwater Chemistry Zones. The applicable Chemistry Zones for BWM include the Fitzroy Groundwater Zone 35 in the south and Zone 36 in the north (**Figure 5-33** and **Table 5-16**) which are characterised as sodic dominant at levels of dissolved material that classify general water quality as low to moderate salinity (Zone 36) and saline (Zone 35).

These WQOs are classified by groundwater depth ('shallow' being <30 m depth, and 'deep' being >30 m depth) and are summarised below. The management intent of each WQO zone is to maintain each of 20th, 50th and 80th percentile values.

Table 5-16 Fitzroy Basin Zone 35 and Zone 36 WQOs for groundwater resources (aquatic ecosystem protection) (DEHP, 2011a and 2011b)

Water Quality Indicator	Unit	Zone 35 Shallow Groundwater (<30m)			Zone 35 Deep Groundwater (<30m)			Zone 36 Shallow Groundwater (<30m)			Zone 36 Deep Groundwater (<30m)		
Percentile	-	20th	50th	80th	20th	50th	80th	20th	50th	80th	20th	50th	80th
EC	(µS/cm)	84	870	1983	4103	9375	13604	3100	6300	7410	3475	4150	7255
Hardness as $CaCO_3$	(mg/L)	37	124	430	401	1216	1905	323	363	528	288	354	619
pH	(mg/L)	7.59	7.6	7.93	7.37	7.6	8.01	7.7	7.80	8.35	8.21	8.3	8.66
Alkalinity	(mg/L)	122	320	556	92	189	311	316	600	843	460	572	1322
Ca	(mg/L)	6	14	81	33	146	366	42	53	105	23	45	75
Mg	(mg/L)	3	27	58	45	204	226	46	56	72	44	74	106
Na	(mg/L)	59	113	256	465	1750	2555	590	1404	1511	520	830	1748
Cl	(mg/L)	54	86	392	1079	3316	5368	610	1885	2373	793	1000	1945
SO_4	(mg/L)	5	11	25	0	20	122	2	5	120	84	115	210
HCO_3	(mg/L)	42	333	646	126	268	376	372	732	1021	541	640	1549
NO_3	(mg/L)	0.15	1.4	9.6	0	0.1	0.5	1	4.25	7.50	0.65	2	2.9
SiO_2	(mg/L)	43	68	72	9	18	76	25	43	60	32	43	81
F	(mg/L)	0.1	0.2	0.5	0.06	0.3	0.5	0.285	0.3	0.39	0.31	0.4	1.12
Fe	(mg/L)	-	-	-	0	0.01	0.047	0.02	0.02	0.02	0.02	0.02	0.047
Mn	(mg/L)	-	-	-	0.01	0.04	2.495	0.02	0.045	0.07	0.02	0.02	0.047
Zn	(mg/L)	-	-	-	0.01	0.14	0.27	-	-	-	-	-	-
Cu	(mg/L)	-	-	-	0	0.005	0.01	-	-	-	-	-	-



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:260,000 at A4
Project Number:	640.031809.00001
Date Drawn:	18-Feb-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

EPP Groundwater Zone

- Zone 35
- Zone 36

Groundwater Management Area

- Carnarvon Groundwater Management Area
- Highlands Groundwater Management Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MANAGEMENT AREAS AND CHEMISTRY ZONES

SLR

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FIGURE 5-33

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_32_Groundwater Management Areas, Fitzroy Basin Groundwater Zones, and Chemistry Zones

5.4.3.2 Comparison of Groundwater Quality to Potentially Relevant Guidelines

In order to understand the possible utilisation of groundwater resources within the study area, given the scheduled EVs discussed above, the available groundwater quality data have been compared to the:

- Australian Drinking Water Guidelines (ADWG) (NHMRC, 2025).
- ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% for protection and 99% for bioaccumulating contaminants).
- Fitzroy Basin Groundwater Water Quality Objectives: Aquatic ecosystems (Zones 35 and Zone 36).
- Mackenzie and Comet River Sub-basin Environmental Values and Water Quality Objectives: stock and irrigation.

A comparison of these guidelines to the 80th percentile of available historical water quality data for each BWM monitoring bore is presented as **Appendix A**. **Table 5-17** summarises **Appendix A** by showing the percentage of analysed bores where the 80th percentile concentration for at least one analyte exceeds the relevant guideline. This is further discussed in detail in the below text.

Table 5-17 Percentage of Analysed Bores in Aquifer with 80th Percentile Groundwater Quality Data Above Relevant Guideline for one or more Analyte (refer Appendix A)

Aquifer	Number of bores Analysed	ADWG Guidelines Health[1]	ADWG Guidelines Aesthetic[1]	Irrigation[2]	Stock[3]	Aquatic 95%[4]	80th %ile WQO limit
Alluvium	1	100%	100%	100%	100%	100%	100%
Tertiary	3	100%	33%	100%	100%	67%	100%
Rewan	2	100%	100%	100%	100%	100%	100%
RCM North	9	100%	44%	100%	100%	78%	44%
RCM South	2	100%	100%	100%	100%	50%	100%
Burngrove Formation	2	100%	50%	100%	50%	50%	100%

1 NHMRC (2025) Australian Drinking Water Guidelines
2 Table 9 of DEHP (2011a) Comet River Sub-basin / Table 9 of DEHP (2011b) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives: Irrigation water (Long term value).
3 Table 10 and Table 11 of DEHP (2011b) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives: Stock.
4 ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% protection).

Quaternary Sediments

Water quality data from one bore in the alluvium with available data shows that concentrations from most analytes are generally higher than the relevant Fitzroy Basin WQOs for aquatic ecosystem protection. Alluvium groundwater data also indicates it is generally not suitable for supporting the Aquatic Ecosystems EV with respect to copper and zinc.

The 80th percentile concentrations of the alluvium data also indicate the alluvial groundwater is generally unsuitable to support the Drinking Water EV with respect to chloride, sodium and manganese and TDS, the Irrigation EV with respect to boron, manganese and uranium, and the Stock Watering EV with respect to TDS (salinity).

Tertiary Sediments

Groundwater quality data, where groundwater is present in the Tertiary sediments/regolith, shows that collectively it is not considered a suitable groundwater resource for drinking and irrigation due to exceedances above Fitzroy Basin WQOs with respect to beryllium, nickel, lead, fluoride and manganese or TDS and boron, iron, manganese, fluoride and molybdenum respectively (see **Appendix A**). Monitoring data from the Tertiary bores show that analyte concentrations exceed the relevant Fitzroy Basin WQOs for Aquatic Ecosystem protection across all three analysed bores, particularly for dissolved metals (see **Appendix A**). The monitoring data also shows that of the two Tertiary bores, one showed water quality above the Stock EV guideline with respect to fluoride, aluminium and TDS (see **Appendix A**).

Triassic Rewan Group

Groundwater quality data from two bores screened in the Rewan Group shows that most analyte concentrations are generally higher than the relevant Fitzroy Basin WQOs for Aquatic Ecosystem protection. The data also indicates it is generally not suitable for supporting the Aquatic Ecosystems EV with respect to most relevant metal concentrations (**Appendix A**). The monitoring bore data also suggests that it is generally not suitable for supporting the Drinking Water, Stock, Irrigation EVs (**Appendix A**).

Rangal Coal Measures

As with the Alluvium, Tertiary and Rewan Group, RCM monitoring bore data shows concentrations of most analytes are generally higher than the relevant Fitzroy Basin WQOs for Aquatic Ecosystem protection. RCM monitoring bore data generally suggests that RCM groundwater at BWM is unsuitable to support the Aquatic Ecosystems EVs with respect to pH, cadmium, chromium, copper, nickel, lead, selenium or zinc and the Drinking Water EV with respect to selenium, manganese or fluoride (see **Appendix A**). The RCM monitoring bore data also generally suggests that RCM groundwater at BWM is also unsuitable to support the irrigation water EV with respect to boron, iron, molybdenum, manganese, selenium or uranium. The monitoring bore data shows water quality generally above the Stock water EV guideline with respect to selenium and TDS (**Appendix A**).

Burngrove Formation

Groundwater quality data is available from two bores screened in the Burngrove Formation namely bores BG No.1 AP and BG No. 2 BG located in the Northern area of BWM.

Burngrove Formation groundwater data also indicates it is generally not suitable for supporting the Aquatic Ecosystems EV with respect to selenium and nickel. Groundwater does not meet the Drinking Water EV criteria with respect to pH, iron, manganese, sodium, chloride or TDS and the Irrigation EV with respect to boron or iron. The monitoring bore data indicates one exceedance in TDS at bore BG No. 2 BG above the Fitzroy Basin WQOs for Stock Watering.



Summary

In summary, the comparison of available groundwater quality data from the BWM monitoring bores shows that all hydrostratigraphic units at BWM generally exhibit water quality that exceeds some of the relevant parameter criteria for the scheduled EVs.

5.5 Groundwater Use and Management

The study area lies within the Highlands and Carnarvon GMAs under the *Water Plan (Fitzroy Basin) 2011*, a subordinate statutory instrument made under the *Water Act 2000* (Qld), as discussed in **Section 5.4.3**.

Environmental Values pertinent to the Project are listed in DEHP (2011b) as:

- Aquatic ecosystems.
- Irrigation.
- Farm supply/use.
- Stock water.
- Primary recreation (Comet Groundwaters only).
- Drinking water.
- Industrial use.
- Cultural and spiritual values.

As presented in **Section 5.4**, the groundwater quality in the vicinity of BWM is typically brackish to saline and generally not suitable for drinking.

Although groundwater in the vicinity of BWM may have cultural and spiritual values, none were identified in the literature reviewed.

5.5.1 Groundwater Dependent Ecosystems

5.5.1.1 National Atlas of Groundwater Dependent Ecosystems

A GDE is a natural ecosystem that requires “access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services” (Richardson, S., et al., 2011).

The BoM’s National Atlas of Groundwater Dependent Ecosystems (GDE Atlas) (BoM, 2017) classifies ecosystems based on the potential for dependence on groundwater through multiple lines of scientific evidence. Ecosystems have been mapped as either:

- High potential for groundwater dependence (indicating a strong possibility the ecosystem is interacting with groundwater);
- Moderate potential for groundwater dependence; or
- Low potential for groundwater dependence (indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

Desktop mapping of potential aquatic and terrestrial GDEs (TGDEs) indicates that areas with possible high, moderate, and low potential for groundwater interaction occur in the vicinity of the Project Area.



5.5.1.2 Local GDE Studies

Field investigations to verify the groundwater dependence of potential GDEs identified in the BoM GDE Atlas desktop mapping (i.e. ground-truthing investigations) have been undertaken in the vicinity of north BWM by EMM (2023a) for potential TGDEs, and EMM (2023b) for potential aquatic GDEs, E2M Pty Ltd (E2M) (2026) for TGDEs, and DPM Enviros ciences Pty Ltd (DPM Enviros ciences) (2026) for GDEs. The outcome of these investigations is summarised below. No ground-truthing local investigations have been undertaken in the vicinity of south BWM.

5.5.1.2.1 2023 Studies

Field surveys were undertaken that identified and characterised remnant regional ecosystem terrestrial vegetation within the vicinity of north BWM. EMM (2023a) then utilised depth to groundwater table mapping prepared by RDM Hydro et al. (2023) and information on maximum plant rooting depths for the identified vegetation species to assess whether the groundwater table was within the potential rooting depths of the vegetation, and thus if the vegetation may be reliant at least in part on groundwater. The results of the work indicated that the riparian terrestrial vegetation associated with Taurus Creek (a tributary of Blackwater Creek) on the eastern margin of the Project Area and a very small area along Sagittarius Creek to the north of the Project Area may represent a TGDE. The terrestrial vegetation in this area consists of narrow linear communities that fringe the creek, with potential TGDE vegetation types consisting primarily of poplar box (*Eucalyptus populnea*), forest red gum *(Eucalyptus tereticornis*), or river red gum (*E. camaldulensis*) (EMM, 2023a).

Assessments to verify mapped potential aquatic GDEs include the field survey undertaken by EMM (2023b) in the vicinity of BWM North. The outcome of this survey is summarised by EMM (2023b) in the Aquatic Ecology Baseline Assessment Report as:

"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."

That is, the field verification of aquatic habitats in the vicinity of north BWM found no indicators of aquatic GDEs (EMM, 2023b) indicating that the BoM GDE Atlas mapping of potential GDEs in this area is potentially erroneous.

5.5.1.2.2 2026 Studies

DPM Enviros ciences completed an assessment in early 2026 to describe the aquatic values of the Project area (the Study Area), identify any conservation significant species under the EPBC Act and Queensland *Nature Conservation Act 1992*, identify the potential for GDEs to occur, identify and describe any aquatic Matters of State or National Environmental Significance, assess impacts of the Project on aquatic and GDE values. The assessment of GDEs concluded:

"*Terrestrial GDEs occur within the Study Area in part of the riparian corridor of Taurus Creek. There is no evidence of surface expression or subterranean GDEs within the Study Area, both of which are unlikely to occur. The presence of stygofauna in an aquifer would indicate a subterranean GDE; however, no stygofauna were detected from five bores and five micropiezometers sampled as part of a pilot survey in both July and October 2025, and*



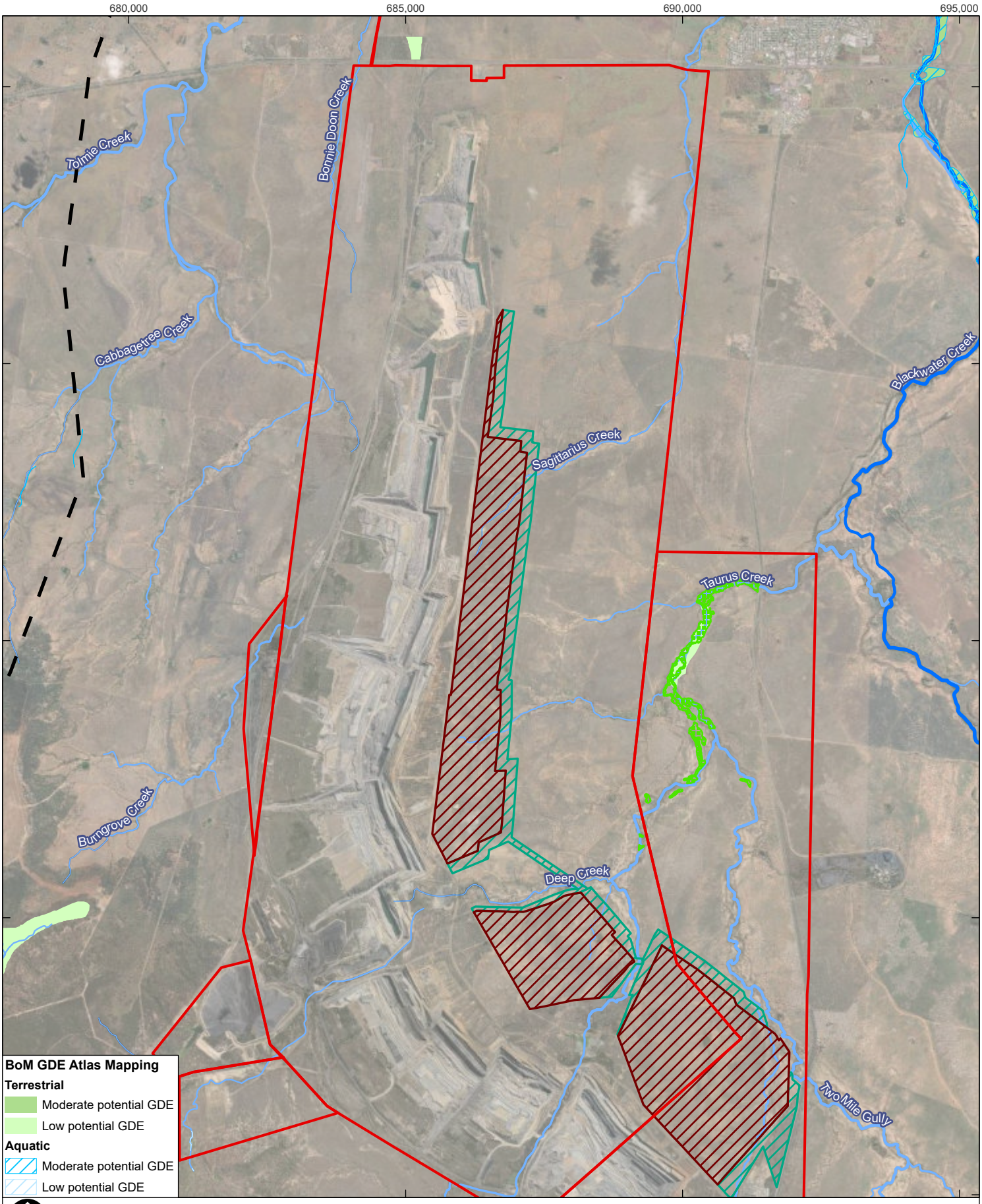
there is no evidence of stygofauna having previously been detected from within 5 km of the Study Area" (DPM Enviros ciences, 2026).

This study generated the most up-to-date and comprehensive mapping of GDEs within the Study Area and this mapping has been adopted for the GDE assessments herein (**Figure** 5-34).

E2M completed a Terrestrial Ecological Assessment including a further review of TGDEs within the Study Area based on the outcomes of the DPM Enviros ciences (2026) study. Preliminary desktop assessments identified potential TGDEs in the central extent of the Study Area around Taurus Creek, via the BoM GDE mapping, as previously identified. A field assessment of potential TGDEs defined by DPM Enviros ciences (2026) concluded the following:

"Based on the species composition of these communities, areas of these REs potentially access groundwater during dry periods, given the presence of E. coolabah and E. populnea, which can be facultative groundwater dependent species (Eamus et al., 2006; Kath et al., 2014; Roberts & Marston, 2000). Remnant vegetation on Two Mile Gully and further upstream on Taurus Creek is unlikely to constitute terrestrial GDEs as they generally contained species that do not represent ground-water dependent vegetation such as Acacia harpophylla and Terminalia oblongata. These species typically have a horizontal root system and are considered unlikely to be dependent on access to groundwater for long-term survival (DES, 2017)" (E2M, 2026).

Areas of TGDEs identified in the Study Area are depicted in **Figure 5-34** (based on DPM Enviros ciences, 2026).



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Potential GDE (DPM, 2026)

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER DEPENDENT ECOSYSTEM MAPPING (BWM NORTH)

SLR

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FIGURE 5-34

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_33_Groundwater Dependent Ecosystem Mapping (BWM North)

Springs

A search with the QSpatial Database showed that 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, a distance considered significant in the context of the Project's potential groundwater related impacts such that this spring is not relevant to the Project's impact assessment.

5.5.2 Wetlands

A wetlands search was conducted using data downloaded from the QSpatial Catalogue. The downloaded dataset shows High Ecological Significance (HES) wetlands that are matters of state environmental significance. The dataset did not show any wetlands within a 10 km buffer of the Project area. The closest wetland is located approximately 19.7 km southeast from the Project area, a distance considered significant in the context of the Project's potential groundwater related impacts such that this wetland is not relevant to the Project's impact assessment.

5.5.3 Anthropogenic Groundwater Users (Landholder Bores)

A search of the Queensland Government's Registered Groundwater Bore Database (GWDB) (Department of Local Government, Water and Volunteers, 2026) and the BoM's National Groundwater was carried out for registered bores within 5 km of the EA boundary. The search returned 451 registered bores with registered uses as mine monitoring (322 bores), petroleum exploration (3 bores), sub-artesian monitoring (24 bores), industrial (2), water resources investigation (3 bores), water supply (33 bores), stock (3), domestic (1), unknown (23 bores) and decommissioned (37 bores).

A landholder bore census was conducted at BWM by EMM (2019). A total of 32 bores were visited during the census, including 20 registered bores and 12 unregistered bores. Of the 12 unregistered bores visited during the census, all but one are located west of BWM. The results of the survey indicated that 10 of the unregistered bores were in use while the other two were not in use.

Of the 20 registered bores visited during the census, the results of the survey showed that eight of the bores were in use, while the other 12 were not in use.

Overall, the bore census identified that of the bores visited (including both the unregistered and registered bores) a total of 20 bores were in use and equipped with pumping infrastructure. The results of the survey showed that these bores were used for stock and farm supply purposes and are screened across either Tertiary basalt or the RCM.

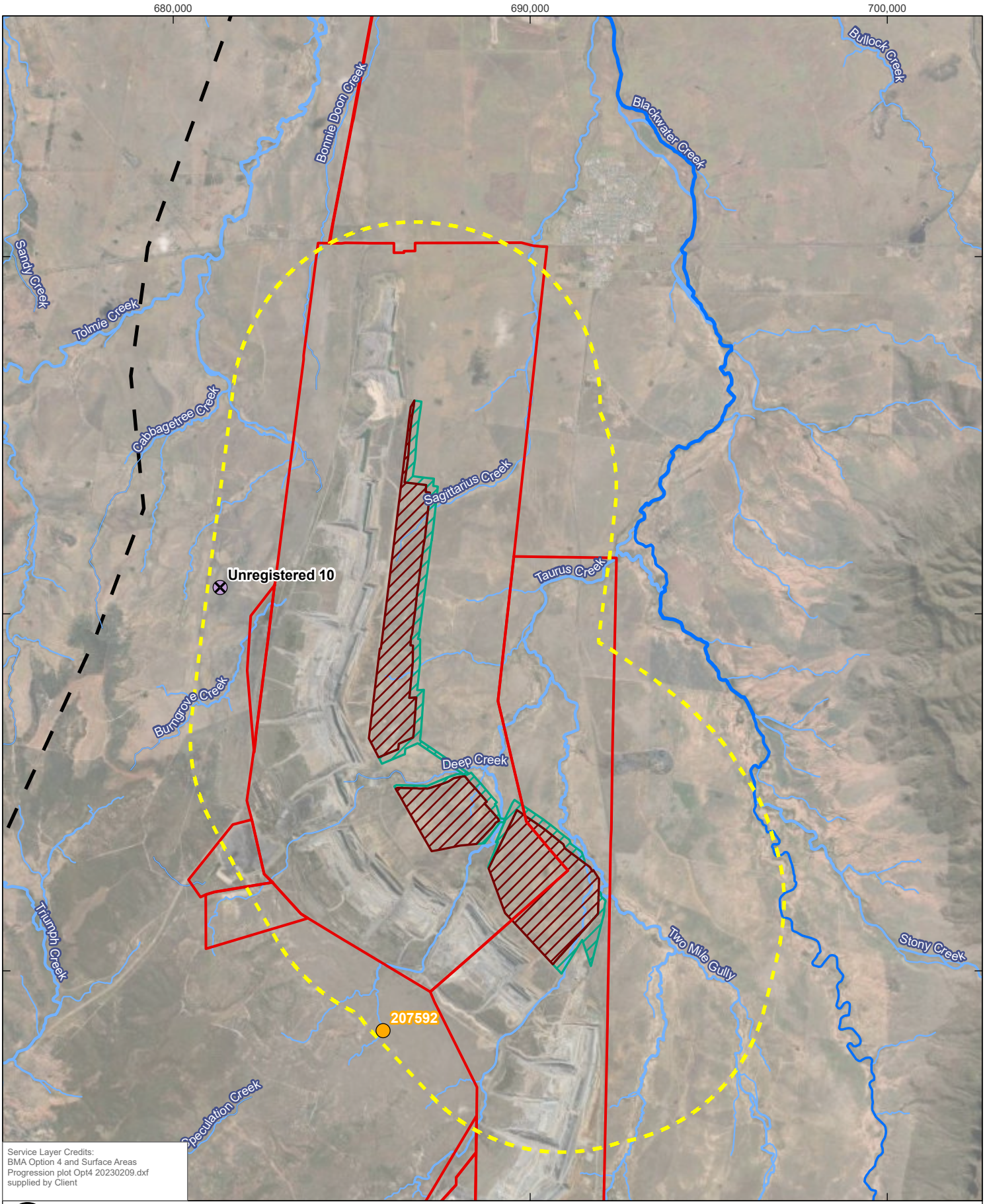
The results of the review of the GWDB search and bore census identified two potential private water supply bores within 5km of the proposed Project area (**Table 5-18** and **Figure** 5-35).

Table 5-18 Potential Private Water Supply Bores within 5km Buffer of the Northern Extension

Bore ID	Easting[1]	Northing[1]	Source	Use	Bore Depth (mBGL)	Assigned Strata
RN207592	685880	7368329	GWDB	Stock	36	RCM
Unregistered 10	681315	7380737	EMM Survey	Not in use	49	RCM

1 Coordinates GDA 2020 z55





Service Layer Credits:
BMA Option 4 and Surface Areas Progression plot Opt4 20230209.dxf supplied by Client

0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:140,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- GIA Study Area
- 5km Buffer from SA7/10
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Groundwater Database Bore

- Stock

Bore Census Registered Bores EMM (2019)

- Not in Use

Bore Census Unregistered Bores EMM (2019)

- Not in Use

BLACKWATER NORTH EXTENSION PROJECT

GROUNDWATER ASSESSMENT

PRIVATE BORES

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FIGURE 5-35

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_35_Private Bores

5.6 Conceptual Hydrogeological Model

A conceptual hydrogeological model of the groundwater regime has been developed based on the review of the hydrogeological data for the Project and surrounds. It is important to note that the conceptual hydrogeological model presented herein represents an evolution of the hydrogeological understanding at BWM, building on a previous conceptualisation presented by AGE (2013), and further studies at BWM.

The Project is located within the southern part of the Bowen Basin, which comprises Permian aged coal measures that have been folded into a syncline structure that strikes in a north-west to south-east direction.

From youngest to oldest, the main hydrostratigraphic units underlying the Project area are:

- Quaternary alluvium including sand, silt clay, basal gravels.
- Tertiary Sediments / Regolith.
- Triassic Clematis Group.
- Triassic Rewan Group.
- Rangal Coal Measures – Target formation for mining.
- Burngrove Formation – considered the basement layer for this assessment.

The principal coal seams in the BWM area in descending order are the Aries (also known Top Seam), Castor (also known as (Middle Seam) and Pollux (also known as Lower Seam).

The coal seams are the main groundwater bearing units within the Permian sequences, with low hydraulic conductivity interburden generally confining the individual seams. The coal seams are dual porosity with a primary matrix porosity and a secondary (dominant) porosity provided by fractures (joints and cleats). Hydraulic conductivity of the coal decreases with depth due to increasing overburden pressure reducing the aperture of fractures.

5.6.1 Groundwater Levels and Flow

Groundwater level data within the alluvium is limited. The alluvium is often found to be limited in extent and thickness, and unsaturated, but may become saturated following rainfall recharge and occasional inflow from ephemeral creeks. Groundwater levels in the unconfined alluvium, where saturated, are expected to be a subdued reflection of topography, with flow toward the north of the Project at North Blackwater and towards the southwest at South Blackwater. If there are times when the alluvium is saturated, flow would still be restricted as the coarser grained alluvium (that could transmit water) is separated by clay lenses and outcropping bedrock, with limited connectivity between areas of saturated alluvium.

Recharge to the alluvium is considered to be mostly from occasional ephemeral stream flow or flooding (i.e. losing streams), with direct infiltration of rainfall also occurring rapidly where there are no substantial clay barriers in the shallow subsurface. However, recharge is expected to be low due to the presence of surficial clays. On a regional scale, discharge occurs via evapotranspiration from vegetation growing along creek beds, drawing on soil moisture or shallow perched water tables rather than the deeper regional water table. This mechanism is limited because the alluvium is often unsaturated and only temporarily saturated after significant rainfall or flooding. Minor short duration baseflow events after significant rainfall/flooding are possible, however there was no data available to support or reject this hypothesis.



Within the Tertiary Sediments and Regolith, the strata is typically unsaturated at north Blackwater but saturated in the south Blackwater area. In the southern area groundwater levels in the Tertiary Sediments are variable, ranging from 2 to 32 mBGL, and groundwater flow is towards the south.

The Triassic Rewan Group is known as a regional scale aquitard, though still may contain low yielding groundwater. There is limited hydraulic connection between the Rewan Group and underlying Rangal Coal Measures due to the low vertical hydraulic conductivity nature of the strata and the overlying Triassic units confine the underlying Permian sediments. In the Rangal Coal Measures, the lower permeability interbedded claystone and shale horizons (interburden) significantly reduce vertical leakage causing most groundwater flow within the Coal Measures to be along the coal seams themselves. In the Project area, groundwater flow within Permian coal seams was inferred to be towards the north for pre-mining conditions. However, with many open-cut pits in the area, groundwater within the Coal Measures now generally flows towards these pits.

Recharge is limited to areas with relatively higher hydraulic conductivity units (e.g. coarse grained sandstone and coal seams) and in areas of outcrop. Coal seam recharge is expected to occur primarily via leakage from the overlying Quaternary and Tertiary units, where the Triassic formation is not present or significantly thinned. As such, the areas with greatest control of Permian formation recharge are proximal to seam outcrops. Some recharge to the coal measures also occurs through mine surface water storages where the seams are hydraulically connected to the storages such as mining pits and waste spoil.

5.6.2 Groundwater – Surface Water Interaction

Groundwater interaction with ephemeral creeks is likely to be limited within the Project area for the alluvium and underlying Regolith, due to the limited extent and saturation of these units, and ephemeral nature of creek flow. Interaction is likely in terms of stream flow leakage to the underlying geology during sporadic creek flow events. Where saturated, water levels in the Tertiary Sediments and Regolith appear to be several meters below the base of the creek bed, thus there would be no groundwater discharge to the creeks.

5.6.3 Groundwater Quality

Groundwater quality within the alluvium across the study area is variable both spatially and temporally ranging from fresh to brackish but is typically brackish. The 80th percentile concentrations of the alluvium data also indicate the alluvial groundwater is generally unsuitable to support the Drinking Water EV with respect to chloride, sodium and manganese and TDS, the Irrigation EV with respect to boron, manganese and uranium, and the Stock Watering EV with respect to TDS (salinity). Field pH results indicate groundwater is moderately acidic.

Groundwater quality in the Tertiary sediments is variable but typically more saline than the shallower alluvial groundwater.

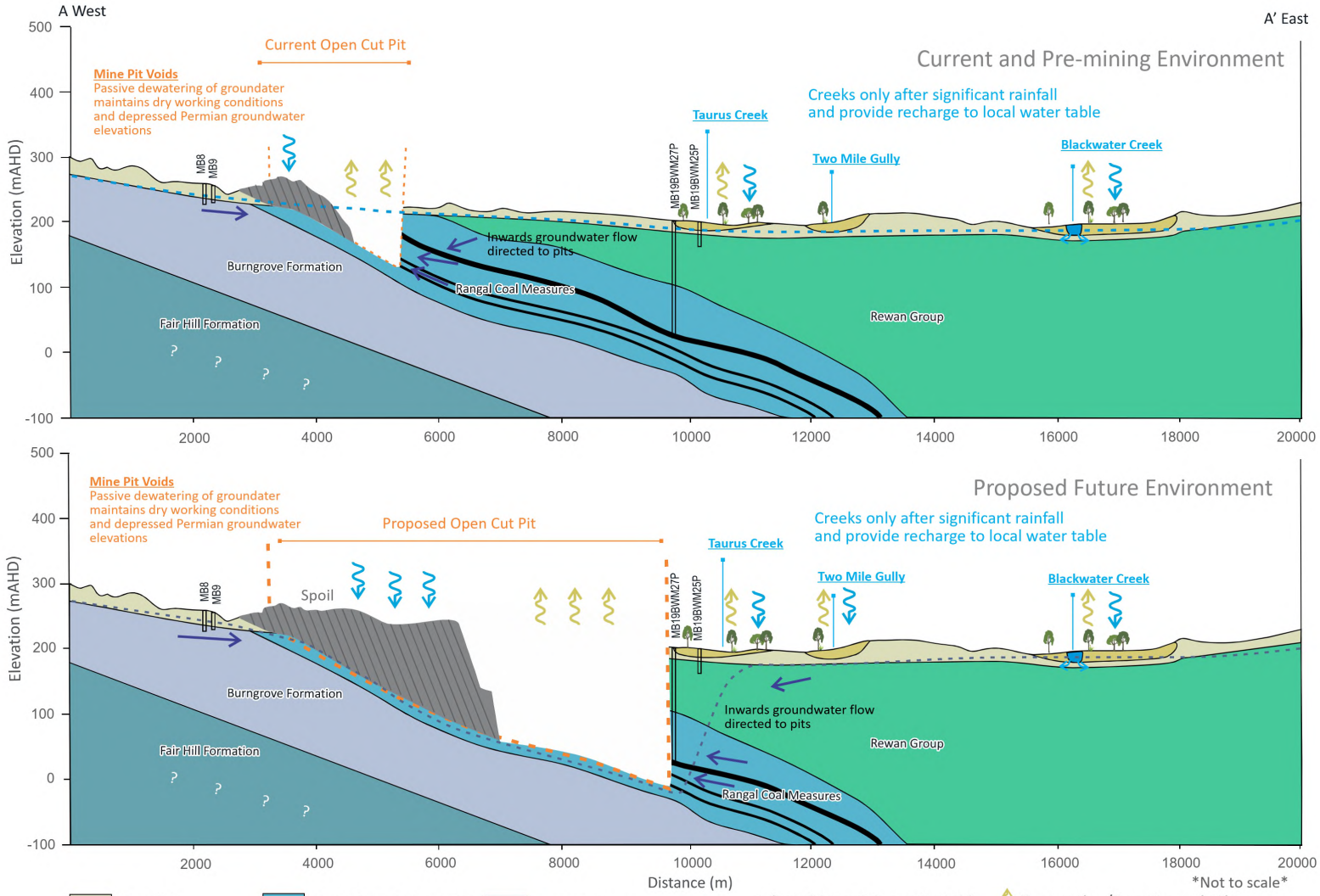
Groundwater quality within the Rewan Group and Permian coal measures is variable, ranging from brackish to highly saline. Groundwater within the coal measures of the Project area is not considered suitable for some livestock.

5.6.4 Mining Impacts

A conceptual hydrogeological cross section was developed for this assessment, showing the current open cut pit and proposed expanded open cut pit is presented in **Figure 5-36**. The current open cut pit is shown with the pre-mining water table and the current inferred water



table. Also shown is the proposed open cut pit with the expanded pit void extending into the Rewan Group to the east. A larger footprint of spoil is depicted on the ground surface and also infilling the western part of the pit. The predicted future water table is shown to be at the base of the RCM and then rising outside the western part of the pit as the influence of dewatering decreases. Throughout both scenarios the hydrogeological environment around Blackwater Creek remains unchanged.



Date Drawn: 15-Feb-2026

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

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CONCEPTUAL HYDROGEOLOGICAL SECTION OF THE PROJECT AREA AND SURROUNDINGS

FIGURE 5-36

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_32_Conceptual Hydrogeological Section

5.7 Conceptual Ecohydrogeological Models

RDM Hydro et al. (2023) presents conceptual ecohydrological models (TGDE types and functions) which are likely to be found in the BWM area and the wider Bowen Basin based on the findings of the desktop study and previous field assessments of other GDE studies in the Bowen Basin.

The conceptual ecohydrological models include perched aquifers in alluvium (Types A and B) and systems exhibiting interactions with Tertiary and Permo-Triassic sediments (coal seams and alluvium) (Types C and D). A description of the types and function of the conceptual ecohydrological models summarised from RDM Hydro et al. (2023) is provided below.

As described in the guideline, ecohydrological expectations describe how TGDEs interact with groundwater under natural conditions, and impact pathways identify how mining activities could alter these interactions. For Type A and B conceptual models, the primary pathway relates to the disturbance of shallow perched aquifers, and temporary loss of short-term water availability for riparian vegetation. For Types C and D, the pathways are more significant as the risk relates to drawdown in the coal seams, which can propagate through connected formations, reducing groundwater availability and increasing salinity stress for TGDEs. These pathways highlight that Type C and D TGDEs present higher risk of potential impact compared to Types A and B, consistent with the IESC (2024) ecohydrological expectations

The Quaternary Alluvium formations, which includes Taurus Creek, groundwater occurs as ephemeral, discontinuous perched aquifers in sandier material; with clayey material forming aquitards (RDM Hydro et al., 2023). The alluvial sediments are of limited extent and thickness but are likely to be episodically recharged by rainfall run-off when the watercourse hosts water, resulting in the presence of perched aquifers associated with the alluvium, aligning with GDE Type A.

A description of the Type A conceptual ecohydrological models summarised from RDM Hydro et al. (2023) is provided below.

Type A: A simplified perched seasonal groundwater system that is commonly associated with alluvium comprising sediments with higher levels of hydraulic conductivity (sandy loams and sand) is depicted in **Figure 5-37** (from RDM Hydro et al., 2023). The characteristics of Type A are as follows (RDM Hydro et al., 2023):

- Groundwater is recharged during channel flow/flooding and diminishes as the system dries through evapotranspiration or leakage into Permo-Triassic sediments below. Following recharge, groundwater perches on Permo-Triassic sediments (or another aquitard layer) at the base of the alluvium, where it is utilised by fringing riparian vegetation. Generally, groundwater depletes during drier periods, and trees then rely on residual soil moisture to support transpiration.
- These systems are relatively common features along larger drainage lines and do not provide a sustained moisture source to support riparian vegetation during drier periods, utilising groundwater during wetter periods when groundwater is present. Consequently, this means that the vegetation does not rely on a deep continuous water table aquifer, but is using shallow, perched water that was discharged after surface water flow events.
- Type A GDE features are relatively low risk from a management perspective, although may be impacted when stream channels are breached during construction with localised impacts to TGDEs.





Figure 5-37 Type A - Conceptual ecohydrological model - perched aquifers in alluvium (from RDM Hydro et al. 2023)

5.7.1 Validation of the Conceptual Ecohydrogeological Models

The potential TGDEs of Taurus Creek are dominated by coolibah (*Eucalyptus coolabah*) on the channel whilst brigalow (*Acacia harpophylla*) dominates further out on the floodplain. RDM Hydro et al. (2023) identify that the coolibah is likely to utilise groundwater only when groundwater is <5 mBGL and moisture availability in the vadose zone is extremely limited. Brigalow (*Acacia harpophylla*) is also prevalent within the State-mapped TGDE polygon, particularly on the floodplain away from the channel. However, brigalow is not considered to represent groundwater-dependent vegetation.

Two field validation events were undertaken by DPM Enviros ciences (2026), and found:

- June 2025: 5 of 12 coolibah trees showed Leaf Water Potential (LWP) ≥ –0.55 megapascals (MPa), indicating access to a saturated water source. Noting saturated sediments present within the upper 1 m of channel bed sediments with drier conditions observed within the upper 2 m of adjoining floodplain sediments.
- October 2025: All 17 trees sampled (coolibah, ironbark, poplar box) recorded LWP < –0.55 MPa, indicating no groundwater uptake at this time and likely reliance solely on soil water.

The facultative TGDE comprising riparian (including floodplain) vegetation of Taurus Creek would likely exist without groundwater input but is known to utilise groundwater on occasion (episodic or opportunistic GDEs, not obligate GDEs) (DPM Enviros ciences, 2026).

6.0 Numerical Modelling

This section outlines the numerical groundwater modelling that has been undertaken to evaluate the potential impacts of the proposed north extension of open cut mining (the Project) on the groundwater system.

6.1 Model Details

The BWM numerical groundwater model was adopted for the hydrogeological assessment supporting the Project. The BWM numerical groundwater model was built in 2025, based on the most recently available site data (i.e. geological models, groundwater bore data, etc). This section provides a summary of the design, development and use of the BWM numerical groundwater model. Full details of the BWM numerical groundwater model utilised in this hydrogeological assessment are included within SLR (2026), provided in **Appendix B**.

The BWM numerical groundwater model was deemed appropriate for the purposes of this assessment for the following reasons:

- Adoption of the MODFLOW-USG code in the model allows for sufficient refinement of the model grid around the entire of BWM operations such that the limitations of a regional model in terms of the grid design are mitigated.
- The model incorporates the full BWM geological framework with model layer representation consistent with the three site geological models covering BWM.
- The model is robustly calibrated to BWM specific monitoring data (recently updated and detailed quality assurance completed to early 2025).
- The model incorporates key regional influences that may interact with the BWM groundwater system, including operations at the Curragh mine to the north (open-cut and underground), underground mining at Cook Colliery east of BWM that are both considered to have a potential to interact with groundwater in the BWM Area given their proximity.
- The BWM model adopted for this assessment is the latest numerical model for BWM, developed for the Blackwater Transitional PRC Plan (PRCP) hydrogeology assessment (SLR, 2025a).

6.2 Model Objectives

Numerical modelling was undertaken in support of this hydrogeology assessment to evaluate the potential impacts of the proposed extension of open cut mining (the Project) on the groundwater regime. The objectives of the predictive modelling were to:

- Assess the groundwater inflow to the mine workings as a function of mine position and timing.
- Simulate the extent of maximum groundwater drawdown/depressurisation due to the Project and also with respect of cumulative impacts.
- Simulate and predict the change in groundwater levels at identified groundwater users (i.e. registered bores, landholder bores and GDEs) due to the Project and also with respect of cumulative impacts.
- Simulate the direct and indirect take of groundwater and surface water (baseflow) due to the Project.

- Simulate the long-term impacts by running the post-mining scenario with the proposed final landform and void lakes.

6.3 Model Design

The numerical model was developed using a Geographic Information System (GIS) in conjunction with MODFLOW-USG (Panday et al. 2013), which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a recent version of industry standard MODFLOW code (McDonald and Harbaugh, 1988) developed by the USGS. MODFLOW is the most widely used code for groundwater modelling and has long been considered an industry standard.

Model layering is discretised into 17 layers as listed in **Table 6-1**. Those layers identified in the table as not present across the entire model domain are 'pinched out' within the MODFLOW-USG code.

Table 6-1 Model Layers and Thicknesses

Model Layer	Formation	Unit	Average Thickness (m)
1	Alluvium/Tertiary	Surface cover and Tertiary	8.5
2	Alluvium/ Weathered zone	Weathered zone / Regolith	13.1
3	Clematis Group	Triassic	372.9
4	Rewan Group (Upper)	Triassic	309.4
5	Rewan Group (Middle)	Triassic	180.9
6	Rewan Group (Lower)	Triassic	114.9
7	Rangal Coal Measures	Overburden	51.5
8		Aries seam	1.7
9		Interburden	15.2
10		Castor seam	1.7
11		Interburden	16.3
12		Pollux seam	4.2
13		Interburden	16.2
14		Orion seam	0.8
15		Underburden	17.9
16	Burngrove Formation	Permian	159.4
17	Basement	Permian and/or below	100

6.4 Model Calibration

The model includes a steady state and a transient calibration (from January 2005 to December 2024). In all, the calibration used 1,789 target heads from 108 bores. The transient warm up calibration captures historical mining at BWM, Curragh mine, Cook Colliery underground mine, Kenmare underground, Laleham underground and Sirius Creek No. 1 and 2 underground mines, while the transient calibration captures historical mining at BWM and Curragh mine. The number of bores associated with each model layer and associated target unit are provided in **Table 6-2**.

Mining was represented in the model using the MODFLOW drain package, with the drain cells set to the base of the target coal seam for each pit, and within the target coal seam for underground mines. Calibration of the model was carried out with the objective being to replicate the measured groundwater levels in accordance with Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Calibration for the model achieved a 11.6 m root mean square (RMS) error, equating to a 6.6% scaled root mean square (SRMS) error, which is within the recommended range (i.e. up to 10%) in the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Table 6-2 Model Calibration Targets

Model Layer	Target Unit	Number of Bores
2	Weathered zone / Regolith	18
5	Rewan Group (Middle)	1
6	Rewan Group (Lower)	6
7	RCM Overburden	14
8	Aries seam	13
9	RCM Interburden	3
10	Castor seam	9
11	RCM Interburden	3
12	Pollux seam	18
13	RCM Interburden	1
14	Orion seam	2
16	Burngrove Formation	20
	Total	**108**

6.5 Model Performance and Limitations

The groundwater modelling was conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012), the MDBC Groundwater Flow Modelling Guideline (MDBC, 2001) and the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023).

The model confidence level (Class 1, Class 2 or Class 3 in order of increasing confidence) based on the Australian Groundwater Modelling Guidelines (Barnett et al., 2012) was previously widely used in the industry. The latest version of the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023) introduces a new concept on how model confidence can be assessed. The document also indicates that this change will follow in the next iteration of the Australian Modelling Guidelines and the new concept for assessing model confidence is hence applied for this model.

The latest version of the IESC Explanatory Note for Uncertainty Analysis defines a model fit for purpose when model results are:

- Usable -- Relevant to the decision-making process, providing information about the uncertainty in conceptualisations and modelling simulations in a way that allows decision-makers to understand the effects of uncertainty on project objectives and

the effects of potential bias. The relevant Quantities of Interests (QoI) in this context are the groundwater inflows (active mining and final voids), drawdown due to mining and fluxes changes due to mining.

- Reliable -- Demonstrate that the range of model outcomes is consistent with the system knowledge and honours historical observations, and provides objective evidence that uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated. The calibration performance was deemed acceptable, and a rigorous uncertainty analysis was undertaken to further improve confidence in the modelling outputs.
- Feasible -- Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the project. This study is a rebuild of historical model variations (i.e. 2021 and 2023) demonstrating multiple model reviews/revisions and inclusion of the latest available data. The model has been peer reviewed for each revision. This model build and associated review process is deemed commensurate with the Project related risk to the groundwater environment.

In order to assess these three points above, the four sources of scientific uncertainty (structural, parametrisation, measurement error, predictions) have been qualitatively assessed with regards key aspects of the BWM groundwater model, as presented in **Table** 6-3**.**

Overall, the model captures depressurisation due to active mining. The model is numerically stable with an acceptable mass balance error. The model shows a good fit between observed and modelled groundwater levels. A depth dependence function was used for hydraulic conductivity, with the calibrated values showing a good fit to observed data as (see SLR [2026], **Appendix B**). Overall, the model is considered fit for purpose to achieve the objectives outlined in **Section 6.2** based on the data provided and the Project timeframe. Updates could be conducted in future to further refine the model, but this would be dependent on the purpose of the modelling and availability of data to inform future changes.

The model sensitivity was explored for an array of parameters. This showed that these parameters were generally well constrained by the calibration. Parameters are likely to contribute the most to predictive uncertainty (Type IV) were also identified. See **Appendix B** for a detailed discussion on sensitivity.

The uncertainty analysis was undertaken to add a likelihood estimate to the prediction for the quantities of interest.



Table 6-3 Groundwater Model Data and Limitations

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	The model has an unstructured Voronoi grid that includes detailed cell refinement around site, neighbouring mines and along drainage features.
	Layers	Fit for purpose	Top of layer 1 incorporates site LiDAR data.
		Fit for purpose	Representation of alluvium based on the CSIRO Regolith mapping Wilford et al (2016) and refined based on site drill data.
	Conceptualisation – Geological Structure	Fit for purpose, future improvements possible where new data collected	The local structure of the geology is based on detailed data at site (BWM Mine geology model), and regional model geometry (outside of site) interpolated based on publicly available data, such as geological mapping and the CSIRO Regolith data set. Geophysical surveys across the Project area have identified minor faulting in the BWM area. Faulting is typically confined to the coal seams of the Rangal Coal Measures. The minor faults show a displacement of up to 5m. Hence, no geological structures (i.e. faults) have been included within the Project area in the model other than through layer displacements from the site geological model. The main regional fault (Shot over fault) was included as the eastern model boundary. Displacements of up to 3,000m are reported at this fault (**Section 4.7**). The Permian coal measures outcrop along the western edge of the site. Therefore, how this is captured within the model influences the model predictions. The structure of the coal seams was checked to ensure it matches observed and mapped geology. The predictions of drawdown adjacent to mining was checked and the model shows a good fit between modelled and observed trends.
	Conceptualisation – GDEs	Fit for purpose, future improvements possible	A GDE conceptualisation is provided in **Section 5.5.1**.
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose	The groundwater-surface water interactions are conceptualised as limited. Due to the gauged creeks to be classified as ephemeral (**Section5.6.2**), no long-term baseflow contribution from the groundwater is expected. Rather, surface water is expected to recharge the groundwater



Type	Part	Status	Comment
			and after such recharge events, some minor baseflow contributions back into the creeks is possible.
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose future improvements possible	Site monitoring network includes one bore mapped within alluvium that was used to inform saturated extent of alluvium locally at site and for calibration targets. However, the alluvium in the area was found dry at this location. Other attempts to drill into the alluvium were abandoned, as either no alluvium was found or the alluvium was dry, or the bores were installed into the Rewan instead. The modelled groundwater levels in alluvium have hence no comparison available.
Parameterisation	Hydraulic Conductivity – Shallow layers	Fit for purpose,	Spatial variability of hydraulic parameters in the Alluvium and Regolith has been incorporated in this model version by adding pilot points in both layer 1 and 2. This enhancement has allowed representing the heterogeneity in the alluvial system, improving the model's ability to replicate water level measurements in these units.
	Hydraulic Conductivity – Depth Dependence	Fit for purpose	Field testing of hydraulic conductivity (horizontal and to a lesser extent vertical) has been conducted in the area. Hydraulic conductivity test results from the other sites within the model domain were also considered. The data shows a general decline in hydraulic conductivity with depth that is replicated in the model.
	Spoil Properties	Fit for purpose, future improvements possible	Limited site-specific data is available for the spoil. Spoil properties were adopted using the previous studies.
	Rivers	Fit for purpose, future improvements possible	Blackwater Creek stage height is changed temporally in the historical calibration model based on observed levels from site stream gauges, and long term annual average level assumed in the predictive model. Blackwater Creek records flow only for a few days per year. The simulation of river stage height involves representing it as the average stage over the entire model stress period. However, since the stress periods (i.e., time slices) in the model are quarterly or annual, the stage height for Blackwater Creek persists in the model for a much longer period than it does in reality. This conservative design approach results in the simulation of what is naturally an ephemeral river reach as a perennial river in the model. Consequently, this leads to an overprediction of water levels in the alluvium along Blackwater Creek.



Type	Part	Status	Comment
			All other watercourses within and in the vicinity of the Project area are ephemeral and only flow briefly after rainfall. Therefore, river stage height of zero was assigned to these watercourses in the model.
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and calibrated recharge rates.
Measurement Error	Observation Data Quality	Fit for purpose	Bore logs and construction details available for most site bores, and long-term site water level data available for various units.
	Landholder Bore Data Quality	Fit for purpose, future improvements possible	Impacts on registered landholder bores are influenced by the assumptions of the bore design, target geology and use. Verification of landholder bore details may be required in future.
	Temporal spread	Fit for purpose	Timeseries water level data from the site as well as for the tertiary and Permian coal measures.
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose	Transient warm-up (1970-2005) and transient (2005 to 2024) calibration model set up and a depth dependence function used and calibration to water levels conducted using automated (PEST) and manual methods.
	Predictive	Fit for purpose	Model captures approved and proposed open cut mining at BWM. The model also includes future mining at Blackwater South and Curragh mines, mainly based on publicly available data. The actual future mine progression for these sites may vary.
	Sensitivity and uncertainty	Fit for purpose	Uncertainty analysis has been conducted using PEST IES. The uncertainty analysis quantified the variability in predictions with changes in maximum predicted drawdowns, mine inflows, impact on alluvium flow and impacts on surface water flow.



6.6 Predictive Modelling

Transient predictive modelling was undertaken to simulate both the proposed mining at the Project and surrounding mines from January 2025 to December 2093. The model timing used annual stress period durations as mining progressed into the future. Transient predictive models have been developed for three model scenarios:

- Cumulative Scenario – all approved and foreseeable mining in the model area and at BWM plus the Project.
- Approved Scenario – all approved and foreseeable mining in the model area and at BWM without the Project.
- Null Run – no mining within in the model area.

The Project effects (i.e. the incremental changes) are determined by the difference between the Cumulative and Approved scenarios.

6.6.1 Predicted Groundwater Interception

The predicted inflows for the Cumulative inflows (Approved mining and the Project) and the Incremental inflows (the Project only) are presented in **Figure 6-1**. The peer reviewer recommended use of the TVM2 model parameter set-up for calculation of pit inflows (please refer **Section 6.4** of the modelling technical report (SLR, 2026) for parametrisation set-up discussion.

The cumulative inflows (Approved mining and Project) are predicted to reach a maximum in year 2056 at 12,585 ML/year. Cumulative inflows are predicted to remain between 2,290 ML/year and 10,790ML/year between year 2025 and 2055, with inflows then decreasing after 2056 until end of mining. The average cumulative mine inflow rate (2025 to 2093) is 5,139 ML/year (14.1 ML/day). The spike in cumulative inflows in 2056 is due to the commencement of the southern mining operations, which are not part of the BNEP and thus the incremental is 0 ML/year.

The incremental inflows into the mine pits on SA 7 and SA 10 are predicted to reach a maximum in year 2055, with a peak just above 8,200 ML/year (22.5 ML/day). The average project mine inflow rate for the Project (2025 to 2055) is 2,272 ML/year (6.2 ML/day).

The Water Plan (Fitzroy Basin) 2011 groundwater area consists of the following:

- Groundwater Unit 1 (containing aquifers of the Quaternary alluvium).
- Groundwater Unit 2 (sub-artesian aquifers).

Planned mining operations at the Project will not intercept Quaternary alluvium at any of the proposed pits. As such, all direct groundwater take predicted by the model is from Groundwater Unit 2.

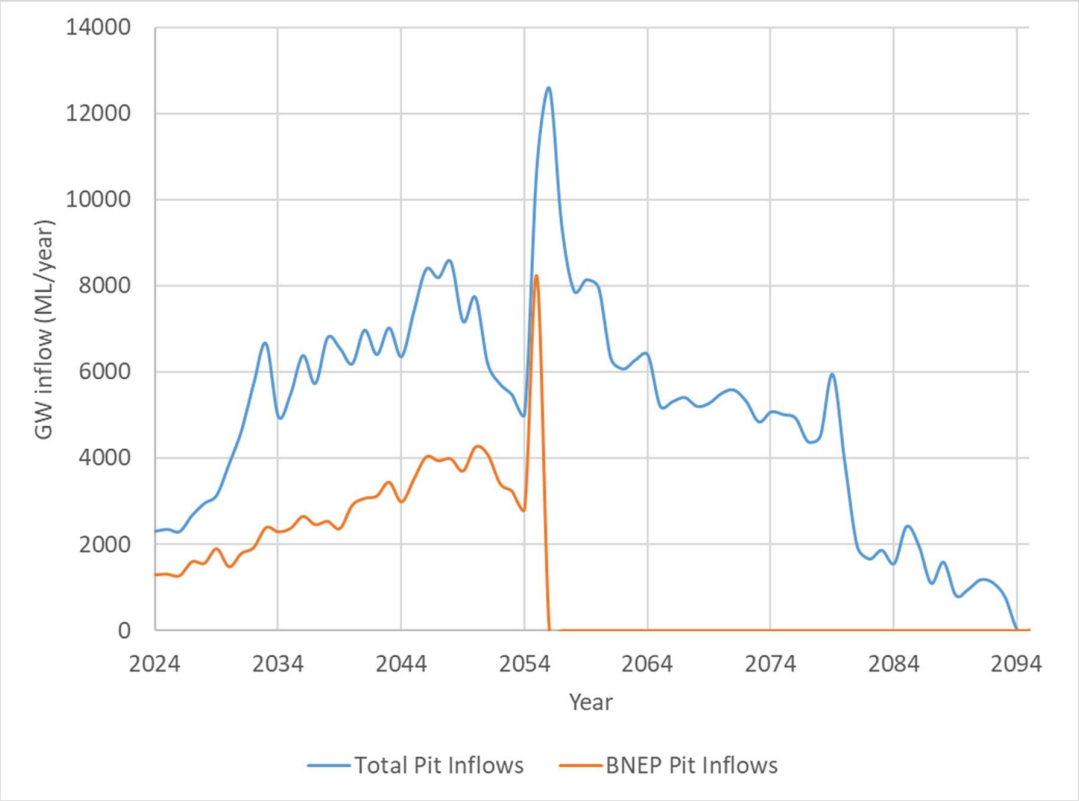


Figure 6-1 Predicted Cumulative and Incremental Project Pit Inflows

6.6.2 Predicted Maximum Drawdowns

The process of mining directly removes water from the groundwater system and reduces water levels in surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown. Aquifer drawdown is greatest at the working coalface and decreases with distance from the mine.

6.6.2.1 Incremental Drawdown

Maximum incremental drawdown refers to the drawdown impact associated with the Project and is obtained by subtracting the predicted maximum aquifer groundwater drawdown for the Approved model scenario (No Mining – Approved) over the model duration from the predicted maximum aquifer groundwater drawdown for the Cumulative model scenario (No Mining – Project) over the model duration. The maximum drawdown represents the maximum drawdown values recorded at each model cell. Predicted incremental drawdown figures are presented in **Figure 6-2** to **Figure 6-6**.

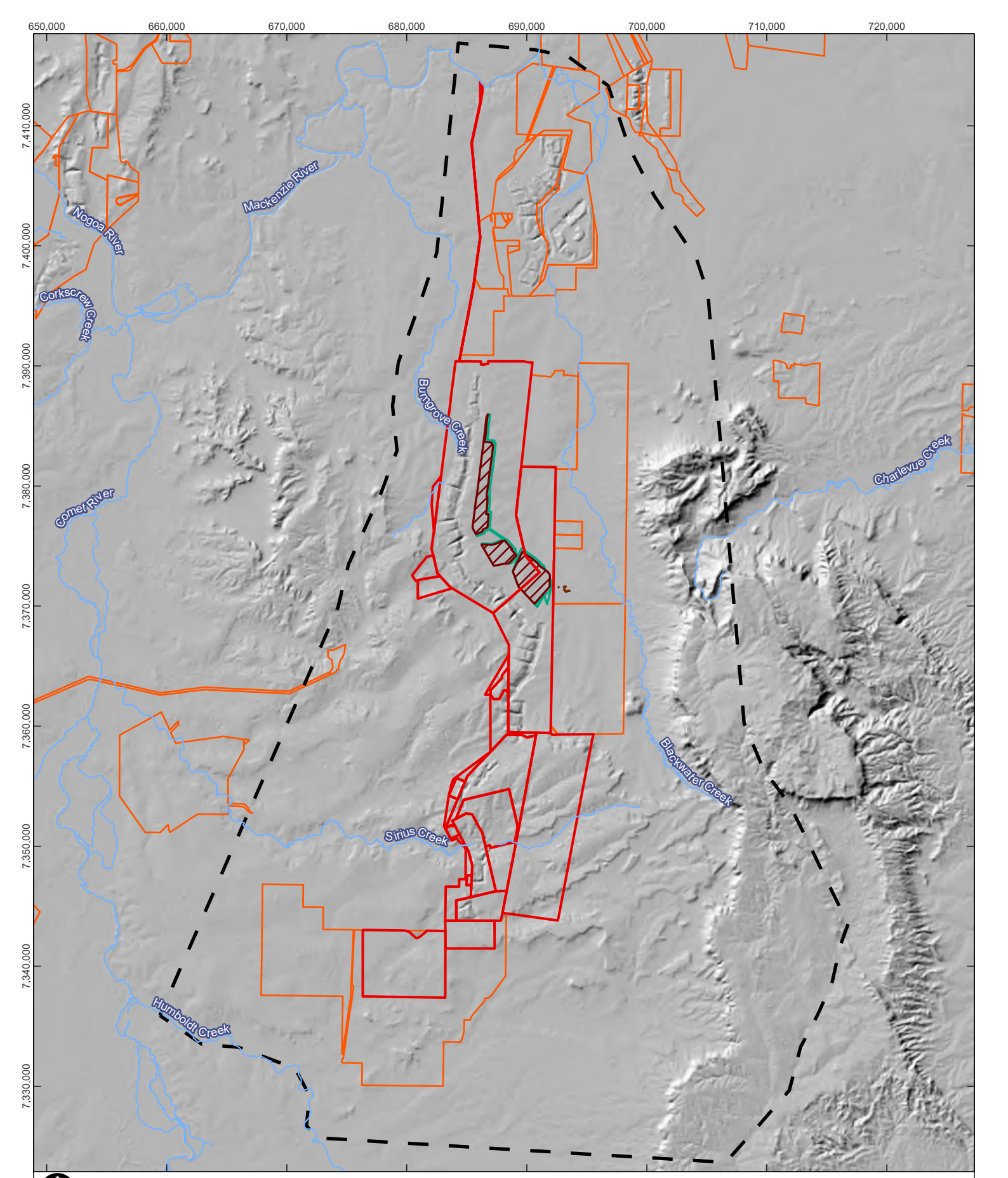
Figure 6-2 shows that no incremental drawdown greater than 1 m are predicted for the alluvium as a result of mining at the Project. For a discussion on the potential incidental water impacts on the alluvium, see **Section 6.6.3.1**.

The maximum predicted incremental drawdowns associated with the Project within the weathered zone is shown in **Figure 6-3**. The incremental drawdown extent within the

weathered zone (Layer 2) is largely confined to near the pit and is influenced by the distribution of predicted saturated zones in the weathered zone.

The Permian coal seams are the primary aquifers targeted by the Project and would experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents. **Figure 6-4** and **Figure 6-5** show the maximum predicted incremental drawdown for the Aries and Pollux Seams in the Rangal Coal Measures, respectively. The figures show that to the west, the extent of maximum predicted incremental drawdown of the Permian coal measures is limited in its extent, maintaining proximity to the pit due to the structural geology (i.e., coal seams subcrop). The extent of maximum predicted incremental drawdown in the coal seams towards the east extends laterally to Blackwater Creek, however at depth, not vertically into the shallow formations, such as alluvium or Tertiary.

Maximum predicted incremental drawdown for the Burngrove is shown in **Figure 6-6**. The figure shows that maximum predicted incremental drawdown is similar to the drawdown in the coal seams and is limited to the coal seam outcrop.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

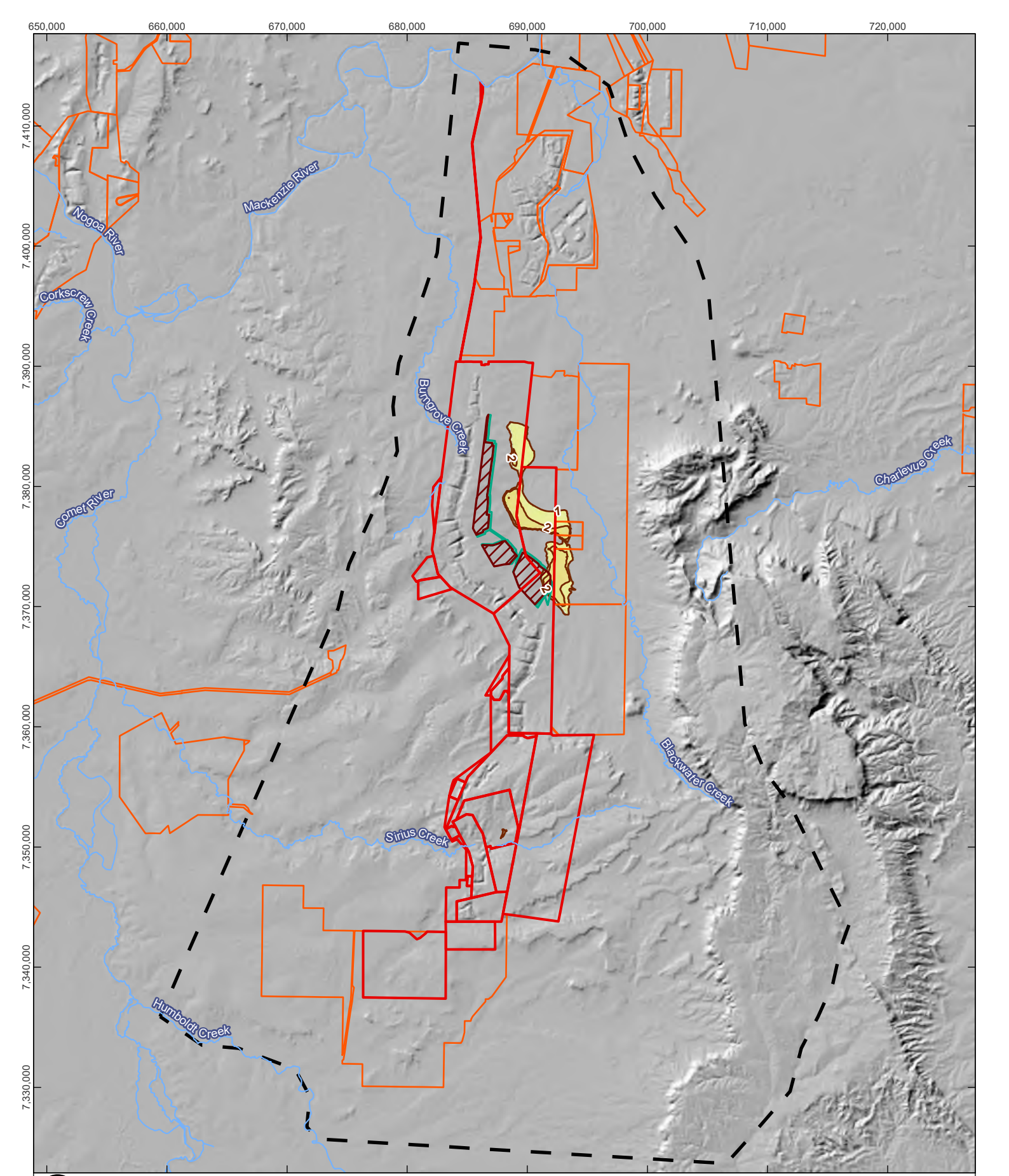
MAXIMUM INCREMENTAL DRAWDOWN IN THE ALLUVIUM AND TERTIARY (LAYER 1)

SLR

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FIGURE 6-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_02_Maximum Incremental Drawdown in the Alluvium and Tertiary (Layer 1)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
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LEGEND

- Watercourse
- BWM Mining Lease
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- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

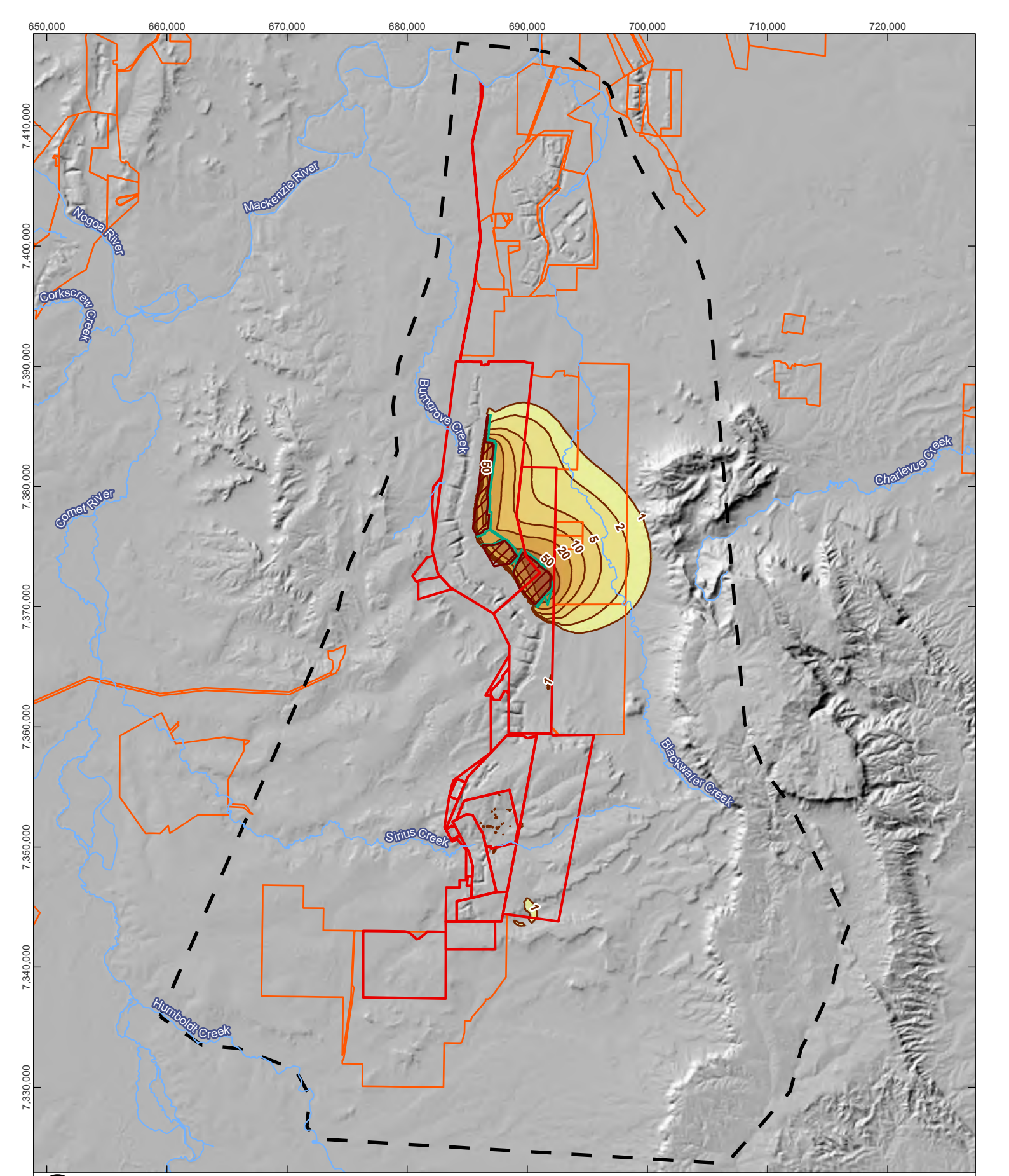
MAXIMUM INCREMENTAL DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

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FIGURE 6-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_03_Maximum Incremental Drawdown in the Alluvium and Weathered Zone (Layer 2)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

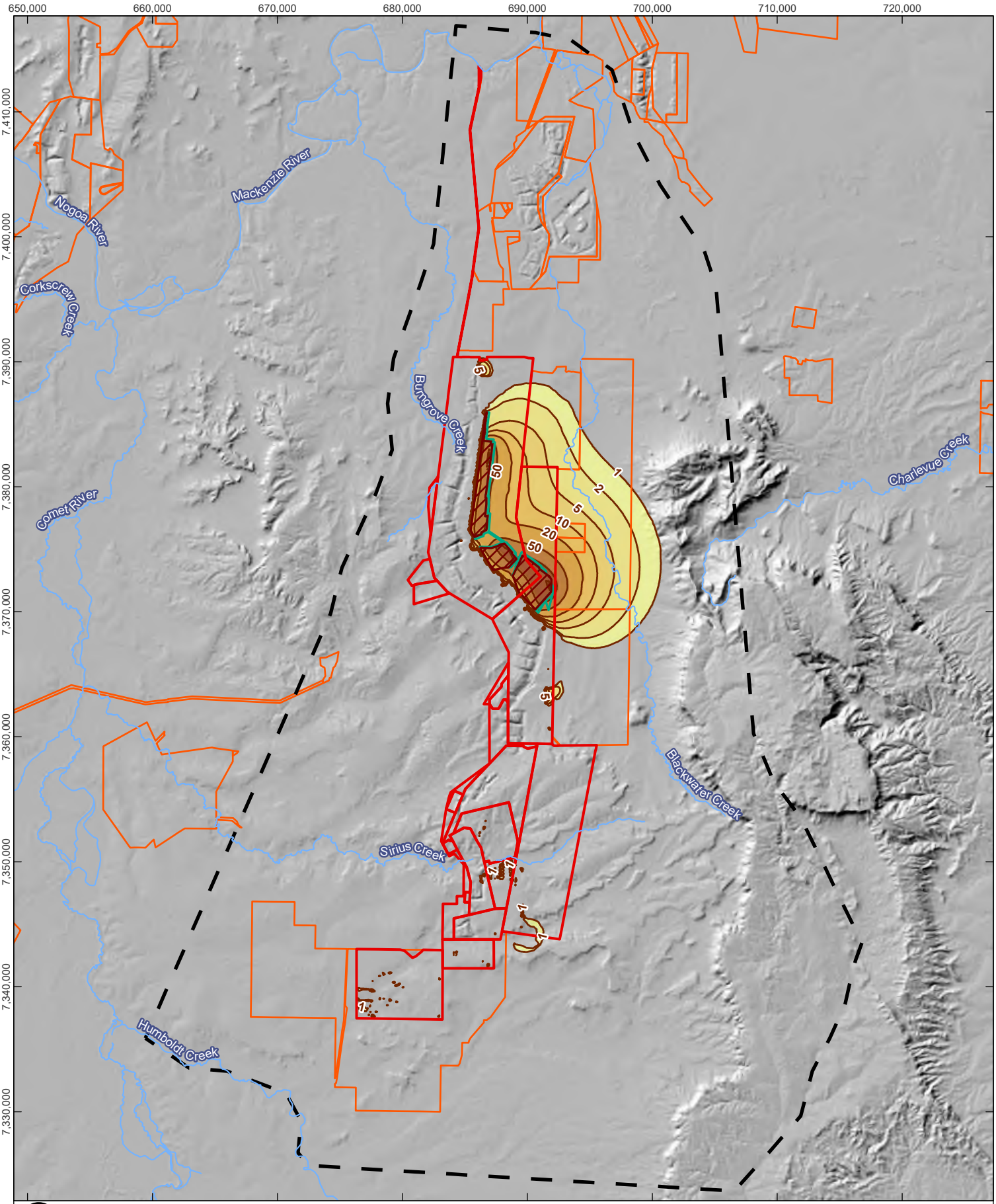
MAXIMUM INCREMENTAL DRAWDOWN IN THE ARIES SEAM (LAYER 8)

SLR

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FIGURE 6-4

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_04_Maximum Incremental Drawdown in the Aries Seam (Layer 8)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

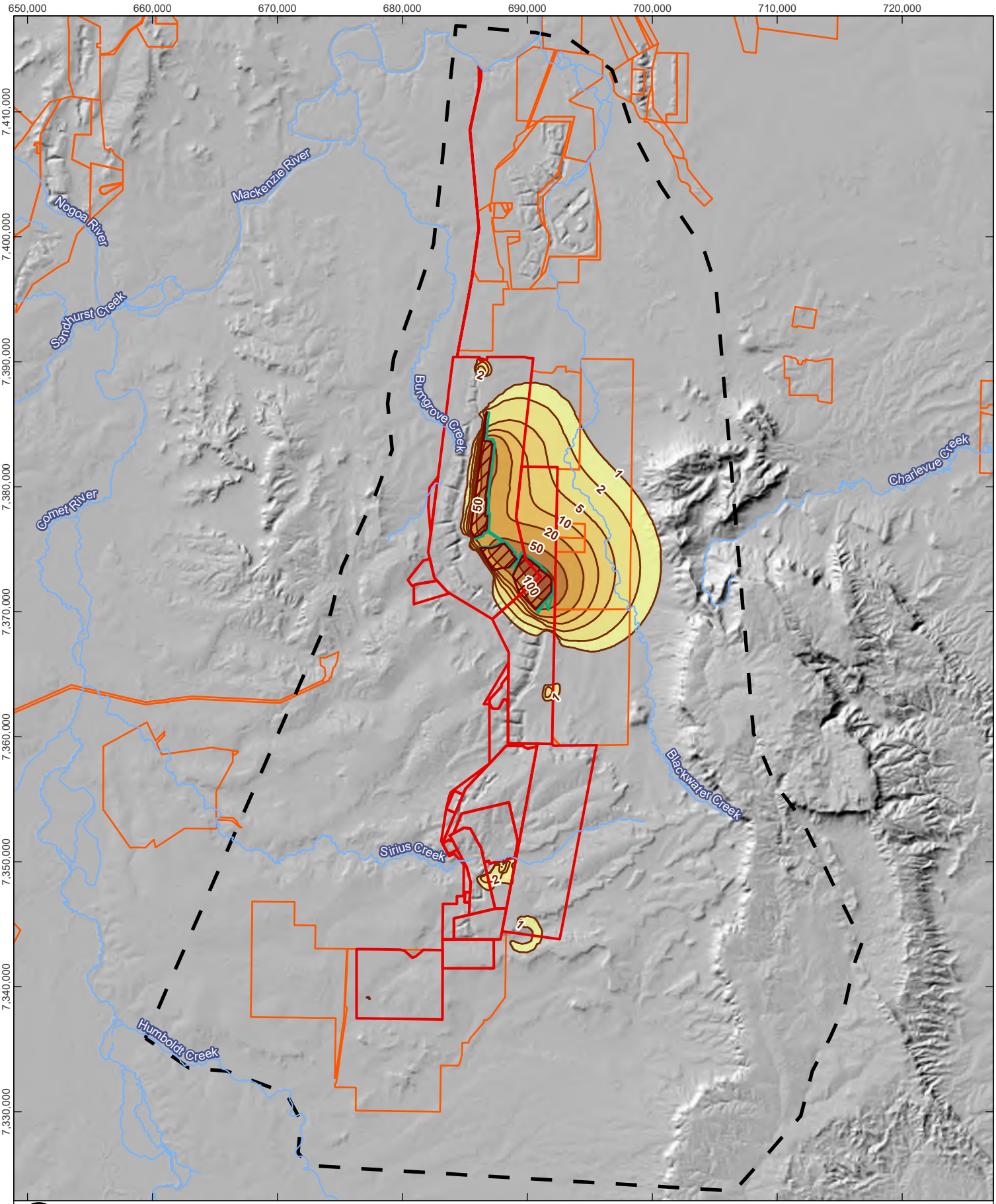
MAXIMUM INCREMENTAL DRAWDOWN IN THE POLLUX SEAM (LAYER 12)

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FIGURE 6-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_05_Maximum Incremental Drawdown in the Pollux Seam (Layer 12)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

MAXIMUM INCREMENTAL DRAWDOWN IN THE BURNGROVE FORMATION (LAYER 16)

SLR

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FIGURE 6-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_06_Maximum Incremental Drawdown in the Burngrove Formation (Layer 16)

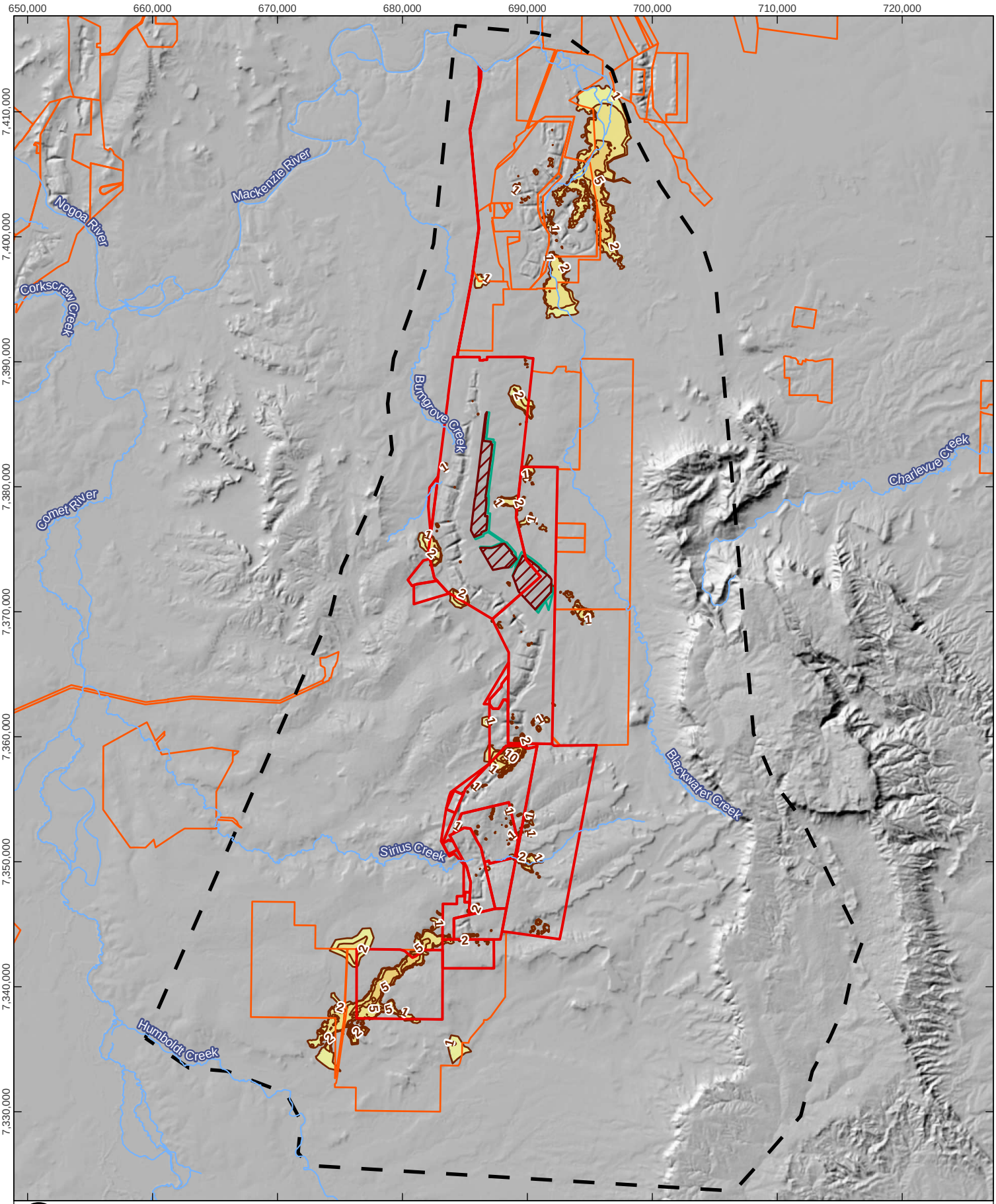
6.6.2.2 Maximum Cumulative Drawdowns

Maximum cumulative drawdown predicted impacts are shown in **Figure 6-7** to **Figure 6-11**. These drawdowns represent the total impact of mining by all current mining and foreseeable mining, including the Project. The cumulative drawdown is derived by calculating the maximum difference in the groundwater levels for the Cumulative scenario with those in a theoretical “No Mining” or Null Run scenario, for all times during the predictive model period.

Cumulative drawdown impacts for the Alluvium and Tertiary (**Figure 6-7**) show that maximum predicted cumulative drawdown impacts are in the north near Blackwater Creek. Cumulative impacts within the weathered zone (**Figure 6-8**) can be seen connecting to the drawdown in the Tertiary.

Figure 6-9 and **Figure 6-14** show the maximum predicted cumulative drawdown in the Aries and Pollux seams in the Rangal Coal Measures. As shown in the figures the maximum cumulative drawdown is bounded on the western side by the coal seam outcrop and predicted to extend generally a distance of 5-7 km east of the mining areas. The cumulative drawdown reached the model boundary in the northeast, which coincides with a major fault (Shotover Fault). An extension of the model in that area would still result in the same drawdown, as the fault is expected to act as a barrier to flow.

Figure 6-11 shows the maximum predicted cumulative drawdown in the Burngrove Formation. The maximum cumulative drawdown for Burngrove is similar to the drawdowns expected in the Permian coal measures and predicted to extend approximately 5-7 km east of the mining areas.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	15-Sep-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundry
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

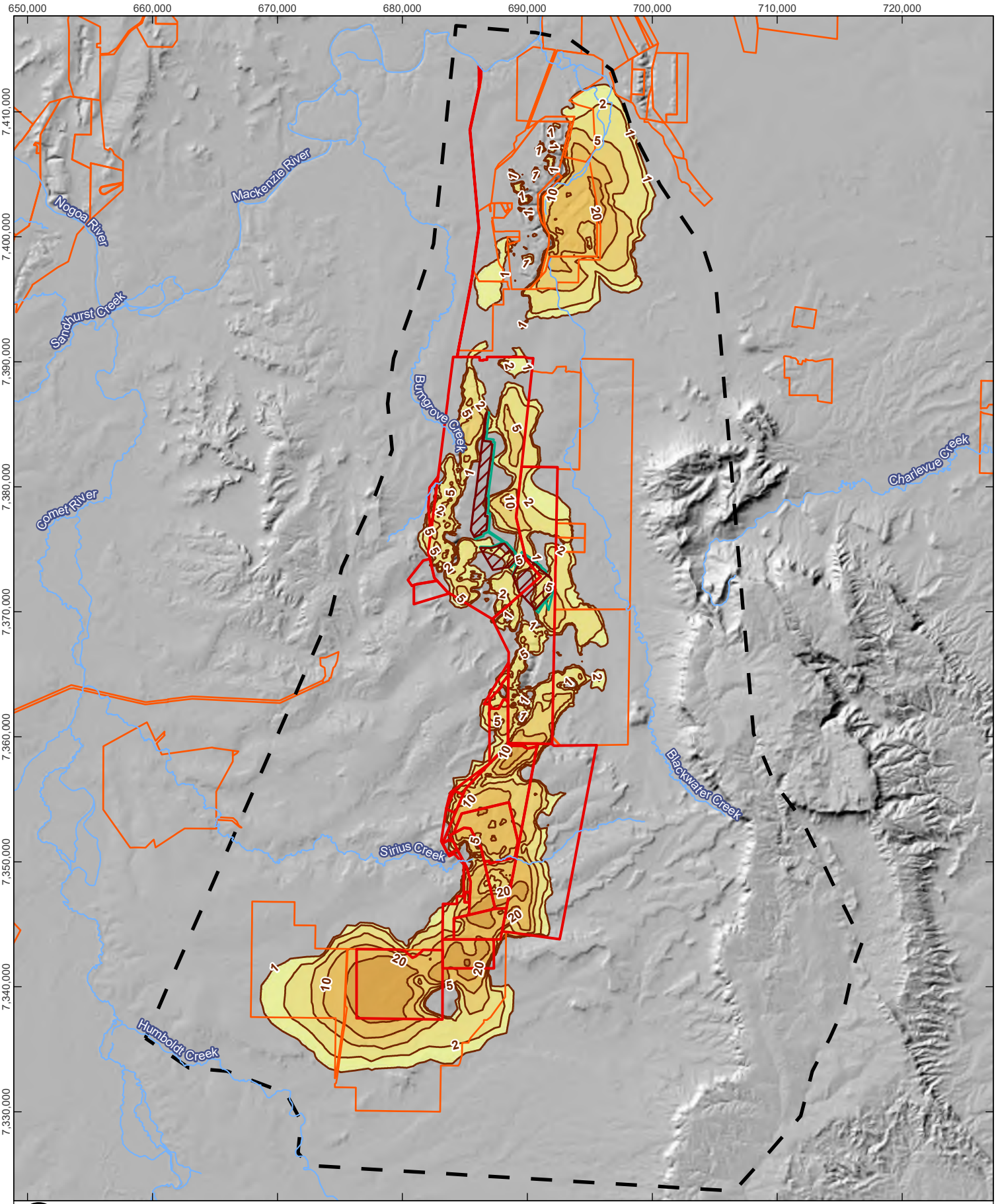
MAXIMUM CUMULATIVE DRAWDOWN IN THE ALLUVIUM AND TERTIARY (LAYER 1)

SLR

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FIGURE 6-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_07_Maximum Cumulative Drawdown in the Alluvium and Tertiary (Layer 1)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

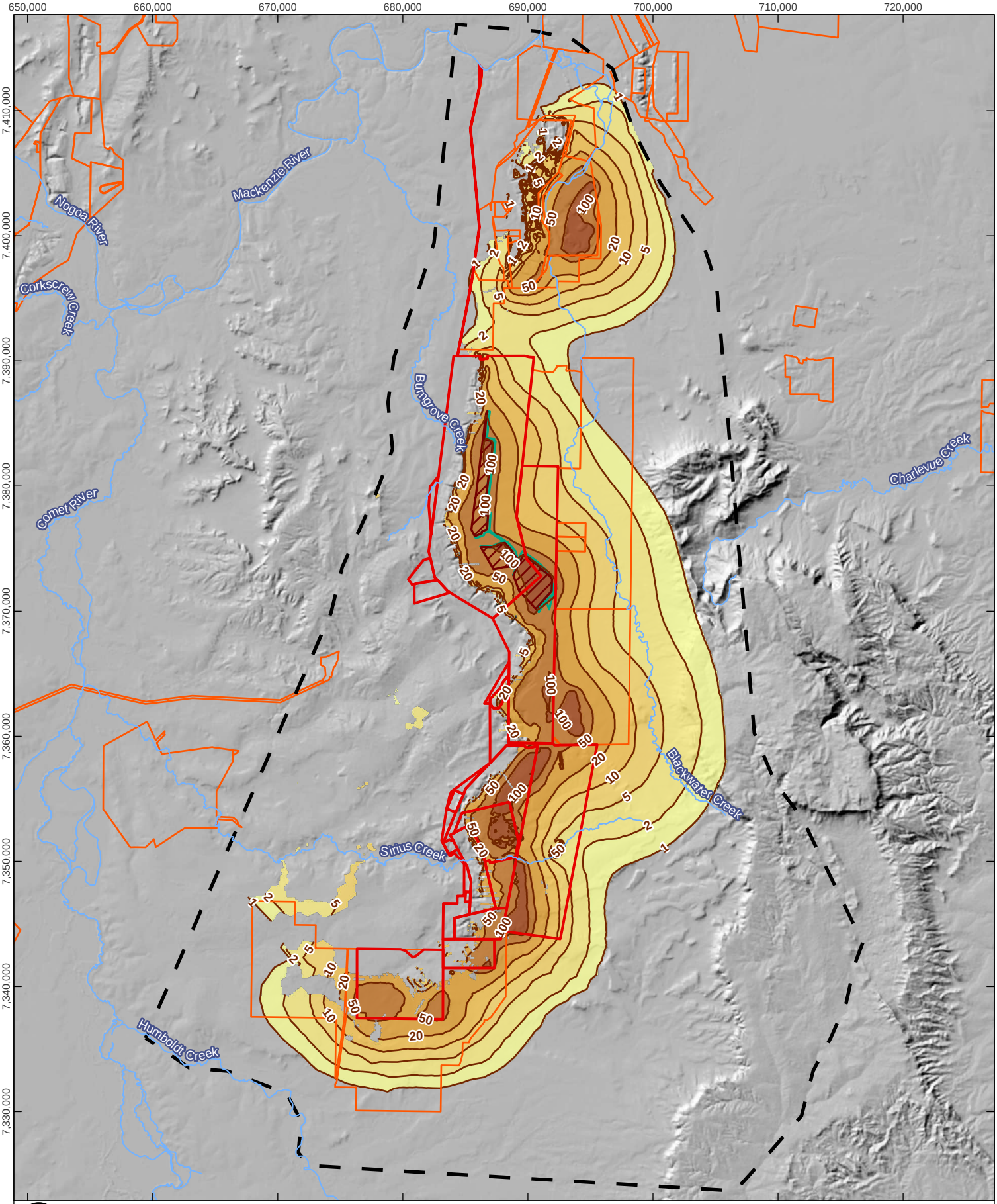
MAXIMUM CUMULATIVE DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

SLR

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FIGURE 6-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_08_Maximum Cumulative Drawdown in the Alluvium and Weathered Zone (Layer 2)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	15-Sep-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

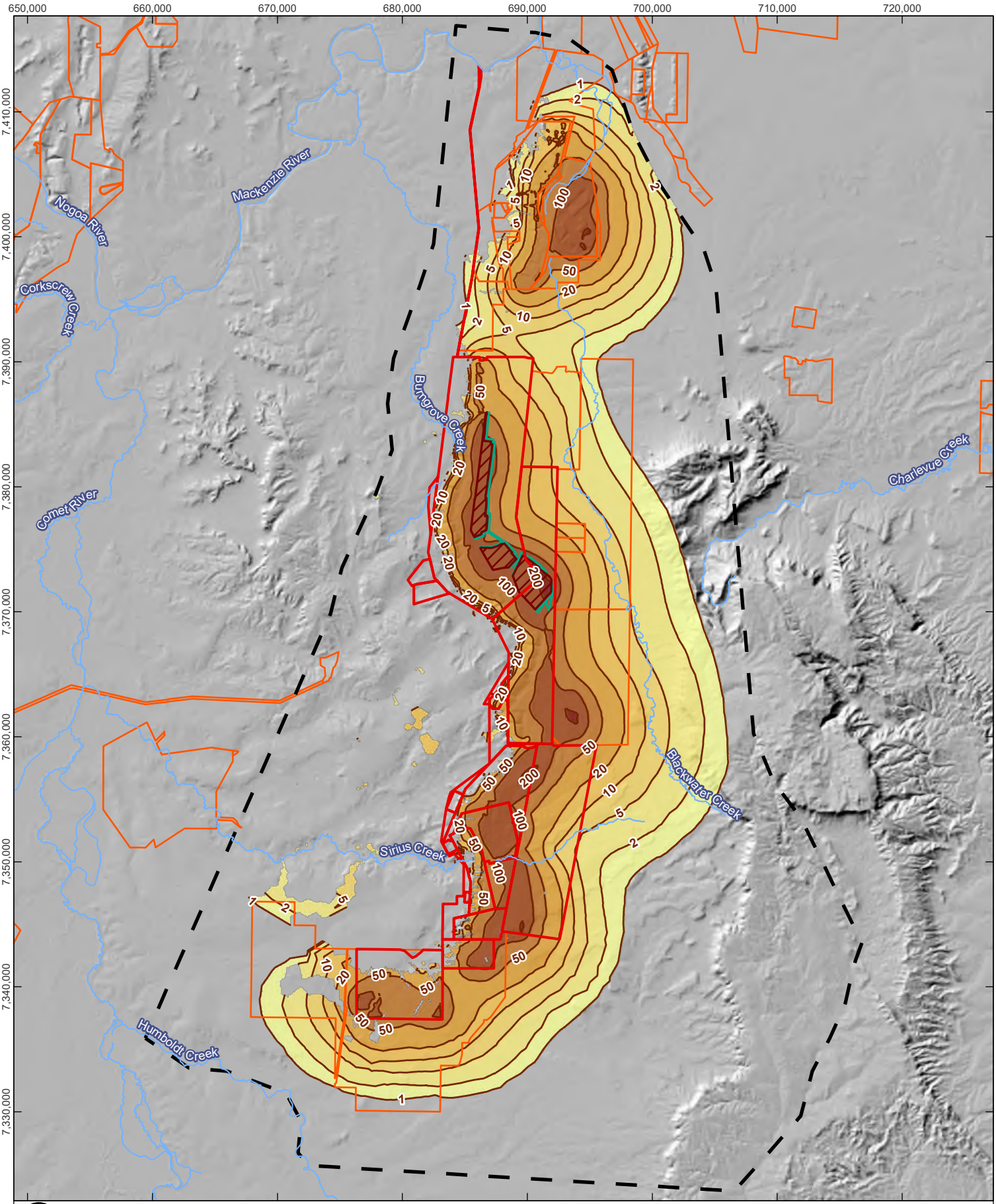
MAXIMUM CUMULATIVE DRAWDOWN IN THE ARIES SEAM (LAYER 8)

SLR

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FIGURE 6-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_09_Maximum Cumulative Drawdown in the Aries Seam (Layer 8)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

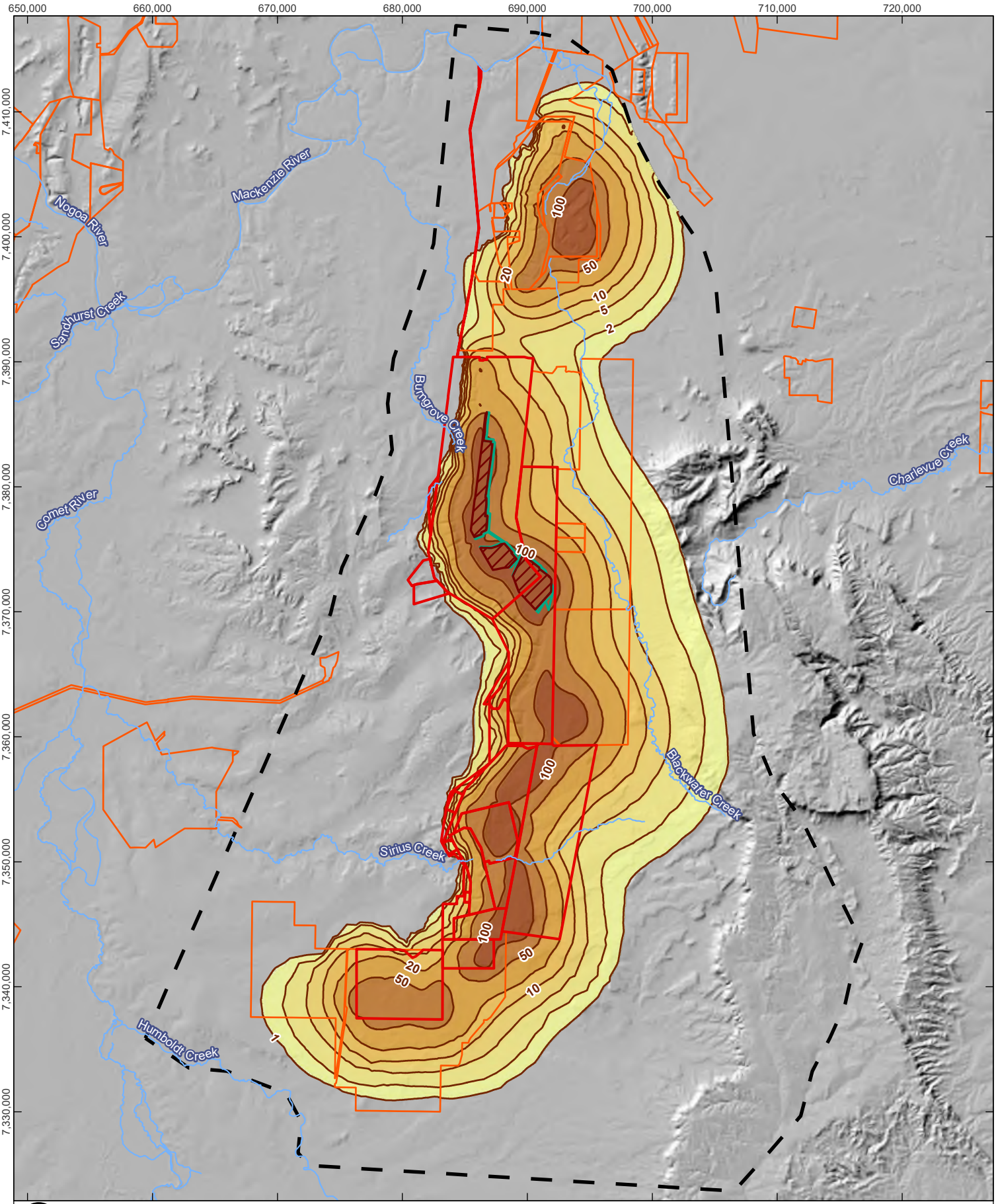
MAXIMUM CUMULATIVE DRAWDOWN IN THE POLLUX SEAM (LAYER 12)

SLR

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FIGURE 6-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_10_Maximum Cumulative Drawdown in the Pollux Seam (Layer 12)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

MAXIMUM CUMULATIVE DRAWDOWN IN THE BURNGROVE FORMATION (LAYER 16)

SLR

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FIGURE 6-11

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_11_Maximum Cumulative Drawdown in the Burngrove Formation (Layer 16)

6.6.3 Incidental Water Impact

6.6.3.1 Influence on Alluvium

The change in alluvial water resources was estimated by comparing water budgets for alluvial zones using the Approved and Cumulative scenarios of the predictive model. Interference of the alluvial groundwater can occur due to reduced upward leakage from Permian Coal Measures that are depressurised because of mining activities. Over the extent of Quaternary alluvium of Blackwater Creek, there is a maximum flow reduction of 0.5 ML/day from the underlying formation into alluvium as a result of the Project. This reduction represents a regional-scale response, as no specific areas of alluvium are predicted to experience drawdown greater than 1 m.

6.6.3.2 Influence on Blackwater Creek

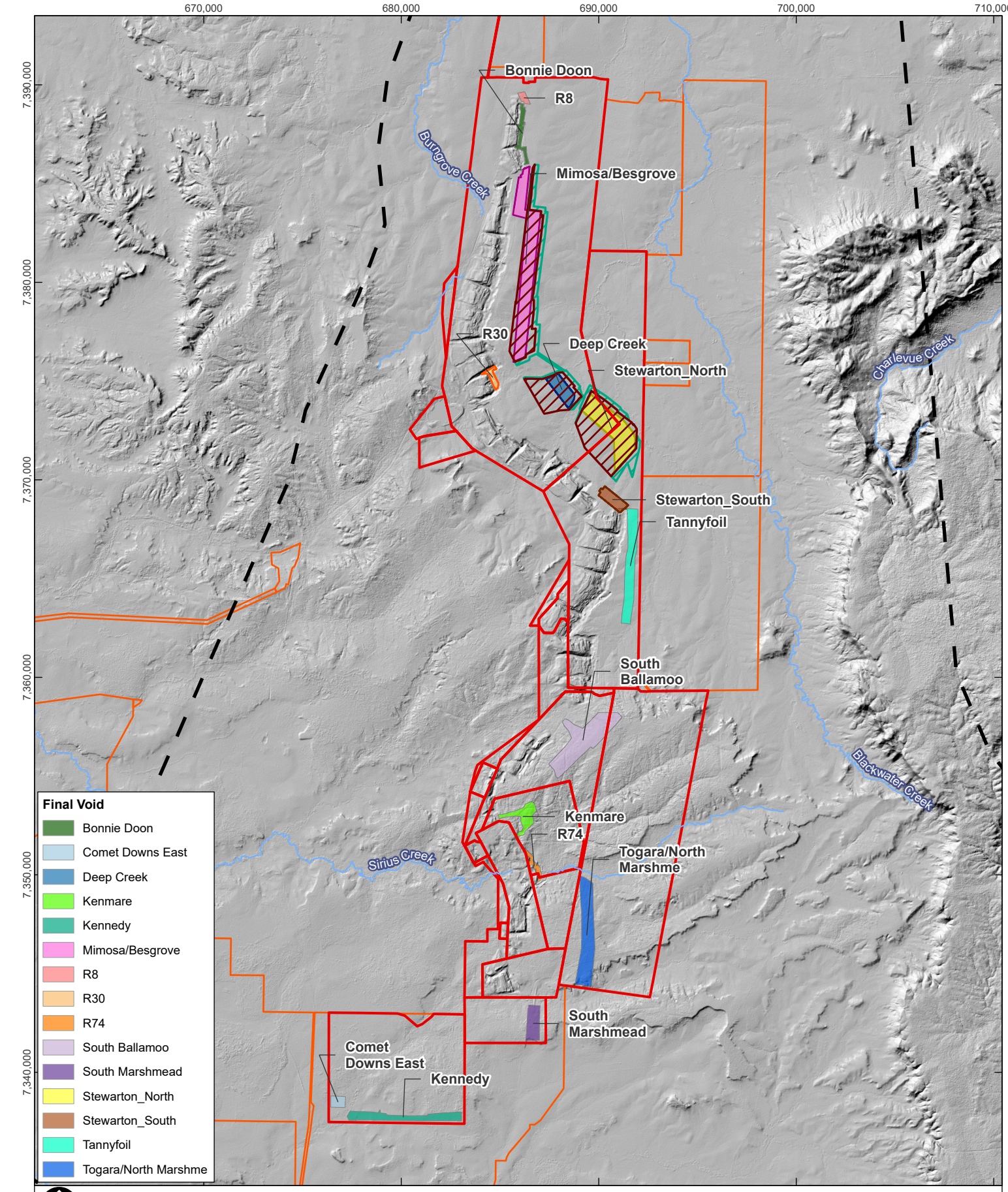
The net groundwater flow to Blackwater Creek is very close in all three scenarios (0.02 ML/day with rounding). All scenarios indicate the flow is generally from groundwater to the Creek, however this flow is very minor (and shows that Blackwater Creek does not receive continuous amounts of baseflow).

The change in groundwater flow to Blackwater Creek due to the Project was calculated by comparing the river flow budgets for Blackwater Creek in the Cumulative scenario against the Approved scenario. This calculation showed that over the life of mine, the maximum change of groundwater flow to Blackwater Creek is negligible (~0.001 KL/d), or 0.005% reduction to the 0.02 ML/day of net groundwater flow to Blackwater Creek.

6.7 Post-mining Predictions

6.7.1 Model set up

The potential post mining impacts of the Project were investigated through a post mining period, commencing at the end of mining at the Project and extending for 1,947 years until the model reached equilibrium. A transient model was created to ascertain post-mining void inflows, with all predictive model drain cells (representing mining) removed. At the end of mining at the Project, the properties of the final void cells were converted to values representative of a void. The void cells were assigned high horizontal and vertical hydraulic conductivities (1,000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, storage coefficient of 5.0×10^{-6} m^{-1}), to simulate free water movement within the final void. This approach is often referred to as a ‘high-K’ lake. The indicative location of the 15 final voids (with five voids in the vicinity of the Project) is provided in **Figure 6-12**.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

INDICATIVE FINAL VOID LOCATIONS

SLR

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FIGURE 6-12

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_01_Indicative Final Void Locations

The recovery model was run transiently with no direct recharge and evaporation onto the open void areas. From this model run, the groundwater inflows to the final voids were incorporated in the site water balance model for the Project's Surface Water Assessment prepared by WRM (2026).

A transient pit lake recovery level time series predicted by the surface water balance modelling was then incorporated into the final groundwater model recovery run. The recovery curves in the five void areas (in the vicinity of the Project) derived from the surface water modelling were integrated into the numerical groundwater model using the time variant constant head boundary condition (CHD).

6.7.2 Long-term Water Levels

Figure 6-13 shows the predicted surface water level at each of the five voids in the vicinity of the Project, used as the CHD for the groundwater model. As shown in the figure, the equilibrated final void water levels are 104.6 mAHD, 74.1 mAHD, 138.7 mAHD, 143.5 mAHD and 83.8 for the Stewarton South, Stewarton North, Deep Creek, R30 and Mimosa/Besgrove voids respectively.

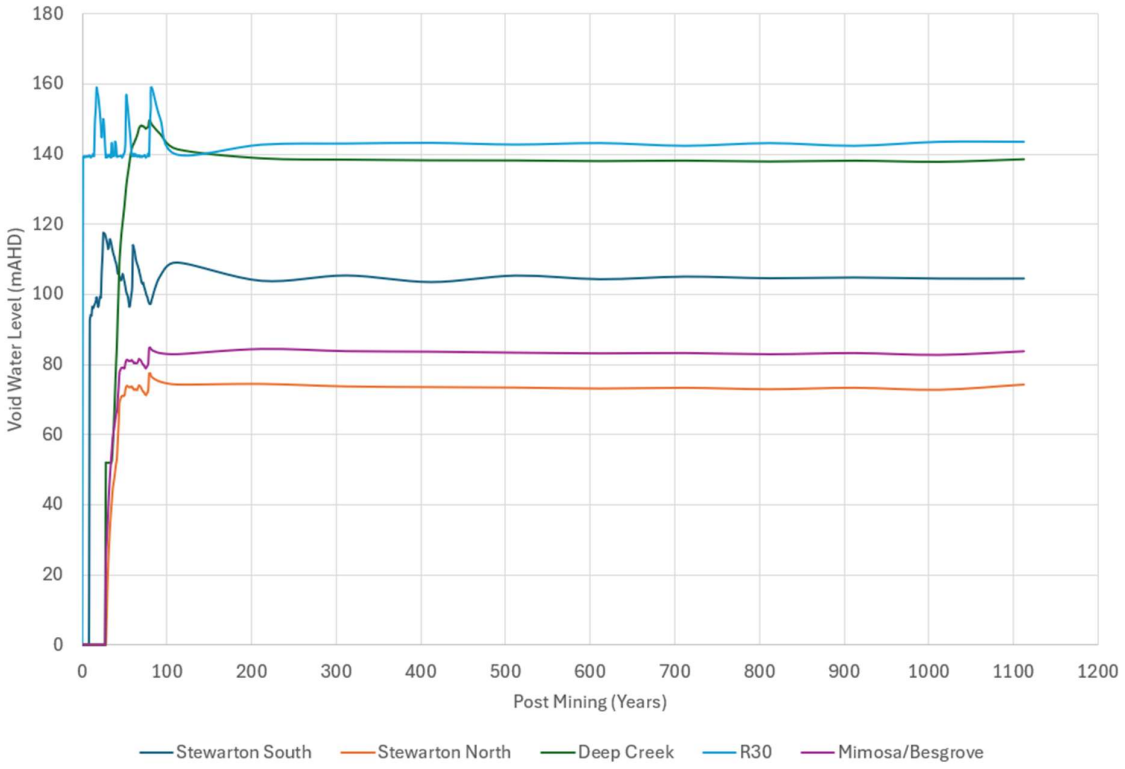


Figure 6-13 Predicted final void water level recovery in the vicinity of the project over time

The equilibrated final void water levels are listed in **Table 6-4**. **Table 6-4** also lists the recovered water table to the east of the pits, at a distance of approximately 250 m. The head difference between the groundwater and the pit lake ranges between -21.88 m and 55.89 m for all pits.

Table 6-4 Final Voids – Equilibrium Water Levels and Groundwater Levels (From North to South)

Component	Equilibrium Void Water Level (mAHD)	Groundwater level (mAHD)[1]	Head difference (m)[2]
R8	144.98	150.56	5.58
Bonnie Doon	159.11	156.79	-2.32
Mimosa/Besgrove	83.8	131.1	47.3
R30	143.46	123.83	-19.63
Deep Creek	138.67	138.84	0.17
Stewarton North	74.31	108.19	33.88
Stewarton South	104.63	143.08	38.45
Tannyfoil	143.17	176.17	33
South Ballamoo	140.27	158.59	18.32
Kenmare	215.48	193.6	-21.88
R74	234.19	244.34	10.15
Togara/North Marshmead	163.86	219.75	55.89
South Marshmead	170.09	181.13	11.04
Comet Downs East	189.24	188.68	-0.56
Kennedy	160.8	173.06	12.26

1 Groundwater level extracted from the recovered water level map, read out approximately 250m away from each pit to the east.
2 A positive number indicates gradient towards the void, a negative number would indicate a gradient away from void.

6.7.3 Long-term Void Net Flows

Final void inflows are shown for all five voids in the vicinity of the Project from **Figure 6-14** to **Figure 6-18**. A positive flow value indicates a net inflow to the void while a negative value indicates a net outflow, from the void toward the local groundwater system. For each void, the net flux to the void is categorised based on its origin: Fluxes from spoil material to the void is shown as “Spoil to void”, while fluxes from the in-situ native rock to the void is show as “native rock to void”. As shown in the figures, final void Stewarton South and R30 show a constant negative net flux, indicating that water in the void primarily flow toward the local groundwater. The fate of these water fluxes is further discussed in **Section 6.7.4**.

The predicted final groundwater water levels are presented in **Figure 6-19**.

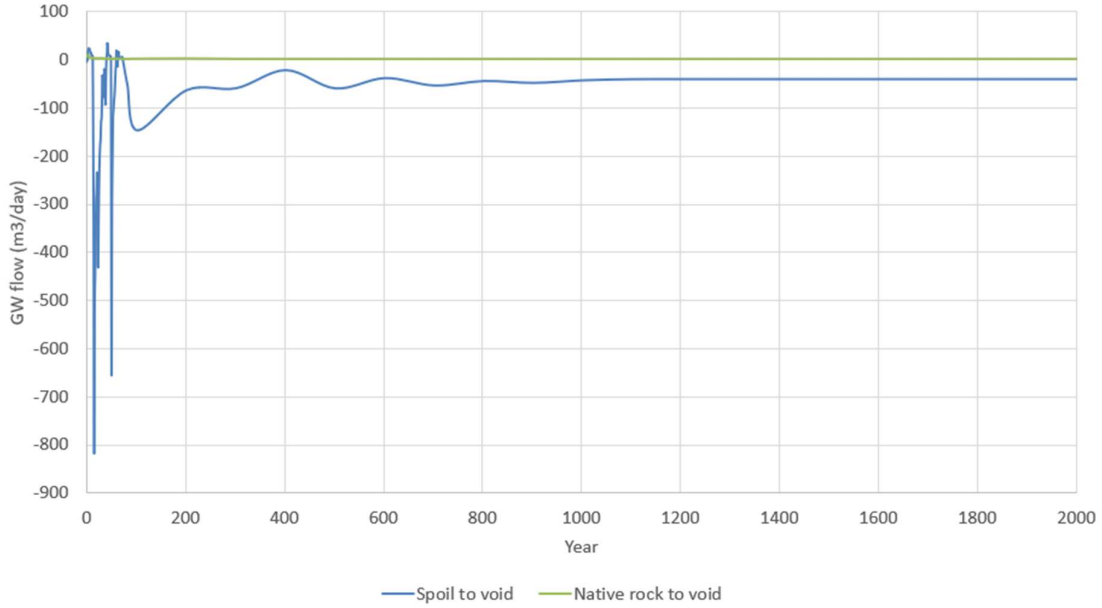


Figure 6-14 Post mining Groundwater inflows to Stewarton South

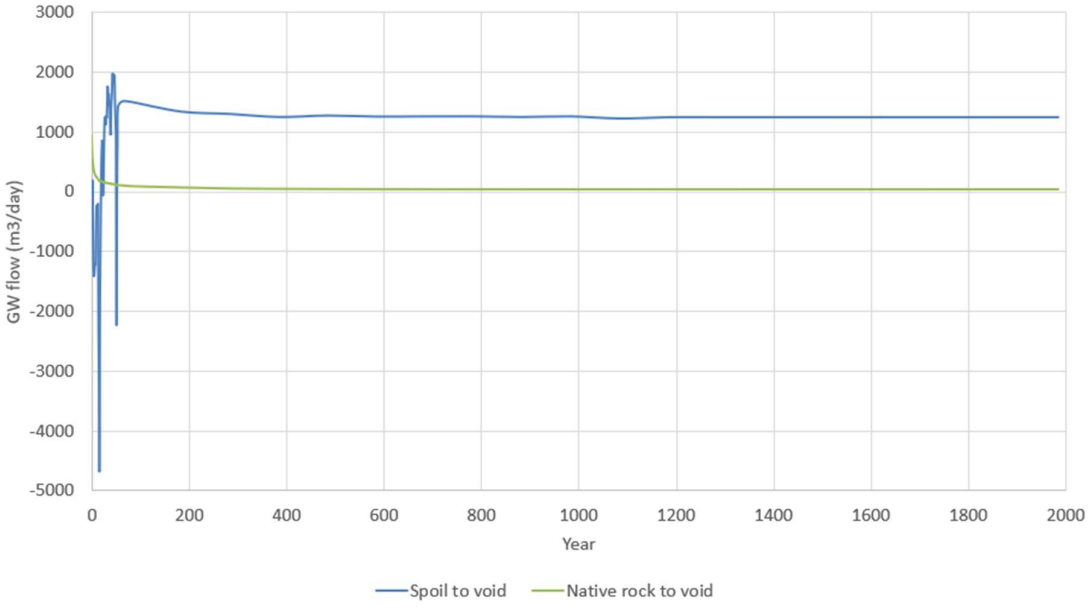


Figure 6-15 Post mining Groundwater inflows to Stewarton North

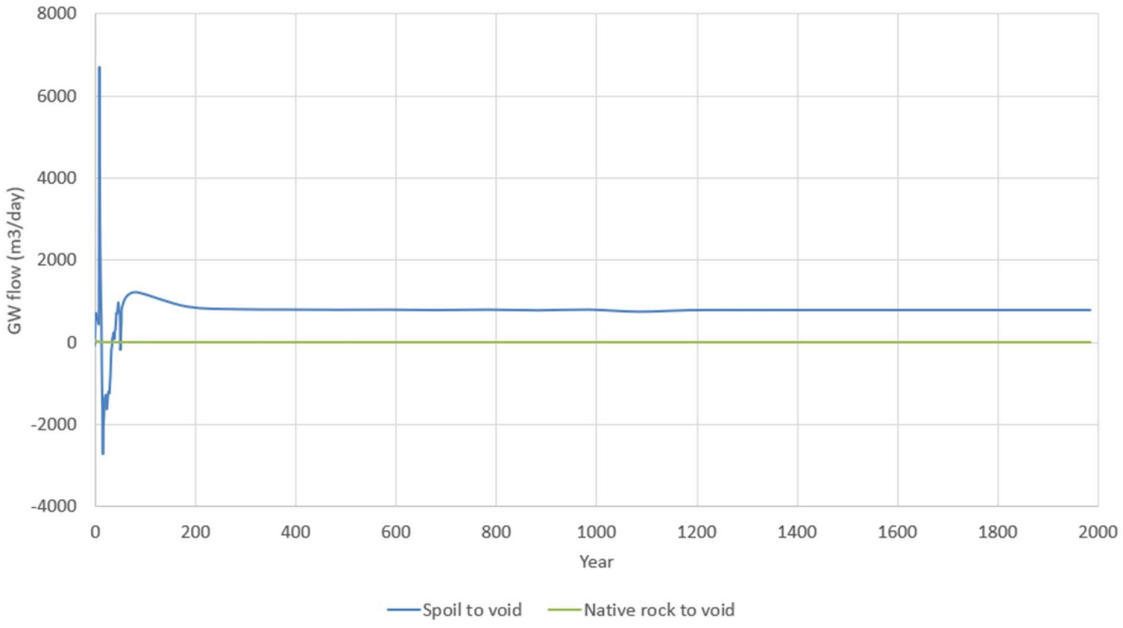


Figure 6-16 Post mining Groundwater inflows to Deep Creek

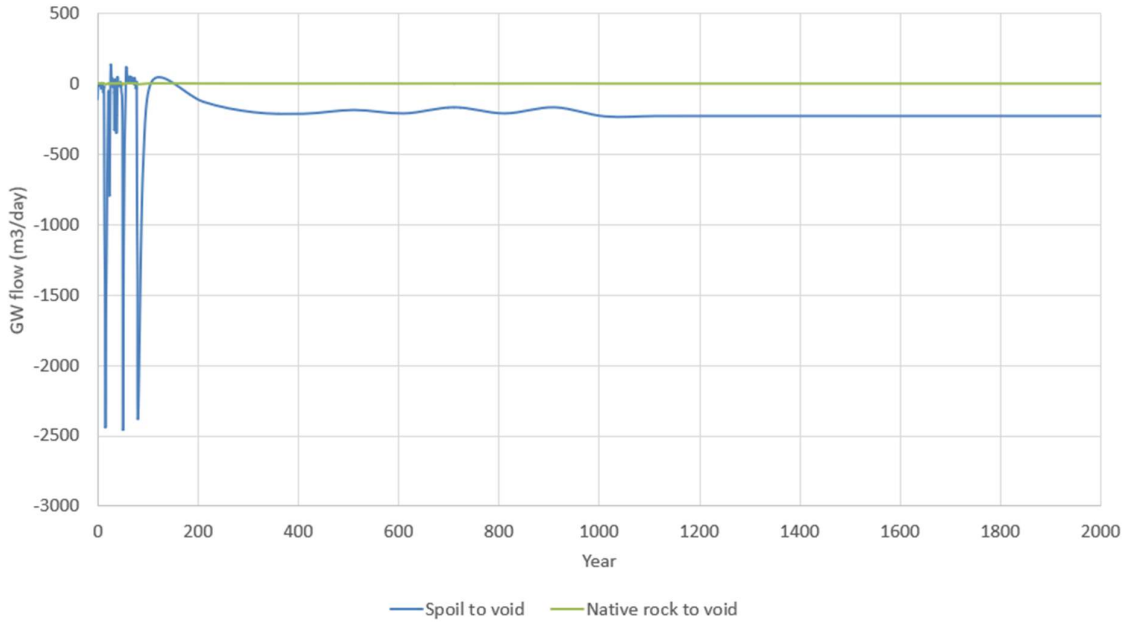


Figure 6-17 Post mining Groundwater inflows to R30

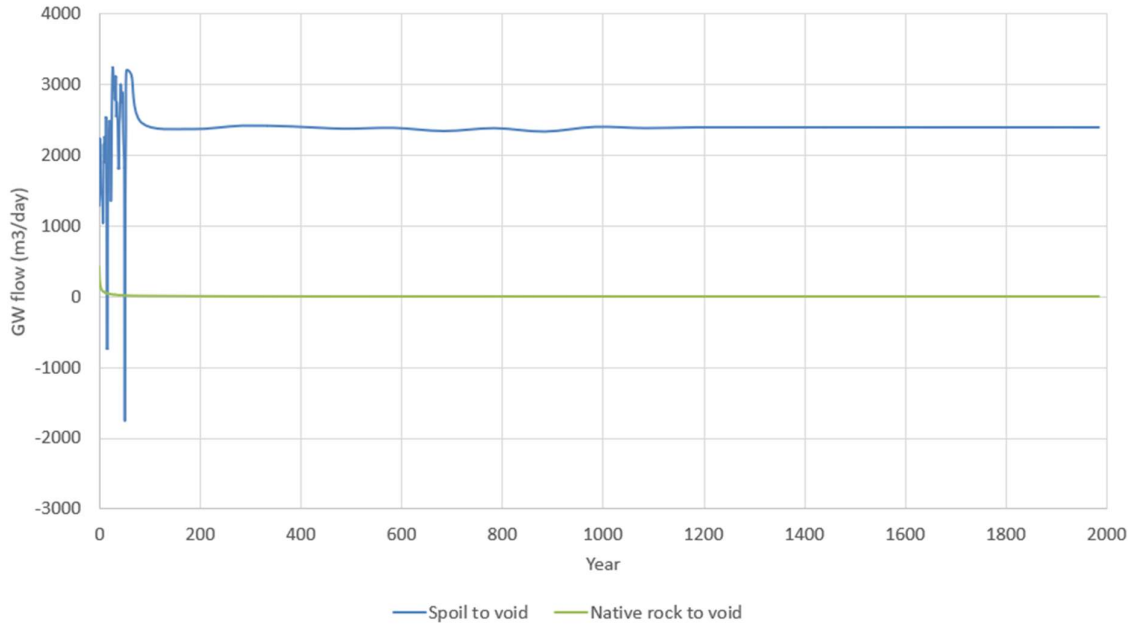
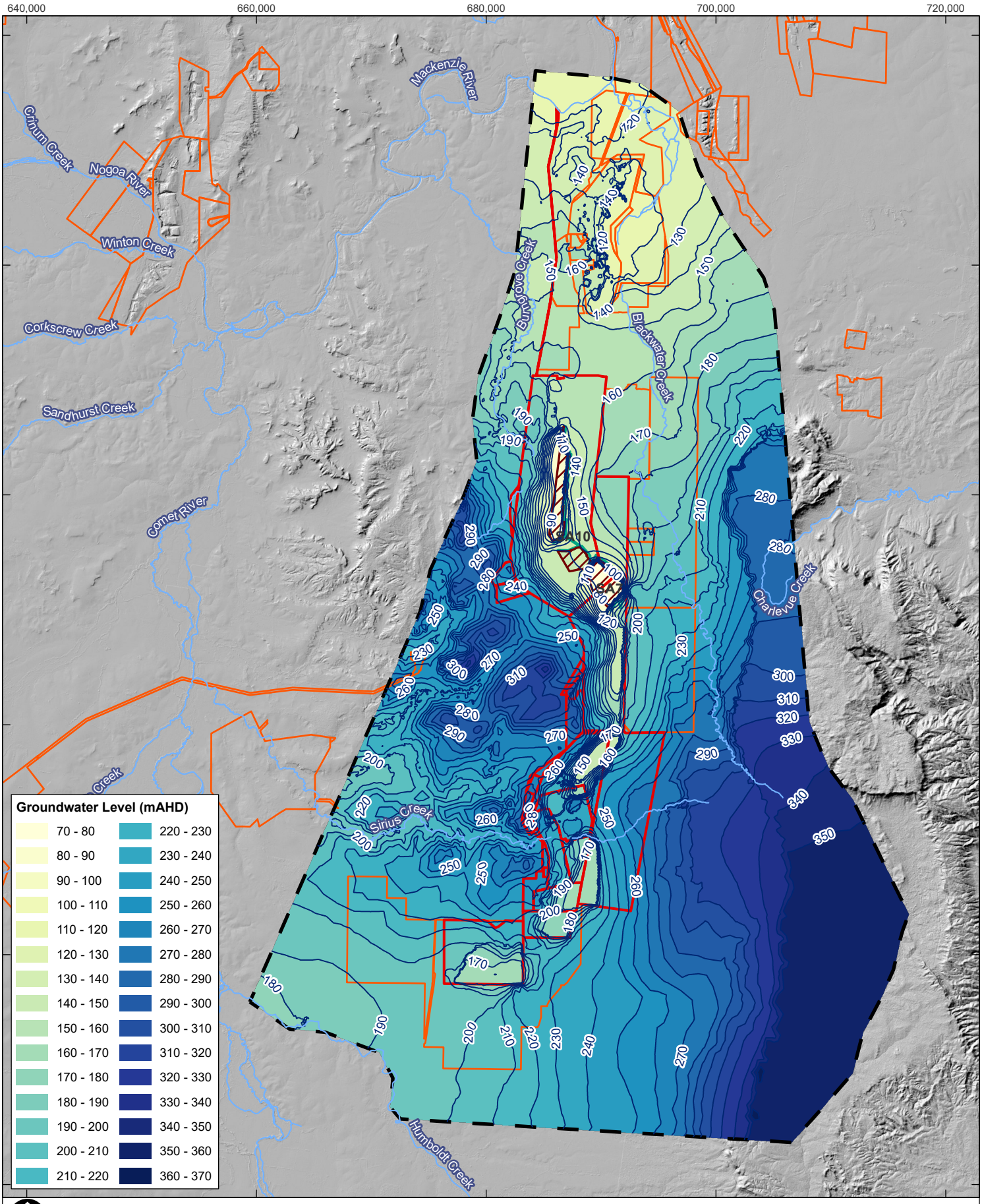


Figure 6-18 Post mining Groundwater inflows to Mimosa Besgrove


640,000
660,000
680,000
700,000
720,000
7,420,000
7,400,000
7,380,000
7,360,000
7,340,000
7,320,000
Mackenzie River
Crnhum Creek
Nogoa River
Winton Creek
Corkscrew Creek
Sandhurst Creek
Comet River
Creek
Sirius Creek
Humboldt Creek
Bungrove Creek
Blackwater Creek
Charlevue Creek
Groundwater Level (mAHD)
70 - 80
80 - 90
90 - 100
100 - 110
110 - 120
120 - 130
130 - 140
140 - 150
150 - 160
160 - 170
170 - 180
180 - 190
190 - 200
200 - 210
210 - 220
220 - 230
230 - 240
240 - 250
250 - 260
260 - 270
270 - 280
280 - 290
290 - 300
300 - 310
310 - 320
320 - 330
330 - 340
340 - 350
350 - 360
360 - 370
0
5
10
km
LEGEND
Groundwater Level Contour (m)
Watercourse
BWM Mining Lease
Mining Lease
GIA Study Area
Proposed Open Cut Extension
Proposed Infrastructure Area
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:433,846 at A4
Project Number: 640.031809.00001
Date Drawn: 16-Feb-2026
Drawn by: RB
BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT
GROUNDWATER TABLE RECOVERY
(POST-MINING)
SLR
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FIGURE 6-19
Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_08_Groundwater Table Recovery (post-mining)

6.7.4 Flow Path Simulation

An analysis of the water movement within the final landform was undertaken to simulate and assess the movement and fate of water particles through the groundwater system post-mining. A number of particles were placed on the final landform and within the residual voids in the recovery groundwater model and the mod-PATH3DU code (S.S. Papadopulos & Associates, Inc., 2018) was used to simulate particle pathways along the groundwater flow field during recovery (i.e., 1,947 years). To run the mod-PATH3DU code the transient head outputs from the groundwater flow model were used by mod-PATH3DU to simulate particle flow path lines.

The particles were placed on the final landform (Landform 4.1) and within the residual voids (**Figure 6-20**), at the surface of the model (with the exception of particles placed within the underground mine workings adjacent to Laleham). Particles placed at the surface of the model are automatically moved to the shallowest saturated layer at the commencement of the simulation. Mod-PATH3DU was configured to release the particles at the midpoint between the base of the first saturated layer and the water table. As shown on **Figure 6-20** for many of the particles this represents the Permian layers (including areas of spoil backfill in model layers that represent Permian units pre-mining) as the shallow layers (Layers 1 and 2) are unsaturated across much of the BWM Area at the commencement of the post-mining simulation. The particles placed in the underground mines were configured to begin their simulation in the Pollux seam (Layer 12) to simulate the fate of water beginning in the flooded underground workings after mine closure.

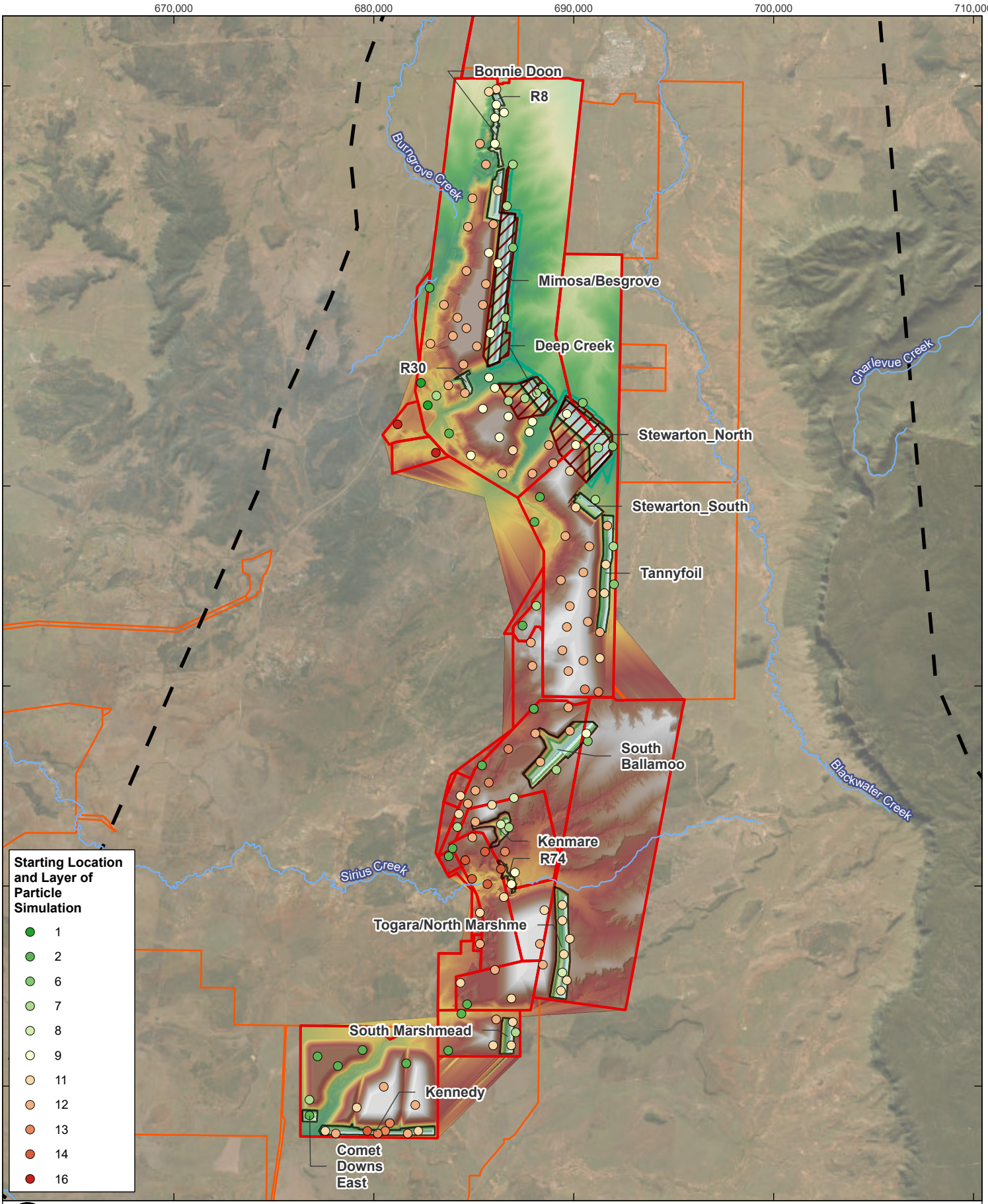
To estimate flow paths from the end of mining until post mining equilibrium, particles were released at the start of the post mining period (year 2093) and tracked until the end of the post mining simulation period (year 4040). **Figure 6-21** shows the predicted movement of water particles in the 1,947-year post mining simulation. The colours along the predicted particle flow paths provide the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallow to deep model layers.

The colour changes along the paths on **Figure 6-21** indicate that particles situated within the shallower saturated layers at the beginning of the post-mining simulation generally move progressively toward deeper layers representing the Permian coal measures (or backfilled spoil where the coal measures has been mined out) over the post-mining period. However, particles that begin in the Pollux seam (Layer 12) and other deeper layers often are observed to move upwards to shallower layers over the course of the recovery simulation, as the saturated water levels in the spoil and aquifers adjacent to the residual voids recover to their long-term post-mining equilibrium state. The flow path analysis indicates the particles generally move toward the void lakes, with the majority of the particles captured in the voids.

As discussed in **Section 6.7**, in the vicinity of the Project, both Stewarton South and Ramp 30 voids are showing a negative net inflow. However, particle tracking indicates that fluxes from these voids do not flow to the regional groundwater and instead flow toward neighbouring voids. As shown on **Figure 6-21**:

- Particles released into Stewarton South are captured by Stewarton North; and
- Particles released into Ramp 30 are captured by Mimosa/Besgrove.

As shown on **Figure 6-21**, no particles are predicted to permanently remain outside of the mine lease in the post mining simulation.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	17-Feb-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- GIA Study Area
- Void Extent
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Final Landform Elevation (mAHD)

450

-5

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

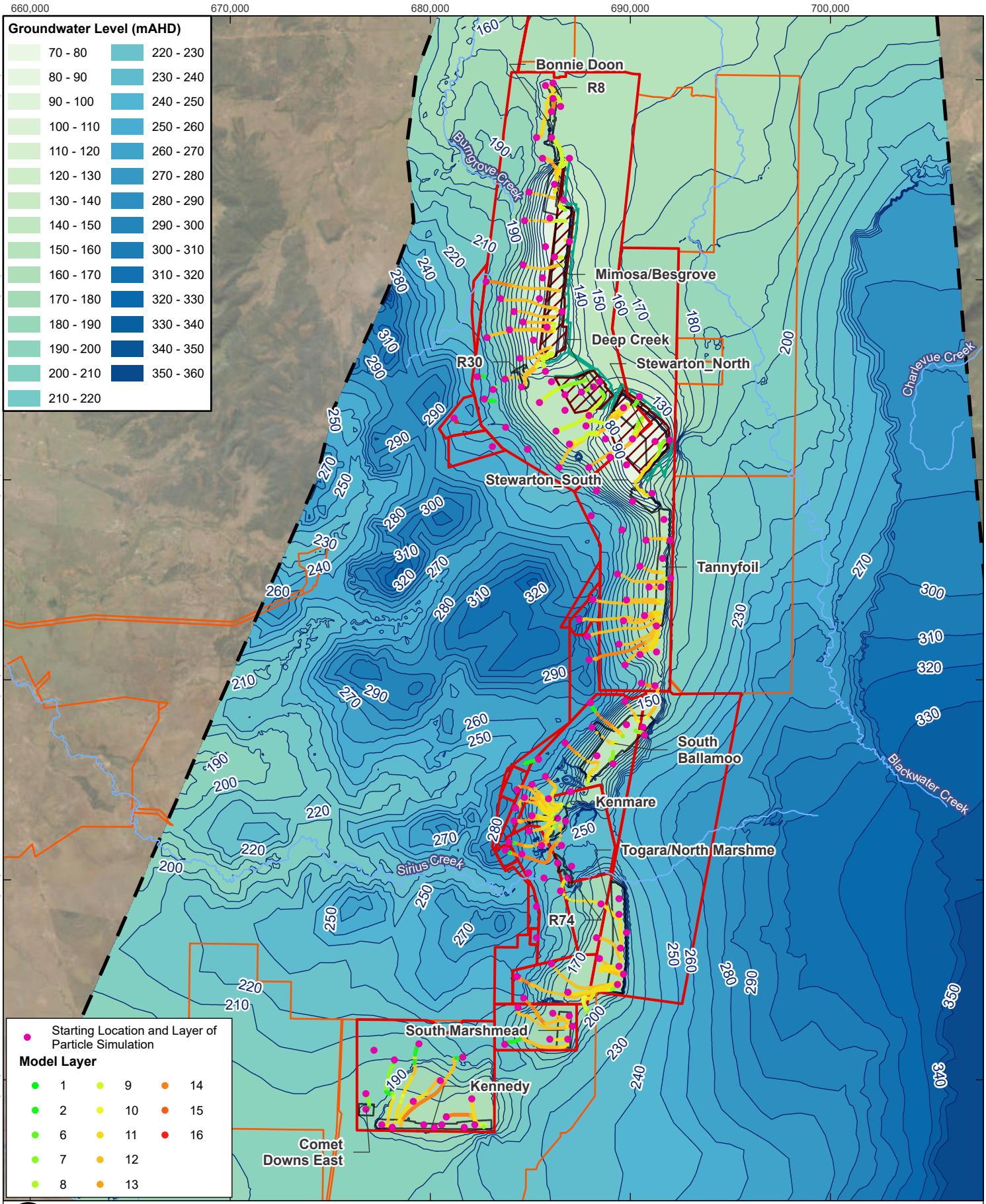
STARTING LOCATION OF PARTICLES

SLR

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FIGURE 6-20

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_09_Particle Starting Location



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	17-Feb-2026
Drawn by:	AS

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

PREDICTED MOVEMENT OF PARTICLES – POST MINING (2093 – 4040)

SLR

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FIGURE 6-21

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_10_Predicted Movement of Particles

6.7.5 Long-term Water Quality

As presented in the previous section, of the five voids near the Project Area, three are predicted to become long-term sinks, and the other two are predicted to be flow through systems reporting to those long-term sinks.

Water within the final voids would evaporate from the final void water body surface and draw in groundwater from the surrounding strata, the two flow-through voids and runoff from the final void catchment areas. As the final voids would act as a sink, evaporation from the final void water bodies would overtime concentrate salts in the final void water bodies. However, the gradual increase in salinity of the final void water bodies is unlikely to pose a risk to the surrounding groundwater regime, as the final voids would remain as a groundwater sink in perpetuity.

Notwithstanding, the Site Water Balance Assessment prepared by Hydrobalance (2026) for the Project has modelled the equilibrated water levels as well as the potential accumulation of salt in the final void. The salinity of Ramp 30 and Stewarton South fluctuates over time, with peak values of 5,000 µS/cm and 10,000 µS/cm, respectively, over the 1,000-year simulation. In contrast, salinity at Deep Creek, Stewarton North and Mimosa/Besgrove increases over time, reaching approximately 180,000 µS/cm, 195,000 µS/cm and 250,000 µS/cm, respectively, over the same period.

6.8 Sensitivity Analysis

As part of this assessment, a calibration sensitivity, calibration identifiability and prediction identifiability were undertaken. The sensitivity analysis suggest that most parameters in the model are adequately constrained by the calibration process. It also highlighted several parameters that contribute to predictive uncertainty and that are likely to be poorly conditioned by the calibration process (Type IV parameters). Details are presented in **Appendix B** (Groundwater Modelling Technical Report).

6.9 Uncertainty Analysis

A Type 3 Monte Carlo uncertainty analysis was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis.

A total of 75 calibrated realisations were selected from the last iteration and regarded as sufficient. The predictions included in the uncertainty analysis were:

- Maximum drawdown.
- Predicted open cut mine inflow.
- Alluvium water take.
- Change in river baseflow.

SLR conducted statistical analyses of predictive results to assess if additional realisations were likely to provide results that would significantly change reported results. SLR calculated the 95 percent confidence interval for the predictive results. It was found that additional realisations are unlikely to significantly increase or decrease the confidence intervals of predictions. This conclusion is drawn based upon the combination of two factors:

1 The rate of change per additional realisation is small.

2 The magnitudes of the confidence interval are small and well below reasonable expectation of the predictive ability of a numerical model.

The full summary of uncertainty analysis findings can be found in **Section 7**, of the **Appendix B** report.

7.0 Potential Impacts on Groundwater Resources

7.1 Highlands Groundwater Management Area

The Project does not directly intercept groundwater from Highlands Groundwater Unit 1 (Quaternary alluvium) under the Water Plan (Fitzroy Basin) 2011, meaning, all direct groundwater taken by the open cut pits for the Project is from Highlands Groundwater Unit 2 (sub-artesian aquifers).

The predicted groundwater take (i.e., inflow into the pits directly associated with mining) over time is presented in **Section 6.6.1**. The licensable take has been derived and indicates that the cumulative groundwater take would remain between 2,290 ML/year and 10,790ML/year between year 2025 and 2055, with inflows then decreasing after 2056 until end of mining. The average cumulative mine inflow rate (2025 to 2093) is 5,139 ML/year (14.1 ML/day).

7.2 Potential Impacts on Groundwater Users

7.2.1 Private Supply Bores

Chapter 3 of the Water Act 2000 provides bore drawdown threshold triggers of 2 m for unconsolidated aquifers, and 5 m for consolidated aquifers, to aid in the assessment of impacts to third party bore users. These criteria have been adopted for the assessment herein.

The impact assessment evaluated the drawdown at the two landholder bores identified within a 5 km radius of the Project area. **Table 7-1** lists the bores, location, assumed screened formation and use. The last two columns present the maximum incremental and cumulative drawdown predicted to occur at each location for the model base case.

There are no predicted incremental or cumulative drawdowns at any of the identified bores that exceed the Water Act bore trigger thresholds as a result of the Project. As shown in **Table 7-1** incremental drawdown from the Project is not predicted at either bore. A maximum cumulative drawdown of 1 m is predicted at RN207592, while none is predicted at the other bore.

Table 7-1 Drawdown Impact on Landholder Bores (Base Case Scenario)

Registered RN (ID)	Easting[1]	Northing[1]	Assumed Formation	Bore Depth (m)	Use	Maximum Incremental Drawdown (m)	Maximum Cumulative Drawdown (m)
207592	685877	7368329	Permian	36	Stock	0.0	1.0
Unregistered 10	681315	7380737	Permian	49	Not in use	0.0	0.0

1 GDA 94 z55

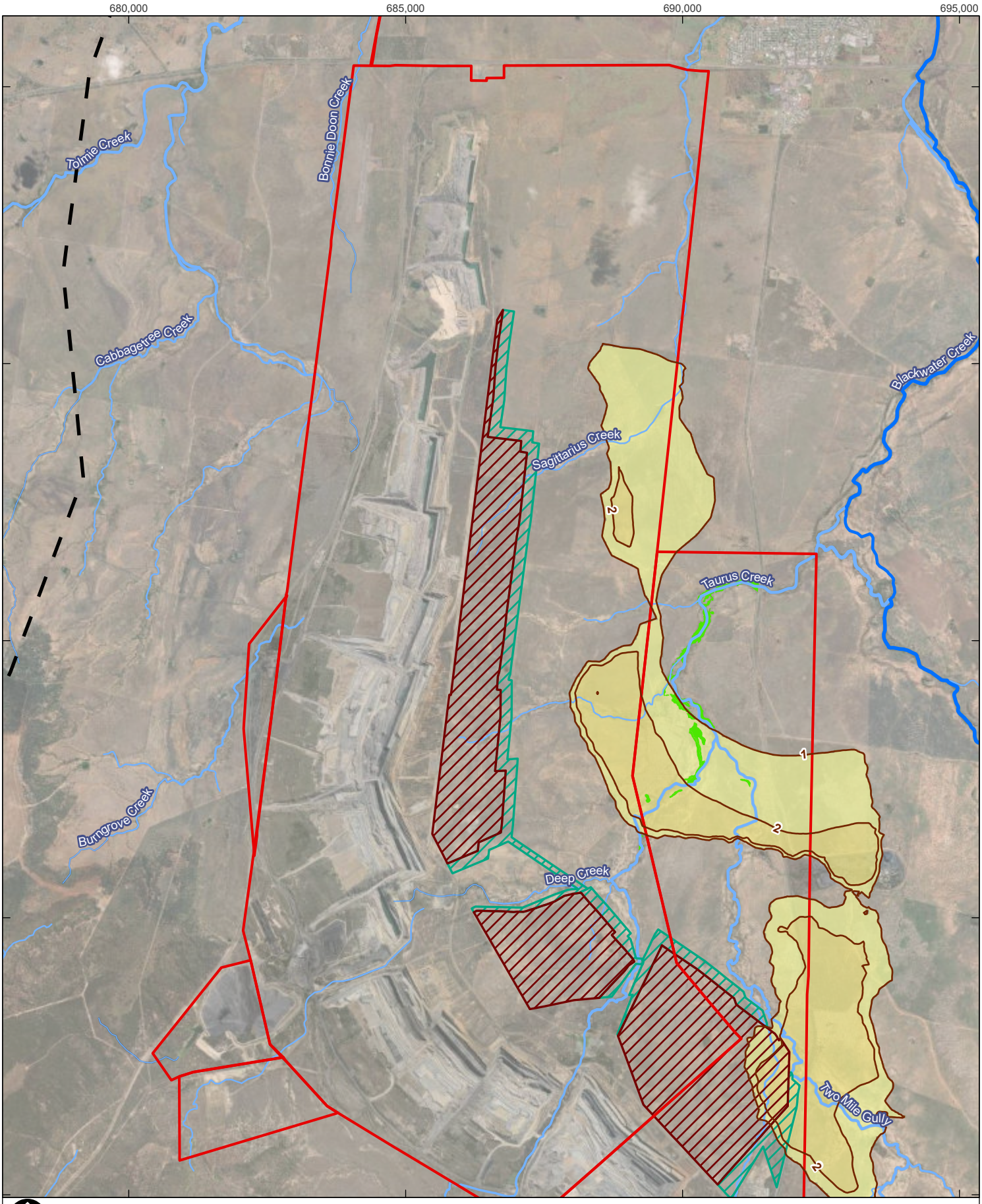
7.2.2 Groundwater Dependent Ecosystems

The presence of potential GDEs is described in detail in **Section 5.5.1**. The mapped GDEs from the most recent and comprehensive study has been utilised for this assessment (DPM Envirosciences, 2026). In summary, the ground-truthing works indicated that only the riparian terrestrial vegetation associated with Taurus Creek (a tributary of Blackwater Creek) on the eastern margin of the Project Area and a very small area along Sagittarius Creek to the north of the Project Area may represent a TGDE.

The predicted incremental drawdown in the shallow layers, Layers 1 and 2, are shown on **Figure 6-2** and **Figure 6-3**, respectively. There is no mapped incremental drawdown in Layer 1, representing the Alluvium and Tertiary in the BWM North region. The minor incremental drawdown predicted in Layer 2, the alluvium and weathered zone, has been overlain on the potential GDEs mapped in BWM North, and is shown in **Figure 7-1**. The cumulative drawdown predicted in Layer 2, the alluvium and weathered zone, has been overlain on the potential GDEs mapped in BWM North, and is shown in **Figure 7-2**.

There is some expected drawdown to occur in Layer 2, beneath a small area of the mapped GDEs. The maximum predicted drawdown is 2 meters, and given its limited extent, the overall impact to the potential GDE is expected to be minimal (and within likely natural fluctuations the vegetative species could adapt to).

Groundwater drawdown in the tertiary and deeper aquifers of the Study Area is unlikely to be of consequence to the TGDEs of the Study Area, as field surveys have demonstrated that these trees are unlikely to be accessing these regional groundwater aquifers (**Section 4.8.3**, DPM [2026]). Consequently, TGDEs of the Study Area are unlikely to be impacted by groundwater drawdown resulting from approved mining and the Project.



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Major Watercourse
- Minor Watercourse
- Potential GDE
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

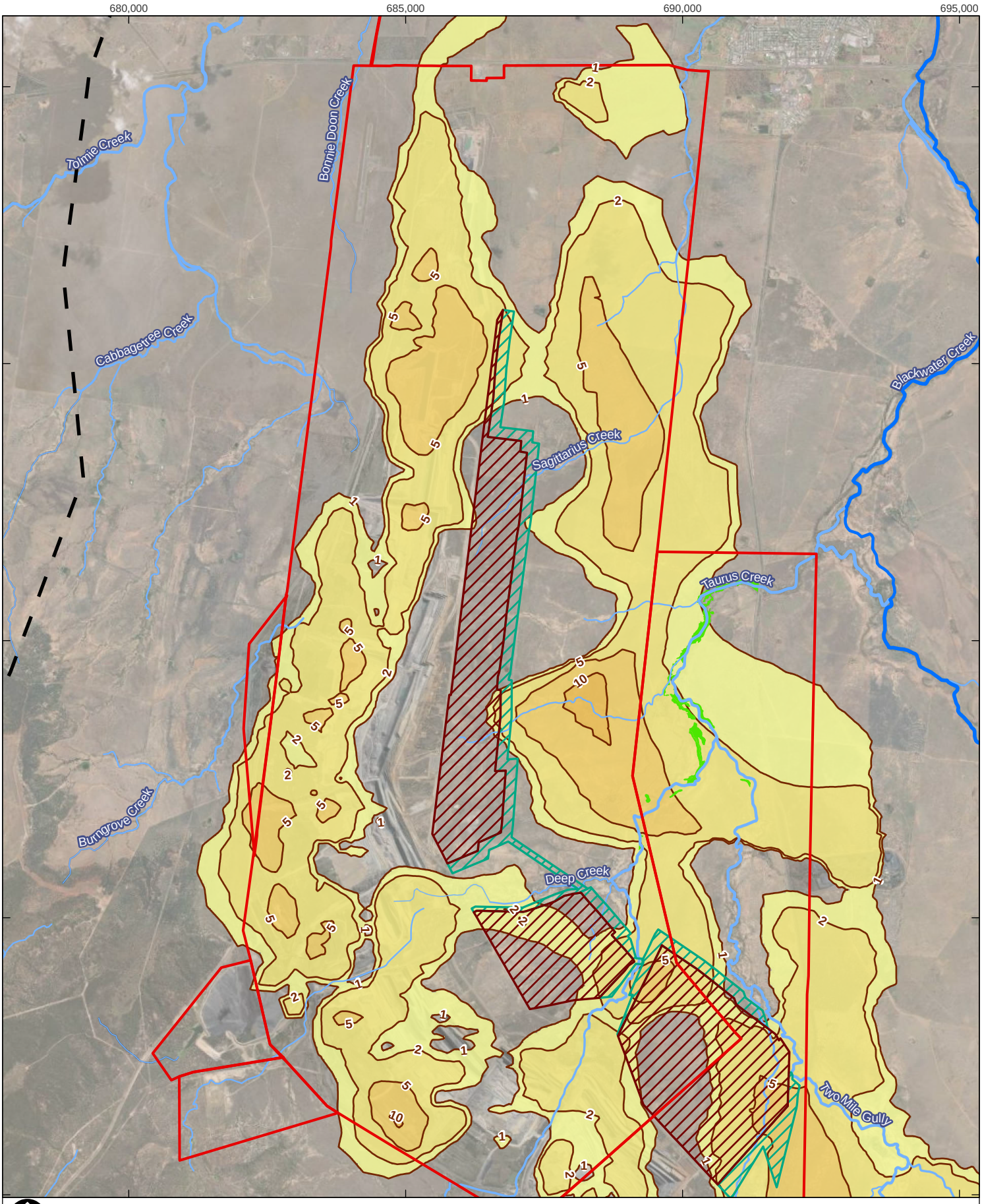
POTENTIAL GDES (BWM NORTH) AND PREDICTED INCREMENTAL DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

SLR

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FIGURE 7-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F07_01_Potential GDEs (BWM North) and predicted inc dd in the alluvium and Weathered Zone (Layer 2)



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A4
Project Number:	640.031809.00001
Date Drawn:	19-Aug-2026
Drawn by:	AS

LEGEND

- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- GIA Study Area
- Potential GDE
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

POTENTIAL GDES (BWM NORTH) AND PREDICTED CUMULATIVE DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

SLR

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FIGURE 7-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Potential GDEs (BWM North) and predicted cum dd in the alluvium and Weathered Zone (Layer 2)

7.3 Potential Impacts on Surface Drainage

The change in groundwater flow to Blackwater Creek due to the Project was calculated by comparing the river flow budgets for Blackwater Creek in the Cumulative scenario against the Approved scenario. This calculation showed that over the life of mine, the maximum incremental change of groundwater flow to Blackwater Creek is negligible (~0.001 KL/d), or 0.005% reduction to the 0.02 ML/day of net groundwater flow to Blackwater Creek. Given the Blackwater Creek is highly ephemeral, the alluvium is not contributing large amounts of water and this reduction due to the Project is deemed insignificant.

7.4 Potential Impacts on Groundwater Quality

This section describes the potential sources and pathways of groundwater contamination associated with the Project.

7.4.1 In Pit Waste Rock Emplacement Areas

The Project would involve progressively rehabilitating the site via backfilling the open cut pit, creating in-pit waste rock emplacement areas, as space becomes available.

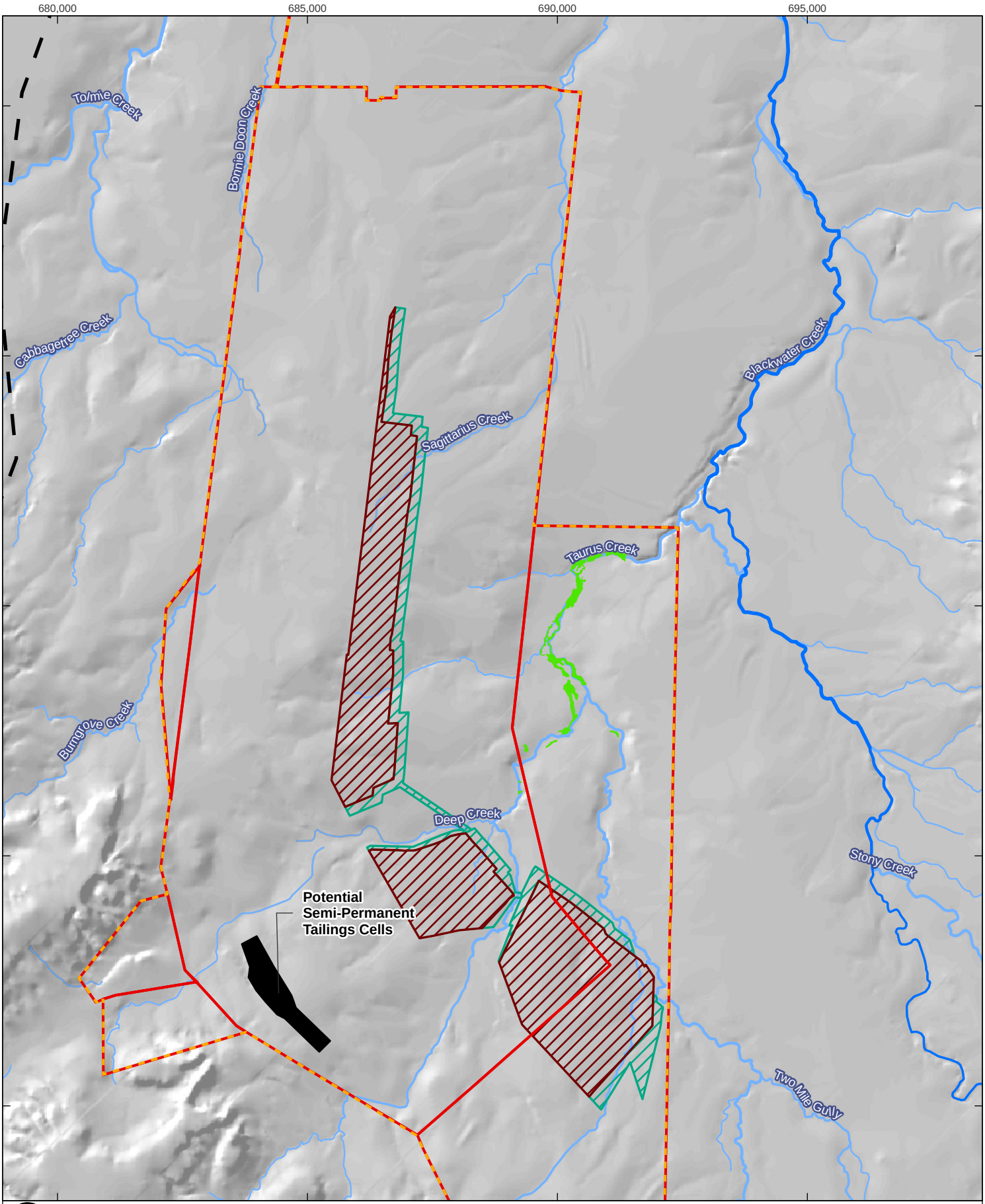
Overburden emplacement will occur within mined voids that function as hydraulic sinks during operations. Local groundwater gradients remain directed toward the pit area, limiting the potential for outward migration of any seepage generated within emplacement areas. In addition, emplacement materials will be managed in accordance with the Project's waste characterisation and water management controls. As a result, the likelihood of mine-affected water migrating from in-pit waste rock emplacement areas to shallow Quaternary alluvial and Rewan Group aquifers is considered negligible

7.4.2 Semi-permanent Tailings Cells

The semi-permanent tailings cells would be located within the original pit development and used for the disposal of fine rejects during operations. **Figure 7-3** shows the potential location of the semi-permanent tailings cells. As active pit dewatering would occur during operations, any seepage from the tailings cells would report to the excavated pits and be managed through the existing site water management system. Following closure, the pit lakes would continue to act as hydraulic sinks, capturing any seepage from the tailings cells. Particle tracking confirmed that there would be no flux out from the voids (see **Section 6.7.4**).

Accordingly, no sustained off-site contaminant transport pathway has been identified because:

- seepage from the semi-permanent tailings cells would be captured by the excavated pits during operations and by the pit lakes post closure;
- the shallow alluvial systems are discontinuous and often absent beneath the facility footprint;
- an unsaturated zone exists between operational facilities and any potential perched groundwater; and
- there is no demonstrated hydraulic connection between the perched alluvial groundwater and deeper regional aquifers.



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	23-Sep-2026
Drawn by:	AS

LEGEND

- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Potential Semi-Permanent Tailings Cells
- Potential GDE

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

POTENTIAL LOCATION OF SEMI-PERMANENT TAILINGS CELLS

SLR

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FIGURE 7-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Potential Location of Semi-Permnant Tailings Cells

7.4.3 Final Void

There are five proposed final voids in the vicinity of the Project area to remain post-closure. The predicted final groundwater water levels are presented in **Figure 6-19**. As discussed in **Section 6.7**, in the vicinity of the Project, both Stewarton South and Ramp 30 voids are showing a negative net inflow. However as demonstrated in **Section 6.7.4**, any outwards flux is recaptured by the voids in the long-term post-mining due to the hydraulic gradient between adjacent voids.

7.4.4 Workshops and Storage

All workshop and fuel/chemical storage areas at BWM are developed in accordance with current Australian Standards. This includes refuelling areas and chemical storage areas designed with adequate bunding and equipped for immediate spill clean-up. These controls represent standard practice and a legislated requirement at mining operations for preventing the contamination of the groundwater regime. Therefore, there is considered to be limited potential for groundwater contamination to occur with relation to workshops and fuel/chemical storage.

7.5 Climate Change

The climate impact was implicitly included during the Uncertainty Analysis (refer to **Appendix B**). The changes in recharge for the UA model runs are believed to represent variable climatic conditions, including extreme conditions as well as expected climate change conditions.

The final void assessment conducted by Hydrobalance (2026), utilised climate data for projections selected according to the following climate sensitivity and climate change model composites:

- climate warming sensitivity assumed to fall in the medium category; and
- the representative future climate cluster was selected as HP, which represents a high level of global warming.

Under projected climatic conditions, the final void lakes will remain as sinks.

7.6 Key Receptor Risk Assessment

A risk assessment matrix has been developed to summarise the potential risks on key receptors arising from the Project's groundwater impacts discussed in the previous report sections. For each of the key groundwater related risks identified, the following were considered and recorded as part of the risk assessment:

- Brief description of the risk.
- Likely cause.
- Potential consequence.
- Potential likelihood.
- Risk rating and rank.

To undertake the risk assessment, it is useful to define (in a descriptive sense) the various levels of consequence of a particular event and the likelihood of such an event occurring. Descriptions of the categories that were used to rank the consequence and the likelihood of a risk are provided in **Table 7-2** and **Table 7-4** respectively.



The level of risk for each potential impact was determined by combining consequences defined in **Table 7-2** with likelihood as defined in **Table 7-3**. The numerical modelling uncertainty analysis discussed in SLR (2026) (**Appendix B**) allows quantification of the likelihood of a particular impact occurring. The resulting risk analysis matrix (combining consequence and likelihood) is presented in **Table 7-5**.

Table 7-2 Consequence Assessment

Rating		Description
5	Severe	Environmental damage or effect (permanent; >10 years)
4	High	Long term (2 to 10 years) impact
3	Moderate	Medium term (<2 years) impact
2	Low	Short term (<1 year) impact
1	Negligible	No lasting environmental damage or effect

Table 7-3 Likelihood Assessment

Likelihood	Probability	Basis of Rating
A	Highly Likely	Expected to occur
B	Likely	More likely to occur than not to occur
C	Possible	As likely to occur as not to occur
D	Unlikely	More likely to not occur than to occur
E	Highly Unlikely	Very unlikely to occur

Table 7-4 Risk Analysis Matrix

		Likelihood				
		E	D	C	B	A
Consequence	5	Insignificant	Low	High	High	High
	4	Insignificant	Low	Moderate	High	High
	3	Insignificant	Low	Moderate	Moderate	Moderate
	2	Insignificant	Low	Low	Low	Low
	1	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

Table 7-5 Risk Assessment

Potential Receptor	Risk Description	Likely cause	Potential Impact	Consequence (pre-mitigation)	Likelihood	Risk Rating
Third party bores.	Loss of supply (yield) from third party bores.	Drawdown of groundwater levels in the bore source aquifer.	Reduction in, or complete loss of, supply (yield) from third party bores.	High (4). Drawdown and therefore reduction or loss of bore yield may persist in the long term.	Highly Unlikely (E). Modelling results indicate no registered third-party water supply bores or unregistered (census) bores will be subject to incremental drawdowns exceeding the relevant *Water Act 2000* bore trigger threshold.	Insignificant
Third party bores.	Reduction in water quality at third party bores.	Release of contaminants (including salts) to the groundwater system from the Project that enter the bore source aquifer and migrate to the bore.	Bore water quality no longer suitable for the intended use.	High (4). Water quality change may persist in the long term.	Highly Unlikely (E). The modelling indicates that in the vicinity of the Project any outwards flux would be recaptured by voids. Therefore, there would be no mechanism for potential contaminants in groundwater to migrate to a third party bore.	Insignificant
Surface water systems.	Reduction in flow in surface water systems.	Drawdown of groundwater levels in the shallow groundwater system either reduces baseflow to the surface water system or increases leakage out of the surface water system.	Impact to environmental receptors reliant on flow in surface water systems.	High (4). Surface flow changes may persist in the long term.	Highly Unlikely (E). Modelling indicates the maximum change of groundwater flow to Blackwater Creek is negligible.	Insignificant
Surface water systems.	Reduction in water quality in	Release of contaminants (including salts) to	Surface water quality no longer suitable for	High (4). Water quality change may	Highly Unlikely (E).	Insignificant



Potential Receptor	Risk Description	Likely cause	Potential Impact	Consequence (pre-mitigation)	Likelihood	Risk Rating
	surface water systems.	the groundwater system from the Project that then enter the surface water systems.	environmental users.	persist in the long term.	The modelling indicates that in the vicinity of the Project any outwards flux would be recaptured by voids.	
TGDEs	Loss of groundwater availability to TGDEs.	Drawdown of groundwater levels in the perched groundwater system utilised by TGDEs.	Decline in health of TGDEs.	High (4). Drawdown resultant from the project may decrease water availability supporting TGDEs.	Highly Unlikely (E). Numerical modelling indicates negligible incremental drawdown in the alluvial/tertiary/weathered layers (layers 1 and 2).	Insignificant
TGDEs	Reduction in water quality used by TGDEs.	Release of contaminants (including salts) to the groundwater system from the Project that then enter the perched groundwater system utilised by TGDEs.	Decline in health of TGDEs.	High (4). Change is shallow groundwater on which TGDEs are dependent would impact health of receptor.	Highly Unlikely (E). The modelling indicates that in the vicinity of the Project any outwards flux would be recaptured by voids (not persistent in shallow groundwater systems).	Insignificant



8.0 Management and Mitigation Measures

8.1 Mitigation Measures

8.1.1 Mine Affected Water

The mine plan for the Project includes strategies to manage mine affected water for the life of the Project.

Groundwater inflows to the open cut pits during mining operations would be pumped out (along with any surface water) via in-pit sumps if the groundwater doesn't passively evaporate on the pit face or from the pit floor. The groundwater inflows would be collected and contained within the mine water management system.

Waste rock material would be emplaced in-pit as the space becomes available and will in some areas form the walls of the final voids. As outlined in **Section 6.7.4**, groundwater would not leave the mine lease permanently with the final voids anticipated to act as a groundwater sink, capturing water associated with in-pit rejects.

8.1.1.1 Semi-permanent Tailings Cells

Semi-permanent tailing cells would be utilised for disposal of fine rejects during operations. The use of these tailings cells would occur during operations, in which active dewatering would be occurring, consequently capturing any water seepage. The existing on site water management processes (i.e capture of pit water) would manage any water captured in the pits.

In the post closure environment, the pit lakes would remain as active sinks and would capture seepage, as confirmed by the particle tracking, indicating no flux out from the voids (see **Section 6.7.4**).

8.1.2 Groundwater Users

The potential impacts on groundwater users (privately-owned bores) are described in **Section 7.2.1**. The incremental drawdown at privately-owned bores is not predicted to exceed relevant bore trigger thresholds in the Chapter 3 of the Water Act, and therefore there are no existing privately-owned bores that would be impacted by the Project to a degree that may require mitigation.

If risk was identified, mitigation measures by way of 'make-good' strategies would be implemented to manage any potential consequence (i.e. reduction in yield).

8.2 Groundwater Monitoring and Management Program

Table I1 under Schedule I, Condition I5, of the current EA (effective 6 March 2026) defined 21 bores at which groundwater must be monitored and the frequency, as reproduced here as **Table 8-1**.

Although not officially included in Table I1 of the EA, bores BWM_MB125_02, BWM_MB164_01, BWM_MB172_02 and BWM_MB168_01 are included in **Table 8-1** as they are currently monitored by Whitehaven as per conditions I17 and I18 of the EA:

- Condition I17 (Bores BWM_MB125_02 and BWM_MB164_01): *"Groundwater monitoring bores must be installed upgradient and downgradient of Red Dam by 31 December 2024 for inclusion in the groundwater monitoring bore network."*

- Condition I18 (Bores BWM_MB172_02 and BWM_MB168_01): “Groundwater monitoring bores must be installed upgradient and downgradient of the NCPP Tailings Dam by 30 June 2025 for inclusion in the groundwater monitoring bore network.”

Table 8-1 Groundwater Monitoring Locations and Frequencies (EA Table I1)

Monitoring Points	Easting[1]	Northing[1]	Monitoring Frequency
BWM_MB03_01	692223	7381510	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB12_01	687961	7356102	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB15_01	686794	7347807	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB17_01	684127	7343376	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB17_02	684119	7343373	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB21	684905	7350813	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB19BWM02A	690112	7390183	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB03_02	692220	7381519	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB02_01	691791	7362760	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB18	691528	7370782	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB14_01	683797	7350477	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB14_02	683798	7350466	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB1	686514	7387022	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB19BWM01P	690024	7390277	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB19BWM27P	689070	7376739	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB20BWM03P2	686490	7387289	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB02_02	691803	7362756	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB19BWM08P	691544	7370740	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB12_02	687969	7356097	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter



Monitoring Points	Easting[1]	Northing[1]	Monitoring Frequency
BG-1	684107	7387742	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BG-2	684414	7384622	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB125_02[2]	683948	7351517	N/A
BWM_MB164_01[3]	683816	7350493	N/A
BWM_MB172_02[4]	681183	7373429	N/A
BWM_MB168_01[5]	683281	7372735	N/A

1 GDA2020 z55
2 Bore upgradient of Red Dam (as per condition I17).
3 Bore downgradient of Red Dam (as per condition I17).
4 Bore upgradient of NCPP Tailings Dam (as per condition I18).
5 Bore downgradient of NCPP Tailings Dam (as per condition I18).
N/A A monitoring frequency has not yet been designated for these bores.

The BWM monitoring network has an additional 122 monitoring bores installed, as detailed in **Section 5.1.2**. Whitehaven Coal is currently undertaking a full review of the network to establish a network suitable for long-term monitoring.

As part of the network review five new monitoring bores, and two existing bores have been proposed for inclusion into the EA monitoring network to support monitoring associated with the Project, as outlined in **Table 8-2** and **Table 8-3**, respectively.

Table 8-2 Proposed additional monitoring bores in BWM North (new bores)

Monitoring Points	Easting*	Northing*	Proposed Depth (mBGL)	Target Aquifer	Reason for Inclusion into the network
Drilling location 3	687649	7387769	120	Aries Seam	The bore is located ~1.5 km east of Bonnie Doon TSF, replacement for current EA bores adjacent the highwall.
Drilling location 4	688199	7383619	180	Aries Seam	The bore is located east of future mining.
Drilling location 5	683969	7390169	60	Burngrove Formation	The bore is located between mining footprint and third-party water supply bores also installed into the Burngrove Formation.
Drilling location 7	689329	7378809	20	First water[1]	Spatial coverage of shallow aquifer for EA purposes. Confirm depth to water table in areas identified as potentially hosting TGDEs.
Drilling location 8	690849	7374329	20	First water[1]	Spatial coverage of shallow aquifer for EA purposes. Confirm depth to water table in areas mapped as ‘alluvium’.

* GDA2020, Zone 55
[1] Bore to be installed at the depth where first groundwater is encountered during drilling



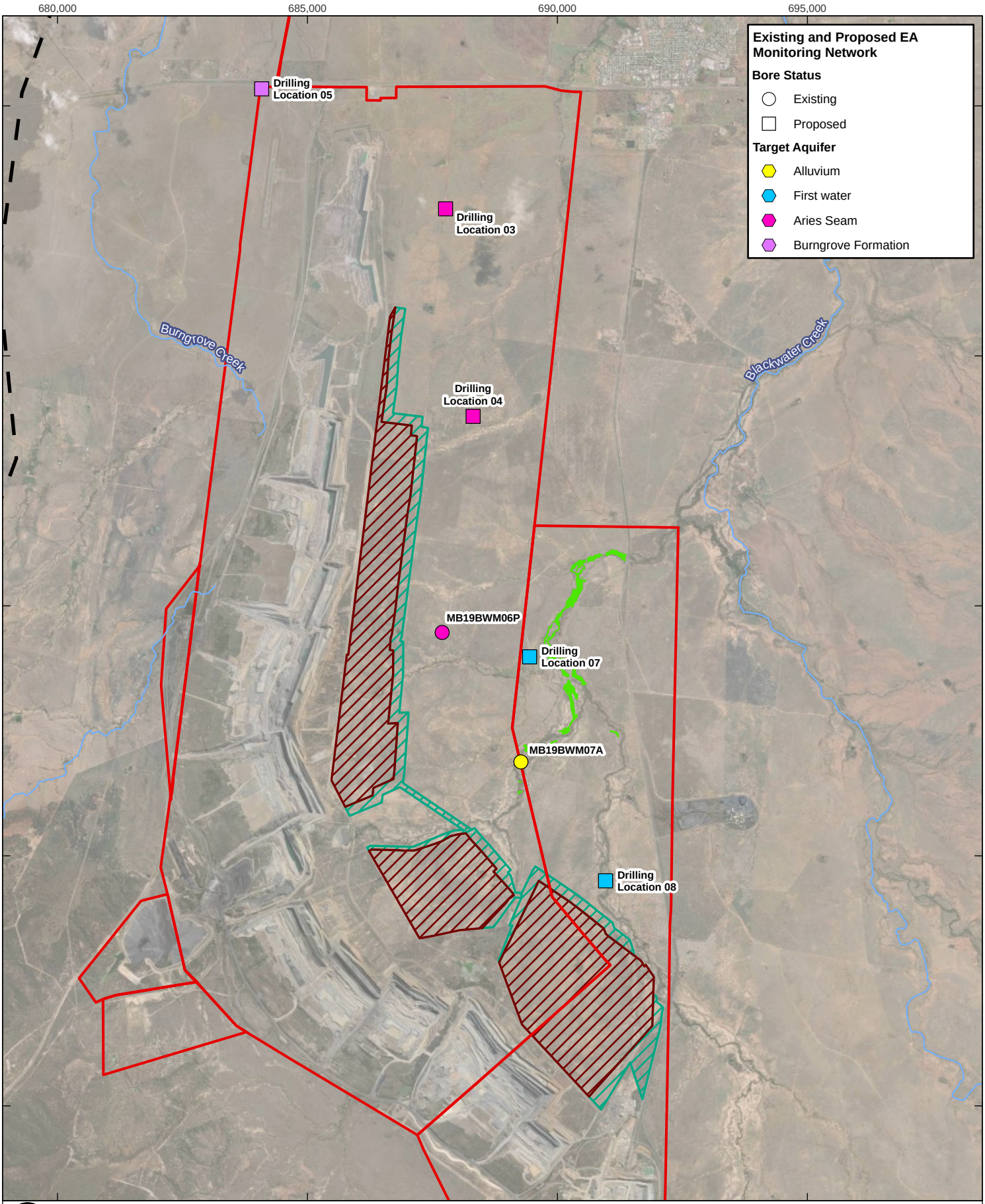
Table 8-3 Proposed additional monitoring bores in BWM North (existing bores)

Monitoring Points	Easting*	Northing*	Depth (mBGL)	Target Aquifer	Reason for Inclusion into the network
MB19BWM06P	687580	7379296	186	Aries Seam	The bore is located east of planned mining. Also provides spatial coverage in general.
MB19BWM07A	689156	7376707	7	Alluvium	The bore is located on an area identified as a potential terrestrial GDE.

* GDA2020, Zone 55

Collectively, inclusion of the five new bores and the two existing bores strengthen the existing EA monitoring network by improving spatial and hydrostratigraphic coverage, enhancing the ability to detect and track potential drawdown and water quality changes, providing additional data to validate groundwater model predictions, and supporting ongoing EA compliance monitoring requirements.

The location of the additional bores proposed for inclusion into the EA monitoring network are presented on **Figure 8-1**.



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	23-Sep-2026
Drawn by:	AS

Rev3

Watercourse
BWM Mining Lease
GIA Study Area
Proposed Open Cut Extension
Proposed Infrastructure Area
Potential GDE

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

PROPOSED ADDITIONAL MONITORING BORES FOR PROJECT

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 8-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Proposed additional monitoring bores for Project1

A Groundwater Monitoring and Management Program (GMMP) (WSP, 2024) exists for BWM. The purpose of the GMMP is to monitor the magnitude and distribution of actual changes to groundwater resources due to existing operations at BWM and to provide early detection of any unforeseen impacts to groundwater levels or groundwater quality. The GMMP reports the groundwater trigger levels (as per the EA) and defines the exceedance procedures, replicated here in **Figure 8-2**.

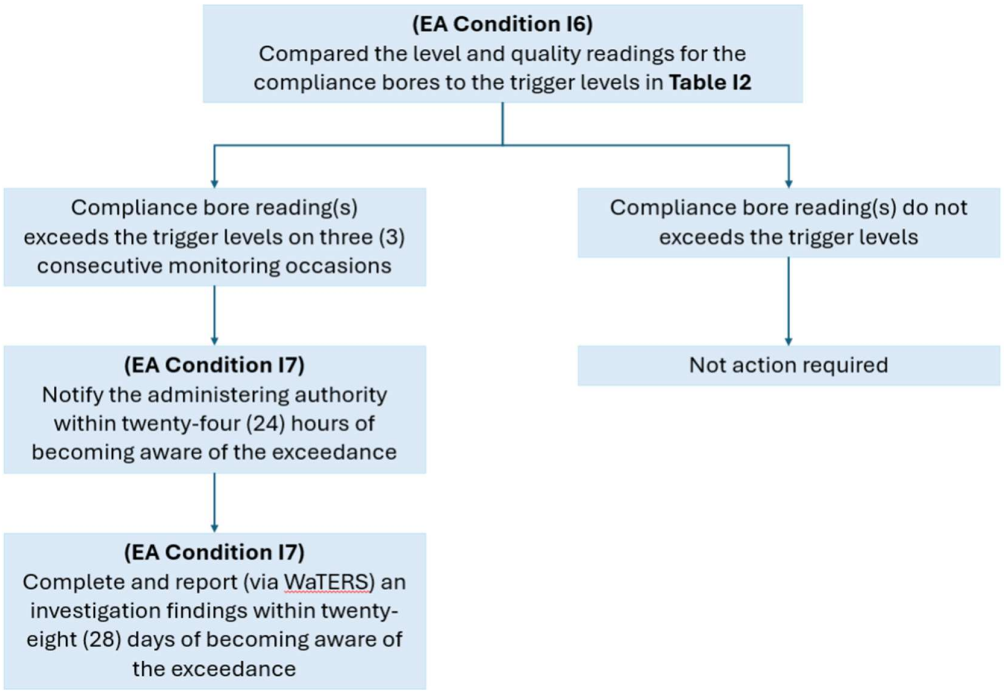


Figure 8-2 Exceedance procedure summary, as per conditions I6 and I7 of the EA (WSP, 2024)

The current GMMP "Whitehaven Coal Groundwater Monitoring and Management Program 2024" was reviewed by SLR (2025b) and is currently being updated.

During the life of the Project, data collected through the GMMP would be used to review and, if deemed necessary, update and refine the Project groundwater model and its impact predictions, to reflect the actual activities undertaken on site (e.g. mine development) and the results of regular groundwater monitoring.

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Appendix A- 80th Percentile Summary Statistics and Comparison to Guideline Values (BWM EA Bores)

Blackwater North Extension Project

Groundwater Impact Assessment

Whitehaven Blackwater Pty Ltd
SLR Project No.: 640.031809.00001

7 October 2026

Appendix A - 80th Percentile Summary Statistics and Comparison to Guideline Values

WQO Zone	Monitored Unit	Bore	pH (20th)	pH (80th)	TDS	EC	Ca	Cl	Na	Mg	SO4	Hardness as CaCO3	Alkalinity as CaCO3	HCO3	Nitrate as N	SiO2	Fluoride	Al (Diss)	Be (Diss)	B (Diss)	Cd (Diss)	Cr (Diss)	Co (Diss)	Cu (Diss)	Fe (Diss)	Pb (Diss)	Li (Diss)	Mn (Diss)	Hg (Diss)	Mo (Diss)	Ni (Diss)	Se (Diss)	Ag (Diss)	As (Diss)	U (Diss)	V (Diss)	Zn (Diss)
Units			-	-	mg/L	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Australian Drinking Water Guidelines (Aesthetic) (NHMRC, NRMMC, 2011)			6.5	8.5	600	-	-	250	180	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	1	0.3	-	-	0.1	-	-	-	-	-	-	-	3
Australian Drinking Water Guidelines (Health) (NHMRC, NRMMC, 2011)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	0.06	4	0.002	0.05	-	2	-	0.01	-	0.5	0.001	0.05	0.02	0.01	0.1	0.01	0.02	-	-
Aquatic Ecosystem (95% Protection) (ANZG, 2018)			6.5	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	0.055	-	-	0.0002	0.001	-	0.0014	-	0.0034	-	1.9	0.0006	-	0.011	0.005	0.05	0.024	-	-	0.008
Irrigation (Fitzroy Basin WQO)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	5	0.1	0.5	0.01	0.1	0.05	0.2	0.2	2	2.5	0.2	0.002	0.01	0.2	0.02	-	0.1	0.01	0.1	2
Stock (Fitzroy basin WQO)			-	-	5000	-	-	-	-	-	-	-	-	-	-	-	2	5	-	5	0.01	1	1	1	-	0.1	-	-	0.002	0.15	1	0.02	-	0.5	0.2	-	20
Zone 35 Shallow Groundwater (<30m)			7.59	7.93	-	1983	81	392	256	58	25	430	556	646	9.6	72	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 35 Deep Groundwater (>30m)			7.37	8.01	-	13604	366	5368	2555	226	122	1905	311	376	0.5	76	0.5	-	-	-	-	-	-	0.01	0.047	-	-	2.495	-	-	-	-	-	-	-	0.27
Zone 36 Shallow Groundwater (<30m)			7.7	8.35	-	7410	105	2373	1511	72	120	528	843	1021	7.5	60	0.39	-	-	-	-	-	-	-	0.02	-	-	0.07	-	-	-	-	-	-	-	-
Zone 36 Deep Groundwater (<30m)			8.21	8.66	-	7255	75	1945	1748	106	210	619	1322	1549	2.9	81	1.12	-	-	-	-	-	-	-	0.047	-	-	0.047	-	-	-	-	-	-	-	-
Zone 35 shallow	Alluvium	BWM_MB01_01	6.7	7.1	11400	21280	124.2	6005	3412	341	475		828.6	828.6	0.04		0.76	0.005	0.0005	2.04	0.0001	0.0005	0.0056	0.0016		0.0005	0.08	0.534	0.00005	0.004	0.005	0.005	0.0005	0.0014	0.0468	0.005	0.0536
Zone 35 shallow	Tertiary	BWM_MB15_01	3.1	3.2	3980	6354	14	1980	816	122	8		1	1	1.12		2.90	49.120	0.12	1.8	0.0004	0.012	0.06	0.063	0.184	0.011		0.2286	0.00005	0.0005	0.148	0.005	0.005	0.004	0.0070	0.005	0.195
Zone 35 shallow	Tertiary	BWM_MB17_02	7.2	7.3	363	570	8	60.8	118	6	10		194	194	0.01		0.7	0.011	0.00005	0.50	0.00005	0.0005	0.0005	0.0005	0.286	0.0005		0.144	0.00005	0.0024	0.006	0.005	0.005	0.002	0.0005	0.005	0.003
Zone 35 shallow	Tertiary	MB21	6.4	6.9	10300	14700	520.6	4806	2258	584	1944		573.6	574	0.01		0.20	0.010	0.0005	0.6	0.00005				3.056			0.3266	0.0001	0.001	0.004	0.01	0.001	0.002			0.017
Zone 36 shallow	Rewan Group	BWM_MB03_02	7.2	7.4		39140	1960	13000	6220	145	3							0.025		0.25					1.578			6.638	0.00025	0.0025	0.0214	0.025		0.0025			0.0241
Zone 36 shallow	Rewan Group	MB19BWM02A	6.2	6.4	29000	38000	1001.2	13500	7086	1064	511	6862	454	454	0.01	12.9	0.10	0.050	0.005	0.70	0.0005	0.005	0.005	0.031	0.368	0.005	0.14	0.103	0.00025	0.005	0.014	0.05	0.005	0.005	0.0025	0.050	0.2400
Zone 36 shallow	RCM north	BWM_MB02_01	6.668	6.7	18500	25080	608.6	8896	4076	607.4	372		346	346	0.01		0.05	0.005	0.0005	0.30	0.00005	0.0005	0.0005	0.0005	2.846	0.0005		0.597	0.00005	0.0005	0.0156	0.005	0.005	0.0025	0.0005	0.005	0.0156
Zone 36 deep	RCM north	MB1	6.55	6.8	26500	35800	756.8	12940	6886	704.4	372		368	368	0.01		0.05	0.050	0.0025	0.25	0.00025	0.0025	0.0025	0.0025	3.944	0.0025		0.144	0.0001	0.005	0.014	0.05	0.005	0.005	0.0025	0.025	0.0125
Zone 36 deep	RCM north	MB19BWM01P	6.992	9.8	16600	26000.6	243	9214	5800	138.4	7	1180	657	660	0.01	22.7	0.30	0.050	0.005	0.45	0.0004	0.004	0.004	0.005	1.548	0.004	1.21	0.121	0.0001	0.0336	0.005	0.035	0.0035	0.005	0.0013	0.050	0.072
Zone 36 deep	RCM north	MB19BWM27P	6.63	6.8	9348	14700.4	119	4440	3390	54	1	529	1896	1896	0.01	23.4	0.4	0.010	0.001	1.36	0.0002	0.001	0.007	0.0058	2.28	0.001	1.70	0.275	0.0001	0.004	0.013	0.01	0.001	0.0122	0.0005	0.010	1.292
Zone 36 deep	RCM north	MB20BWM03P2	6.89	7.0	12260	19820	167	6878	4276	104	3	957	584	584	0.01	20.8	0.4	0.005	0.0005	0.42	0.00005	0.0005	0.004	0.0164	1.288	0.0005	1.71	0.0968	0.00005	0.005	0.005	0.005	0.0005	0.0025	0.0020	0.005	0.3236
Zone 36 deep	RCM north	MB18	6.68	7.2	12160	17360	645.8	6370	2970	117	3		120	120	0.02		0.20	0.010	0.0005	0.48	0.00005	0.0005	0.0005	0.0005	2.558	0.0005		2.328	0.0001	0.001	0.009	0.01	0.001	0.001	0.007	0.0005	0.005	0.026
Zone 36 deep	RCM north	MB19BWM08P	7.446	7.6	3468	5411	33	1370	1216	6	2	109	788	799	0.01	17.8	0.50	0.010	0.001	1.56	0.0001	0.001	0.001	0.001	0.202	0.001	0.68	0.048	0.0001	0.003	0.003	0.01	0.001	0.001	0.0005	0.010	0.1216
Zone 36 deep	RCM north	BWM_MB02_02	8.08	9	10000	3420	8	715.6	704.4	6	4		17					0.008		1					0.06			0.011	0.00005	0.0268	0.0005	0.005	0.0005	0.002			0.0025
Zone 35 deep	RCM north	BWM_MB12_02	8.174	9.4		1952	14	423.8	405	6	25							0.009		0.20					0.062			0.003	0.00005	0.024	0.0005	0.005		0.004			0.0025
Zone 35 shallow	RCM south	BWM_MB14_01	6.5	6.6	13100	17780	374	5344	2784	717	1892		865.6	865.6	0.01		0.05	0.012	0.0005	0.80	0.00005	0.0005	0.002	0.0005	5.61	0.0005		1.418	0.00005	0.001	0.0192	0.005	0.0005	0.0066	0.0040	0.005	0.0158
Zone 35 deep	RCM south	BWM_MB14_02	7.6	7.7	4732	7408	7	1100	1980	8	26		2730	2856	0.01		1.8	0.014	0.0005	0.30	0.00005	0.0005	0.0007	0.0005	0.36	0.0005		0.011	0.00005	0.0005	0.001	0.005	0.0005	0.004	0.0005	0.005	0.0025
Zone 36 deep	Burngrove Formation	BG No.1 AP	7.17	7.9	4060	6950	37	1930	1504	21.6	28		670	691	0.01		0.60	0.010	0.0005	0.5	0.00005	0.0005	0.0005	0.0005	0.08	0.0005		0.017	0.0001	0.001	0.0005	0.01	0.001	0.001	0.0005	0.005	0.0060
Zone 36 deep	Burngrove Formation	BG No.2 BG	6.572	7.3	11140	17200	303.8	5238	3078	472.8	1510		875	875	0.01		0.20	0.010	0.0005	0.9	0.00005	0.0005	0.0005	0.0005	0.43	0.0005		0.195	0.0001	0.001	0.0348	0.01	0.001	0.001	0.0005	0.005	0.0025

Highlight cell indicates 80th Percentile is above criteria:

- Australian Drinking Water Guidelines (Aesthetic) (NHMRC, NRMMC, 2011)
- Australian Drinking Water Guidelines (Health) (NHMRC, NRMMC, 2011)
- Aquatic Ecosystem (95% Protection) (ANZG, 2018)
- Irrigation (Fitzroy Basin WQO)
- Stock (Fitzroy basin WQO)
- Zone 35 Shallow Groundwater (<30m)
- Zone 35 Deep Groundwater (>30m)
- Zone 36 Shallow Groundwater (<30m)
- Zone 36 Deep Groundwater (<30m)
- Multiple of above

Appendix B Groundwater Modelling Technical Report

Blackwater North Extension Project

Groundwater Impact Assessment

Whitehaven Blackwater Pty Ltd
SLR Project No.: 640.031809.00001

7 October 2026

Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

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7 October 2026

Revision: V4.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	13 February 2026	Haili Jia	Louis Bouchet	Brian Rask
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3.0	09 April 2026	Haili Jia	Brian Rask	Brian Rask
4.0	7 October 2026	Haili Jia	Brian Rask	Brian Rask

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Whitehaven Blackwater Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.



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Appendix C Predictive Period Timing
Appendix D Post-mining predicted water levels
Appendix E Parameter Distribution Plots for Sampled Prior and Calibrated Ensemble
Appendix F Sensitivity Analysis Plots
Appendix G Uncertainty in 1 m Drawdown Contours

1.0 Introduction

1.1 Background

SLR Consulting Australia Pty Ltd (SLR) was engaged by Whitehaven Blackwater Pty Ltd, a wholly owned subsidiary of Whitehaven Coal Limited to undertake a Groundwater Impact Assessment for the Blackwater North Extension Project (the Project), for incorporation into an application for an Environmental Authority (EA) Amendment and an application for an *Environment Protection and Biodiversity Conservation Act 1999* Approval.

The Project is an extension of mining into Surface Area (SA) 10 on Mining Lease (ML) 1759 and SA 7 on ML 1762 utilising existing Blackwater Mine (BWM) mining methods, mining fleet, mine infrastructure and facilities.

As part of the Groundwater Impact Assessment, a numerical groundwater model for the BWM has been developed to predict impacts of the Project on the local groundwater regime.

1.2 This Report

This report outlines the technical details of the BWM numerical groundwater model development to support the BWM groundwater assessment.

The conceptualisation provides a simplified overview of the groundwater regime (i.e., the distribution and flow of groundwater) based on available data and expert knowledge. Maintaining consistency between the numerical model results and the conceptual understanding of the groundwater regime enhances the credibility of the model's predictions. The numerical model presented in this report was developed in line with the conceptual framework described in the BWM Groundwater Assessment report (SLR, 2026).

1.3 Model Objectives

Numerical modelling was undertaken in support of the hydrogeological assessment to evaluate the potential impacts of the Project on the groundwater regime. The overall objectives of this modelling are to:

- Assess the groundwater inflow to the mine workings as a function of mine position and timing.
- Simulate the extent of maximum groundwater drawdown/depressurisation due to the Project and also with respect to cumulative impacts.
- Simulate and predict the change in groundwater levels at identified groundwater users (i.e. registered bores, landholder bores and groundwater dependent ecosystems [GDEs]) due to the Project and also with respect to cumulative impacts.
- Simulate the direct and indirect take of groundwater and surface water (baseflow) due to the Project.
- Simulate the long-term impacts in the post-mining environment utilising the proposed final landform and void lakes.



2.0 Model Construction

2.1 Model Code

MODFLOW-USG Transport was used as the model code (Panday et al. 2013). 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. MODFLOW-USG optimises the model grid and increases numerical stability by using unstructured, variably sized cells. These cells take any polygonal shape, with variable size constraints allowing for refinement in areas of interest.

Where previous MODFLOW versions restricted interlayer flow to vertical connectivity, MODFLOW-USG offers lateral connectivity between model layers. Lateral connectivity enables more accurate representations of hydrostratigraphic units, particularly those that pinch out, outcrop or cross geological faults.

MODFLOW-USG is also able to simulate unsaturated conditions, allowing progressive mine dewatering and post mining rewetting to be represented by the model. For the BWM model, vadose zone properties have been excluded, and the unsaturated zone was simulated using the upstream-weighting method.

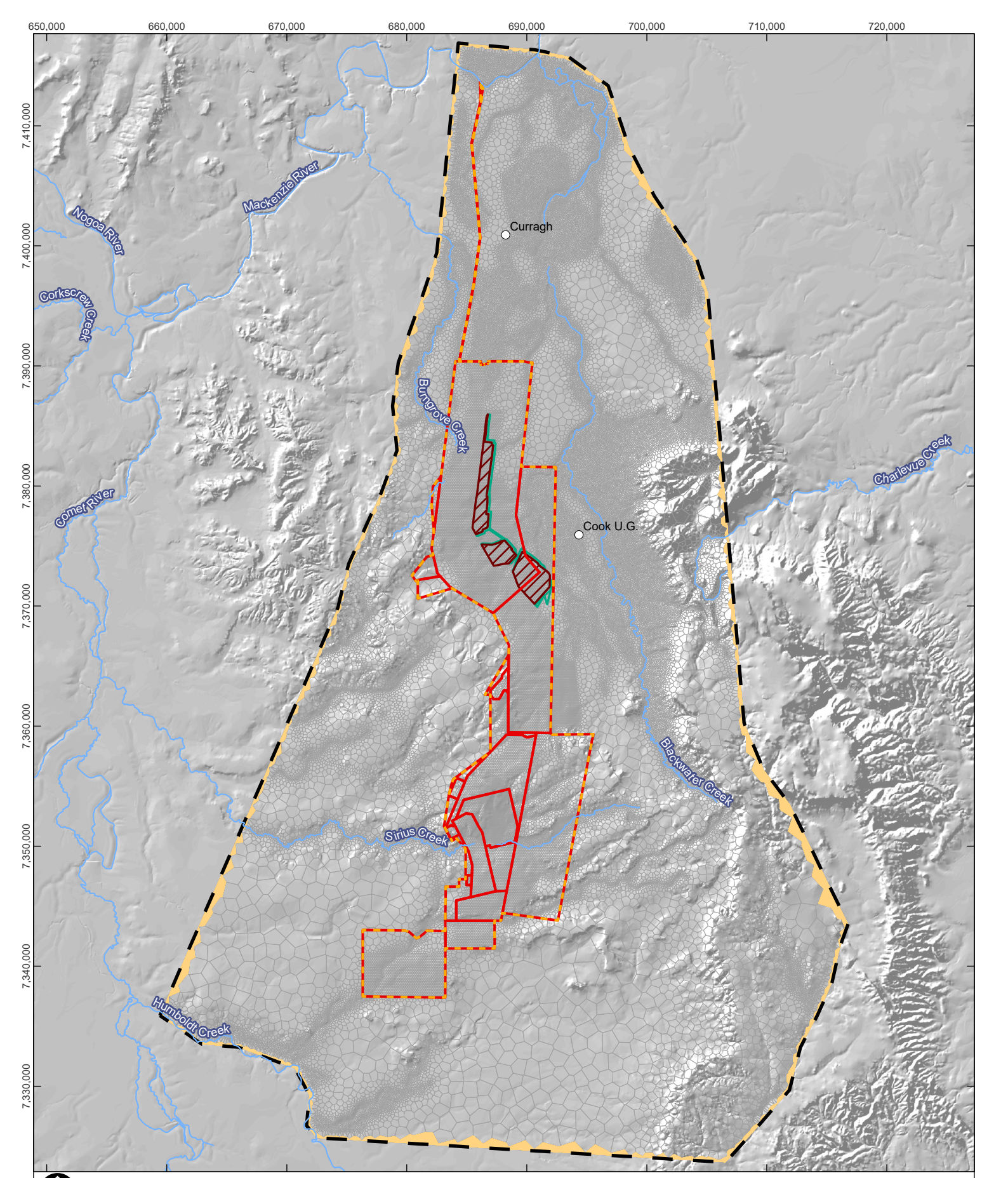
In-house Python codes and a MODFLOW-USG edition of the Groundwater Data Utilities (Watermark Numerical Computing) were used to construct the MODFLOW-USG input files.

2.2 Model Extent and Mesh Design

The model domain and mesh are presented on **Figure 2-1**. Both the northern and southern BWM geological models were adopted to set up the groundwater model layers. The model incorporates regional influences that have interacted with the local groundwater system in the past (during the calibration period) and may continue to interact with it in the future, including during the predictive mining and post-mining periods. These regional influences include operations at the Curragh Mine to the north (open cut) and underground mining at Cook Colliery to the east of BWM, both of which are considered to have a potential to interact with groundwater in the BWM area due to their proximity.

The model domain is intended to place boundary conditions sufficiently distant from the BWM site to allow the extent of potential impacts from mining activities on the groundwater system to be assessed. At its widest extents, the model is approximately 57 kilometres (km) west-east by 93 km north-south. The model domain was selected based on the following considerations:

- The western boundary is represented by the outcrop boundary of the Burngrove Formation, which underlies the Rangal Coal Measures (RCM) and is considered the basement formation for the purpose of this modelling.
- The northern boundary extends to include the open cut Curragh Mine and is 25 km north of the Project area.
- The southern boundary is set approximately 12 km south of the BWM site and is expected to be far outside the range of predicted BWM related drawdown.
- The eastern boundary is set along the Shotover fault which is located approximately 20 km to the east of the Project area. This boundary is expected to be far outside the range of predicted Project related drawdown.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Coal Mine
- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Model Grid
- General Head Boundary
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

MODEL MESH AND BOUNDARY CONDITIONS

SLR

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FIGURE 2-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_01_Model Mesh and Boundary Conditions

To allow stable numerical modelling of the large spatial area of the model domain, an unstructured grid with varying Voronoi cell sizes was designed using Algomesh (HydroAlgorithmics Pty Ltd, 2014). Varying Voronoi cell sizes allowed refinement around areas of interest, while a coarser resolution elsewhere reduces the total cell count to a manageable size. Compared with the previous model, the current mesh includes additional refinements around the bottom dam and underground mines. The refinement scale was also adjusted to ensure a reasonable total cell count.

Vertically, the model domain was vertically discretised into 17 layers, each layer comprising a cell count of up to 64,880. The total number of cells in the model is 815,467. This is after pinching out areas in layers 3 to 15 where layers are not always present based on the mapped geology. The current model also incorporates updated geological elevation data in South Blackwater, which were largely assumed in the previous model.

The following features have been included in the grid design:

- Open cut mining for the BWM including the historical mine and proposed extension is represented with a 150 metres (m) cell size constraint.
- Open cut mining for the historical Curragh mine is represented with a 200 m cell size constraint.
- Underground mining at Cook Colliery and Laleham projects has an oriented regular grid of 100 m width squares to represent longwalls.
- Underground mining at Sirius Creek No. 1 and 2 (ML 1771) are represented with a 50 m cell size constraint.
- Bottom dam area is represented with a 50 m cell size constraint.
- Alluvium areas are represented with a 200 m cell size constraint.
- Rivers, including major rivers and minor creeks and drains, are represented with a 100 m cell size constraint.
- The northwest-southeast striking faults within the model domain are represented with a 200 m cell size constraint.

2.3 Model Layers

The topography within the model domain has been defined using high-resolution (1 m) Digital Elevation Model data for pre-mining surface of the BWM area. Public domain 1-second Shuttle Radar Topography Mission data was used to define the topography in the remainder of the model domain.

The model domain is discretised into 17 layers, as listed in **Table 2-1**. Model layer extents (lateral and vertical) have been defined using data from the following sources:

- BWM site geological model.
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) Regolith depth survey (Wilford et al, 2016).
- Queensland Globe bore hole logs.
- Queensland surface geology and basement geological maps.
- Office of Groundwater Impact Assessment (2019) model layers.

Layer 17 was designed as a basement layer to mitigate the risk of abnormal model behavior caused by the thin thickness of the Burngrove Formation in the western part of the model.



Table 2-1 presents the average thickness across the model domain for each layer.

Table 2-1 Model Layers and Thicknesses

Model Layer	Formation	Unit	Average Thickness (m)
1	Alluvium/Tertiary	Surface cover and Tertiary	8.5
2	Alluvium/Weathered zone	Weathered zone/Regolith	13.1
3	Clematis Group	Triassic	372.9
4	Rewan Group (Upper)	Triassic	309.4
5	Rewan Group (Middle)	Triassic	180.9
6	Rewan Group (Lower)	Triassic	114.9
7	RCM	Overburden	51.5
8		Aries seam	1.7
9		Interburden	15.2
10		Castor seam	1.7
11		Interburden	16.3
12		Pollux seam	4.2
13		Interburden	16.2
14		Orion seam	0.8
15		Underburden	17.9
16	Burngrove Formation	Permian	159.4
17	Basement	Permian and/or below	100.0

The regional site geology model (BM Alliance Coal Operations Pty Ltd, 25 m grid) provides the surfaces for tertiary and weathering zone within the BWM area. These surfaces were used to assign the bottom of layers 1 (i.e. Tertiary) and 2 (i.e. weathering) in the model. Outside the geology model extent, CSIRO Regolith survey depths (i.e. weathering depth) was used to define the base of layers 1 and 2. In doing so, the CSIRO Regolith depth was divided into two with each layer covering 50 percent (%) of total depth. Both Layers 1 and 2 are fully extensive across the model. The depth of alluvium was calculated from the site monitoring bores, drill holes, and available public Queensland Globe bore logs. Similar to weathering zone, layers 1 and 2 each cover 50% of total alluvium thickness, where present.

The underlying Rewan and Permian layers are present only to their outcrop extents, with some inference made for the presence of older units beneath the surface outcrop due to folding and faulting. The bottom of layers 3 to 16 was constructed based on the BWM geology model. Outside of the geology model extent, the surface geology map was used to define the location of outcrops of each unit. The average thicknesses were then extrapolated out into the extended model area to cover the layer outside the geology model.

As it is not practical to represent every individual coal seam in a regional groundwater model, a “combined thickness” totalling the individual seam thicknesses for each relevant seam has been simulated. The coal seams of the RCM were combined into four major coal seams: the Aries, Castor, Pollux and Orion seams.

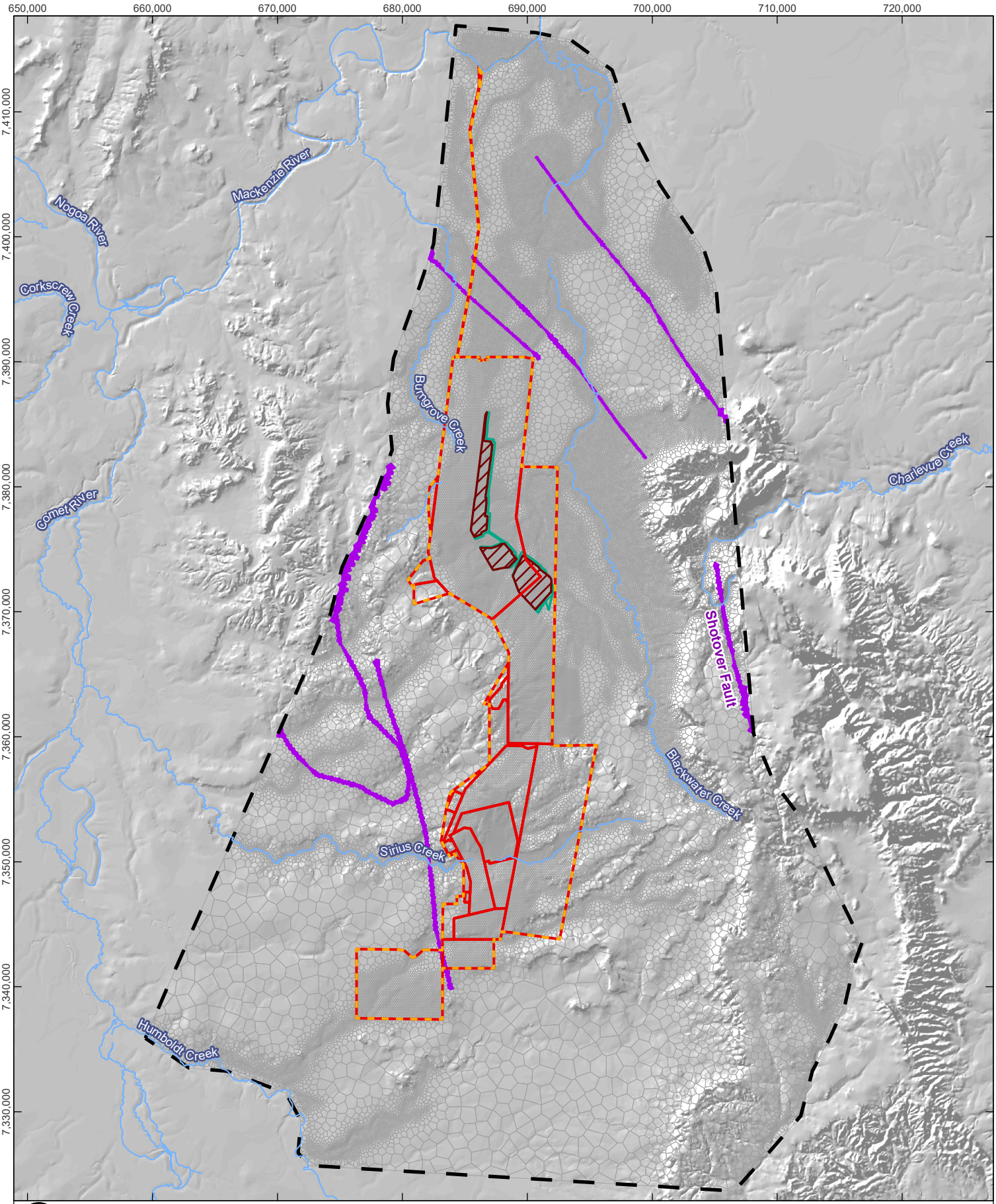
The Burngrove Formation is considered the regional low-permeability basement for the purpose of this modelling. However, due to its thin thickness in the western part of the model

and to prevent abnormal model behaviour, an extra layer, Layer 17, with a uniform thickness of 100 m, was added to define the base of the model and the western and eastern model boundaries.

2.3.1 Geological Structures

Mapped faults and geological structures in the vicinity of the Project area are shown in **Figure 2-2**. The most significant feature is the Shotover Fault, an east-dipping thrust fault with a displacement of up to 3,000 m (Mallet et al., 1988), located approximately 20 km east of the Project area and incorporated along the model's eastern boundary. Numerous smaller local faults are also mapped within the extent of the BWM and its proposed extension, with throws typically less than (<) 5 m, but reaching up to 20 m in some areas (Jeuken, 2011). These faults can fully offset coal seams and potentially act as barriers to groundwater flow, however, their hydraulic impacts are currently not well understood.

To reflect the structural complexity shown in **Figure 2-2**, the model grid was refined in areas where faults are present. While the faults were not assigned distinct hydraulic properties (e.g., reduced permeability or barrier features) due to the lack of site-specific hydrogeological data, their influence is implicitly incorporated through the layering and geometry in the refined grid. Should further data become available, the model could be updated to include fault-specific hydraulic characteristics.



0 5 10 km

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LEGEND

- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Model Grid
- Fault Cell
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

LOCAL AND REGIONAL FAULTS

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FIGURE 2-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_02_Faults in the Model

2.4 Timing

The model timing includes a combined transient warm up, steady state and transient calibration periods (**Table 2-2**).

To help with convergence in the steady state, a warmup transient stress period of 5 years from January 1966 to December 1969 was added to the timing as stress period 1. The calibration period includes a combined steady state (pre-mining) period and a transient historical period from January 1970 to January 2005. The transient calibration period runs from January 2005 to December 2024 with quarterly time intervals to replicate influence of historical mining.

To assist the model in overcoming numerical difficulties, MODFLOW-USG Adaptive Time-Stepping (ATS) option was used. The ATS option of MODFLOW automatically decreases time-step size when the run fails to converge. Once the run converged with a reduced time-step size, it increases the time-step size for the next time step to speed up the model run time. The minimum time step size used in the simulations was one day.

Table 2-2 Model Timing

Stress Period	Date Start	Date End	Mining Period	Max Stress Period Length (days)	Max Time Step Length (days)
1	01-01-1966	31-12-1969	Transient Warmup	1,460	1,460
2	-	-	Steady State	1	1
3 - 5	01-01-1970	31-12-2004	Historical	12,784	5,479
6 - 85	01-01-2005	31-12-2024	Calibration	7,305	92

2.5 Parameterisation

The modelled hydraulic zones are reflective of the conceptual (and geological) model. The site conceptualisation, as presented in SLR (2024), describes the hydraulic conductivity (K) data sources and the horizontal (Kx) and vertical (Kz) hydraulic conductivity parameter ranges for each stratigraphic unit as derived from field data. Overall, a broadly declining K with depth is noted for most of the solid geology stratigraphic units.

In the model, the decrease in hydraulic conductivity of the RCM, Rewan Group and Burngrove Formation is simulated to decrease exponentially with depth according to the following equation:

$$HC = HC_0 \times e^{(Slope \times dept\ )}$$

where: HC = horizontal hydraulic conductivity at the specific depth

HC_0 = horizontal hydraulic conductivity at depth of 0 m

Slope = term representing slope of the formula (steepness of the curve)

Depth = depth of the floor of the layer (thickness of the cover material)

Note: The hydraulic conductivity at zero depth (HC_0) is estimated in the calibration.

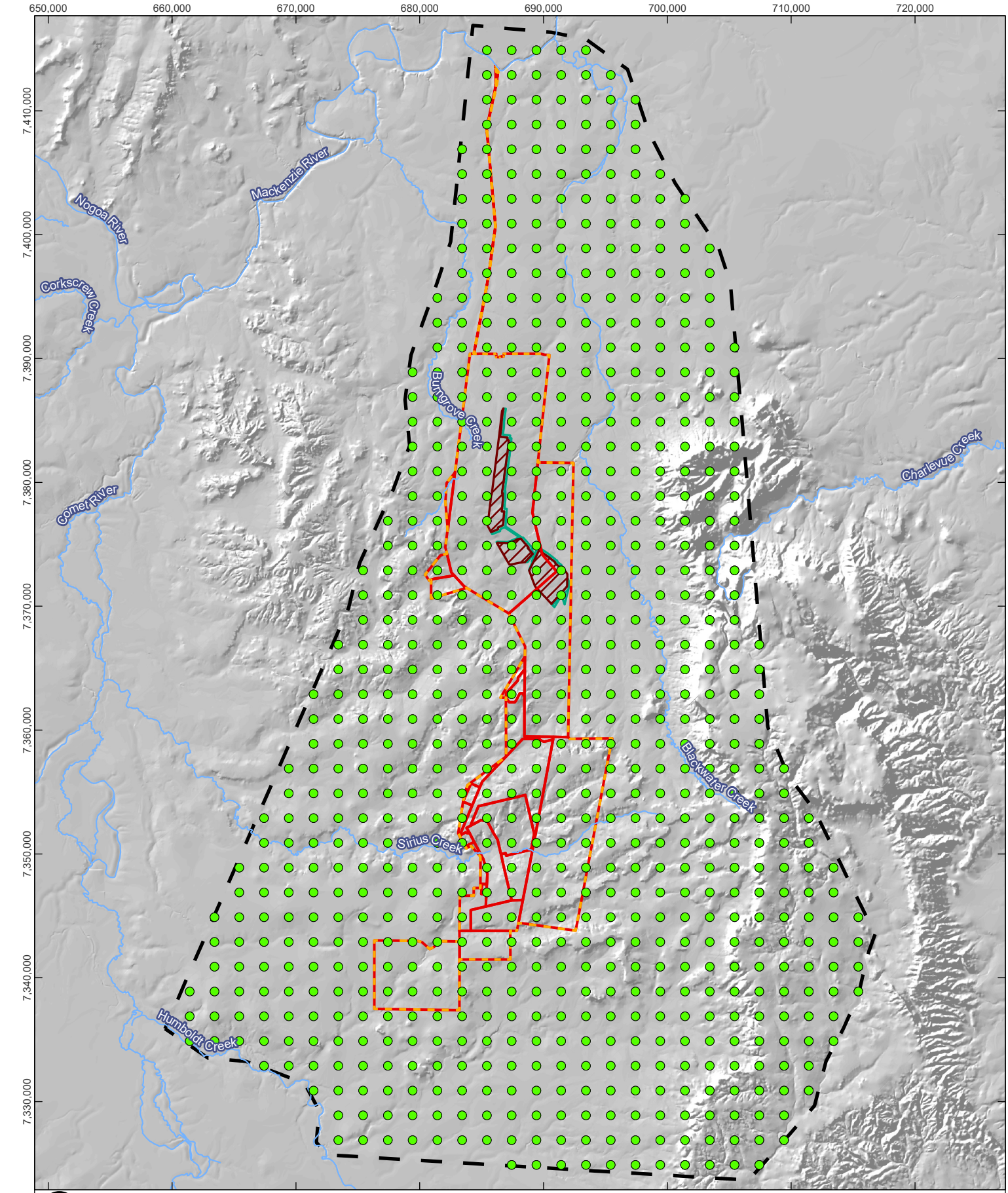
To allow spatial variability in unconsolidated units and the Clematis Group, pilot points were used from layer 1 to layer 3 (**Figure 2-3**). Pilot points were spaced uniformly. PEST++ use its PLPROC utility to interpolate between the pilot point values and creates a surface across the model domain for a targeted model parameter. This surface of model parameter values is then interrogated to provide a value at each model cell.

Hydraulic parameter zones and spatial variation options (e.g. pilot points, depth dependent equation or factor) are summarised on **Table 2-3**.

Table 2-3 Hydraulic Property Zones

Hydraulic Zone	Model Layer	Formation	Unit	Spatial Variation Options			
				Kx	Kz	Sy[1]	Ss[2]
1	1	Alluvium/Tertiary	Surface cover	Pilot Point	Pilot Point	Pilot Point	Constant
2	1	Regolith	Surface cover	Pilot Point	Pilot Point	Pilot Point	Constant
3	2	Alluvium/ Weathered zone	Surface cover	Pilot Point	Pilot Point	Pilot Point	Constant
4	2	Regolith	Surface cover	Pilot Point	Pilot Point	Pilot Point	Constant
5	3	Clematis Group	Triassic	Pilot Point	Pilot Point	Pilot Point	Constant
6	4	Rewan Group (Upper)	Triassic	Eq.1	Factor Kx	Constant	Constant
7	5	Rewan Group (Middle)	Triassic	Eq.1	Factor Kx	Constant	Constant
8	6	Rewan Group (Lower)	Triassic	Eq.1	Factor Kx	Constant	Constant
9	7	RCM	Overburden	Eq.1	Factor Kx	Constant	Constant
10	8	RCM	Aries seam	Eq.1	Factor Kx	Constant	Constant
11	9	RCM	Interburden	Eq.1	Factor Kx	Constant	Constant
12	10	RCM	Castor seam	Eq.1	Factor Kx	Constant	Constant
13	11	RCM	Interburden	Eq.1	Factor Kx	Constant	Constant
14	12	RCM	Pollux seam	Eq.1	Factor Kx	Constant	Constant
15	13	RCM	Interburden	Eq.1	Factor Kx	Constant	Constant
16	14	RCM	Orion seam	Eq.1	Factor Kx	Constant	Constant
17	15	RCM	Underburden	Eq.1	Factor Kx	Constant	Constant
18	16	Burngrove Formation	Permian	Eq.1	Factor Kx	Constant	Constant
19	17	Burngrove Formation	Permian	Eq.1	Factor Kx	Constant	Constant

1 Sy = Specific yield
2 Ss = Specific storage



0 5 10 km

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Drawn by:	RB

LEGEND

- Pilot Point
- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PILOT POINTS LOCATIONS

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FIGURE 2-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_03_Pilot Points Used in the Model

2.6 Model Stresses and Boundary Conditions

2.6.1 Regional Groundwater Flow

General Head Boundaries (GHB) have been specified along the perimeter of the model domain, as represented in **Figure 2-1**.

The GHB boundary condition was used to represent regional groundwater inflow and outflow across the model domain. GHB cells were assigned along the perimeter of the model area in all layers except where river cells are present. For each GHB cell, the head was estimated during the steady state calibration.

Groundwater enters the model where the GHB head exceeds the modelled head in the adjacent cell and leaves the model when the water level is lower in the GHB. GHB conductance is calculated using the hydraulic conductivity and the dimensions of each GHB cell and is therefore variable in this model due to variable cell size.

2.6.2 Watercourses

2.6.2.1 Natural Watercourses

The largest local creek (Blackwater Creek), along with selected higher-order tributaries, was incorporated into the model using the MODFLOW-USG River (RIV) package. The rivers within the model that were included in the RIV package are presented in **Figure 2-4,** and were categorized into 10 zones based on their scales and spatial distribution within the model domain. Only higher-order streams were included in the RIV package to represent the primary surface water–groundwater interactions. Lower-order stream segments were not incorporated. As a result, some streams (e.g., Rockland Creek) appear to terminate at or near the mine lease boundary in the model representation.

River boundaries were also applied to the southwestern and southeastern parts of the model where the boundary cells intersect with Humboldt Creek and Planet Creek, both of which are tributaries of the Fitzroy River.

After reviewing water stage data from several stations via the Water Monitoring Information Portal, it was determined that all rivers within the model domain are ephemeral. Consequently, the stage level was set to 0 for all river cells, effectively replicating the behaviour of the DRN package. River widths were assumed to be fixed for each river in the model. The river conductance was calculated using river width, river length, riverbed thickness, and the vertical hydraulic conductivity of riverbed material (**Table 2-4**).

2.6.2.2 Mining Infrastructure

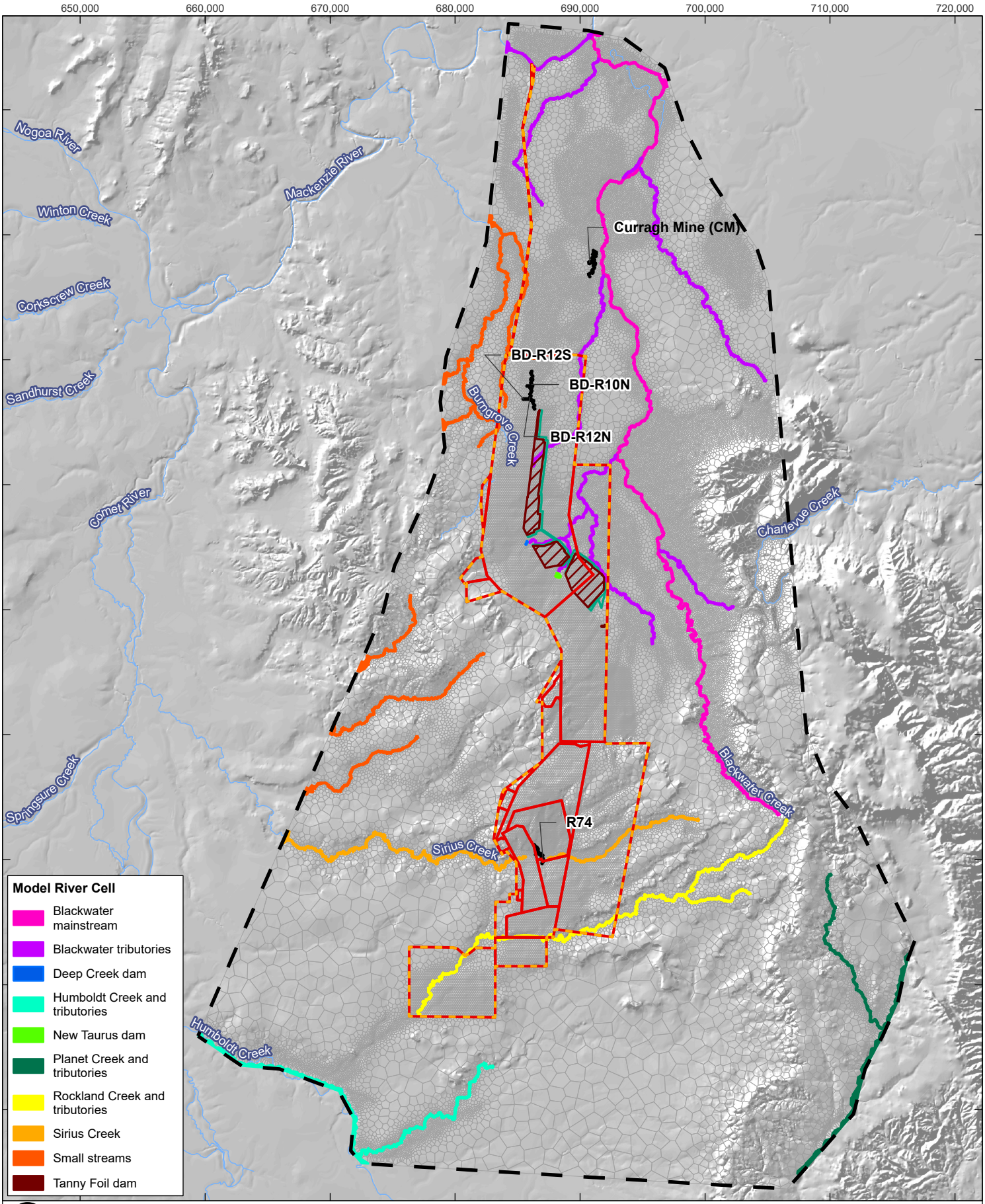
The RIV package was also used to represent dams and tailing storage facilities within the area, with dams presented in **Table 2-4.** Tailings dams are listed **Table 2-5** and their location is presented on **Figure 2-4**.

Table 2-4 River and Surface Water Features in the Model

Zone	Vertical K (meters per day [m/day])	River Width (m)	River Bed Thickness (m)	Name
1	0.05	5	1	Blackwater mainstream
2	0.05	1	1	Blackwater tributaries
3	0.05	2	1	Sirius Creek
4	0.05	1	1	Rockland Creek and tributaries
5	0.05	1	1	Humboldt Creek and tributaries
6	0.05	1	1	Planet Creek and tributaries
7	0.05	1	1	Small streams
8	0.001	1	1	Deep Creek dam
9	0.001	1	1	New Taurus dam
10	0.001	1	1	Tannyfoil dam

Table 2-5 Mining Infrastructure in the Model

Tailing Dams	Kz (m/day)	Stage
BD-R10N	5.0×10^{-1}	Deposited from July 2023 until 2040
BD-R12N	5.0×10^{-1}	Deposited from July 2023 until 2040
BD-R12S	5.0×10^{-1}	Deposited from July 2023 until 2040
R74	5.0×10^{-1}	Deposited from Jan 2025 until 2040
Curragh Mine (CM)	5.0×10^{-1}	Deposited from Jan 2007 until 2023



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Model Grid
- TSF Cell
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

RIVER CELLS

SLR

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FIGURE 2-4

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_04_River Cells

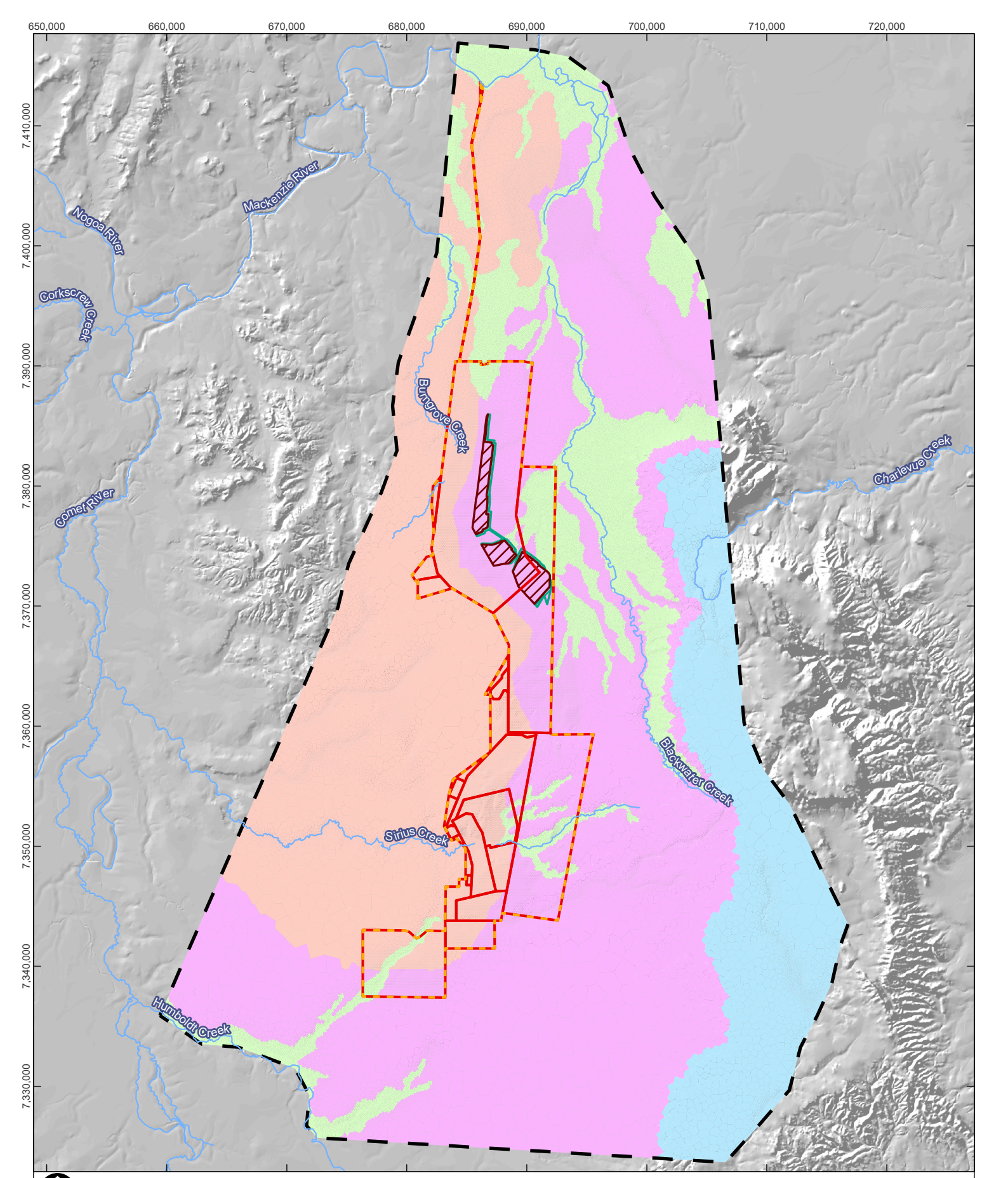
2.6.3 Rainfall Recharge

Diffuse infiltration of rainfall through the soil profile and subsequent deep drainage to underlying groundwater systems were represented using the MODFLOW-USG Recharge package (RCH). For the period from January 1970 to December 2024, recharge rate data was sourced from the Bureau of Meteorology's Australian Water Resources Assessment Landscape model, which simulates deep drainage, and introduces seasonality to the modelled recharge rates for the quarterly stress periods used during calibration. The recharge rate for the steady state condition was calculated using the long-term average daily recharge rate from January 1911 to December 1967. For the subsequent stress periods, daily recharge rates were calculated based on the average daily recharge rate over the corresponding date range within each stress period.

Multipliers were then utilised during the calibration process. Separate multipliers are used for each recharge zone. Rainfall recharge was imposed as a percentage of actual rainfall from the Scientific Information for Land Owners (SILO) Grid Point observations. Long-term average rainfall was used for the steady-state model. The historical rainfall data were averaged on an annual basis (2000 to 2004) and on a quarterly basis (2004 to 2024) for the transient calibration model. Also, the averages of the historical rainfall data from 1980 to 1990 and from 1990 to 2000 were used for these periods. For the predictive model, long-term average rainfall was used.

The model includes 4 recharge zones, as presented in **Figure 2-5**:

- Zone 1 - Quaternary Alluvium.
- Zone 2 - Regolith.
- Zone 3 - Weathered Clematis.
- Zone 4 - Weathered Permian.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

Recharge Zone

- Zone 1 - Quaternary Alluvium
- Zone 2 - Regolith
- Zone 3 - Weathered Clematis
- Zone 4 - Weathered Permian

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MODELLED RECHARGE ZONES

SLR

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FIGURE 2-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_05_Recharge Zones

2.6.3.1 Mining Induced Recharge

Enhanced recharge via spoil was simulated by progressively introducing a fifth recharge zone for the spoil. That zone expands as mining progresses and spoil is deposited in the open cut pits.

The calibrated recharge rates for all zones are discussed in **Section 3.4.3.1**.

2.6.4 Evapotranspiration

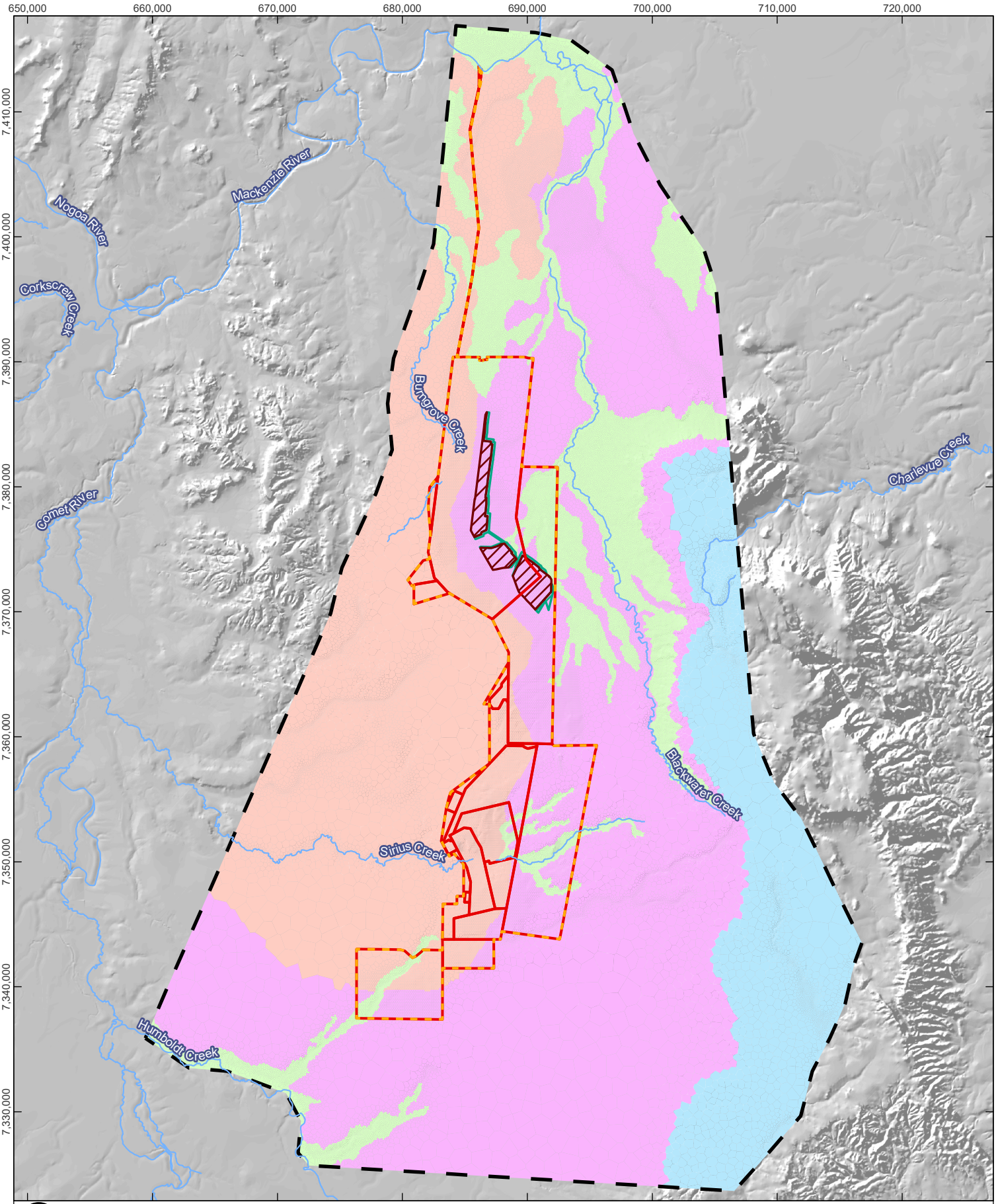
Evapotranspiration (ET) from the shallow water table was simulated using the Evapotranspiration package (EVT). ET was represented in the upper most cells of the model domain, with the extinction depth varied spatially based on the estimated rooting depths of regionally vegetation type.

In this model, EVT is excluded from cells that also contain RIV or GHB conditions. This approach is taken to avoid double-counting groundwater discharge in locations where other boundary conditions already represent flow out of the aquifer. Applying EVT in the same cells could result in non-physical water losses and distort the water balance by allowing multiple boundary conditions to compete for the same volume of groundwater. Excluding these cells from the EVT zone ensures that each type of boundary condition represents a distinct and non-overlapping physical process.

Same zones as recharge were assigned as EVT zones (refer to **Figure 2-6**):

- Zone 1 - Quaternary Alluvium.
- Zone 2 - Regolith.
- Zone 3 - Weathered Clematis.
- Zone 4 - Weathered Permian.

The maximum ET rate was derived from the SILO Grid Point series (Queensland Government, 2023). A single value of 0.0045 m/day was applied in the model for the steady-state and initial stress periods preceding the calibration period, and also the predictive period. Varied rates were applied to the calibration periods, while a single value was used for the first two stress periods, as well as the predictive period. An ET rate of zero was assigned to model cells representing rivers.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

Recharge Zone

- Zone 1 - Quaternary Alluvium
- Zone 2 - Regolith
- Zone 3 - Weathered Clematis
- Zone 4 - Weathered Permian

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

EVAPOTRANSPIRTION ZONES

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FIGURE 2-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_05_Recharge Zones

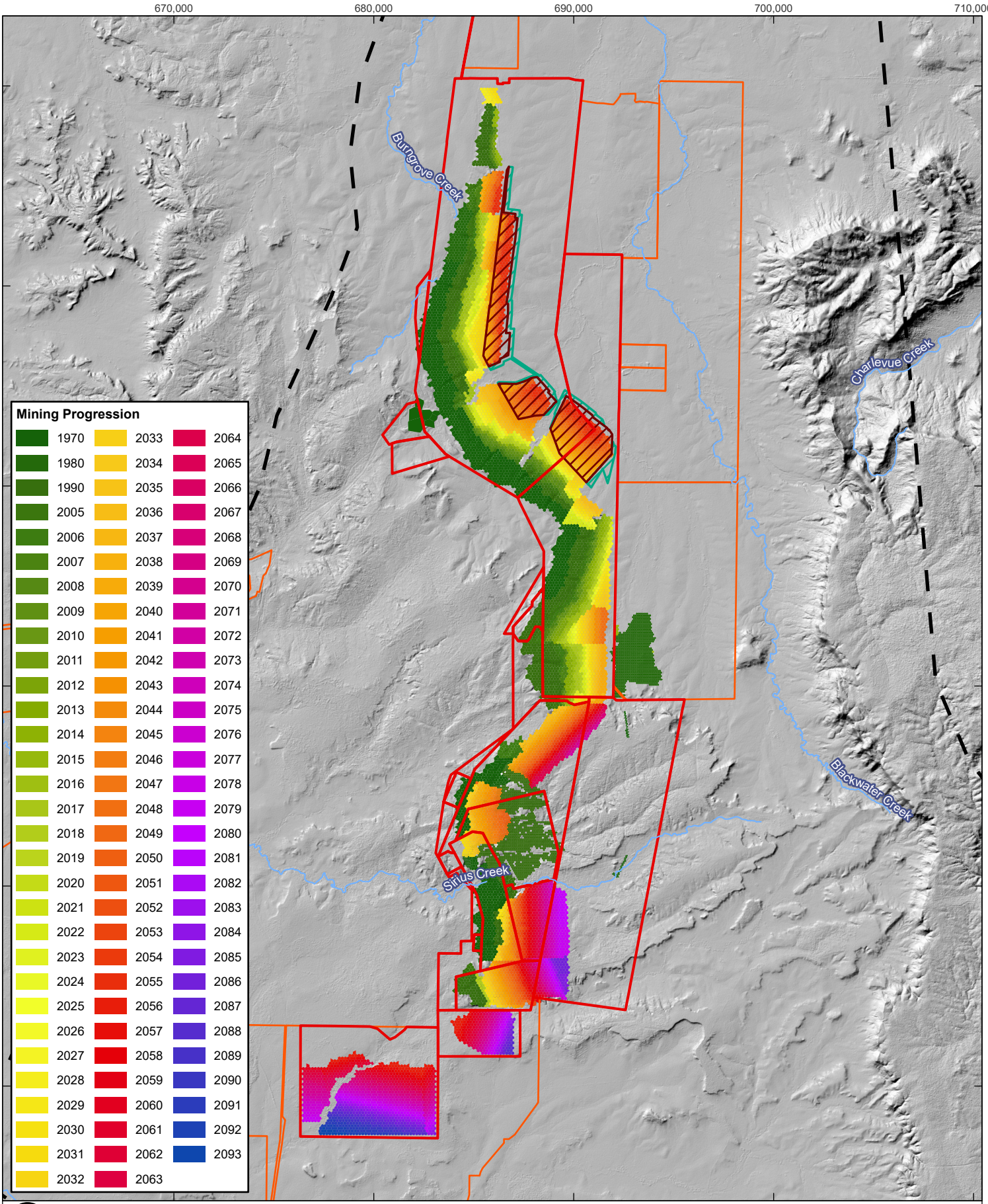
2.6.5 Mining

All mines included in this assessment, namely BWM, BWM South (Kenmare and Laleham), Cook Collieries, and Curragh Mines are targeting the RCMs, hence a cumulative assessment of impacts is carried out. The location of both the open pit and underground mines is shown in **Figure 2-7**.

2.6.5.1 Dewatering

The MODFLOW Drain (DRN) package is used to simulate mine dewatering in the model for the Project and surrounding mines. Boundary conditions for drain cells allow one-way flow of water out of the model. When the computed head drops below the pre-defined stage elevation of the drain, the drain cells become inactive. This is an effective way of theoretically representing removal of water seeping into a mine over time, with the actual removal of water being via pumping and evaporation.

To simulate BWM open cut pits in the model, drain cells are applied to all active layers from the surface to the base of the lowermost mined seam, which is the Pollux seam (Layer 12). The drain cells representing the surrounding open cut mines were interpolated from previous reports, publicly available Environmental Impact Statement documentation and aerial photography.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area
- Study Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MINING PROGRESSION

SLR

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FIGURE 2-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_07_Mining Progression

2.6.5.2 Variation in Hydraulic Properties due to Mining

Two types of mining have been considered; open cut and underground.

For open cut mining, Hawkins (1998) and Mackie (2009) indicate that spoil and waste rock are more permeable than the undisturbed strata. Completed open cut mining areas will be backfilled with waste overburden as the extraction proceeds. Backfilling of open cut mine areas with spoil was modelled using the MODFLOW-USG Time-Variant Material (TVM) package. The model cell properties were updated to spoil properties guided by operational mine plans. Horizontal hydraulic conductivity, vertical hydraulic conductivity, specific yield and specific storage of the spoil were adjusted during the calibration process. Hydraulic conductivity (Kx and Kz) change within the stress period when mining (DRN) is activated, and storage properties are activated in the stress period when DRNs become inactive

Several tailings storage areas were defined by the proponent, with tailing hydraulic properties applied in the model and adjusted during the calibration process.

For the underground mines, the hydraulic properties were changed with time in the goaf and overlying fractured zone directly above each longwall panel. The TVM package was used to simulate changes to aquifer properties in response to mining within the overlying strata and fracture zone. Calculated multipliers were used to enhance hydraulic conductivities within the fracture zone overlying coal extraction areas, with multipliers generally following a ramp function, so that the multipliers with highest values are applied to the units closest to the mined seam and then gradually decrease as the units become close to the maximum height of connective cracking. The fracture zone multipliers are listed in **Table 2-6**.

The maximum height of connective cracking was derived using the Ditton/Merrick equation (Ditton and Merrick, 2014). The fracture heights over the Pollux seam in the underground mines ranged from 57 m to 154 m, with an average fracture height of 119 m and no fracturing of the surface is expected.

Table 2-6 Fracture Zone Multipliers

Layer	Unit	Average Kx Multipliers	Average Kz Multipliers
1	Alluvium/Tertiary	1	1
2	Alluvium/Weathered zone	1	1
6	Rewan Group (Lower)	1	1
7	RCM - Overburden	44	51
8	RCM - Aries seam	6	30
9	RCM - Interburden	1	2
10	RCM - Castor seam	1	1.3
11	RCM - Interburden	12	295

3.0 Calibration

3.1 Calibration Method

Automated calibration utility PESTPP-IES (White et al, 2020) was used to match the available water level data. The numerical algorithm that is implemented by PESTPP-IES is referred to as an “iterative ensemble smoother”. The job of an ensemble smoother is to assimilate data in a “batch” sense. To accomplish this, PESTPP-IES begins the model parameterisation process with a collection of random parameter fields drawn from the prior parameter probability distribution. Through a series of iterative adjustments, PESTPP-IES modifies the parameter realisations that make up the ensemble to satisfy calibration constraints. The results presented in this section are from the realisation that yielded the lowest simulated error (sum of squares). However, where possible, results have been provided for all realisations within the ensemble. The model variables included in the calibration were:

- Aquifer parameters, including horizontal and vertical hydraulic conductivity, specific storage and specific yield by zone.
- Pilot point multiplications for horizontal and vertical hydraulic conductivity, and specific yield.
- RCH rate factors by zone.
- EVT rate factors and extinction depths by zone.
- Vertical conductivity of RIV cells. Additionally, tailing dams were modelled using the RIV package, with their vertical hydraulic conductivities also parameterized.
- Hydraulic properties of spoils and tailings, including horizontal and vertical hydraulic conductivity, specific storage, and specific yield, with vertical conductivity linked to horizontal conductivity.

The calibration methodology for the BWM model involved running the model numerous times with different parameter sets to identify those that yielded the best calibration statistics. The process began with 500 initial realisations, sampled within the defined parameter ranges by PESTPP-IES. After 10 iterations, 75 realisations were optimized to achieve satisfactory calibration performance. The ensemble size was deemed sufficient based on a review of uncertainty convergence on predicted fluxes (**Section 7.1**)

The calibration statistics were calculated for each realisation and the realisation that produced the lowest Scaled Root Mean Square (SRMS) error was considered to be the best-calibrated model for the purposes of the BWM. This model is referred to as “Best Calibrated Model” (BCM) and calibration results are presented for the BCM herein.

3.2 Calibration Dataset

The groundwater levels recorded between Aug 2009 to Dec 2024 were used as calibration targets. They were processed into two groups – initial water level and drawdowns from the initial water levels for each bore. In all, 1,789 observation targets, including 108 initial heads and 1,681 drawdowns, were established for 108 bores from the BWM area.

Groundwater targets were selected where valid information on bore construction or geology information was available for the site. Targets were manually reviewed to ensure the measurements were realistic.

Details on each of the observation points are presented in **Appendix A** of this report.



3.2.1 Groundwater Levels

Table 3-1 summarizes the initial groundwater levels measured from 108 observation points, which have been used as the first group of calibration targets for the groundwater model. The groundwater levels from various geological formations, including the weathered zone, Rewan Group, RCM overburden/interburdens and RCM coal seams.

Table 3-1 Summary of Initial Groundwater Levels used for Calibration Targets

Model Layer	Target Unit	Number of Bores
2	Weathered zone/Regolith	18
5	Rewan Group (Middle)	1
6	Rewan Group (Lower)	6
7	RCM Overburden	14
8	Aries seam	13
9	RCM Interburden	3
10	Castor seam	9
11	RCM Interburden	3
12	Pollux seam	18
13	RCM Interburden	1
14	Orion seam	2
16	Burngrove Formation	20
	Total	**108**

3.2.2 Drawdown

Table 3-2 summarizes the drawdowns used as calibration targets for the groundwater model. These values are derived by subtracting the initial groundwater level from the subsequent measurements taken from the same observation bores. A total of 1,681 drawdowns across 107 bores were converted from the measured water levels. The data spans multiple geological layers, including the weathered zone, Rewan Group, RCM overburden/interburdens, RCM coal seams and Burngrove Formation, offering a comprehensive view of the groundwater system's response.



Table 3-2 Summary of Drawdowns Used for Calibration Targets

Model Layer	Target Unit	Number of Bores	Number of Observations
2	Weathered zone/Regolith	18	167
5	Rewan Group (Middle)	1	7
6	Rewan Group (Lower)	6	137
7	RCM Overburden	14	433
8	Aries seam	13	354
9	RCM Interburden	3	74
10	Castor seam	9	95
11	RCM Interburden	3	38
12	Pollux seam	18	190
14	Orion seam	2	21
16	Burngrove Formation	20	165
	Total	**107**	**1681**

3.2.3 Calibration Weighting

During calibration, each groundwater bore in each group (initial water level or head difference) was assigned a base weight of 1, and the weight for each observed target was calculated as $1/\sqrt{n}$, where n is the total number of observations recorded at that bore.

3.3 Calibration Performance

3.3.1 Calibration Statistics

An industry-standard approach for assessing the calibration of a model is to analyse statistics related to the calibration. One way of doing this is by comparing the simulated differential (i.e. error) between the simulated and observed (measured) water levels, which is often expressed as the root mean square (RMS). The RMS value is calculated by taking the square root of the mean of the squared differences between the simulated and observed water levels. RMS is expressed as:

$$\mathrm{RMS} = \left[\frac{1}{\mathrm{n}}\sum(\mathrm{h_o} - \mathrm{h_m})_\mathrm{i}^{\,2}\right]^{0.5}$$

where: n = number of observations

h_o = observed water level

hm = simulated water level

Another option for measuring the goodness of fit is the SRMS error. SRMS is computed by dividing the RMS by the range of measured heads and expressing it as a percentage. When the goal is to fit historical measurements of water levels, SRMS provides a valuable indicator of the goodness of fit (Barnett et al., 2012). This is primarily due to its ability to compare errors in the simulated values against the total head changes in the system. If the errors are small relative to the total head change, they can be considered negligible.

The PESTPP-IES ensemble calibration process was initiated with 500 randomly generated realisation and 75 calibrated realisations from the final iteration were retained as sufficient for assessing uncertainty in the quantities of interest (QOIs). A summary of statistical analyses of the error residual between simulated and observed water level elevation for all calibrated realisations is provided in **Table 3-3.**

Although there is no universal recommendation for an acceptable SRMS error, Barnett et al. (2012) suggest that establishing SRMS targets, such as 5% or 10%, may be appropriate in certain circumstances. In this study, RMS error calculated for the Best Calibrated Realisation within the ensemble is 11.6 m. The total measured head change across the model domain is 177.3 m, leading to a SRMS value of 6.6%. For the ensemble, the maximum SRMS is 7.4% (**Table 3-3**).

Figure 3-1 presents the observed and simulated groundwater levels graphically as a scattergram for the historic transient calibration (1990 to 2024), for the BCM. As can be seen in **Figure 3-1**, hydraulic gradients are well reproduced across the calibration dataset.

Table 3-3 Calibration Statistics

Statistic	Minimum	Median	Maximum	Best Calibrated Realisation
Mean Residual (m)	1.3	3.7	5.5	3.8
Mean Absolute Residual (m)	8.8	9.3	10.2	9.1
Standard Deviation (m)	10.9	11.5	12.6	11.0
Sum of Squares (square metres [m^2])	242581.2	259575.5	308003.7	242581.2
RMS error (m)	11.6	12.1	13.1	11.6
Minimum Residual (m)	-51.6	-33.3	-26.5	-30.2
Maximum Residual (m)	29.0	33.1	39.4	34.2
Number of Observations	1789	1789	1789	1789
Range in Observations (m)	177.3	177.3	177.3	177.3
Scaled Standard Deviation (%)	6.2	6.5	7.1	6.2
Scaled Absolute Mean (%)	5.0	5.3	5.8	5.1
SRMS (%)	6.6	6.8	7.4	6.6

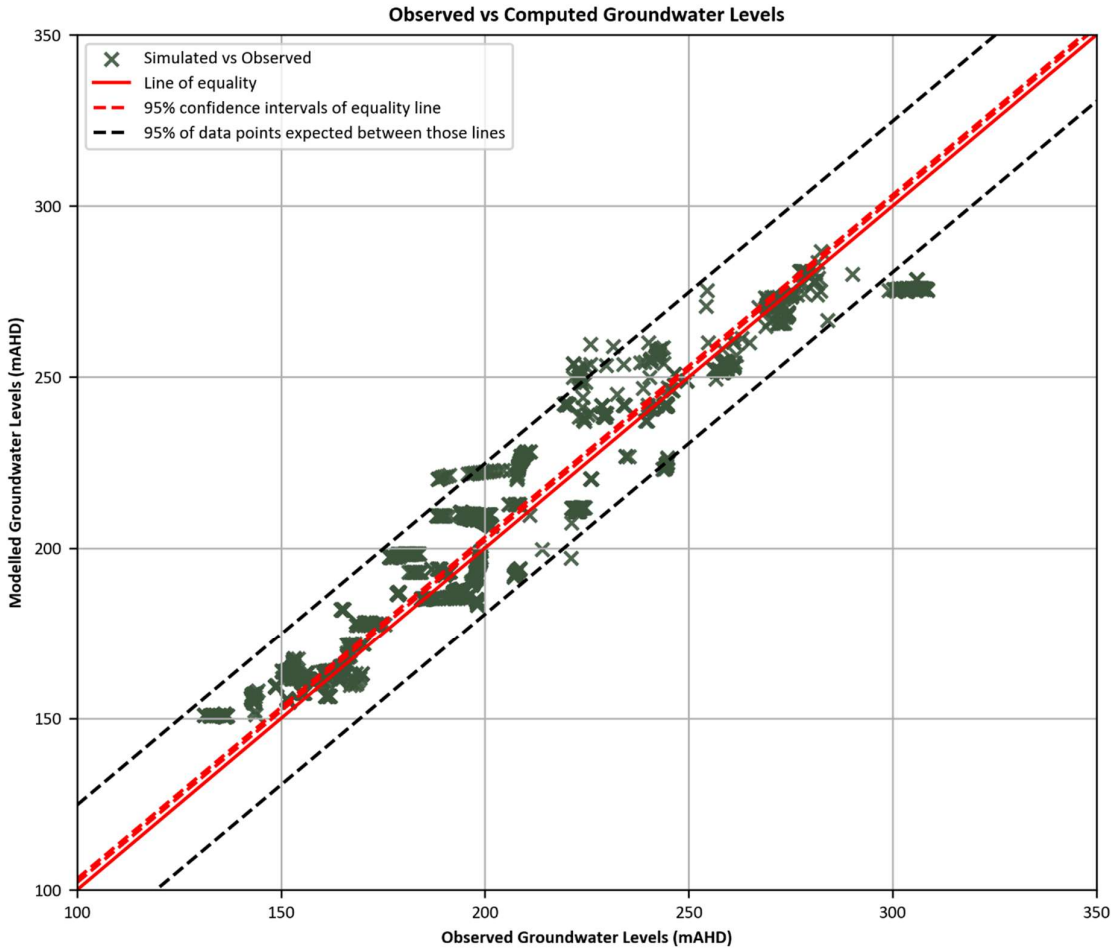


Figure 3-1 Calibration Scattergram

Figure 3-2 shows the distribution of calibration residuals for the BCM. As shown in the figure the calibration residuals in majority of the calibration data points are within ± 10 m. **Figure** 3-2 indicates that in general, the model tends to slightly overpredict groundwater levels.

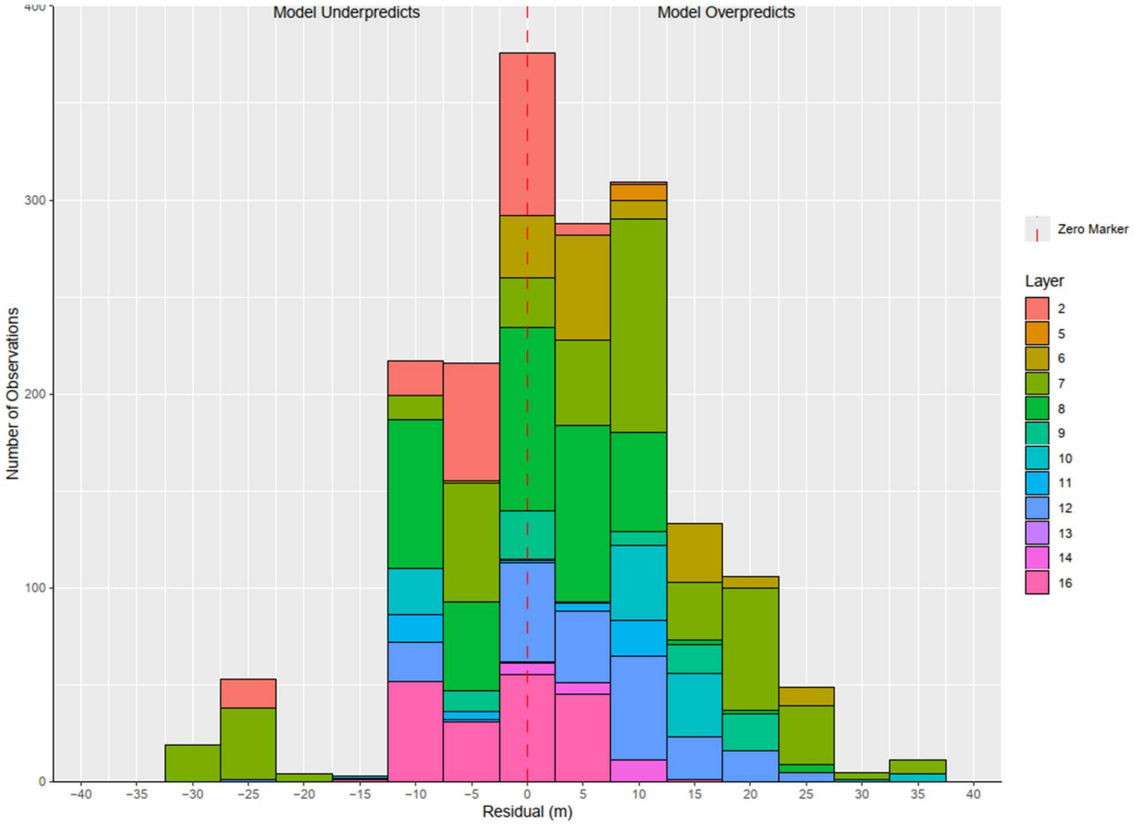


Figure 3-2 Calibration Residual Histogram

Table 3-4 shows the average calibration residual and absolute average residual per model layer, for the BCM. The residual is the difference between the measured and the modelled water level at each bore. A negative residual represents an over estimation of water levels, while a positive residual represents an underestimate.

Table 3-4 shows a general overestimation of water level in the model layers except for the Alluvium/weathered zone, some interburden and the Burngrove formation. The overestimation is greater for the Rewan Group (9.5 m on average).

Table 3-4 Average Residual by Model Layer

Model Layer*	Formation	Unit	Average Residual (m)	Average Absolute Residual (m)	Number of Observation Targets	Number of bores
2	Alluvium/ Weathered zone	Surface cover	-3.6	4.6	185	18
5	Rewan Group (Middle)	Triassic	9.8	9.8	8	1
6	Rewan Group (Lower)	Triassic	8.9	9.0	143	6
7	RCM	Overburden	5.6	13.8	447	14
8		Aries seam	1.0	6.4	367	13
9		Interburden	7.7	9.8	77	3
10		Castor seam	10.7	13.1	104	9
11		Interburden	1.9	9.1	41	3
12		Pollux seam	7.5	9.5	208	18
13		Interburden	-2.4	2.4	1	1
14		Orion seam	7.1	7.1	23	2
16	Burngrove Formation	Permian	-1.5	5.1	185	20

*There are no observation bores in Layers 1, 3, 4, 15 and 17.

The spatial distribution of average residuals for each bore from the transient calibrated model is shown in **Figure 3-3**. The size of the bore symbol in **Figure 3-3** is proportional to the residual (i.e. larger residual has a larger symbol size). **Figure 3-3** shows regionally there is a good match between the observed and simulated groundwater levels.

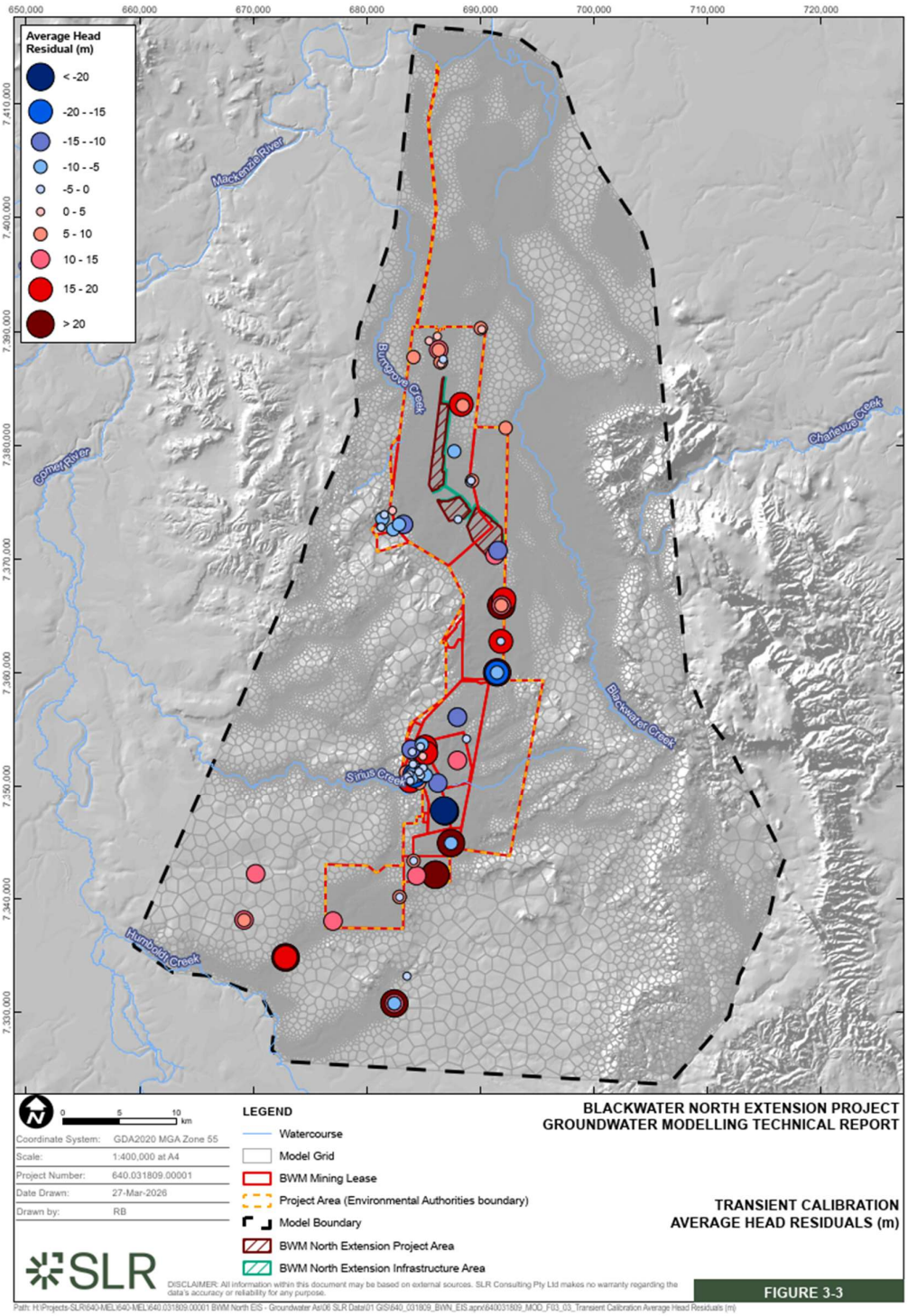


Figure 3-3 Transient Calibration Average Head Residuals (m)

3.3.2 Calibration Hydrographs

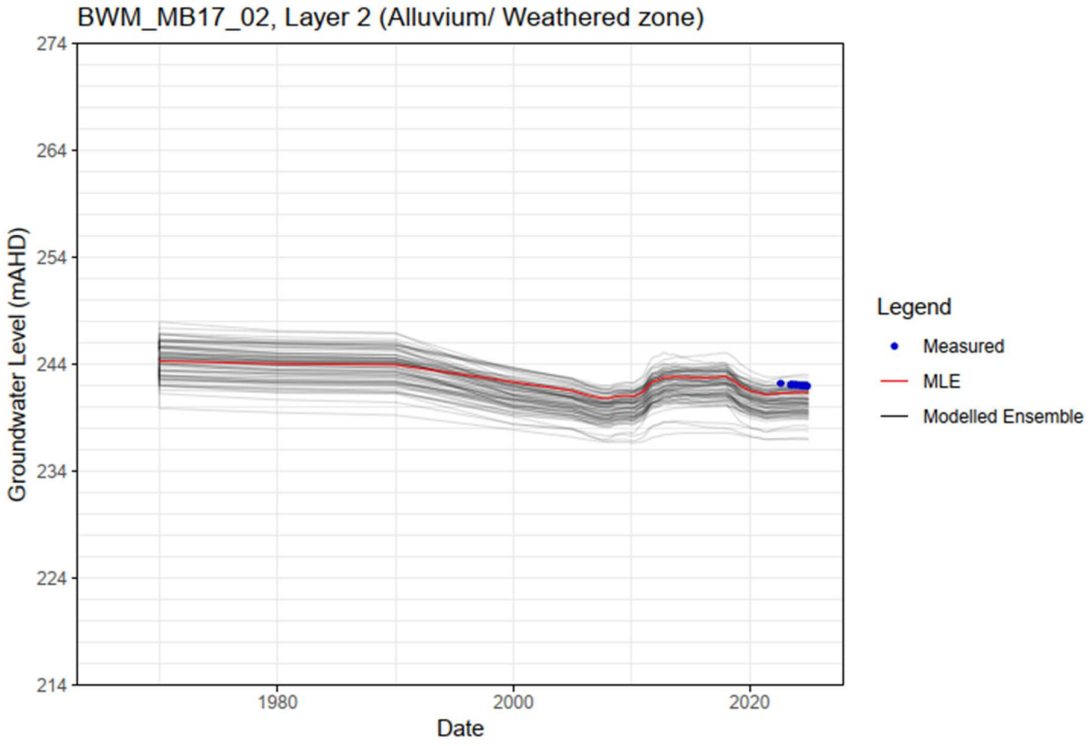
This section provides discussion on the modelled to observed groundwater level trends (calibration hydrographs) for key bores across the BWM site. Calibration hydrographs for the full calibration dataset are presented in **Appendix B**.

3.3.2.1 Alluvium and Regolith

There are no bores with valid observation data in the Alluvium and Regolith (Layer 1) in the model area.

Figure 3-4 presents the fit between simulated and observed heads in BWM_MB17_02, BWM_P4, BWM_P7 within the Alluvium and Weathered zone (Layer 2). BWM_MB17_02 is located at the edge of the South Marshmead Pit, whereas BWM_P4 and BWM_P7 are located along the western edge of the Kenmare Pit. The hydrographs for these bores generally show a close match between the simulated and measured groundwater levels.

However, as shown in the hydrographs in **Appendix B**, regionally there is a relatively good match between the simulated and measured groundwater levels in regolith bores.



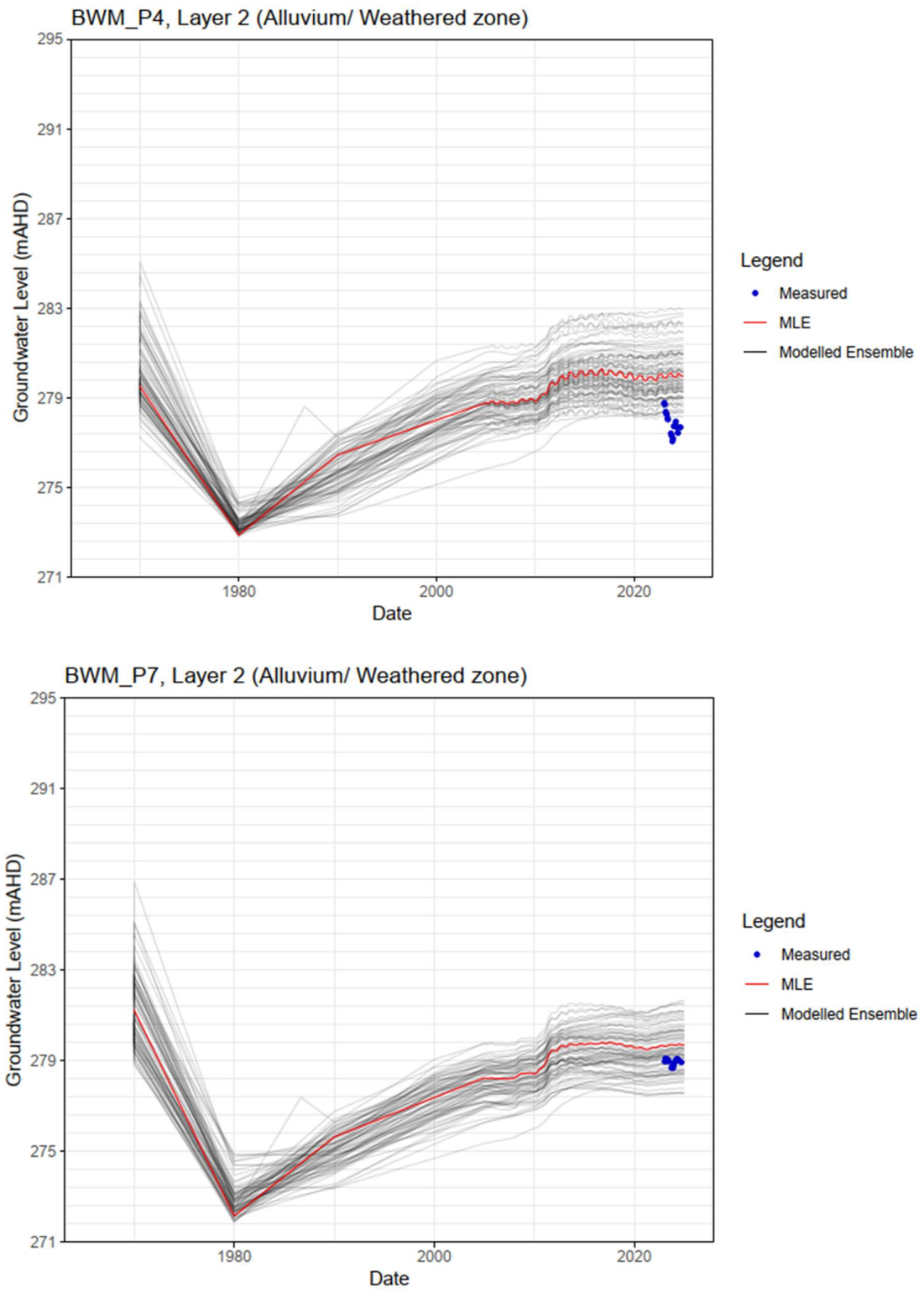
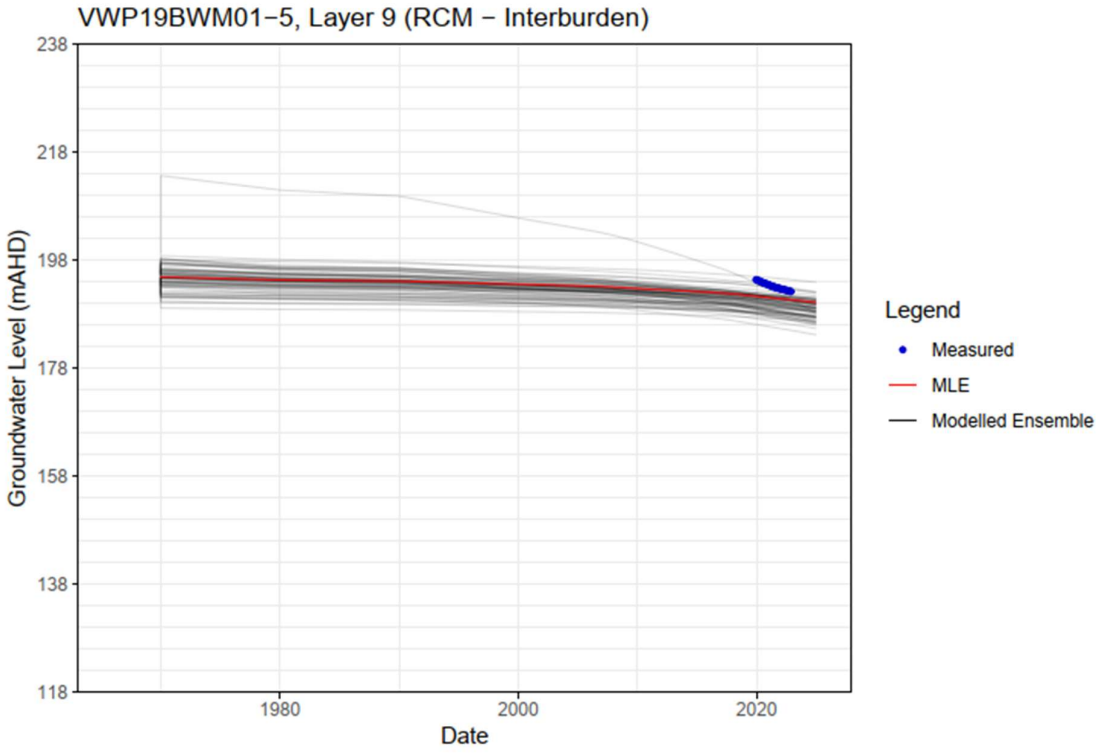


Figure 3-4 Calibration Fit - Alluvium and Regolith Bores

3.3.2.2 Interburden

The hydrographs for some of the Interburden bores are shown in **Figure 3-5** for bores VWP19BWM01-5 and VWP19BWM02-3 in the Interburden layers, located to the east of the Besgrove Pit and in the Tannyfoil Pit respectively, show that the model results in a reasonable (± 3 m) fit between modelled and observed groundwater. Trends are also relatively well reproduced.



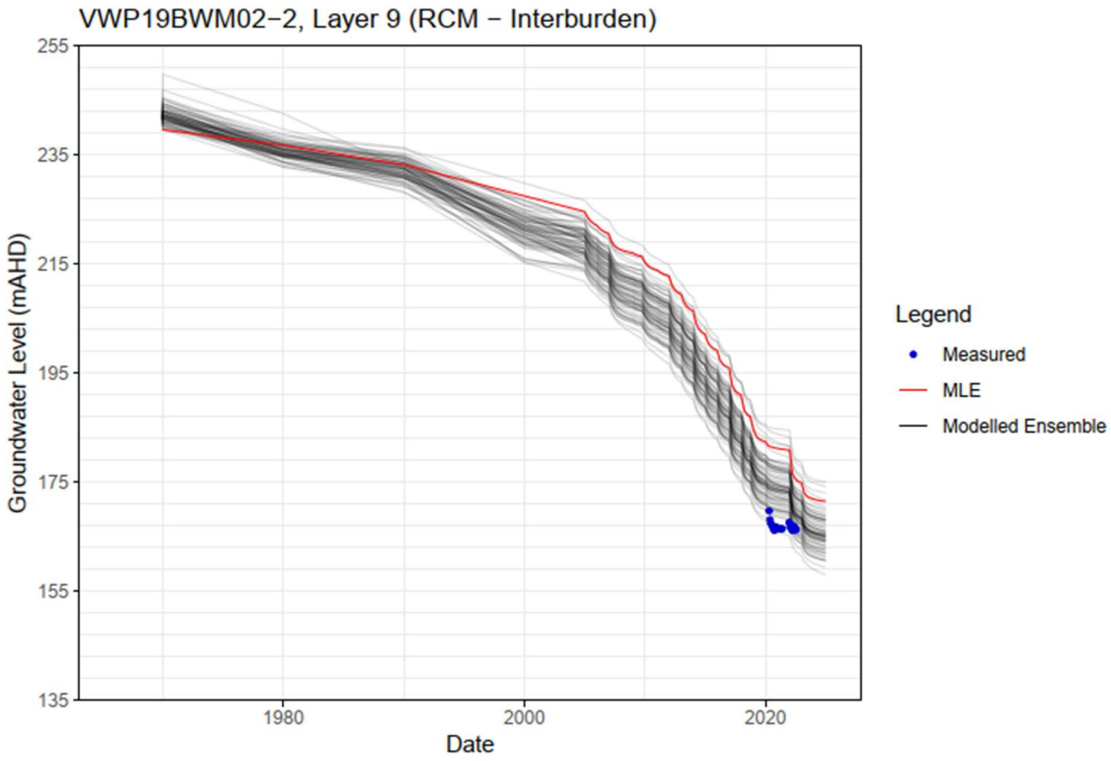


Figure 3-5 Calibration Fit - Interburden Bores

3.3.2.3 Coal Seams

The hydrographs for bores MB3, MB20BWM03P1, FY16_PZ_2 and VWP19BWM02_5 located in the Aries, Castor, Pollux and Orion seams respectively are shown in **Figure 3-6** and **Figure 3-7**. The hydrographs show that the model results in a reasonable (± 3 m) fit between modelled and observed groundwater levels for these bores. Trends are also relatively well reproduced.

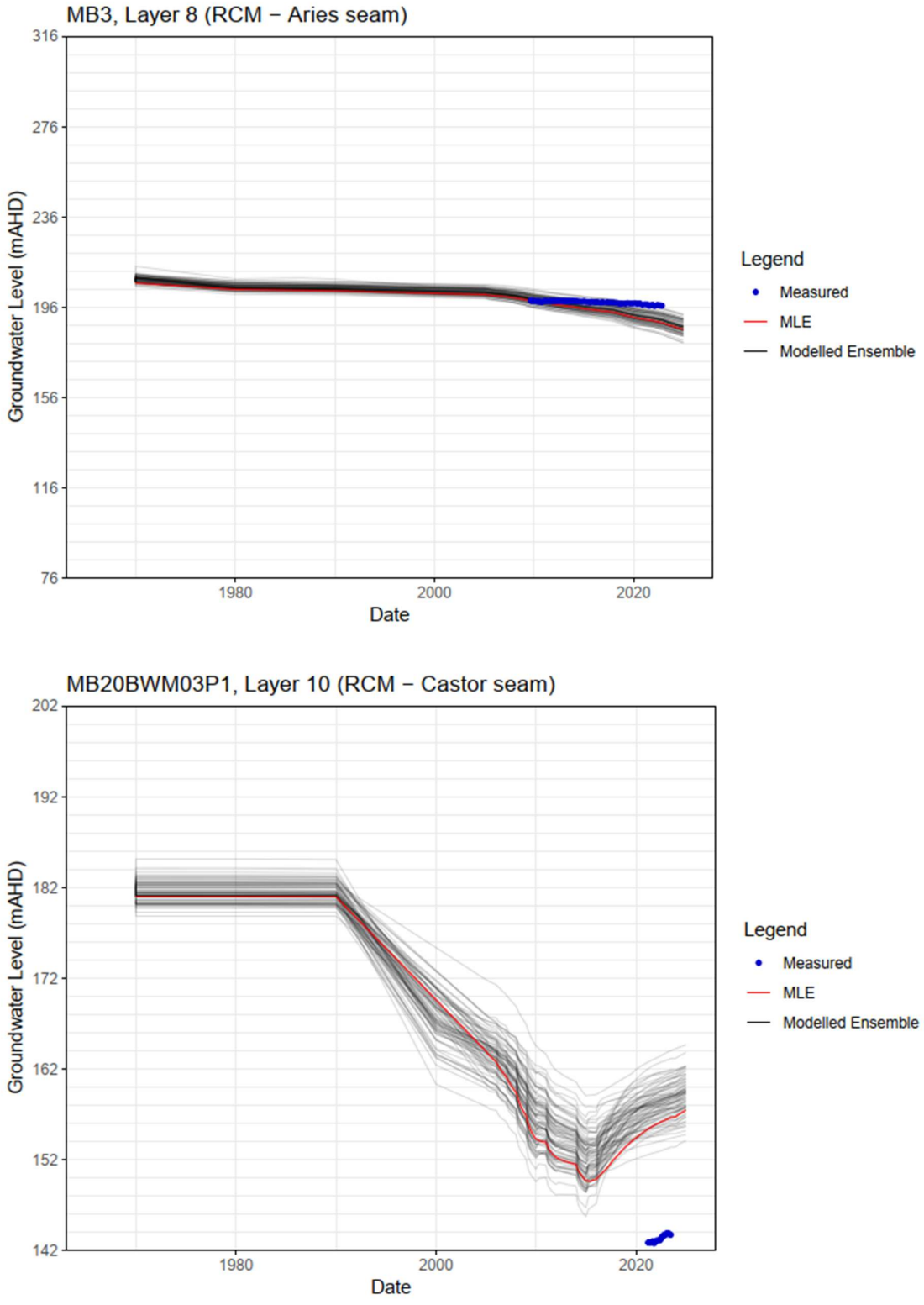


Figure 3-6 Calibration Fit – Coal Seams Bores (Aries and Castor)

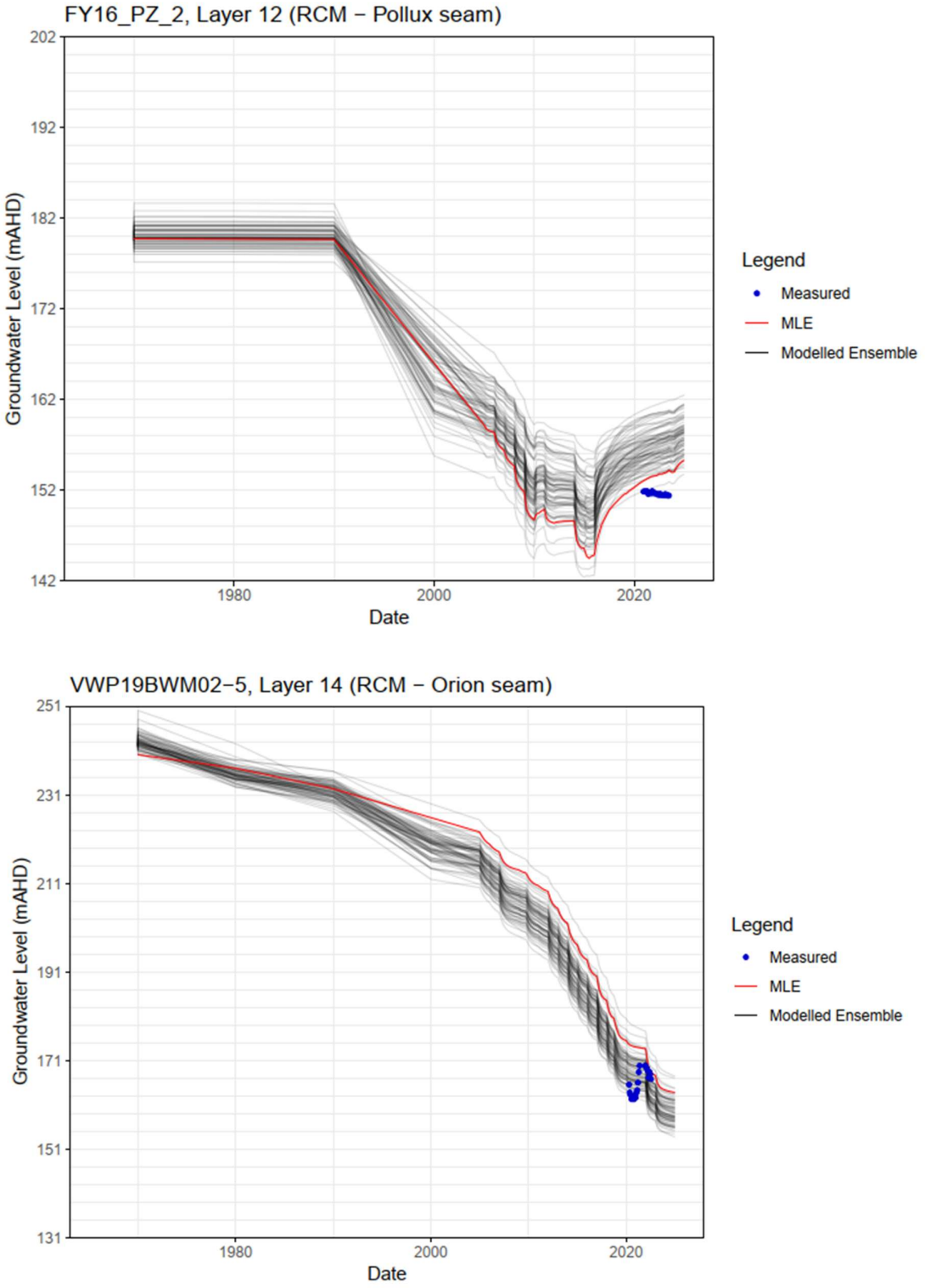


Figure 3-7 Calibration Fit – Coal Seams Bores (Pollux and Orion)

3.4 Calibration Results

3.4.1 Calibrated Fluxes

3.4.1.1 Steady State Water Balance

The water balance for the steady state model calibration is shown in **Table 3-5**. The results indicate that recharge is the dominant inflow contributor (61.8 Megalitres per day [ML/day]). ET is the highest groundwater outflow (61.6 ML/day), indicating that groundwater primarily leaves the model domain through ET. Other outflow components, such as river and GHBs, contributed only minimally. The mass balance error for the steady state calibration is 0.03%, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Table 3-5 Steady-State Model Water Balance

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	61.8	100.0	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	61.6	99.8
River (RIV)	0.0	0.0	0.0	0.0
Regional Groundwater Flow (GHB)	0.0	0.0	0.1	0.2
Mines (DRN)	0.0	0.0	0.0	0.0
Storage	0.0	0.0	0.0	0.0
Total	**61.8**	**100.0**	**61.8***	**100.0**

* Total values may not exactly equal the sum of individual components due to rounding.

3.4.1.2 Transient Water Balance

The model water balance for the transient simulation averaged over the duration of the calibration period is presented in **Table 3-6** and **Figure 3-8**.

The water balance for the transient calibration period indicates that recharge to the groundwater system within the model averages 63.8 ML/day. Approximately 56.6 ML/day is lost to ET in areas where the water table is within a few metres of the land surface.

The net flux from the GHB component is -0.4 ML/day indicating that groundwater leaves the model domain through this boundary. 10 ML/day is removed from the model by the Drain boundary condition that represents mining in the model.

The mass balance error recorded for each stress period of the transient calibration is between -0.45% and 0.08%, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Table 3-6 Transient Model Water Balance

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	63.8	88.0	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	56.6	78.1
River (RIV)	0.0	0.0	0.0	0.0
Regional Groundwater Flow (GHB)	0.2	0.3	0.6	0.8
Mines (DRN)	0.0	0.0	10.0	13.8
Storage	8.5	11.7	5.3	7.3
Total	**72.5**	**100.0**	**72.5**	**100.0**

The ET response (ET Out) to increases in recharge (Recharge In) are the largest components of outflow and inflow respectively.

Water coming out of storage (Storage In) shows peaks are associated with mine dewatering (Drains Out) peaks. Water going into storage (Storage Out) shows peaks associated with large rainfall events.

Contributions from regional boundary flow (GHB In and Out) and rivers (Riv In and Out) are small overall (**Figure 3-8**).

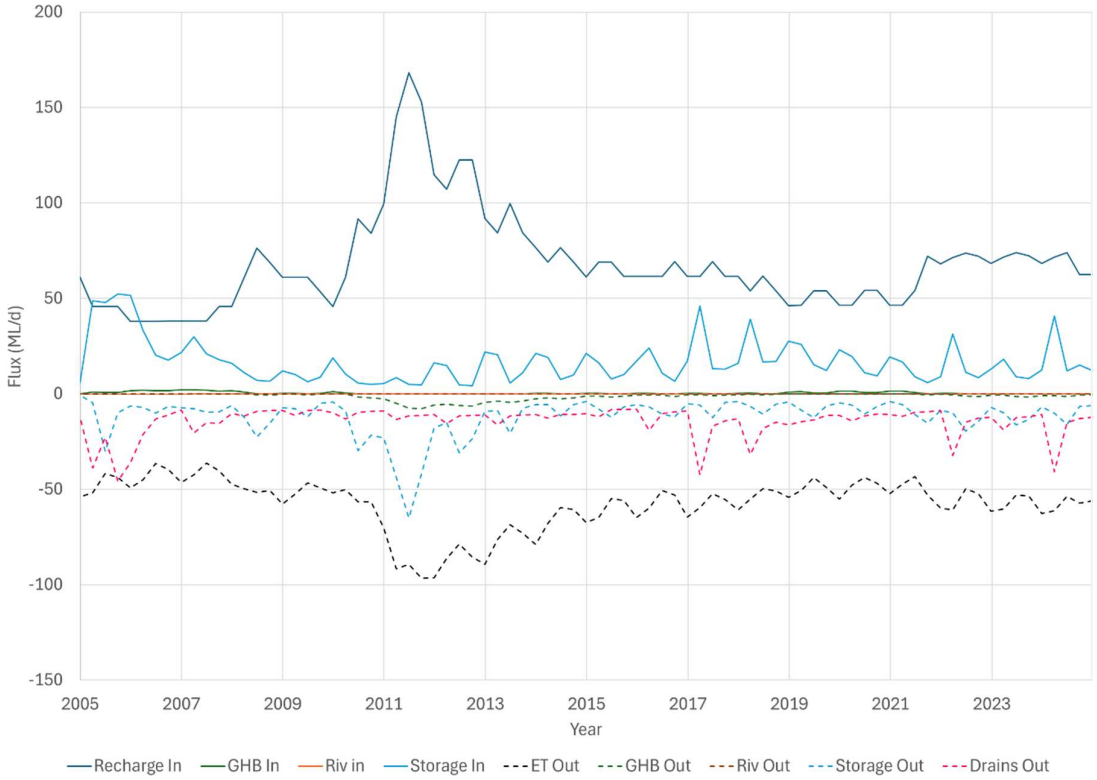


Figure 3-8 Transient Water Balance

3.4.2 Calibrated Hydraulic Parameters

3.4.2.1 Calibrated Hydraulic Conductivities

Table 3-7 provides a summary of the model layer parameter values for horizontal and vertical hydraulic conductivity.

3.4.2.1 Calibrated Storage Properties

Table 3-8 summarises the calibrated values of specific storage and specific yield for the hydrostratigraphic units.

Table 3-7 Calibrated Hydraulic Conductivity

Model Layer	Formation	Unit	Kx min (m/day)	Kx max (m/day)	Kx mean (m/day)	Kx BCM (m/day)	Kz min (m/day)	Kz max (m/day)	Kz mean (m/day)	Kz BCM (m/day)
1	Alluvium/Tertiary	Surface cover	8.7E-02	6.4E+00	1.3E+00	8.7E-02	2.2E-03	1.9E-01	3.8E-02	2.2E-03
1	Alluvium/Tertiary	Tertiary	2.1E-01	1.8E+00	8.6E-01	1.1E+00	6.7E-03	6.9E-02	2.8E-02	3.6E-02
2	Alluvium/Weathered zone	Weathered zone	9.9E-01	2.2E+01	5.6E+00	4.7E+00	1.8E-02	7.5E-01	1.6E-01	7.9E-02
2	Alluvium/Weathered zone	Regolith	3.7E-01	2.1E+00	1.3E+00	8.8E-01	9.0E-03	6.7E-02	3.5E-02	2.5E-02
3	Clematis Group	Triassic	4.2E-02	1.7E+00	6.2E-01	1.4E+00	3.5E-03	2.0E-01	3.9E-02	1.0E-01
4	Rewan Group (Upper)	Triassic	9.0E-04	1.3E+00	1.7E-01	4.7E-02	2.4E-05	6.2E-01	2.2E-02	3.8E-04
5	Rewan Group (Middle)	Triassic	2.5E-05	4.4E-02	9.2E-03	1.4E-03	6.6E-07	1.3E-02	1.2E-03	3.9E-05
6	Rewan Group (Lower)	Triassic	2.1E-05	1.1E-01	1.3E-02	1.2E-02	6.0E-07	1.2E-02	2.0E-03	8.3E-04
7	RCM	Overburden	1.3E-04	1.3E-02	2.0E-03	1.6E-03	1.0E-05	1.8E-03	1.1E-04	1.3E-04
8		Aries seam	2.3E-05	3.4E-04	6.1E-05	2.3E-05	1.7E-07	1.3E-06	4.0E-07	6.6E-07
9		Interburden	9.6E-04	1.5E-02	6.0E-03	1.4E-02	5.5E-05	1.2E-02	5.9E-04	1.5E-04
10		Castor seam	7.5E-05	8.6E-02	7.9E-03	2.2E-02	9.5E-07	5.0E-03	5.0E-04	4.0E-04
11		Interburden	4.2E-04	3.6E-02	6.6E-03	3.8E-03	5.0E-06	1.6E-04	3.4E-05	1.4E-05
12		Pollux seam	5.0E-05	2.6E-02	3.8E-03	7.7E-04	3.5E-06	6.0E-03	5.4E-04	2.2E-04
13		Interburden	1.6E-04	2.4E-02	5.0E-03	1.1E-03	1.5E-05	4.5E-03	6.0E-04	1.7E-04
14		Orion seam	3.1E-05	2.8E-01	2.3E-02	2.8E-01	2.7E-06	2.0E-01	1.0E-02	2.0E-01
15		Underburden	1.6E-05	1.1E-02	1.0E-03	4.0E-04	4.3E-08	1.6E-03	1.3E-04	1.1E-04
16	Burngrove Formation	Permian	2.4E-05	6.8E-03	8.8E-04	5.0E-05	2.4E-05	1.3E-03	1.6E-04	4.1E-05
17	Basement	Permian and/or below	1.2E-05	1.9E-03	5.0E-04	3.1E-04	3.6E-07	1.2E-03	5.2E-05	4.3E-06



Table 3-8 Calibrated Storage Parameters

Model Layer	Formation	Unit	Sy min (-)	Sy max (-)	Sy mean (-)	Sy BCM (m/day)	Ss min (m^{-1})	Ss max (m^{-1}))	Ss mean (m^{-1})	Ss BCM (m^{-1})
1	Alluvium/Tertiary	Surface cover	3.5E-02	7.2E-02	4.9E-02	5.0E-02	5.0E-07	2.7E-05	4.7E-06	5.8E-06
1	Alluvium/Tertiary	Tertiary	2.5E-02	4.0E-02	3.2E-02	2.8E-02	5.9E-07	3.7E-05	8.4E-06	3.0E-06
2	Alluvium/Weathered zone	Weathered zone Regolith	2.8E-02	6.7E-02	4.8E-02	4.0E-02	8.0E-07	4.6E-05	1.3E-05	5.5E-06
2	Alluvium/Weathered zone	Regolith	2.8E-02	4.2E-02	3.5E-02	3.6E-02	5.0E-07	1.4E-05	3.4E-06	1.7E-06
3	Clematis Group	Triassic	2.7E-03	5.3E-03	3.9E-03	3.4E-03	1.0E-07	2.1E-06	4.9E-07	8.4E-07
4	Rewan Group (Upper)	Triassic	1.4E-03	2.6E-02	8.5E-03	8.9E-03	1.3E-07	3.6E-06	1.0E-06	2.8E-07
5	Rewan Group (Middle)	Triassic	1.7E-03	2.4E-02	8.1E-03	3.9E-03	1.0E-07	2.5E-06	6.9E-07	4.6E-07
6	Rewan Group (Lower)	Triassic	3.0E-03	3.0E-02	1.4E-02	2.7E-02	1.3E-07	3.9E-06	9.4E-07	6.1E-07
7	RCM	Overburden	1.3E-03	1.5E-02	5.2E-03	2.9E-03	1.9E-07	4.5E-06	1.4E-06	1.7E-06
8		Aries seam	1.1E-03	2.4E-02	7.6E-03	4.2E-03	1.0E-07	3.2E-06	6.8E-07	2.1E-07
9		Interburden	2.1E-03	3.0E-02	1.1E-02	6.9E-03	2.2E-07	5.0E-06	2.1E-06	2.8E-06
10		Castor seam	1.1E-03	2.7E-02	5.8E-03	2.2E-03	2.3E-07	5.0E-06	1.5E-06	2.0E-06
11		Interburden	2.6E-03	3.0E-02	1.1E-02	4.7E-03	1.2E-07	3.1E-06	6.3E-07	1.4E-07
12		Pollux seam	1.1E-03	1.6E-02	5.9E-03	8.2E-03	1.5E-07	4.5E-06	8.0E-07	5.2E-07
13		Interburden	1.1E-03	2.3E-02	5.6E-03	2.9E-03	1.9E-07	5.0E-06	1.1E-06	5.7E-07
14		Orion seam	1.3E-03	2.3E-02	7.1E-03	2.7E-03	1.2E-07	4.5E-06	9.5E-07	1.1E-06
15		Underburden	1.1E-03	1.7E-02	6.0E-03	1.7E-02	1.1E-07	3.1E-06	8.2E-07	1.3E-06
16	Burngrove Formation	Permian	1.1E-03	2.2E-02	6.7E-03	8.0E-03	1.0E-07	2.2E-06	4.4E-07	2.7E-07
17	Basement	Permian and/or below	1.7E-03	2.8E-02	9.9E-03	1.4E-02	1.0E-07	1.2E-06	3.9E-07	3.6E-07



3.4.3 Calibrated Boundary Conditions

3.4.3.1 Calibrated Recharge

Table 3-9 presents the calibrated recharge rates for each zone in the model. The mean annual rainfall was assumed to be 546 millimetres per year (mm/year), based on SILO gridded data. This value was used to convert deep drainage to an equivalent annual rainfall.

Table 3-9 Calibrated Rainfall Recharge

Model Recharge Zone	Percentage of Rainfall (%)				Long-term Average Rainfall Recharge (mm/year)			
	Min	Max	Mean	BCM	Min	Max	Mean	BCM
Alluvium Quaternary	0.1	0.9	0.3	0.2	0.6	5.2	1.8	1.1
Regolith	0.0	0.3	0.1	0.1	0.1	1.7	0.4	0.4
Weathered Clematis	0.2	4.2	1.3	1.1	1.0	23.1	7.1	6.0
Weathered Permian	1.5	5.1	3.8	4.0	8.1	28.1	20.7	21.9
Spoil	1.0	5.4	2.8	3.0	5.6	29.7	15.3	16.1
Tailing	0.0	2.5	0.4	0.2	0.1	13.8	2.0	1.1

3.4.3.2 Calibrated Evapotranspiration

Table 3-10 presents the calibrated EVT rates and extinction depth. The mean annual potential ET was assumed to be 1,644 mm/year, based on SILO gridded data. This value was applied to the steady-state and predictive periods, while a time-varying series was applied during the transient calibration period.



Table 3-10 Calibrated Evapotranspiration Rate and Extinction Depth Bounds

Model EVT Zone	EVT factor of PAN				EVT Depth (m)				Long-term Potential EVT (mm/year)	Long-term Average EVT (mm/year)			
	Min	Max	Mean	BCM	Min	Max	Mean	BCM		Min	Max	Mean	BCM
Alluvium Quaternary	0.5	0.9	0.7	0.6	1.7	13.7	6.6	5.0	1644.0	845.6	1543.9	1105.2	1041.6
Regolith	0.5	0.9	0.7	0.8	0.7	11.2	3.3	4.5		897.6	1557.7	1198.5	1361.8
Weathered Clematis	0.5	0.8	0.7	0.6	0.6	12.5	3.6	4.3		822.7	1372.4	1077.7	1044.1
Weathered Permian	0.5	0.8	0.6	0.6	6.6	14.9	11.5	12.7		821.3	1350.1	1028.7	1025.5
Spoil	0.5	0.9	0.6	0.5	0.5	2.5	1.2	1.3		821.3	1404.9	1056.4	821.3
Tailing	0.5	0.9	0.7	0.6	0.5	2.9	1.2	1.2		838.2	1471.0	1102.5	903.4



3.4.3.3 Calibrated River Boundary

Calibrated river vertical conductivity are presented in **Table 3-11** and calibrated tailing deposition vertical conductivity are presented in **Table 3-12**.

Table 3-11 Calibrated River Vertical Conductivity

Zone	Vertical K (m/day)				River Name
	Min	Max	Mean	BCM	
1	1.2E-05	1.6E-01	1.5E-02	8.9E-03	Blackwater mainstream
2	8.5E-04	1.0E+00	3.6E-01	2.1E-01	Blackwater tributaries
3	1.0E-05	1.9E-01	7.7E-03	3.7E-03	Sirius Creek
4	5.3E-05	5.6E-01	3.2E-02	2.7E-03	Rockland Creek and tributaries
5	2.1E-05	7.9E-01	3.8E-02	1.5E-02	Humboldt Creek and tributaries
6	9.0E-05	7.4E-01	8.3E-02	2.5E-02	Planet Creek and tributaries
7	1.0E-05	2.8E-01	1.5E-02	3.8E-05	Small streams
8	1.1E-05	1.5E-01	7.3E-03	7.4E-05	Deep Creek dam
9	1.0E-05	6.7E-02	4.2E-03	8.8E-04	New Taurus dam
10	3.7E-05	6.2E-01	3.8E-02	1.7E-04	Tannyfoil dam

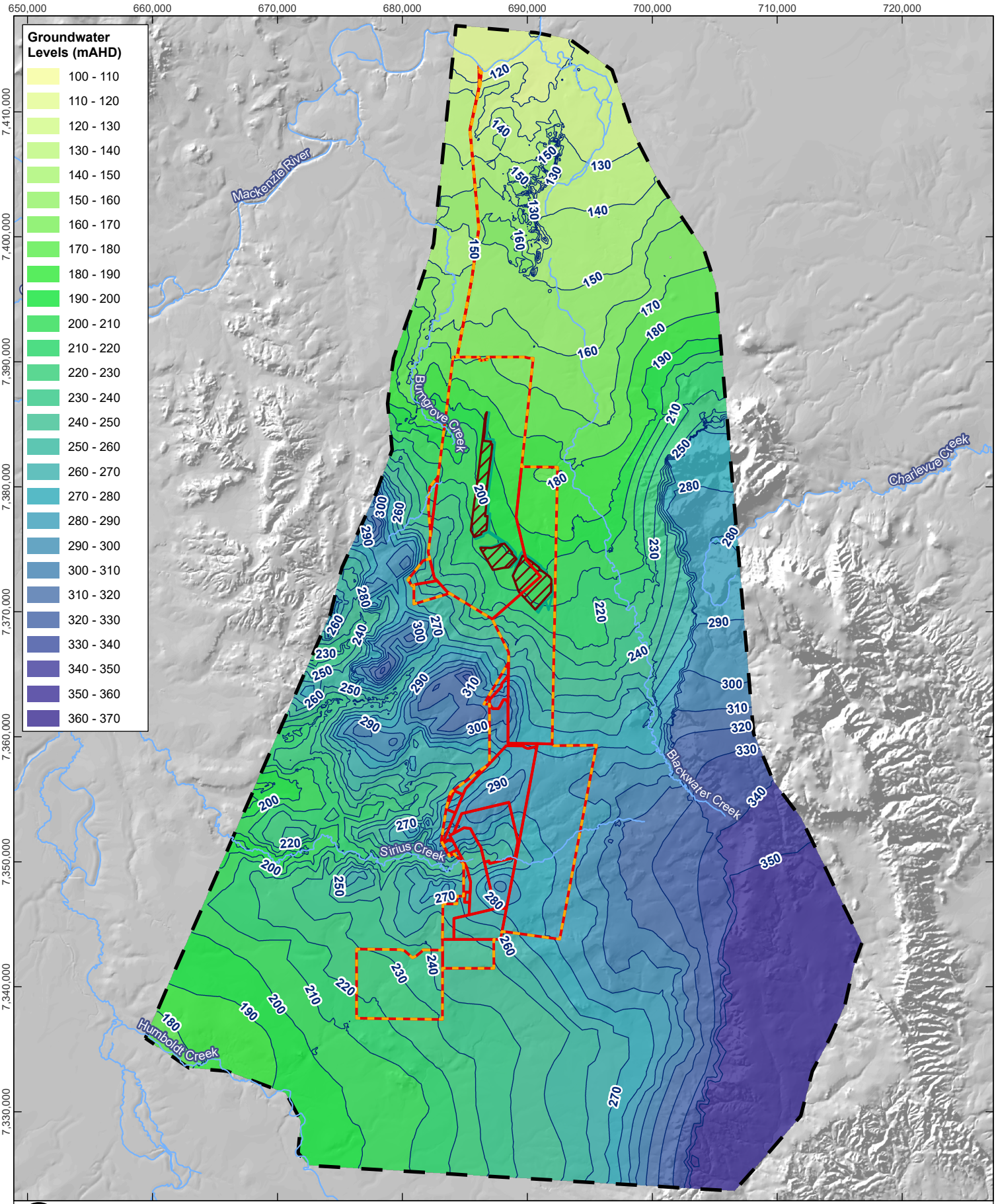
Table 3-12 Calibrated Tailing Deposition Vertical Conductivity

Tailings	Kz (m/day)				Stage
	Min	Max	Mean	BCM	
BD-R10N	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from July 2023 until 2040
BD-R12N	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from July 2023 until 2040
BD-R12S	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from July 2023 until 2040
R74	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from Oct 2015 until 2023
Curragh Mine	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from Jan 2007 until 2023

3.4.4 Calibrated Water Table Elevation

The calibrated water table elevation is presented for steady state period (**Figure 3-9**) and the end of the calibration period (**Figure 3-10**).





0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- Groundwater Level Contour (10mAHD)
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

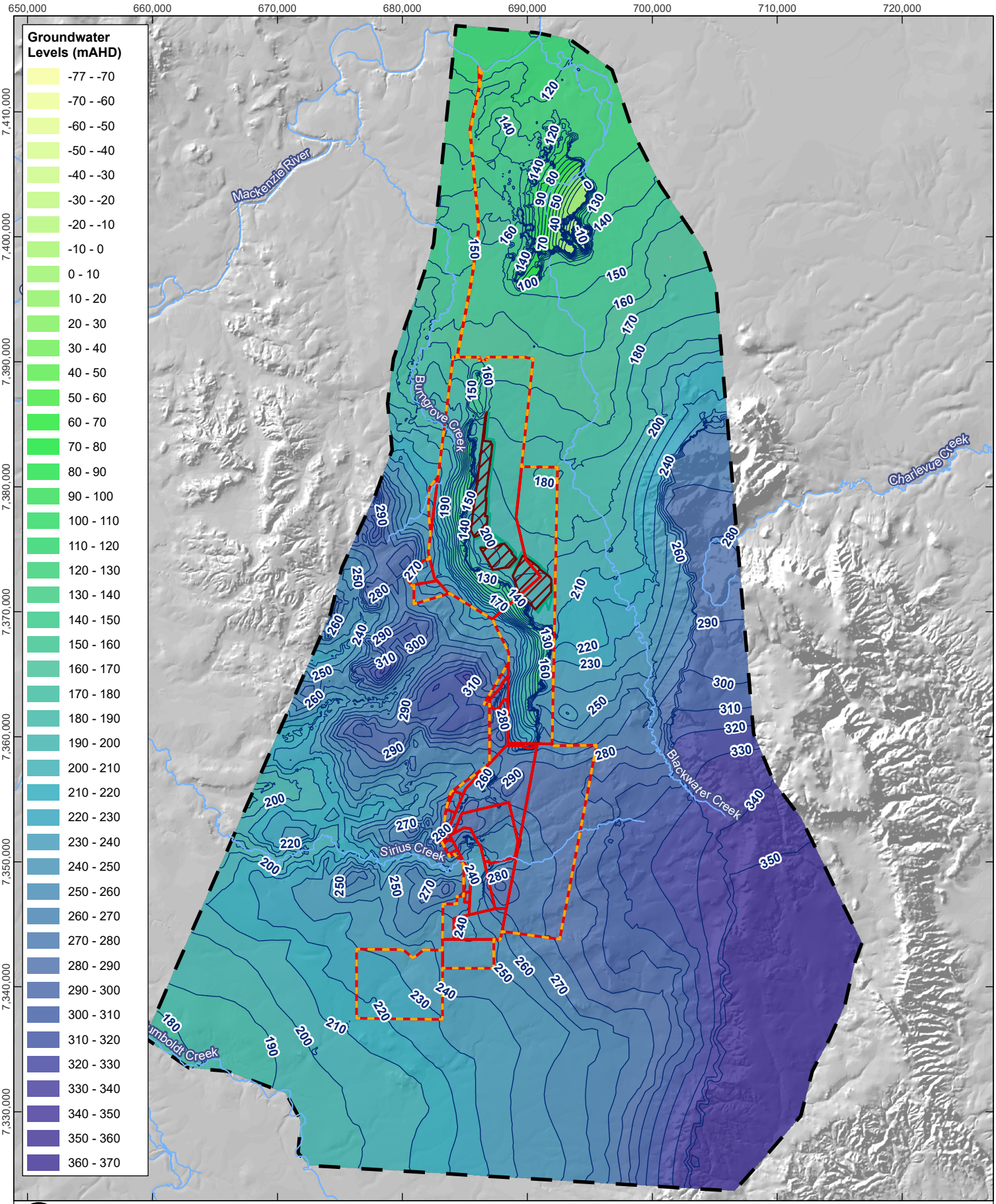
CALIBRATED WATER TABLE ELEVATION, STEADY STATE

SLR

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FIGURE 3-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F03_09_Calibrated Water Table Elevation - Steady State Period



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- Groundwater Level Contour (10mAHD)
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

CALIBRATED WATER TABLE ELEVATION - END OF CALIBRATION

SLR

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FIGURE 3-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F03_10_Calibrated Water Table Elevation - End of Calibration

4.0 Predictive Modelling – Mining Period

4.1 Timing and Mining

Transient predictive modelling was used to simulate the proposed mining at the Project as well as mining at other approved and foreseeable mines within the model domain. The cumulative assessment was undertaken for BWM (northern portion), the Project (SA 7 and SA 10), BWM (southern portion), Curragh Mine (operating mine), and Cook Collieries. The simulated predictive mine progression for BWM, including the Project, is presented in **Figure 4-1**.

The predictive part of the model comprises annual stress periods, commencing January 2025 through until December 2093. The predictive model stress period setup is detailed in **Appendix C** alongside simulated mine timings.

Transient predictive models have been developed for three scenarios:

- Cumulative Scenario– all approved and foreseeable mining in the model area and at BWM plus the Project.
- Approved Scenario– all approved and foreseeable mining in in the model area and at BWM without the Project.
- Null Run – no mining within the model area.

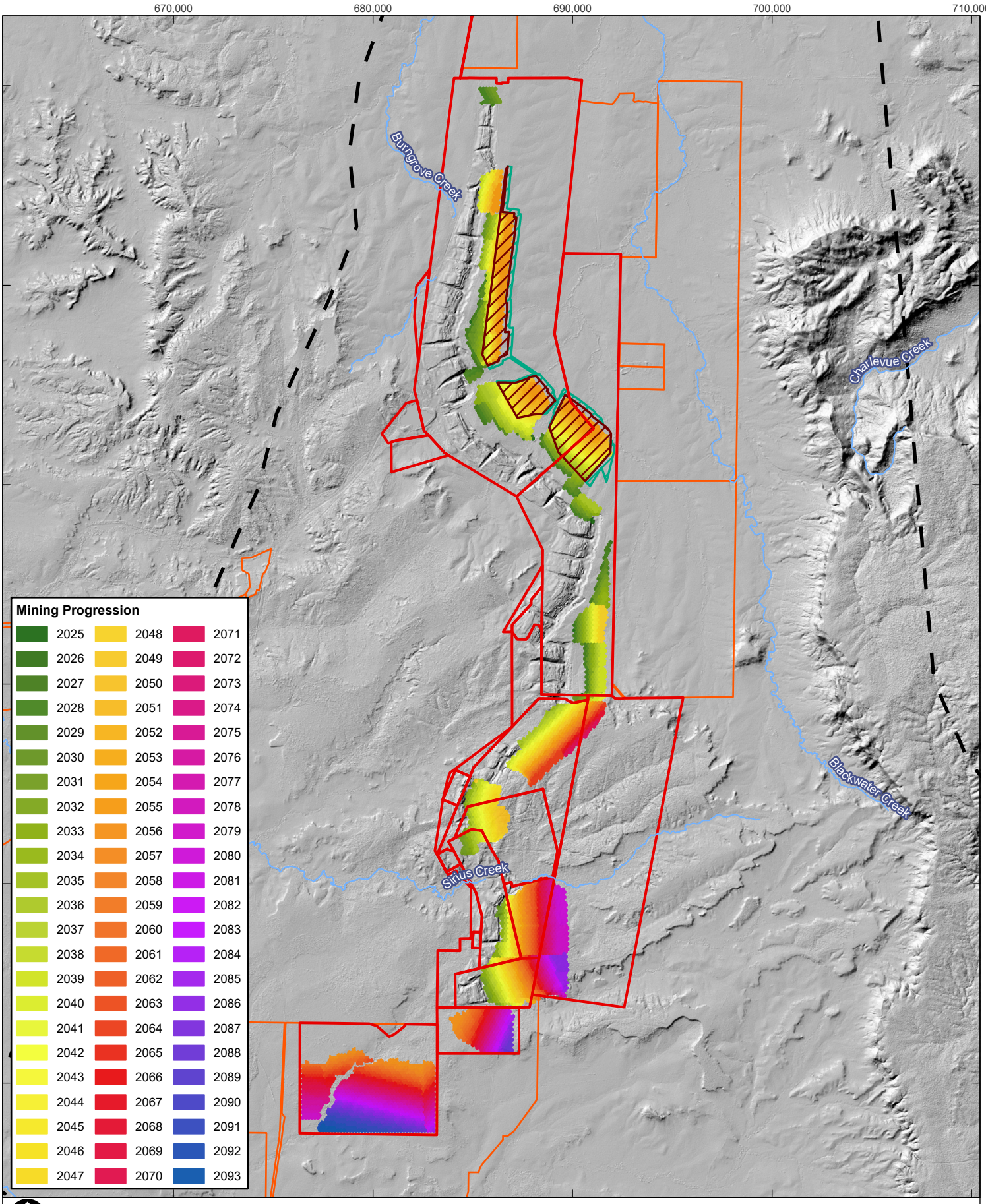
The Project effects (i.e. the incremental changes) are estimated by the difference between the Cumulative and Approved scenarios. Mining cells progressed annually and drain cells simulating the mining were projected down to the base of the lowermost target coal seam (i.e. the Pollux seam).

To define the active drainage period for the mining cells at the project, rather than assuming a fixed period of 1 or 2 years, an in-house script that dynamically calculates this period by referencing adjacent mining cells was utilised. For each cell, the script identifies the nearest mined neighbour in the same pit and compares their mining time. The difference determines how long the cell should be draining, providing a more realistic and spatially responsive representation of pit dewatering. After the drains were removed the TVM package was used to assign spoil/void/tailing properties to the cells depending on their spatial location.

Appendix C presents the simulated mine timings for the Project and surrounding mines used in the predictive model. BWM (including the Project) was included for the predictive run, as all other mines have either been in closure or care and maintenance or the future mining sequence was not available. The cumulative impact assessment however will consider those mines as they were included in the calibration period up to end of 2024. The following applies:

- Cook Colliery underground mining: in closure, active during calibration period and included as such.
- Curragh mine: Coronado currently operates the Curragh coal mine complex, which is located adjacent to the Project and approximately 8 km north of Blackwater Township. The complex comprises two open cut mines (Curragh North and Curragh South) and an underground mine (Mammoth Underground). The open cut operations began in 1983, extracting coal from the Aries, Pisces, Castor and Pollux coal seams of the RCM, while the underground mine started in 2024.

All mines included in the model were simulated using the DRN package. A nominally high drain conductance of 100 square metres per day (m²/day) was applied to drain cells to simulate rapid removal of water from the system.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Study Area
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PROJECT INDICATIVE MINE PROGRESSION

SLR

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FIGURE 4-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_01_Project Indicative Mine Progression

4.2 Water Balance

Table 4-1 to **Table 4-3** provide average flow rates (January 2025 until December 2093) for water transfer into and out of the groundwater model domain for the three predictive scenarios; the Cumulative, Approved and Null Run. The cumulative mass balance error over the entire simulation period is < 0.1% for all three scenarios.

The tables show that simulated recharge increased from 61.8 ML/day in the Null scenario to 64.5 ML/day and 62.7 ML/day in the Cumulative scenario and the Approved scenario respectively. The increase in recharge is due to the presence of open cut mining and enhanced recharge through the spoil to the groundwater system in the Approved and Cumulative scenarios.

Table 4-1 to **Table 4-3** and **Figure 4-2** to **Figure 4-4** show that in all three predictive scenarios, groundwater leaves the model through regional groundwater flow (GHB). The GHB inflow and outflow are < 0.4% of the total inflow and outflow in water balance for all the scenarios indicating the model boundary conditions do not have a significant influence on the model predictions.

ET decreased from 56.6 ML/day in the Null Scenario to 51.4 ML/day and 51.7 ML/day in the Project and Approved scenarios. The ET decline is primarily due to the mining activities and decline of water levels within the saturated shallow areas such as voids, pits or outcropping areas.

The net groundwater flow to Blackwater Creek is 0.02 ML/day in all three scenarios. All scenarios indicate the flow is generally from groundwater to the Creek, however this flow is very minor (and shows that Blackwater Creek does not receive continuous amounts of baseflow).

Groundwater outflow from the model occurs predominantly via drain cells, used to simulate open cut and underground mining activity in the model. **Table 4-1** and **Table 4-2** show that the Cumulative scenario resulted in an increase in the average drain outflow (to 14.5 ML/day from 11.8 ML/day predicted for the Approved scenario). The storage component in the table refers to changes in the water level over the transient simulation timeframe. Changes in the storage between the Approved and Cumulative Scenarios relate to the change in mine footprint and added recharge through spoil.

Table 4-1 Average Simulated Water Balance over the Predictive Period - Cumulative

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total outflow (%)
Recharge (RCH)	64.5	75.4	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	51.4	60.0
Surface Drainages (RIV)	0.0	0.0	0.0	0.0
Pit Lakes and dams (CHD)	6.9	8.1	5.2	6.1
Regional Groundwater Flow (GHB)	0.3	0.4	0.1	0.2
Mines (DRN)	0.0	0.0	14.5	16.9
Storage	13.8	16.1	14.3	16.8
Total	**85.5**	**100.0**	**85.6**	**100.0**

Table 4-2 Average Simulated Water Balance over the Predictive Period – Approved

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total outflow (%)
Recharge (RCH)	62.7	77.2	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	51.7	63.6
Surface Drainages (RIV)	0.0	0.0	0.0	0.0
Pit Lakes and dams (CHD)	6.0	7.5	7.9	9.8
Regional Groundwater Flow (GHB)	0.3	0.4	0.1	0.2
Mines (DRN)	0.0	0.0	11.8	14.5
Storage	12.2	15.0	9.6	11.9
Total	**81.2**	**100.0**	**81.2**	**100.0**

Table 4-3 Average Simulated Water Balance over the Predictive Period - Null Run

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total outflow (%)
Recharge (RCH)	61.8	99.6	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	61.8	99.7
Surface Drainages (RIV)	0.0	0.0	0.0	0.0
Pit Lakes and dams (CHD)	0.0	0.0	0.0	0.0
Regional Groundwater Flow (GHB)	0.0	0.0	0.2	0.2
Mines (DRN)	0.0	0.0	0.0	0.0
Storage	0.2	0.4	0.0	0.0
Total	**62.0**	**100.0**	**62.0**	**100.0**



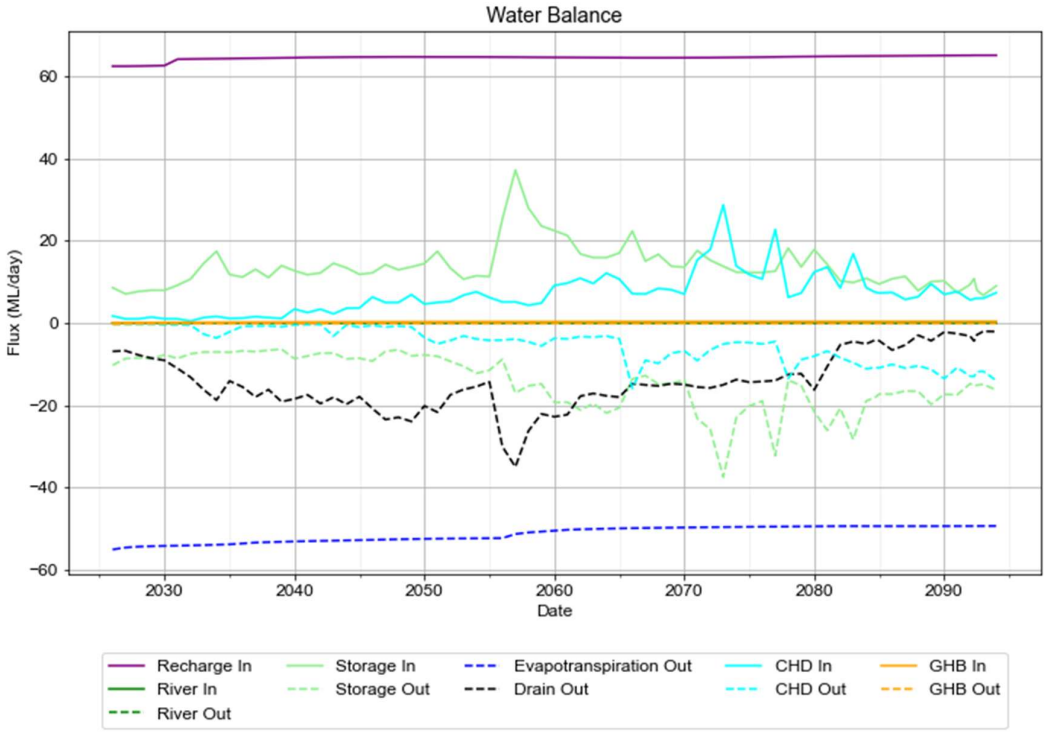


Figure 4-2 Transient Water Balance Over the Prediction Period – Cumulative

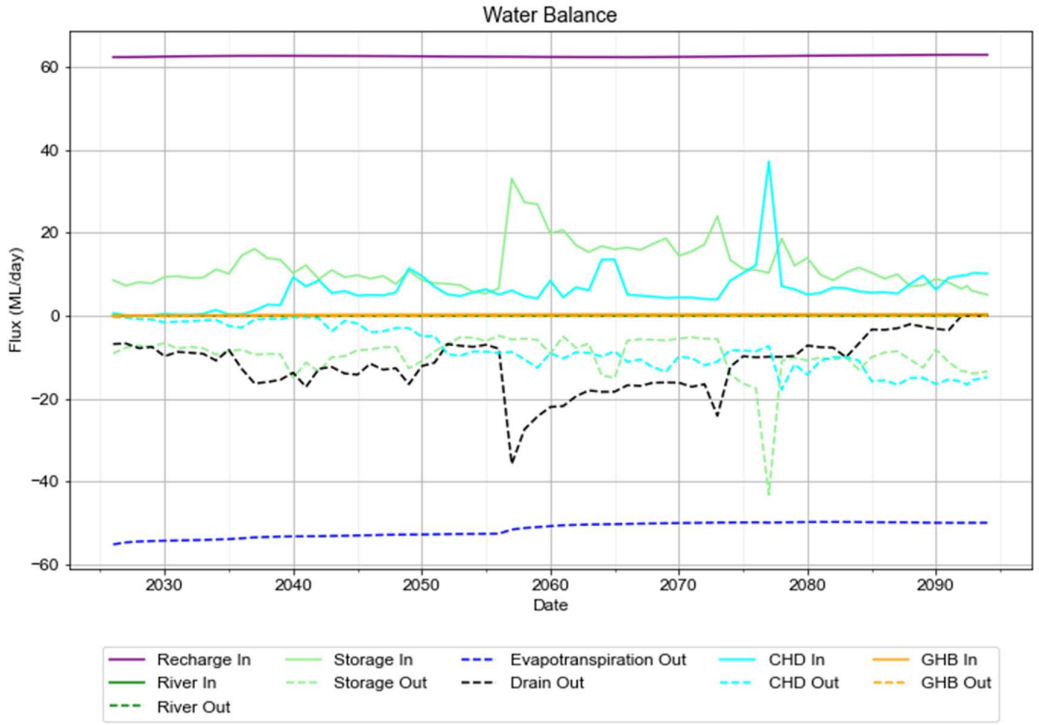


Figure 4-3 Transient Water Balance Over the Prediction Period - Approved

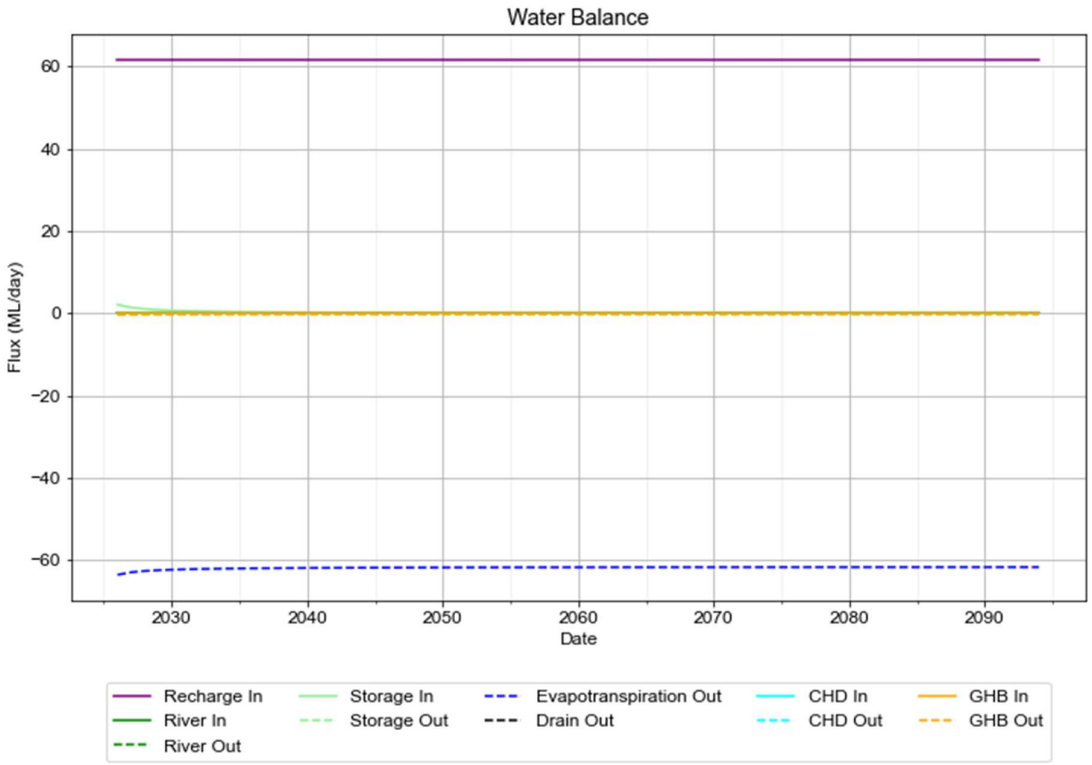


Figure 4-4 Transient Water Balance Over the Prediction Period – Null Run

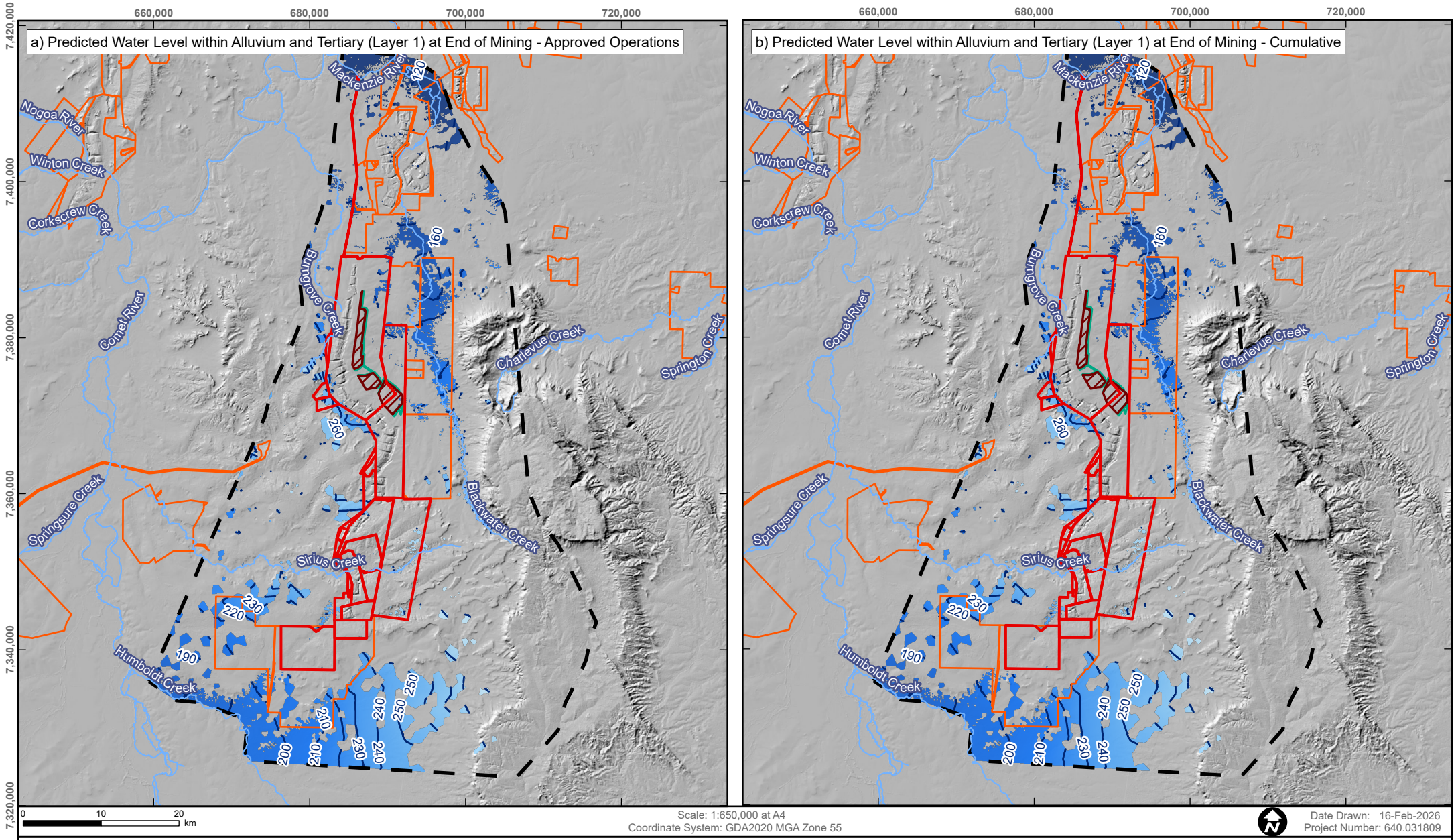
4.3 Predicted Groundwater Levels

Predicted groundwater levels at the end of the modelling timeframe for the Approved and Cumulative scenarios are provided in **Figure 4-5** to **Figure 4-8**. In these four figures, the Approved scenario is presented on the left side, and the Cumulative scenario is presented on the right side. The grey cells in the water level grids represent unsaturated areas (i.e., where the simulated water level elevation is below the base of cell) or an area where the layer is not present.

Minimal changes to alluvium/tertiary (Layer 1) groundwater levels are observed between the Approved and Cumulative mining scenarios (**Figure 4-5**). **Figure 4-6** shows that the dewatering of the weathered zone (Layer 2) caused by the Project occurs particularly within the area immediately to the east of the Project area. **Figure 4-6** also shows that there are no significant changes to the water levels along Blackwater Creek between the Approved and Cumulative Scenarios.

Figure 4-7 shows the predicted groundwater levels in the Clematis sandstone (Layer 3). The Clematis Sandstone is presenting as an outcrop at the eastern side of the model and is disconnected from the Permian coal measures by the Rewan formation. **Figure 4-7** also shows that there are no significant changes to the water levels between the Approved and Cumulative scenarios, indicating that the Clematis sandstone would not be impacted by the Project.

Figure 4-8 show the predicted water levels in the Permian coal measures (Layer 12) at the end of mining for the Approved and Cumulative mining scenarios. **Figure 4-8** shows that the groundwater flow is generally from southeast and south towards Blackwater Creek in the centre and north of the model. Zones of depressurisation at the Project and surrounding mines are shown to cause localised interruptions to the regional flow gradient.



Scale: 1:650,000 at A4
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Credits:

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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Study Area
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

332

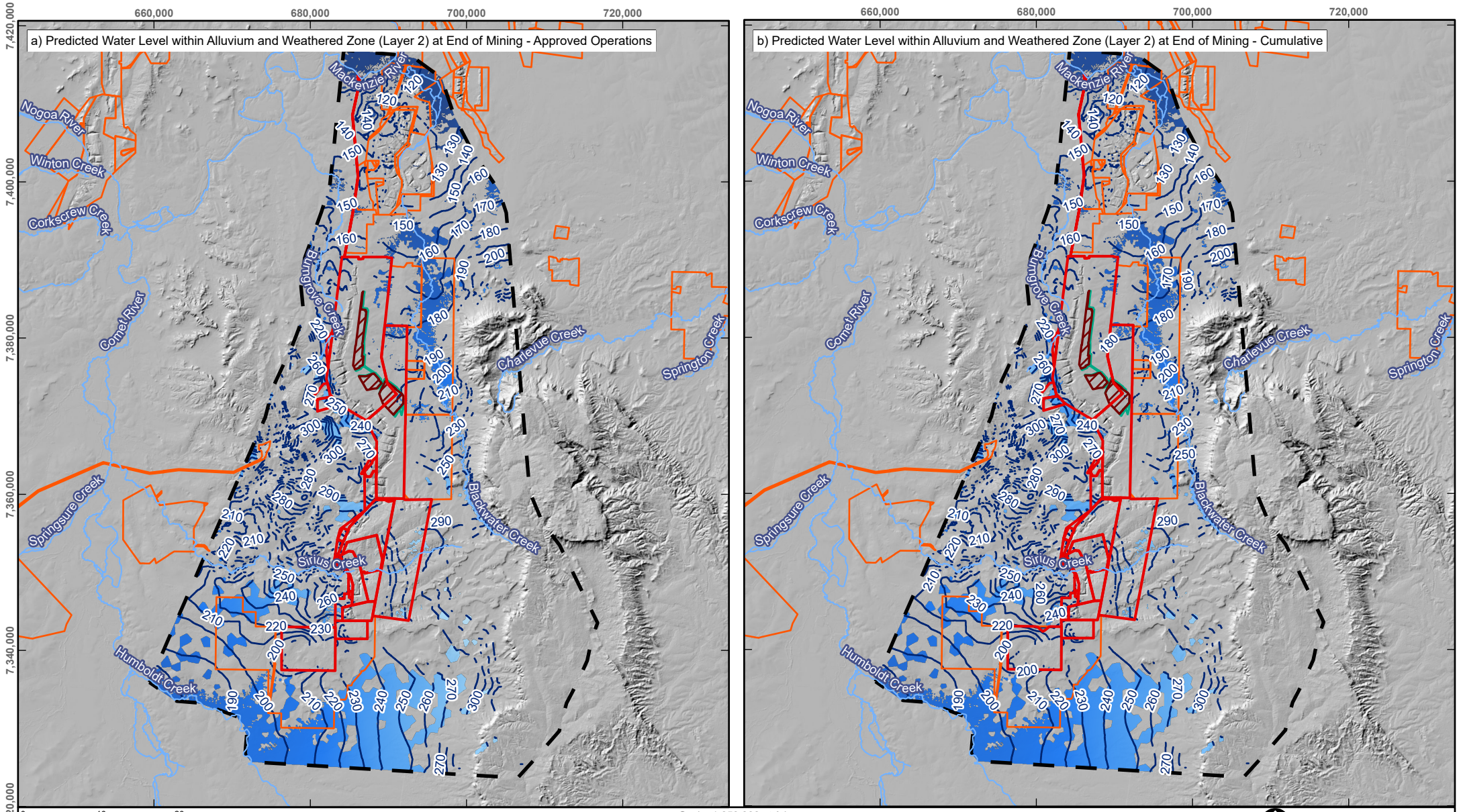
90

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER LEVEL WITHIN THE ALLUVIUM AND TERTIARY (LAYER 1) AT THE END OF MINING

FIGURE 4-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_05_Predicted Water Level within the Alluvium and Tertiary (Layer 1) at the EOM



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

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Project Number: 640.031809

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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

334

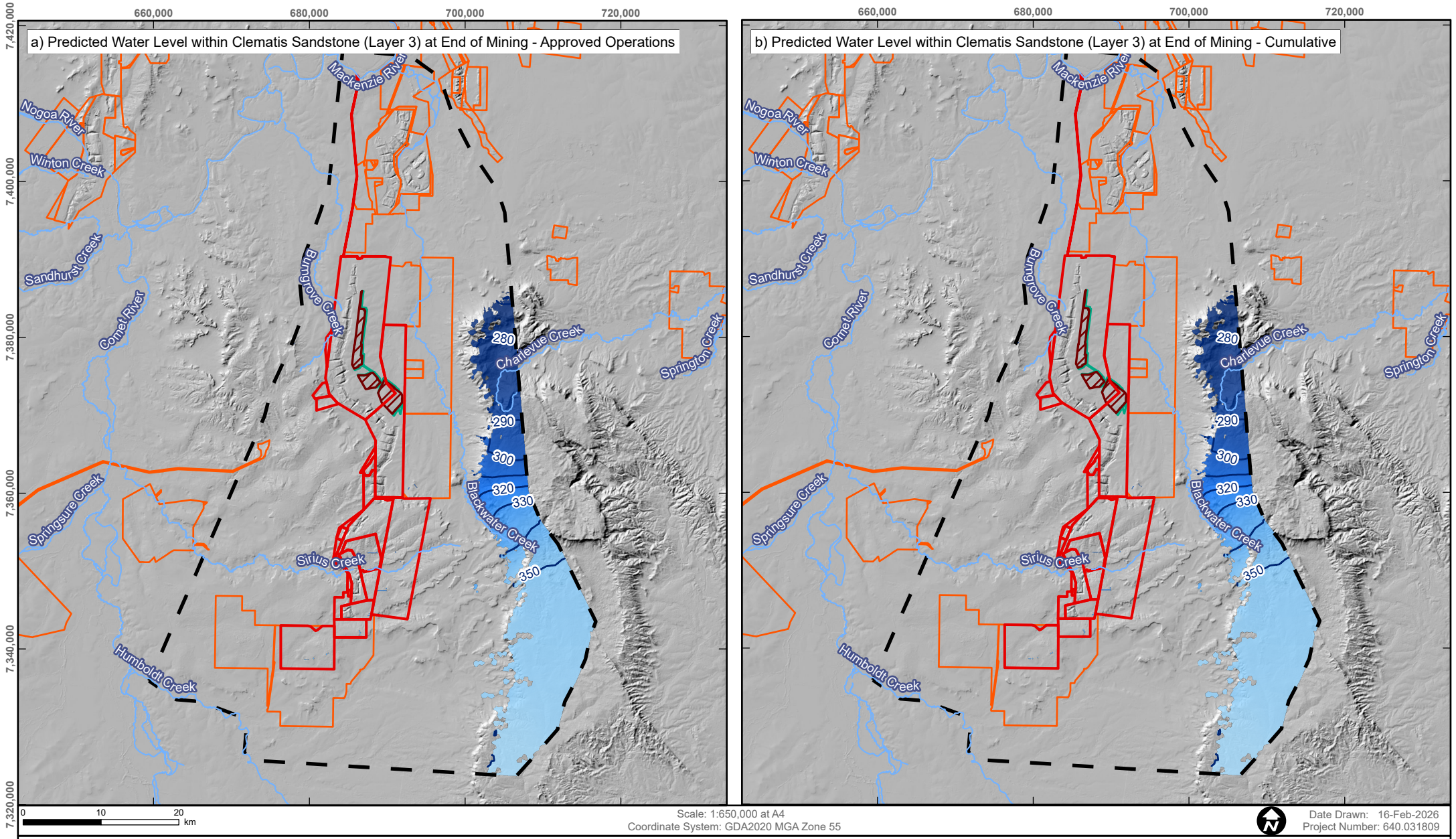
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BLACKWATER NORTH EXTENSION PROJECT
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PREDICTED WATER LEVEL WITHIN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2) AT THE END OF MINING

FIGURE 4-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_06_Predicted Water Level within the Alluvium and Weathered Zone (Layer 2) at the EOM



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

363

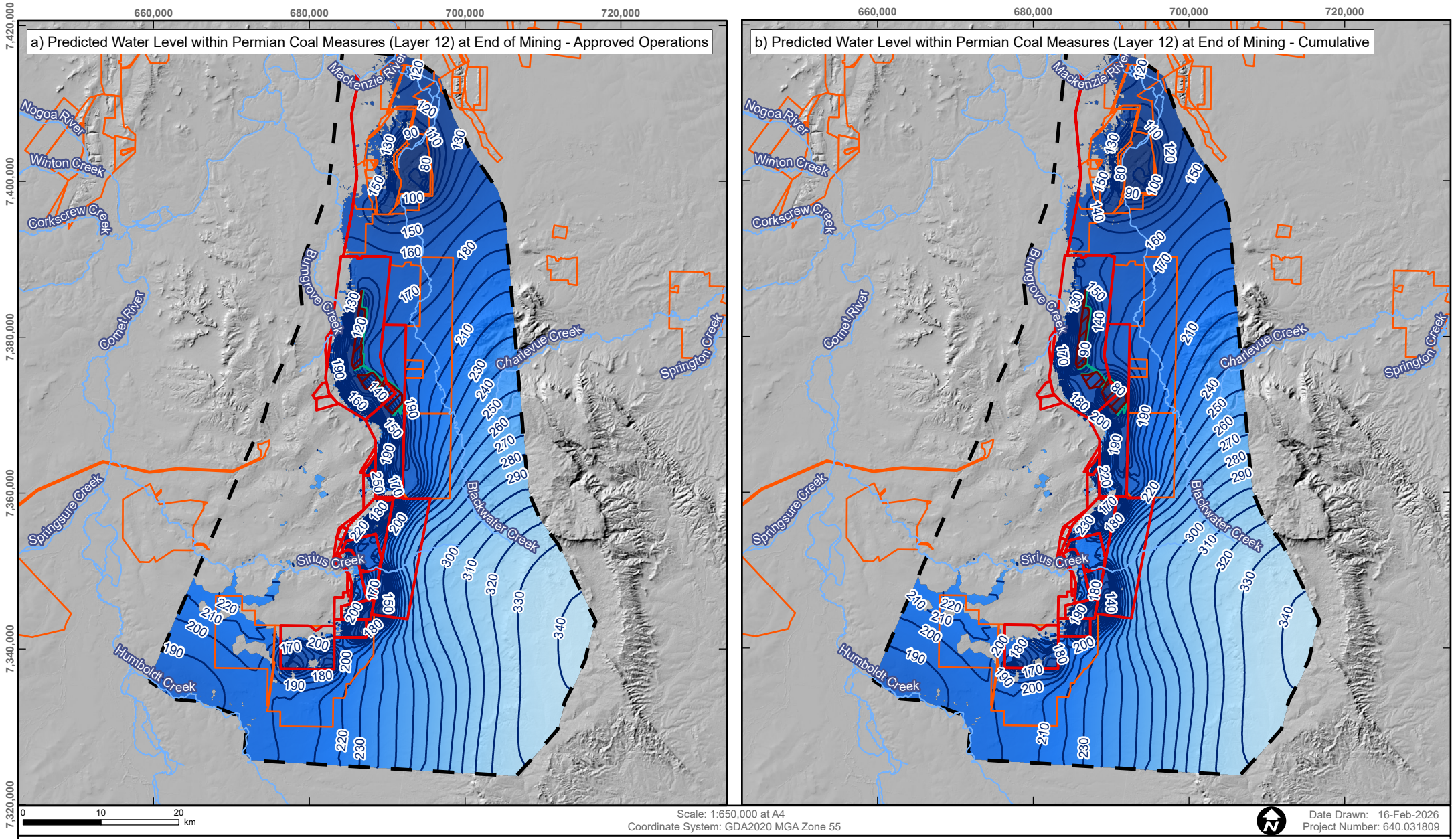
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BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER LEVEL WITHIN THE CLEMATIS SANDSTONE (LAYER 3) AT THE END OF MINING

FIGURE 4-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_07_Predicted Water Level within the Clematis Sandstone (Layer 3) at the EOM



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 16-Feb-2026
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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

342

68

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER LEVEL WITHIN THE PERMIAN COAL MEASURES (LAYER 12) AT THE END OF MINING

FIGURE 4-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_08_Predicted Water Level within the Permian Coal Measures (Layer 12) at the EOM

4.4 Maximum Predicted Drawdowns

The process of mining directly removes water from the groundwater system and reduces water levels in surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown. Aquifer drawdown is greatest at the working coalface and decreases with distance from the mine.

4.4.1 Maximum Incremental Drawdowns

Maximum incremental drawdown refers to the drawdown impact associated with the Project and is obtained by subtracting the predicted maximum aquifer groundwater drawdown for the Approved model scenario (Null – Approved) over the model duration from the predicted maximum aquifer groundwater drawdown for the Cumulative model scenario (Null – Project) over the model duration. The maximum drawdown represents the maximum drawdown values recorded at each model cell. Predicted incremental drawdown figures are presented in **Figure 4-9** to **Figure 4-16**, on the left side.

Figure 4-9 (a) shows that no incremental drawdown greater than (>) 1 m are predicted for the alluvium as a result of mining at the Project. For a discussion on the potential incidental water impacts on the alluvium, see **Section 4.6.1**. The maximum predicted incremental drawdowns associated with the Project within the weathered zone is shown in **Figure 4-10** (a). The incremental drawdown extent within the weathered zone (Layer 2) is largely confined to near the pit and is influenced by the distribution of predicted saturated zones in the weathered zone.

Figure 4-11 (a), **Figure 4-12** (a), and **Figure 4-13** (a) show the maximum predicted incremental drawdown in the Upper, Middle and Lower Rewan Formation, respectively. Drawdown increases with depth across the Rewan Formation, with Layer 6 showing incremental drawdown associated with the Project. The incremental drawdown extent is largely confined to near the pit, and in the lower Rewan. The lower Rewan is expected to be primarily disconnected from shallow receptors, and the drawdown does not propagate into the upper Rewan.

The Permian coal seams are the primary aquifers targeted by the Project and will experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents. **Figure 4-14** (a) and **Figure 4-15** (a) show the maximum predicted incremental drawdown for the Aries and Pollux Seams in the RCM, respectively. The figures show that to the west, the extent of maximum predicted incremental drawdown of the Permian coal measures is limited to near the pit due to the structural geology (i.e., coal seams subcrop). The extent of maximum predicted incremental drawdown in the coal seams towards the east extends laterally to Blackwater Creek, however at depth, not vertically into the shallow formations, such as alluvium or Tertiary.

Maximum predicted incremental drawdown for the Burngrove Formation is shown in **Figure 4-16** (a). The figure shows that maximum predicted incremental drawdown is similar to the drawdown in the coal seams and is limited to the coal seam outcrop.

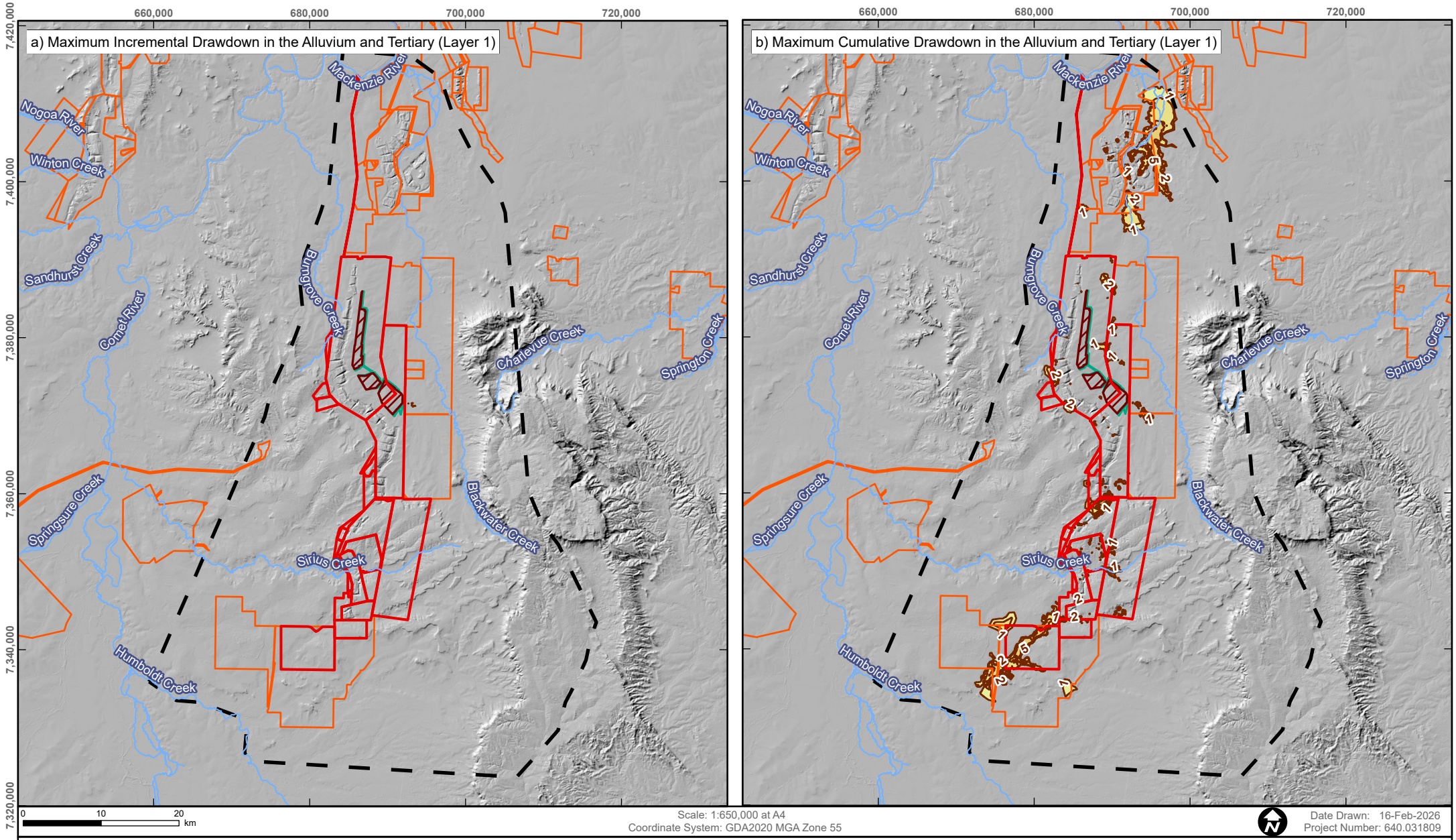
4.4.2 Maximum Cumulative Drawdowns

Maximum cumulative drawdown predicted impacts are shown in **Figure 4-9** to **Figure 4-16**, on the right side. These drawdowns represent the total impact of mining by all current mining and foreseeable mining, including the Project. The cumulative drawdown is derived by calculating the maximum difference in the groundwater levels for the Cumulative scenario with those in a theoretical “No Mining” or Null Run scenario, for all times during the predictive model period.

Cumulative drawdown impacts for the Alluvium and Tertiary (**Figure 4-9**, [b]) show that maximum predicted cumulative drawdown impacts are in the north near Blackwater Creek. Cumulative impacts within the weathered zone (**Figure 4-10**, [b]) can be seen connecting to the drawdown in the Tertiary.

Figure 4-14 (b) and **Figure 4-15** (b) show the maximum predicted cumulative drawdown in the Aries and Pollux seams in the RCM. As shown in the figures the maximum cumulative drawdown is bounded on the western side by the coal seam outcrop and predicted to extend generally a distance of 5-7 km east of the mining areas. The cumulative drawdown reached the model boundary in the northeast, which coincides with a major fault. An extension of the model in that area would still result in the same drawdown, as the fault is expected to act as a barrier to flow.

Figure 4-16 (b) shows the maximum predicted cumulative drawdown in the Burngrove Formation. The maximum cumulative drawdown for Burngrove is similar to the drawdowns expected in the Permian coal measures and predicted to extend approximately 5-7 km east of the mining areas.



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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Study Area
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

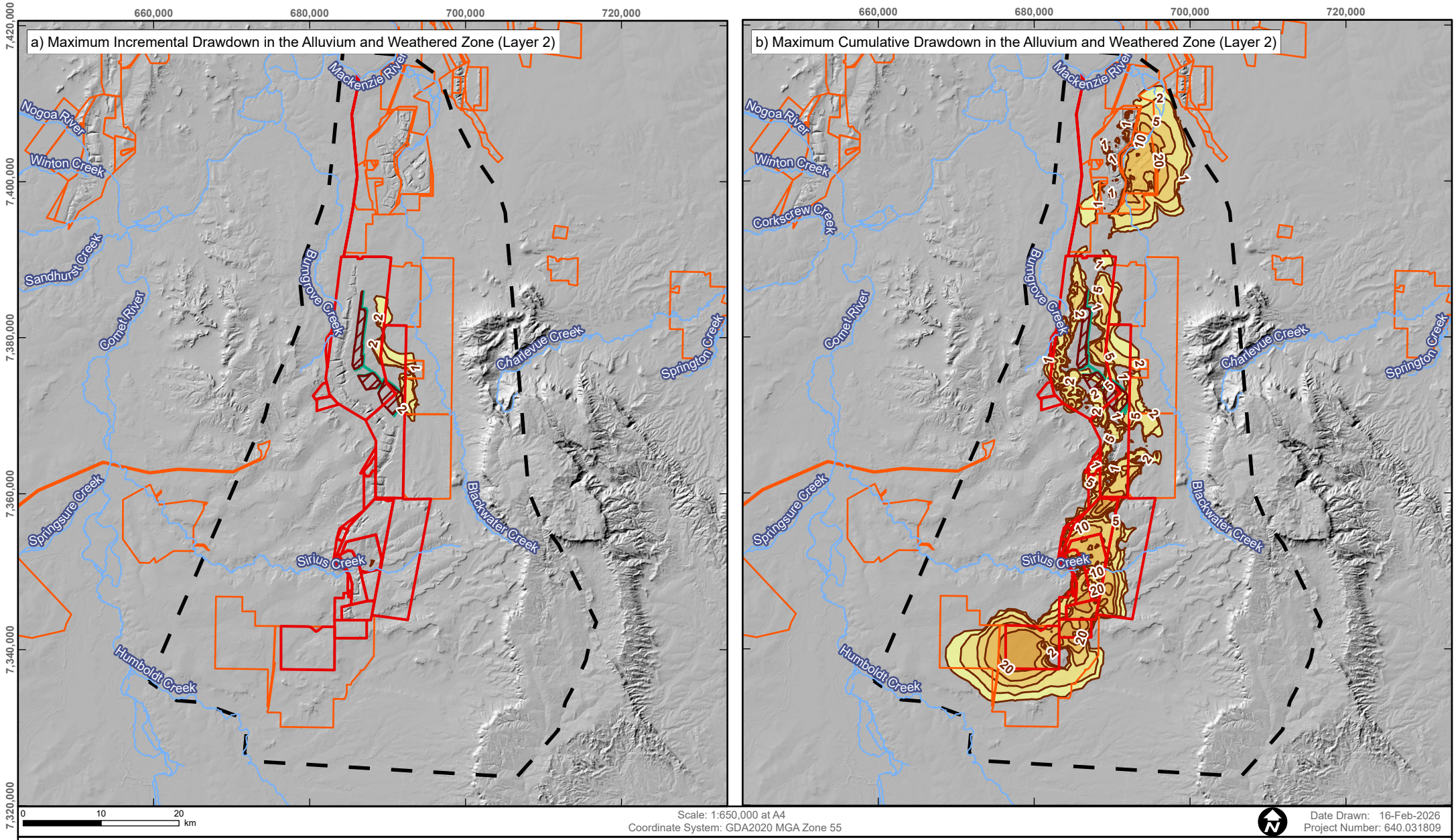
1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE ALLUVIUM AND TERTIARY (LAYER 1)

FIGURE 4-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_09_Maximum Incremental (a) and Cumulative (b) Drawdown in the Alluvium and Tertiary (Layer 1)



Scale: 1:650,000 at A4
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Project Number: 640.031809

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Service Layer Credits:

Credits:

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LEGEND

- Watercourse
- BWM Mining Lease
- Model Boundary
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

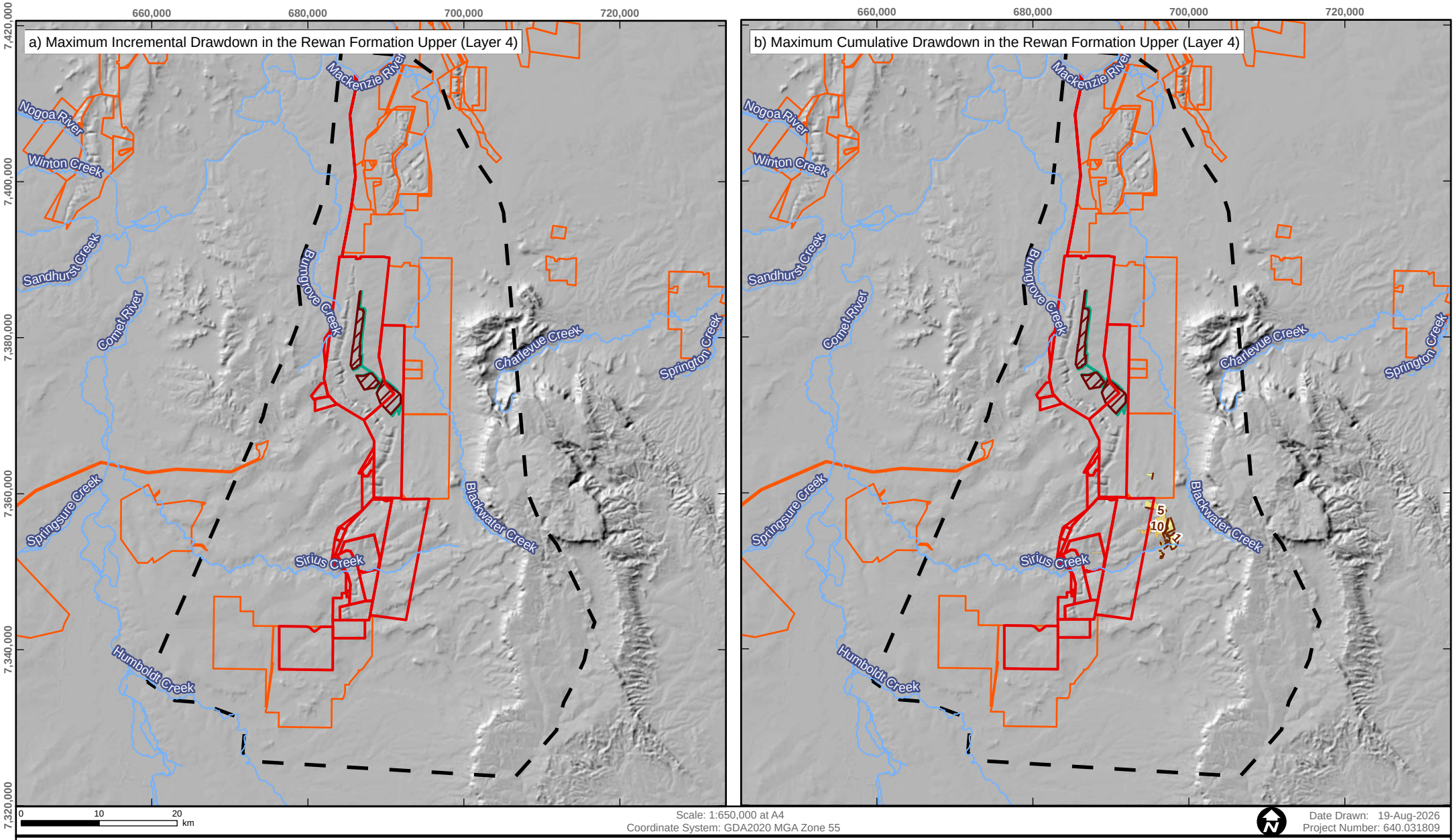
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2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

FIGURE 4-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_10_Maximum Incremental (a) and Cumulative (b) Drawdown in the Alluvium and Weathered Zone (Layer 2)



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 19-Aug-2026
Project Number: 640.031809

SLR

Service Layer Credits:

Credits:

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LEGEND

- Watercourse
- Drawdown Contour (m)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Drawdown (m)

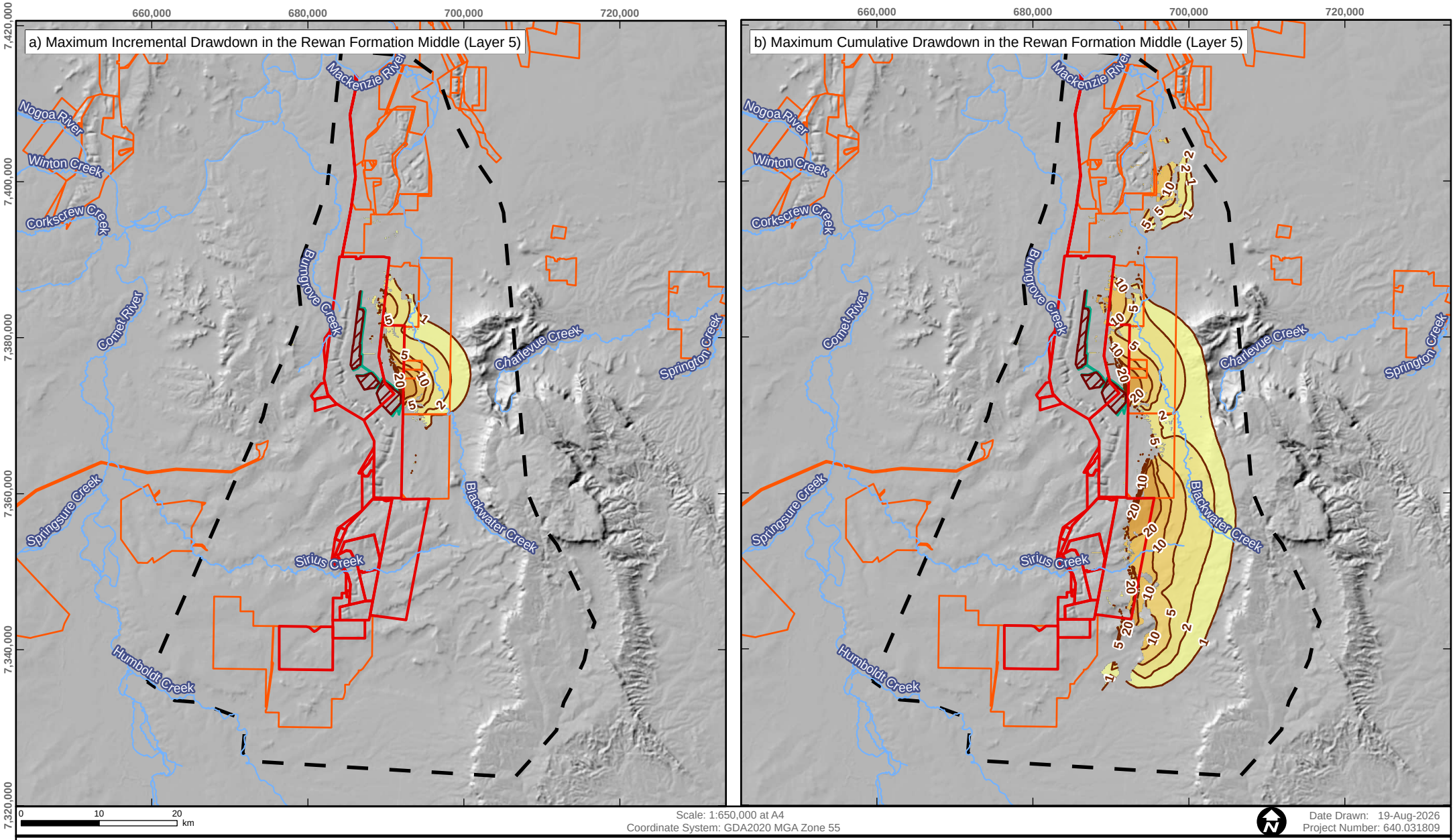
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE REWAN FORMATION UPPER (LAYER 4)

FIGURE 4-11

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Maximum Incremental (a) and Cumulative (b) Drawdown in the Rewan Formation Upper (Layer 4)



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 19-Aug-2026
Project Number: 640.031809

SLR

Service Layer Credits:

Credits:

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LEGEND

- Watercourse
- Drawdown Contour (m)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Drawdown (m)

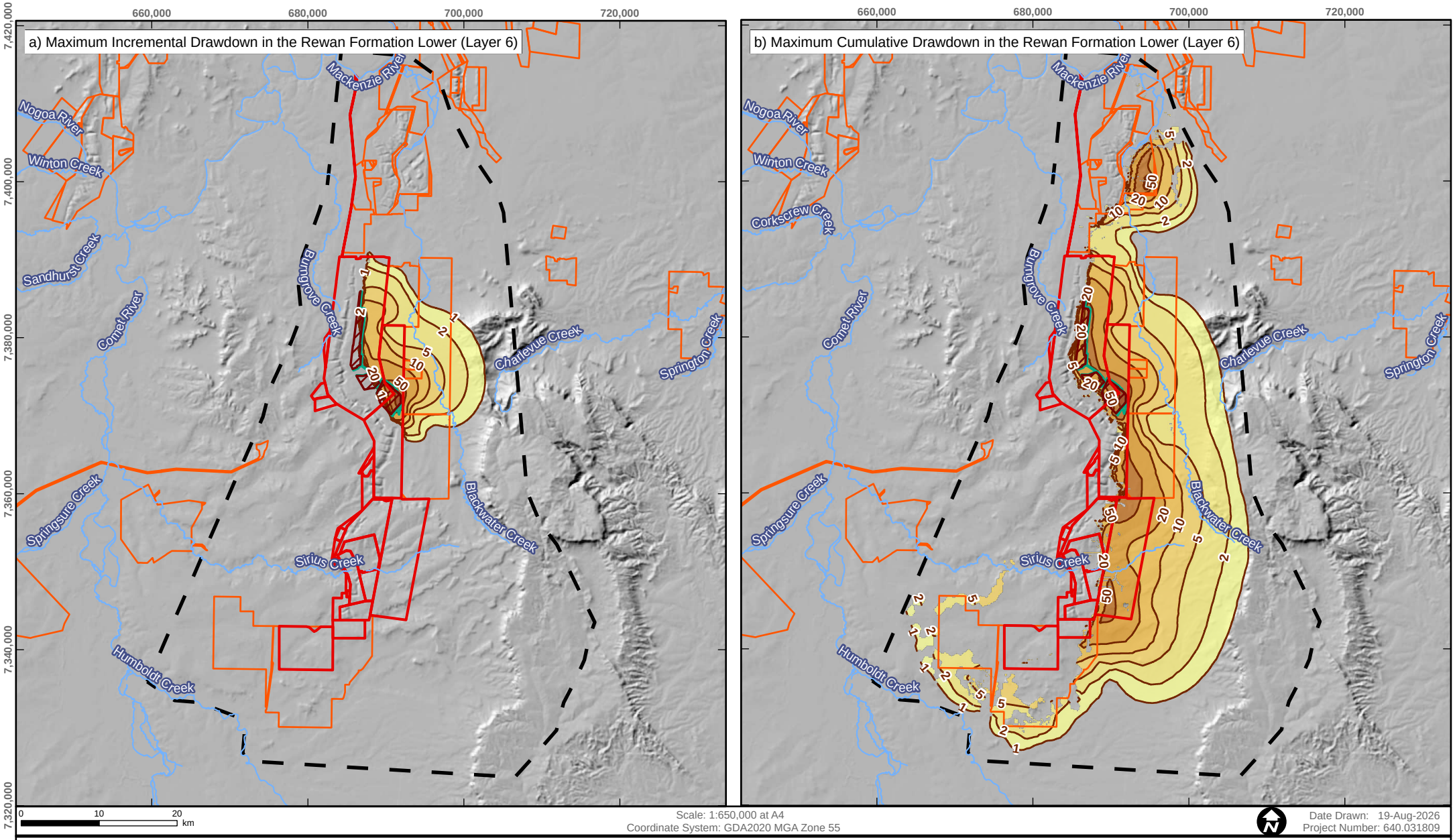
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE REWAN FORMATION MIDDLE (LAYER 5)

FIGURE4-12

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Maximum Incremental (a) and Cumulative (b) Drawdown in the Rewan Formation Middle (Layer 5)



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 19-Aug-2026
Project Number: 640.031809

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Service Layer Credits:

Credits:

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LEGEND

- Watercourse
- Drawdown Contour (m)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Drawdown (m)

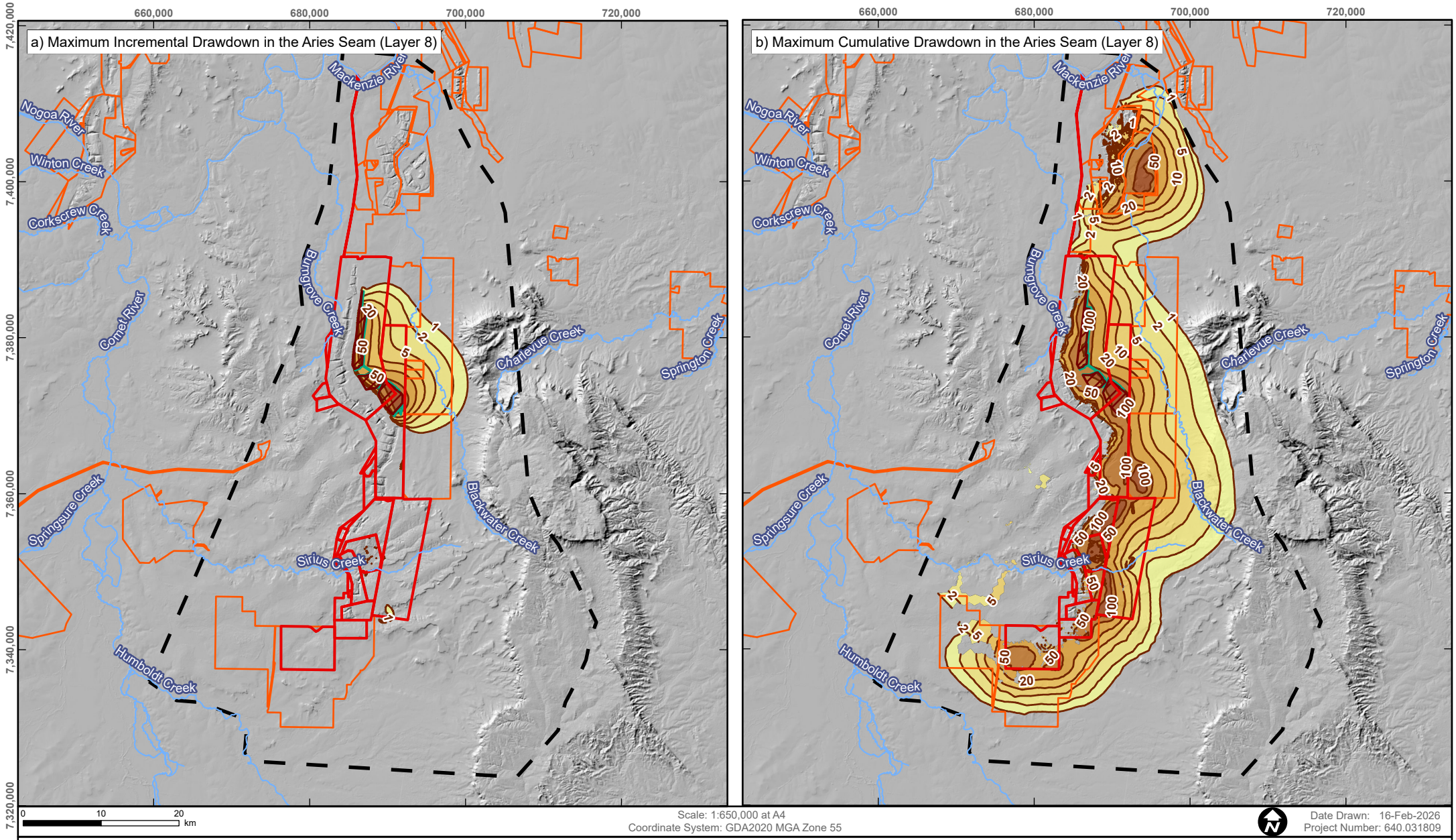
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE REWAN FORMATION LOWER (LAYER 6)

FIGURE 4-13

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Maximum Incremental (a) and Cumulative (b) Drawdown in the Rewan Formation Lower (Layer 6)



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 16-Feb-2026
Project Number: 640.031809

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Study Area
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

SLR

Service Layer Credits:

Credits:

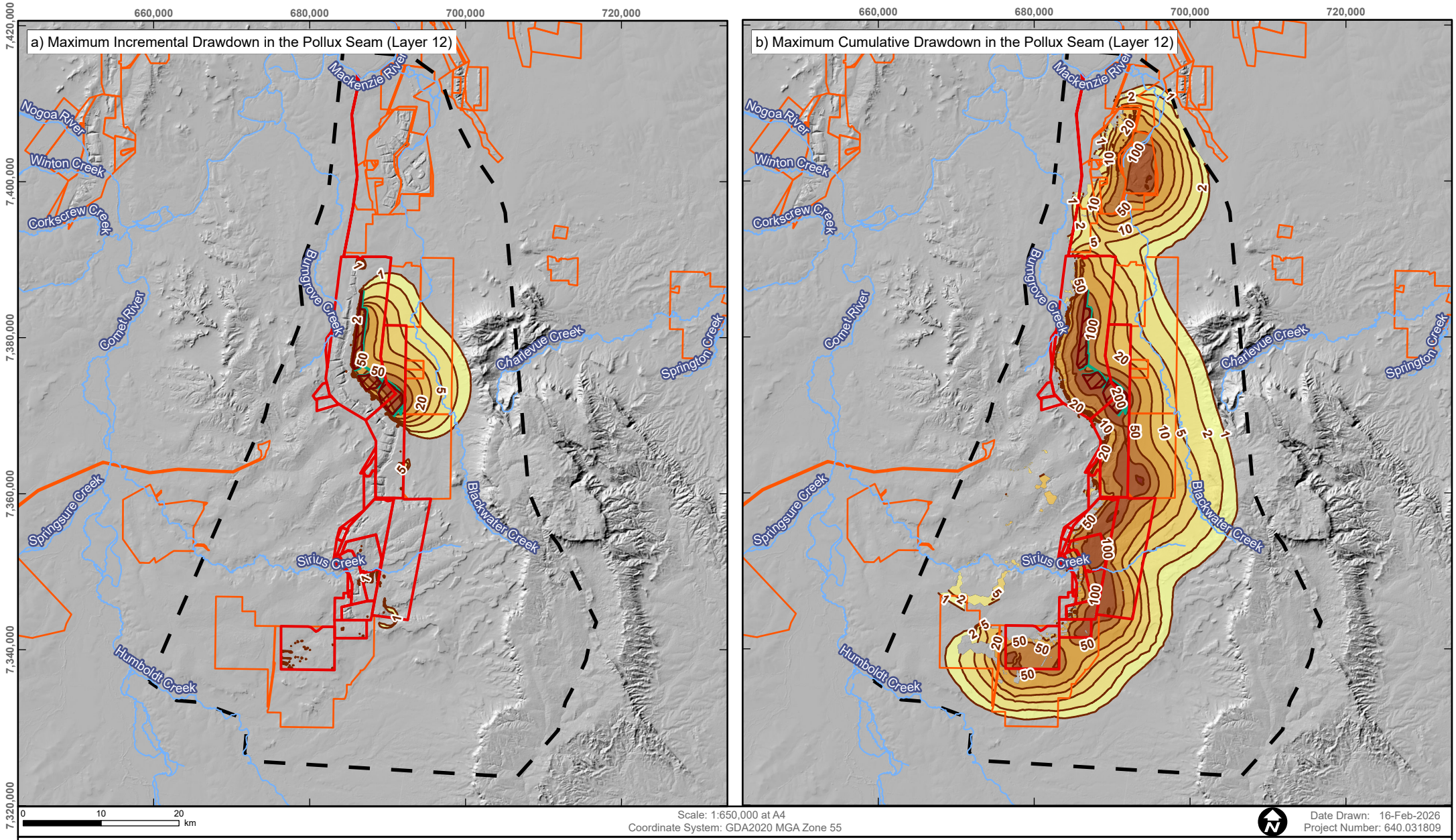
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BLACKWATER NORTH EXTENSION PROJECT
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MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE ARIES SEAM (LAYER 8)

FIGURE 4-14

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_11_Maximum Incremental (a) and Cumulative (b) Drawdown in theAries Seam (Layer 8)



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 16-Feb-2026
Project Number: 640.031809

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Study Area
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

SLR

Service Layer Credits:

Credits:

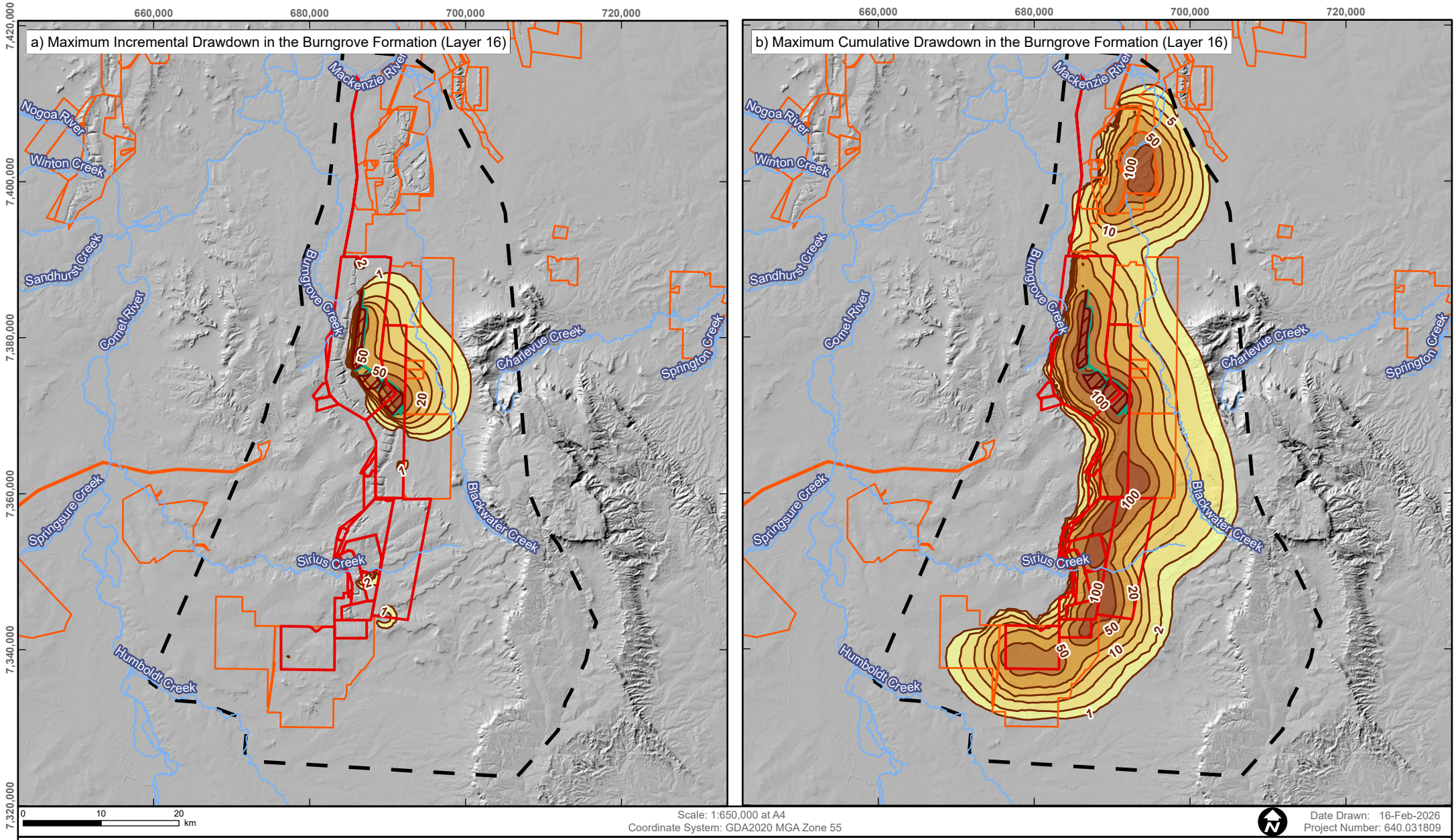
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BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE POLLUX SEAM (LAYER 12)

FIGURE 4-15

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_12_Maximum Incremental (a) and Cumulative (b) Drawdown in the Pollux Seam (Layer 12)



LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

SLR

Service Layer Credits:

Credits:

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BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE BURNGROVE FORMATION (LAYER 16)

FIGURE 4-16

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_13_Maximum Incremental (a) and Cumulative (b) Drawdown in the Burngrove Formation (Layer 16)

4.5 Predicted Groundwater Interception

The mine inflow volumes have been calculated as time weighted averages of the outflow reported by Zone Budget software for the relevant drain cells. The predicted inflows for the Cumulative inflows (Approved mining and the Project) and the Incremental inflows (the Project only) are presented in **Figure 4-17**.

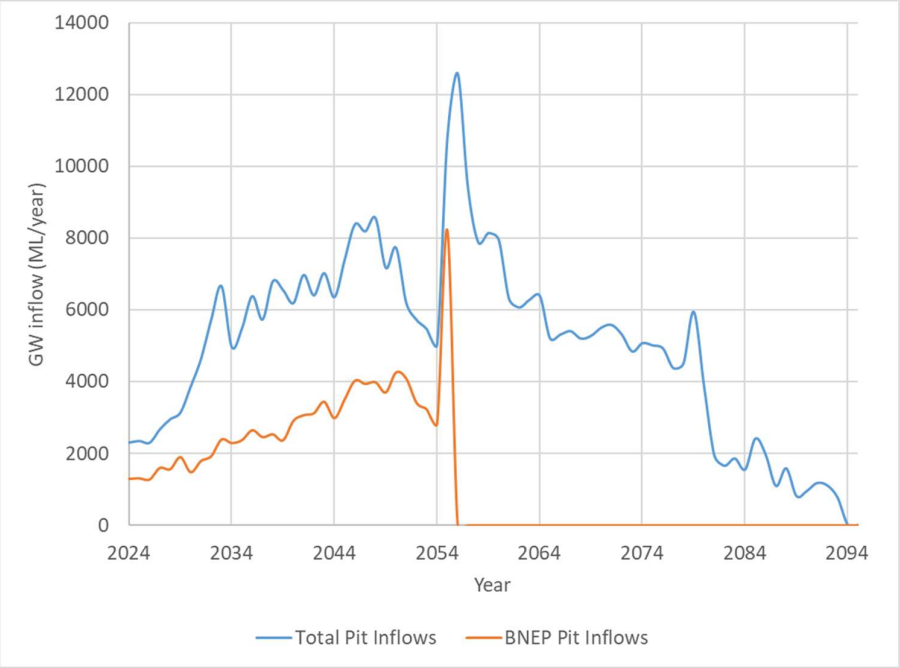


Figure 4-17 Predicted Cumulative and Incremental Project Mine Inflows

Cumulative inflows are predicted to range between 2,290 ML/year and 12,585 ML/year from year 2025 and 2056, peaking in 2056, then decrease until end of mining. The average predicted cumulative mine inflow rate (2025 to 2093) is 5,139 ML/year (14.1 ML/day). The spike in cumulative inflows in 2056 is due to the commencement of the southern mining operations, which are not part of the BNEP and thus the incremental is 0 ML/year.

The incremental inflows into the mine pits on SA 7 and SA 10 are predicted to reach a maximum in year 2055, with a peak just above 8,200 ML/year (22.5 ML/day). The average project mine inflow rate for the Project (2025 to 2055) is 2,272 ML/year (6.2 ML/day).

The Water Plan (Fitzroy Basin) 2011 groundwater area consists of the following:

- Groundwater Unit 1 (containing aquifers of the Quaternary alluvium).
- Groundwater Unit 2 (sub-artesian aquifers).

Planned mining operations at the Project will not intercept Quaternary alluvium at any of the proposed pits. As such, all direct groundwater take predicted by the model is from Groundwater Unit 2.

4.6 Incidental Water Impacts

4.6.1 Alluvium Take

The change in alluvial water resources was estimated by comparing water budgets for alluvial zones using the Approved and Cumulative scenarios of the predictive model. Interference of the alluvial groundwater can occur due to reduced upward leakage from Permian coal measures that are depressurised because of mining activities. Over the extent of Quaternary alluvium along Blackwater Creek, there is a maximum flow reduction of 0.5 ML/day (500 kilolitres per day [KL/day]) from underlying formation to alluvium as a result of the Project (**Figure 4-18**). This reduction represents a regional-scale response, as no specific areas of alluvium are predicted to experience drawdown > 1 m Layer 1 - Alluvium and Tertiary.

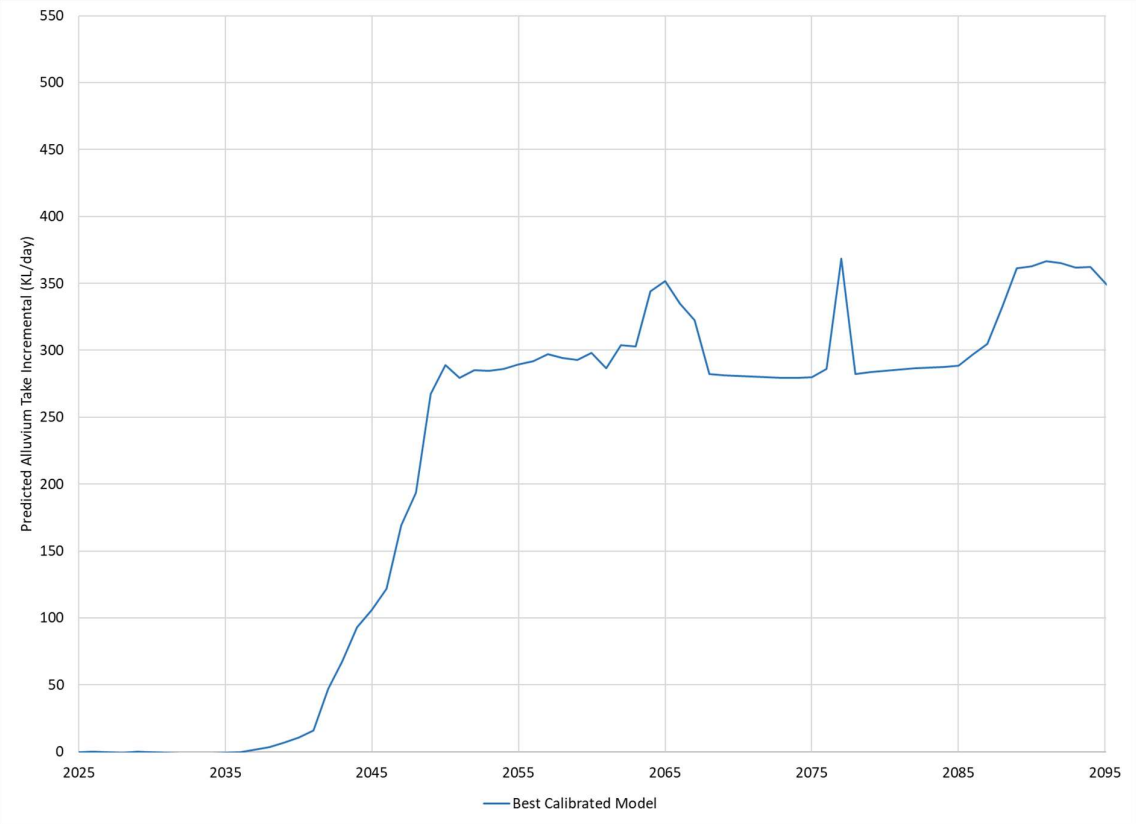


Figure 4-18 Predicted Alluvium Incremental Take

4.6.2 Groundwater – Surface Water Interaction

The change in groundwater flow to Blackwater Creek due to the Project was calculated by comparing the river flow budgets for Blackwater Creek in the Cumulative scenario against the Approved scenario (**Figure 4-19**). This calculation showed that over the life of mine, the maximum change of groundwater flow to Blackwater Creek is negligible (0.001 KL/day).

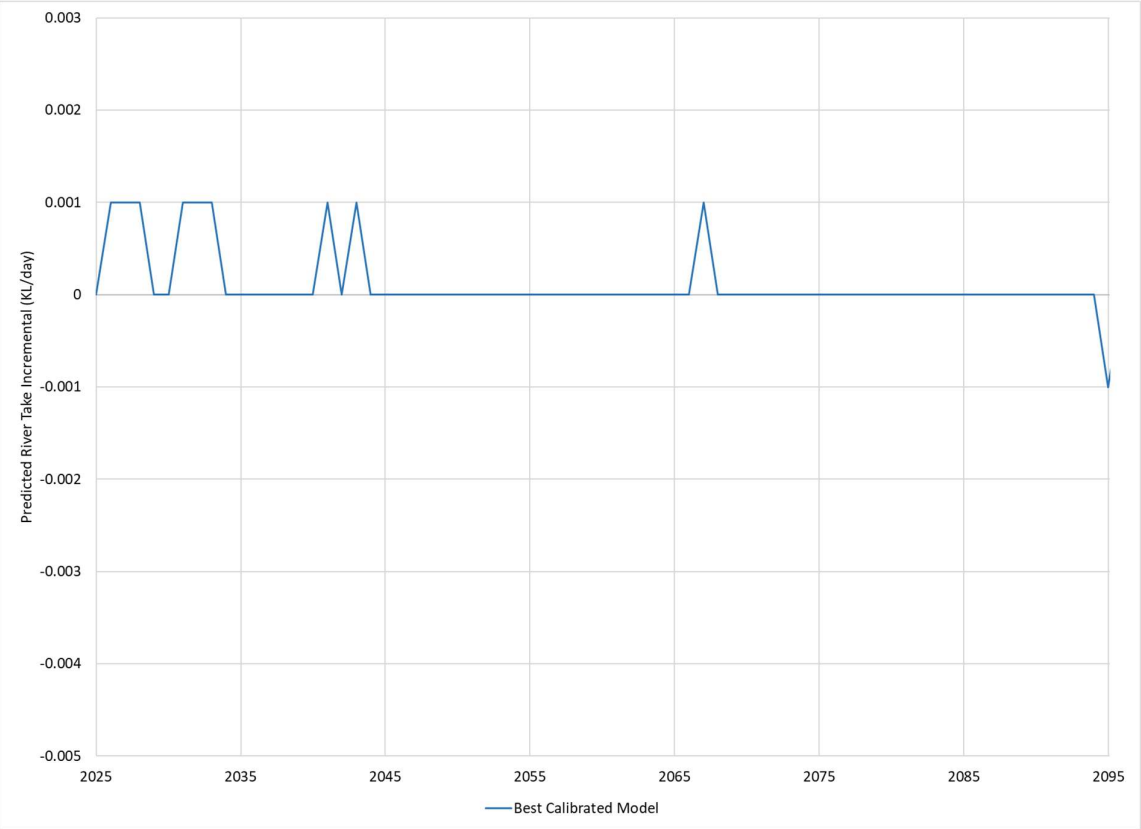


Figure 4-19 Predicted Incremental Loss in River Baseflow (Blackwater Creek)

4.6.3 Drawdown at Landholder Bores

Drawdown was assessed for landholder bores identified in a 5 km radius of the mining lease. **Table 4-4** lists the bores with their name, location, screened formation and use. The last two columns present the maximum incremental and cumulative drawdown predicted to occur at each location. Incremental drawdown from the Project is not predicted to be > 0.5 m at any bore. Only bores with casing depth information, and therefore, able to be assigned to a model layer, were assessed.

Table 4-4 Drawdown Impact on Landholder Bores

Registered RN (ID)	Bore name	Easting (GDA94 z55)	Northing (GDA94 z55)	Assumed Model Layer	Bore Depth (m)	Use	Maximum Incremental Drawdown (m)	Maximum Cumulative Drawdown (m)
38998	-	681119	7391492	Permian	36.6	Unknown	0	0
43097	-	681800	7392230	Permian	22.8	Water Supply	0	0
43459	Top Bore	683719	7395787	Permian	54.9	Unknown	0	0
57410	House well	674936	7345038	Weathered zone/Regolith	24.4	Unknown	0	0.2
57421	Home well	675898	7343916	Weathered zone/Regolith	30.5	Water Supply	0	4.7
57423	Mikes Bore	677244	7341916	Weathered zone/Regolith	38	Water Supply	0	23.2
57424	Plain Bore (OLD)	675422	7336214	Weathered zone/Regolith	39.6	Water Supply	0.5	13.7
57425	Plain Bore (NEW)	675596	7336268	Weathered zone/Regolith	39.6	Water Supply	0.5	14.6
57461	House Bore	692896	7340485	Triassic	28.9	Unknown	0	14.6
57462	Kulla well (1)	694367	7340239	Surface cover and Tertiary	4.9	Unknown	0	0
57463	Kulla well (2)	694678	7340159	Surface cover and Tertiary	7.6	Unknown	0	0
62660	Thomas Bore	672542	7339045	Interburden	100	Unknown	0.1	9.4
62663	Kevanaghs Bore	675228	7346704	Permian	43	Unknown	0	0
84221	-	683596	7390708	Permian	24	Unknown	0	0



Registered RN (ID)	Bore name	Easting (GDA94 z55)	Northing (GDA94 z55)	Assumed Model Layer	Bore Depth (m)	Use	Maximum Incremental Drawdown (m)	Maximum Cumulative Drawdown (m)
90446	-	686300	7340827	Permian	220	Water Supply	0	62.6
90447	-	685251	7340020	Permian	200	Water Supply	0	41.4
103345	-	684091	7363016	Permian	47	Water Supply	0	0.1
103347	-	678897	7350341	Permian	35	Water Supply	0	0
103348	-	678064	7347791	Permian	38	Water Supply	0	0
103349	-	679152	7345733	Permian	43	Water Supply	0	0.3
103388	-	687575	7340715	Triassic	32	Water Supply	0	21.3
103469	Walro Bore	673410	7335977	Interburden	171.13	Water Supply	0.3	9.5
111709	-	680013	7390877	Permian	72	Water Supply	0	0
132075	-	692910	7340474	Weathered zone/Regolith	9	Water Supply	0	0
158911	-	695505	7341762	Triassic	90	Unknown	0	10.3
165937	-	694749	7341252	Triassic	52	Water Supply	0	12
207590	-	683925	7368395	Surface cover and Tertiary	30	Domestic	0	0
207592	-	685877	7368329	Permian	36	Stock	0	1
208967	-	694466	7340032	Triassic	18	Stock	0	9.9
Unregistered 1	-	671980	7343932	Weathered zone / Regolith	33	Stock	0	0.1
Unregistered 10	-	681315	7380737	Permian	49	Not in use	0	0

5.0 Predictive Modelling – Post Mining

5.1 Timing

The potential post mining impacts of the Project were investigated through a post mining period, commencing at the end of mining at the Project and extending for 1,947 years until the model reached equilibrium. The stress period lengths for the post mining periods are shown in **Table 5-1**. In total, there are 38 stress periods of varying lengths.

Table 5-1 Stress Period Set-up for Post Mining Model

Stress Period	Date Range	Time Interval
155 - 167	01/01/2094 – 31/12/2110	Annual
168	01/01/2111 – 31/12/2120	10 years
169	01/01/2121 – 31/12/2140	20 years
170 - 189	01/01/2141 – 31/12/4040	50 years and greater

The above post mining stress periods were added to the predictive model to ascertain post-mining inflows, with all drain cells removed.

5.2 Final Voids Inflows

The indicative location of the 15 final voids (with three voids in the Project area and two voids in the immediate vicinity of the Project area) at the Project is provided in **Figure 5-1**. The cells were assigned high horizontal and vertical hydraulic conductivities (1000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, storage coefficient of 5.0×10^{-6} m^{-1}), to simulate free water movement within the final voids. This approach is often referred to as a 'high-K' lake. There are 10 other final voids, not located in the immediate vicinity of the Project area (but within the BWM site), which have also been modelled.

5.2.1 Methodology

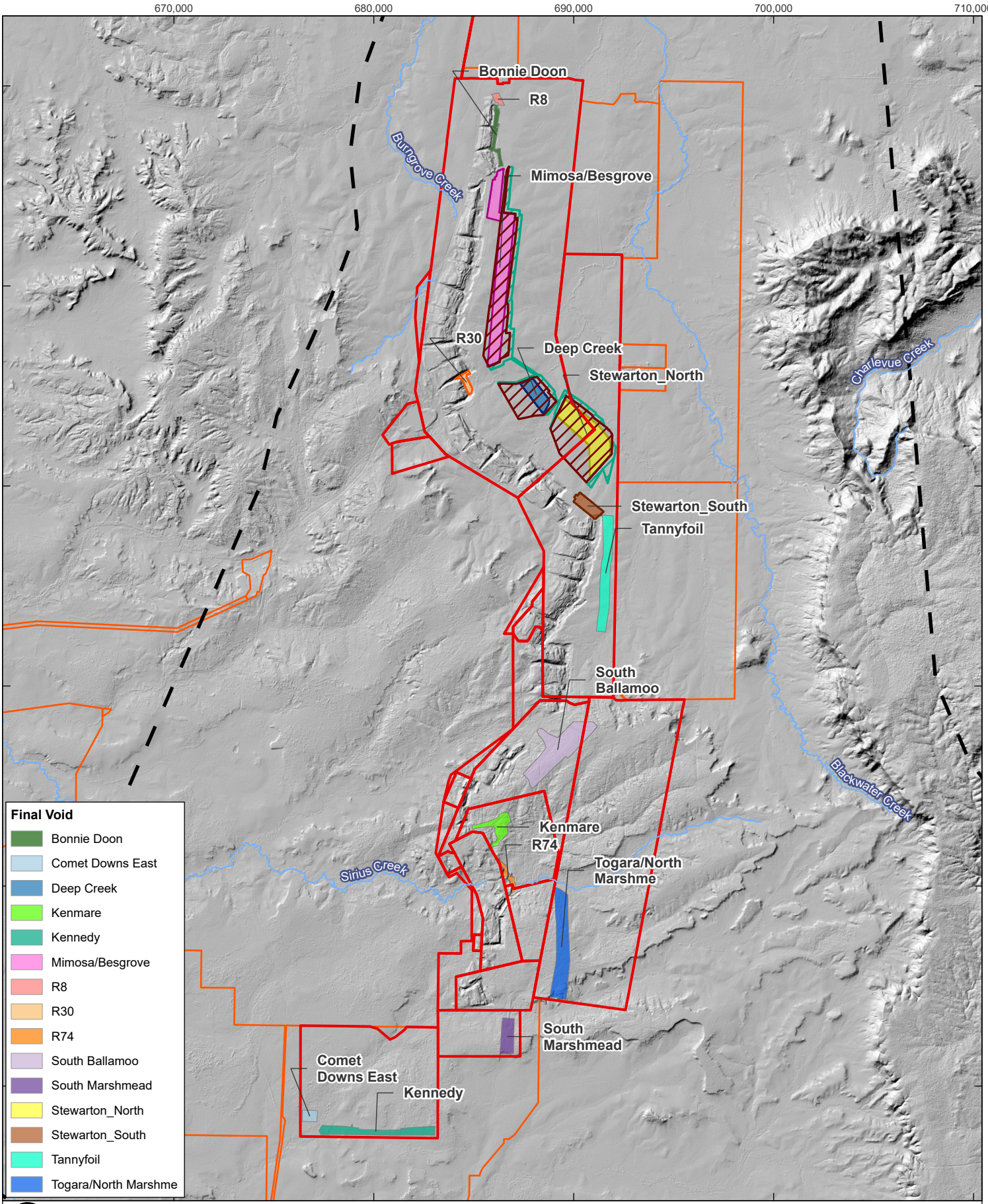
The following methodology was used to allow convergence between the groundwater and water balance models with respect to void lakes. The groundwater modelling methodology involves a stepwise iterative process with the water balance model:

1. Initial predicted groundwater inflows with time to the voids from the groundwater model were incorporated in the initial water balance model.
2. The pit lake recovery levels and timings were then predicted by the water balance model, incorporating both groundwater and surface water fluxes and processes.
3. The void water elevations and recovery timings derived from the water balance modelling were then replicated within the numerical groundwater recovery model using the time variant constant head boundary (CHD) condition, to refine the groundwater model prediction of void groundwater inflows and lake recovery.
4. Assessment was made to check that the refined groundwater model predictions for fluxes to the voids agree with what was used as input to the water balance modelling.

To avoid iterating many times between the groundwater model and the water balance model before reaching agreement, SLR used an automated process (using python code) that iterates between the groundwater model and the water balance model until a predefined convergence criteria is reached (Xiao et al., 2025). Not only does this automated process



save time, it also allows reaching full convergence between the groundwater and the water balance model, increasing confidence in the modelling process.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Study Area
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

FINAL VOID LOCATIONS

SLR

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FIGURE 5-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_01_Indicative Final Void Locations

5.2.2 Results

Once the convergence was achieved, the resulting pit lake recovery curves (HydroBalance, 2026) for the five voids (**Figure 5-2**) were applied within the numerical groundwater model using time-variant constant head boundary conditions (CHD) to represent long-term equilibrium conditions. The groundwater model was subsequently run for 1,947 years.

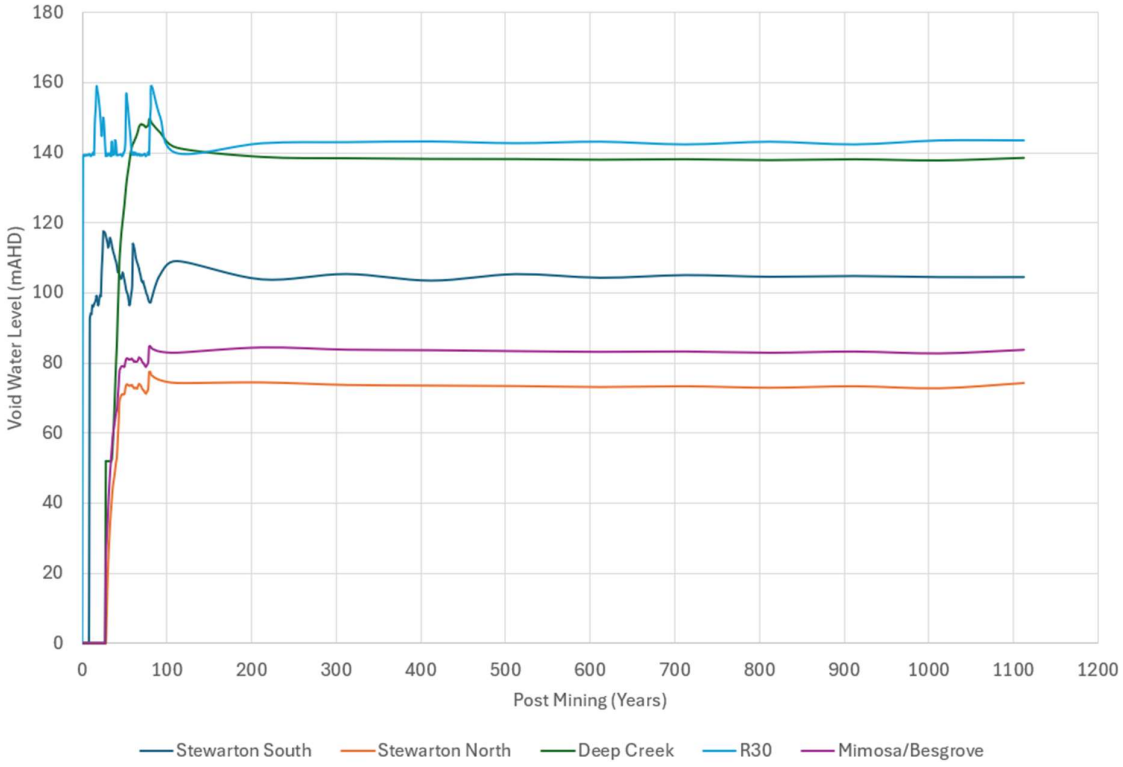


Figure 5-2 Final Void Recovery Curves

The equilibrated final void water levels are listed in **Table 5-2**. **Table 5-2** also lists the recovered water table to the east of the pits, at a distance of approximately 250 m. The head difference between the groundwater and the pit lake ranges between -21.88 m and 55.89 m for all pits.

Final void inflows are shown for all five voids from **Figure 5-3** to **Figure 5-7**. A positive flow value indicates a net inflow to the void while a negative value indicates a net outflow, from the void toward the local groundwater system. For each void, the net flux to the void is categorised based on its origin: Fluxes from spoil material to the void is shown as “Spoil to void”, while fluxes from the in-situ native rock to the void is show as “native rock to void”.

Final void Stewarton South and R30 show a constant negative net flux, indicating that water in the void primarily flow toward the local groundwater. The fate of these water fluxes is further discussed in **Section 5.3**.

Table 5-2 Final Voids – Equilibrium Water Levels and Groundwater Levels (From North to South)

Component	Equilibrium Void Water Level (mAHD)	Groundwater Level (mAHD)[1]	Head Difference (m)[2]
R8	144.98	150.56	5.58
Bonnie Doon	159.11	156.79	-2.32
Mimosa/Besgrove	83.8	131.1	47.3
R30	143.46	123.83	-19.63
Deep Creek	138.67	138.84	0.17
Stewarton_North	74.31	108.19	33.88
Stewarton_South	104.63	143.08	38.45
Tannyfoil	143.17	176.17	33
South Ballamoo	140.27	158.59	18.32
Kenmare	215.48	193.6	-21.88
R74	234.19	244.34	10.15
Togara/North Marshmead	163.86	219.75	55.89
South Marshmead	170.09	181.13	11.04
Comet Downs East	189.24	188.68	-0.56
Kennedy	160.8	173.06	12.26

1 Groundwater level extracted from the recovered water level map, read out approximately 250 m away from each pit to the east.
2 A positive number indicates gradient towards the void, a negative number would indicate a gradient away from void.

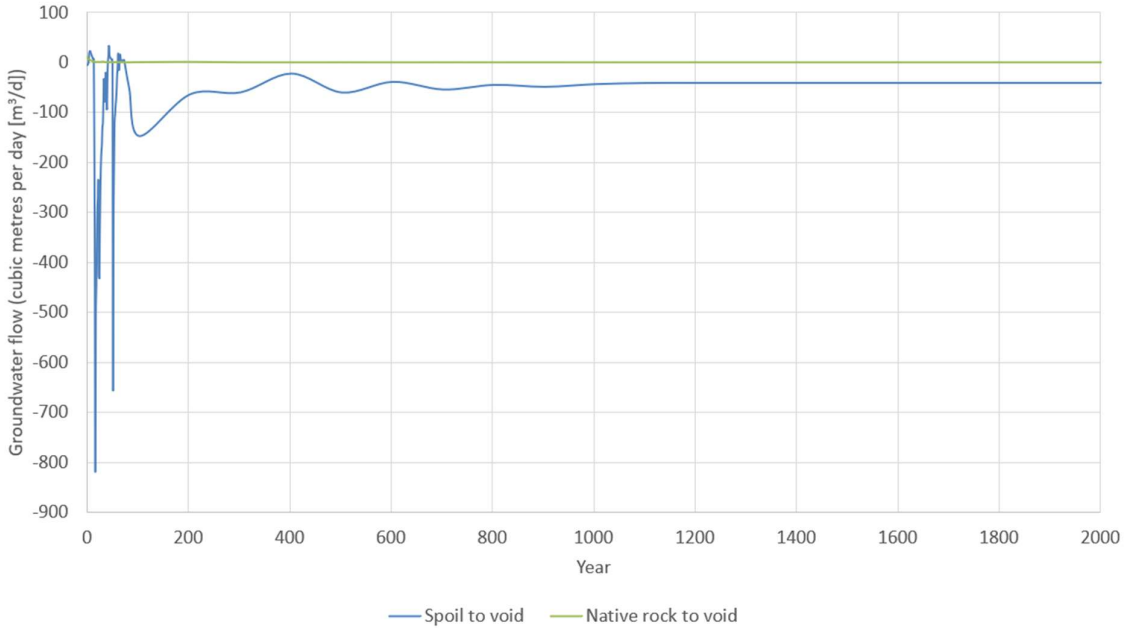


Figure 5-3 Post-mining Groundwater Inflows to Stewarton South

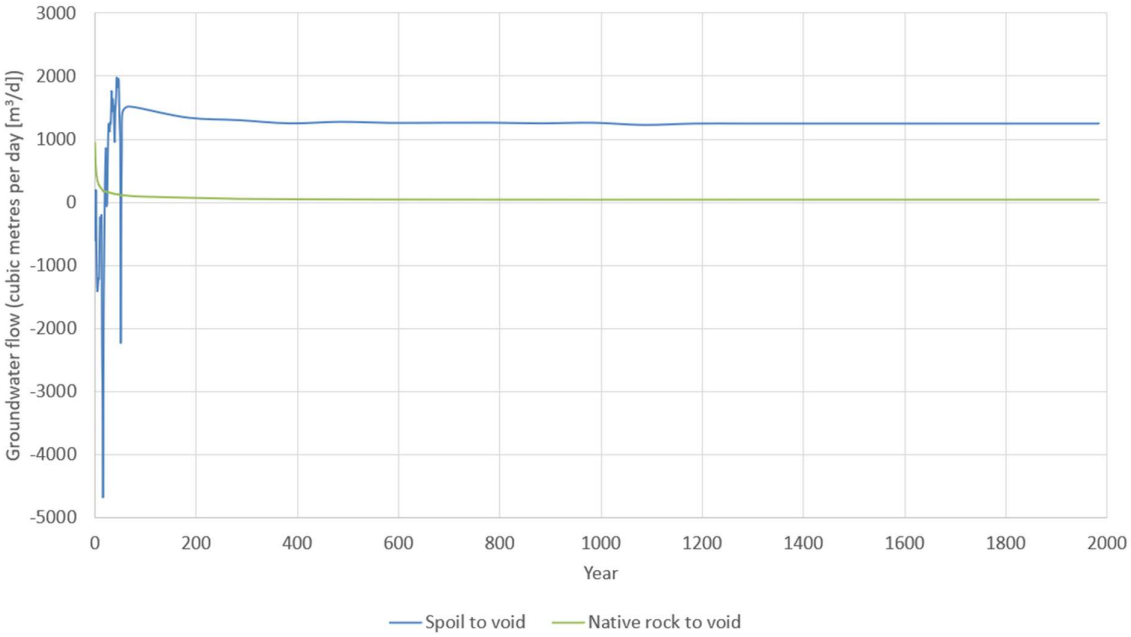


Figure 5-4 Post-mining Groundwater Inflows to Stewarton North

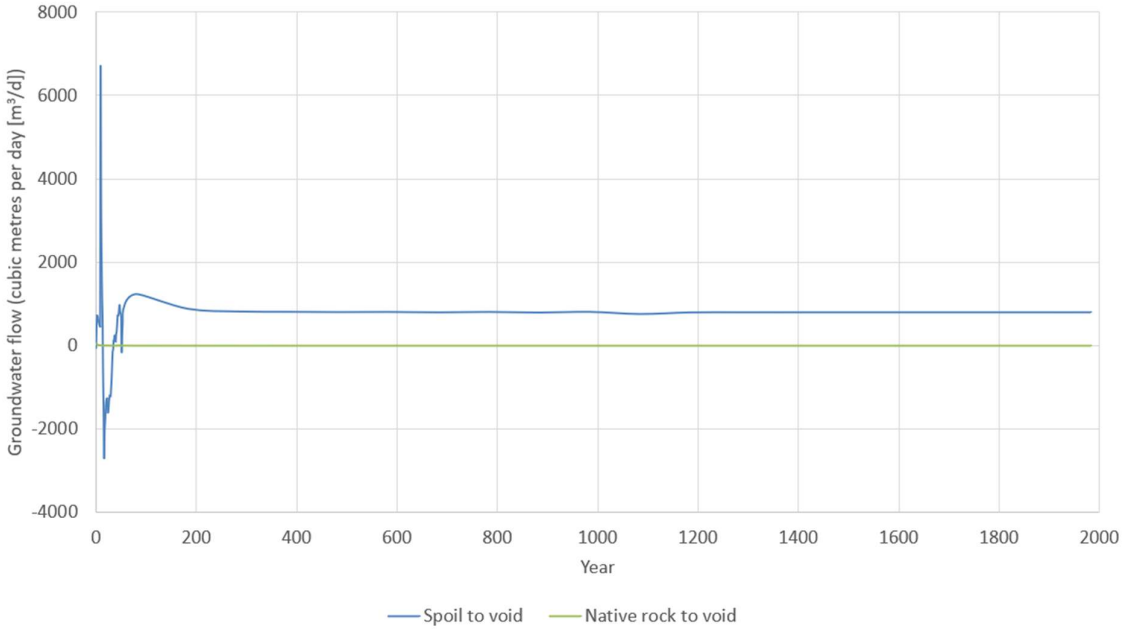


Figure 5-5 Post-mining Groundwater Inflows to Deep Creek

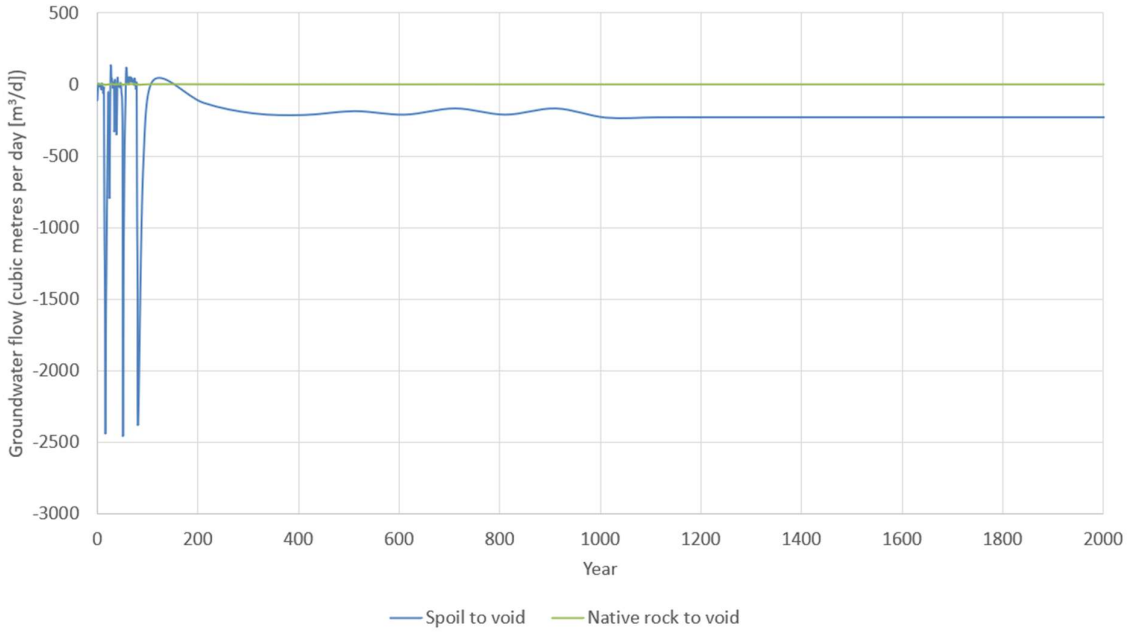


Figure 5-6 Post-mining Groundwater Inflows to R30

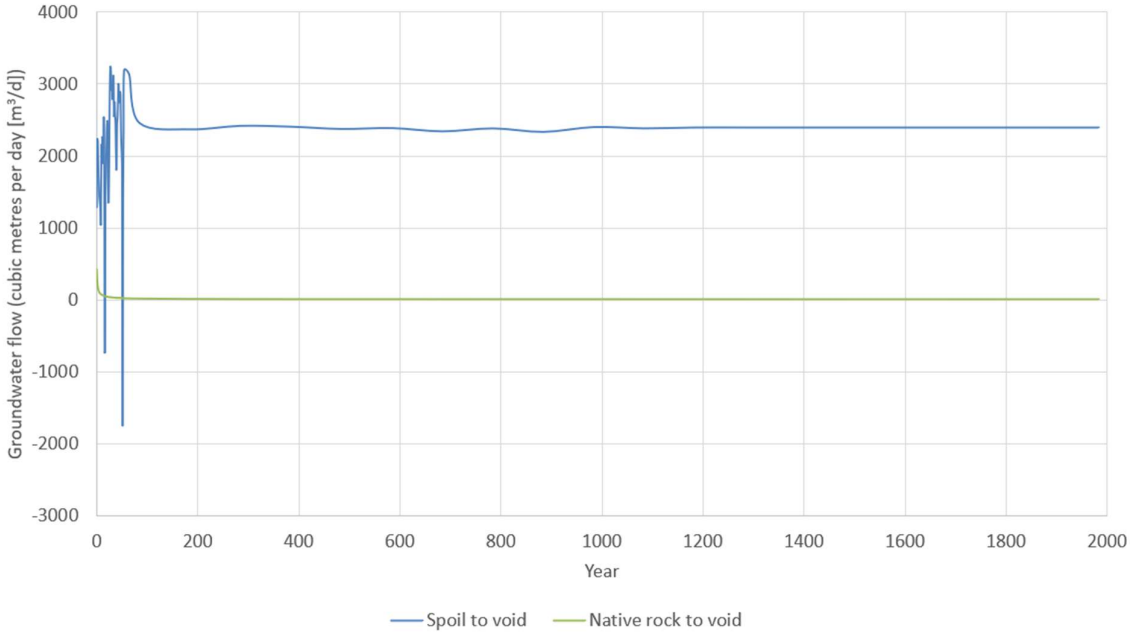
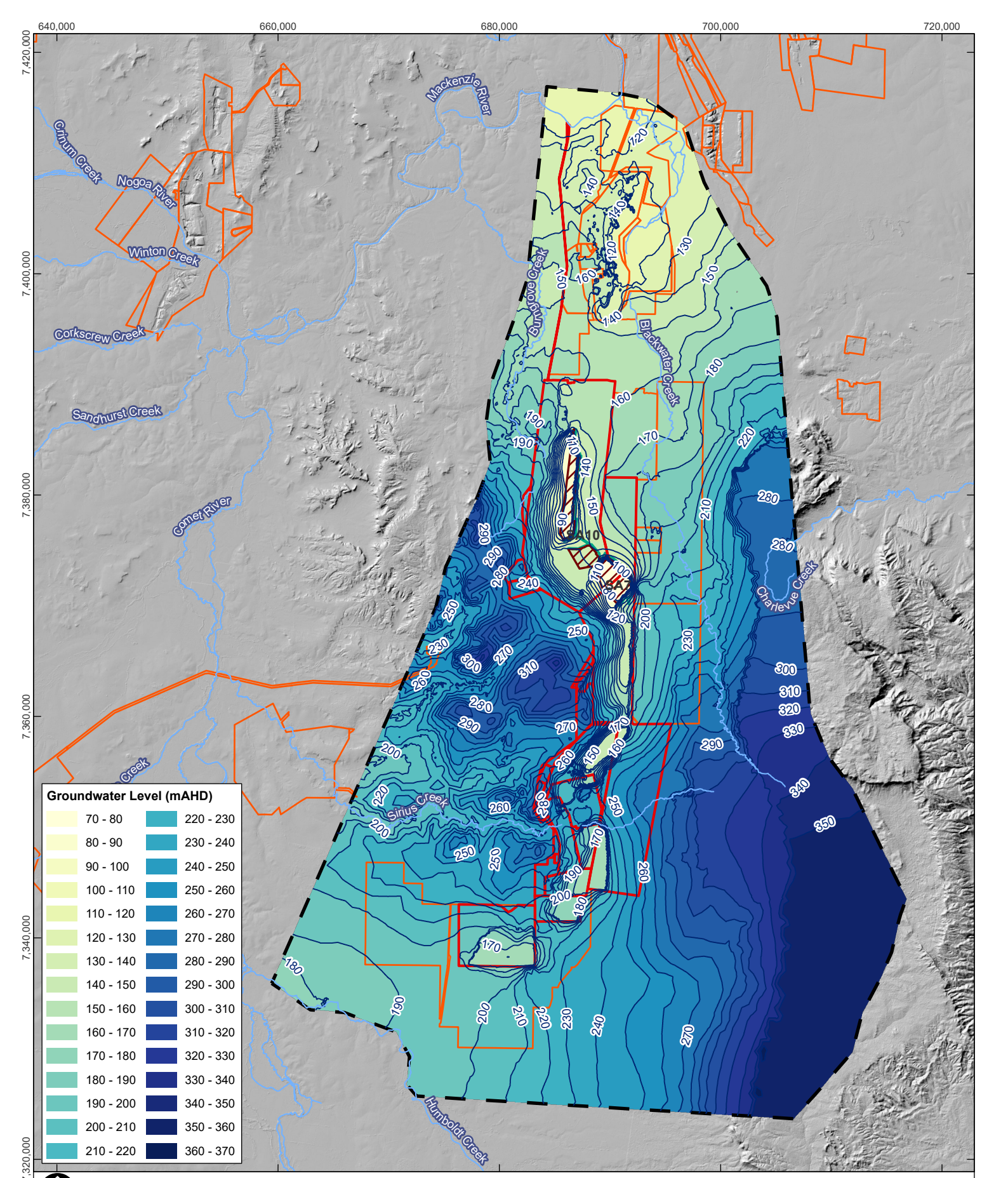


Figure 5-7 Post-mining Groundwater Inflows to Mimosa Besgrove

The predicted final groundwater water levels are presented in **Figure 5-8** and **Figure 5-9**. Predicted final groundwater levels for the Tertiary Sediments, Rewan Formation, Rangal Coal Measures and the Burngrove Formation are provided in **Appendix D.**



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:433,846 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Groundwater Level Contour (m)
- Watercourse
- BWM Mining Lease
- Mining Lease
- Study Area
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

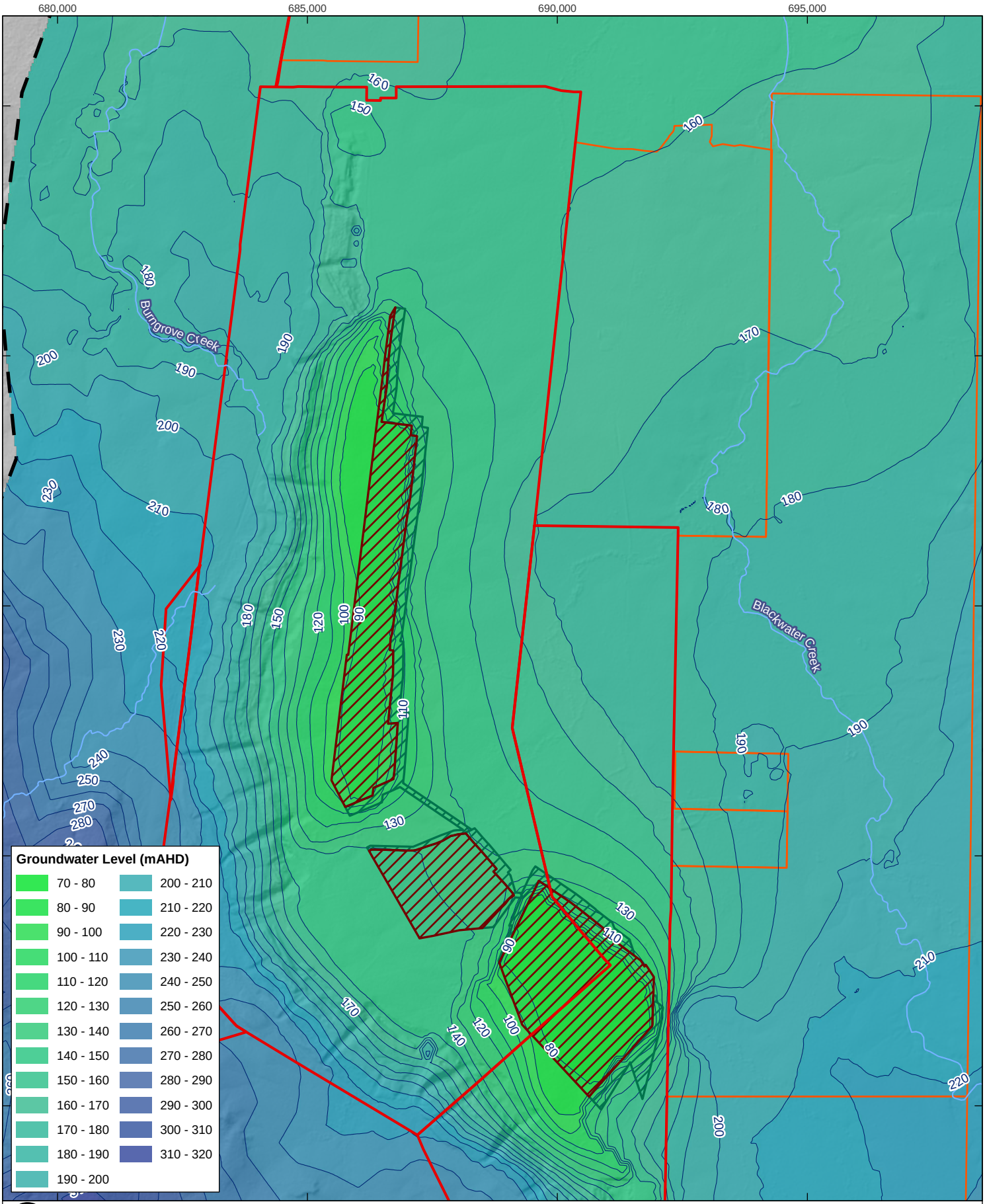
GROUNDWATER TABLE RECOVERY (POST-MINING)

SLR

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FIGURE 5-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_08_Groundwater Table Recovery (post-mining)



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	20-Aug-2026
Drawn by:	RB

LEGEND

- Groundwater Level Contour (m)
- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

GROUNDWATER TABLE RECOVERY (POST-MINING) - NORTHERN VOIDS

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FIGURE 5-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Groundwater Table Recovery (post-mining)

5.3 Particle tracking

The mod-PATH3DU code (S.S. Papadopulos & Associates, Inc., 2020) was used to simulate particle pathways along the groundwater flow field post mining. To run the mod-PATH3DU code the transient head outputs from the groundwater flow model were used by mod-PATH3DU to simulate particle flow path lines.

The particles were placed on the final landform (landform 4.1) and within the residual voids (**Figure 5-10**), at the surface of the model (with the exception of particles placed within the underground mine workings adjacent to Laleham). Particle placed at the surface of the model are automatically moved to the shallowest saturated layer at the commencement of the simulation. Mod-PATH3DU was configured to release the particles at the midpoint between the base of the first saturated layer and the water table. As shown on **Figure 5-10** for many of the particles this represents the Permian layers (including areas of spoil backfill in model layers that represent Permian units pre-mining) as the shallow layers (Layers 1 and 2) are unsaturated across much of the BWM Area at the commencement of the post-mining simulation. The particles placed in the underground mines were configured to begin their simulation in the Pollux seam (Layer 12) to simulate the fate of water beginning in the flooded underground workings after mine closure.

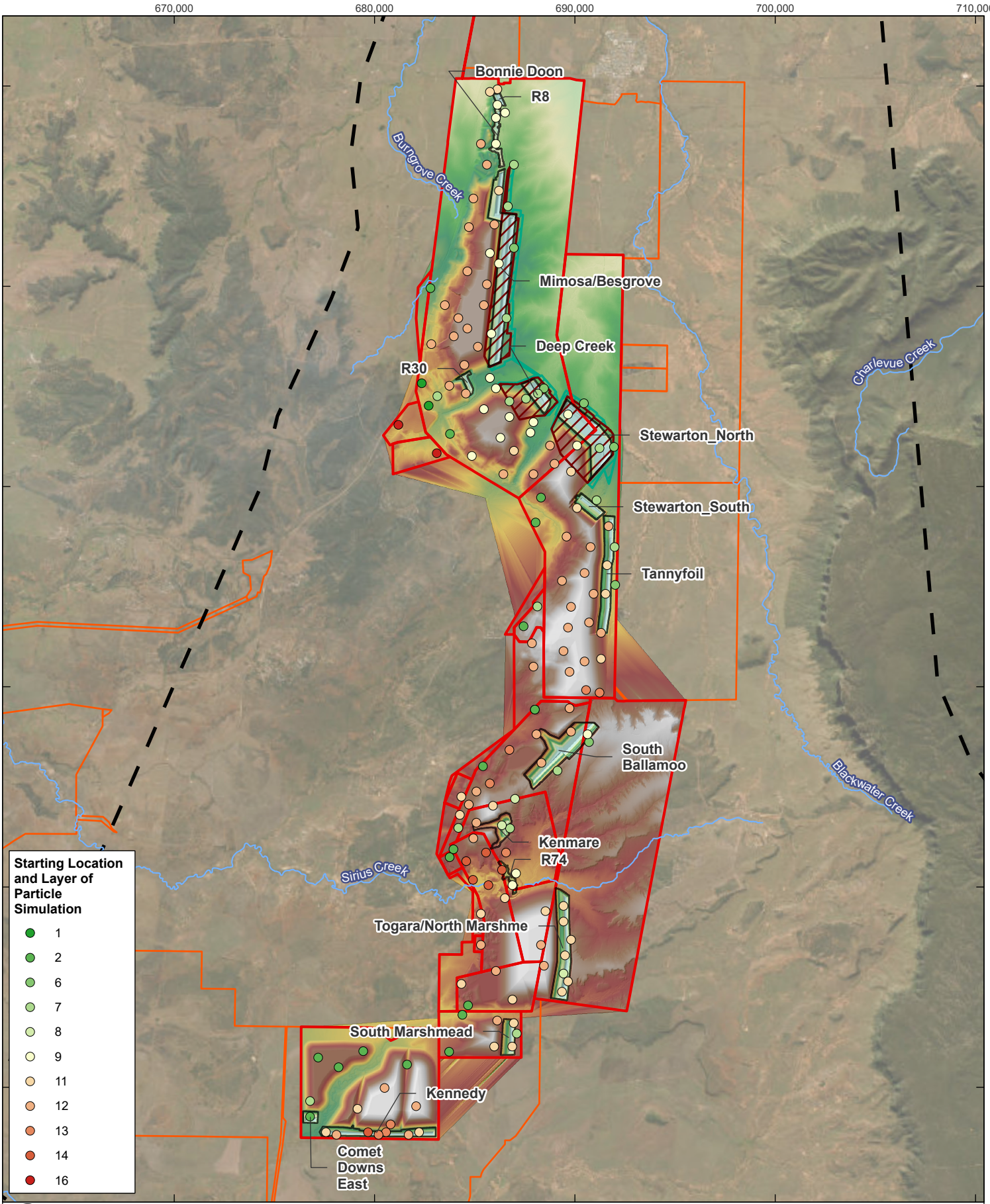
To estimate flow paths from the end of mining until post mining equilibrium, particles were released at the start of the post mining period (year 2093) and tracked until the end of the post mining simulation period (year 4040). **Figure 5-11** shows the predicted movement of water particles in the 1,947-year post mining simulation. The colours along the predicted particle flow paths provide the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallower to deeper model layers.

The colour changes along the paths on **Figure 5-11** indicate that particles situated within the shallower saturated layers at the beginning of the post-mining simulation generally move progressively toward deeper layers representing the Permian coal measures (or backfilled spoil where the coal measures has been mined out) over the post-mining period. However, particles that begin in the Pollux seam (Layer 12) and other deeper layers often are observed to move upwards to shallower layers over the course of the recovery simulation, as the saturated water levels in the spoil and aquifers adjacent to the residual voids recover to their long-term post-mining equilibrium state. The flow path analysis indicates the particles generally move toward the void lakes, with the majority of the particles captured in the voids.

As discussed in **Section 5.2,** both Stewarton South and Ramp 30 are showing a negative net inflow; However, particle tracking indicates that fluxes from these voids do not flow to the regional groundwater and instead flow toward neighbouring voids. As shown on **Figure 5-11**:

- particles released into Stewarton South are captured by Stewarton North; and
- particles released into Ramp 30 are captured by Mimosa/Besgrove.

No particles are predicted to travel outside of the mine lease in the post-mining simulation.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	17-Feb-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Study Area
- Void Extent
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

Final Landform Elevation (mAHD)

450

-5

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

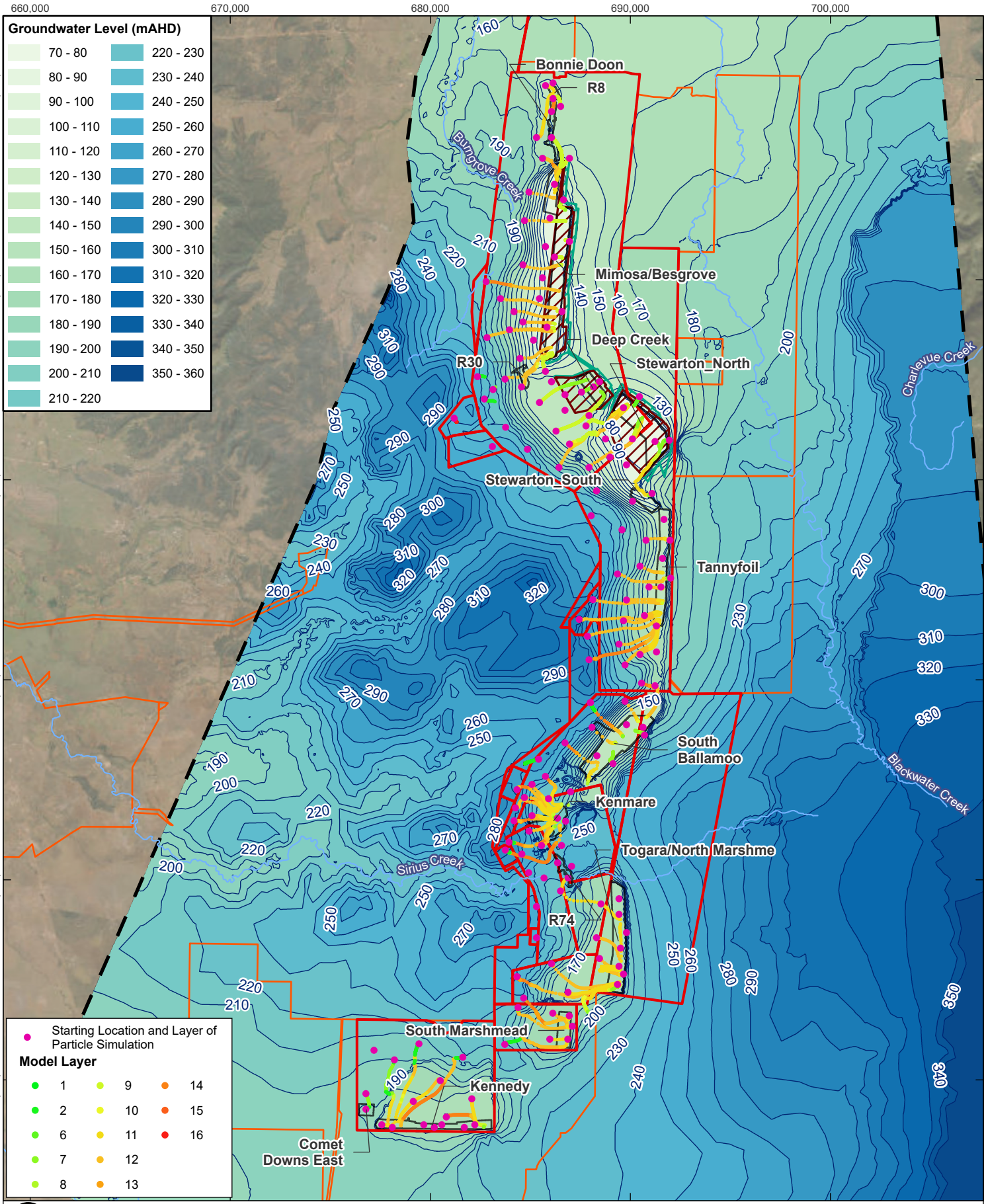
STARTING LOCATION OF PARTICLES

SLR

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FIGURE 5-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_09_Particle Starting Location



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	17-Feb-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Level (mAHD)
- BWM Mining Lease
- Mining Lease
- Study Area
- Void Extent
- BWM North Extension Project Area
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MOVEMENT OF PARTICLES – POST MINING (2093 – 4040)

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DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 5-11

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_10_Predicted Movement of Particles

6.0 Sensitivity Analysis

6.1 Purpose

Quantifying the sensitivity of both calibration performance and model predictions to input parameters provides critical insight into model behaviour and uncertainty. The combined sensitivity analysis presented in this section supports two primary objectives:

1 **Assessing parameter conditioning through calibration sensitivity**: Parameters that have a strong influence on calibration performance metrics are more likely to be conditioned by the calibration process. In contrast, parameters with low sensitivity to calibration performance are less likely to be conditioned by the calibration process, meaning that their posterior distributions will likely remain broad regardless of the amount or quality of calibration data.

2 **Understanding prediction sensitivity to parameter uncertainty**: When model predictions are highly sensitive to specific parameters, it indicates that uncertainties in those parameters have a strong influence on predictive outcomes. Conversely, if predictions are insensitive to a given parameter, then uncertainty in that parameter has limited influence on the modelled forecast.

Comparing calibration and predictive sensitivity allows for distinguishing between parameters that are constrained during calibration, and parameters that drive predictive uncertainty, which may or may not overlap. Such insights support decision-making in model refinement, data collection prioritisation and risk-based scenario analysis.

6.2 Methodology

To evaluate how variations in model parameters affect calibration and prediction outcomes, SLR employed two complementary global sensitivity analysis methods:

- Spearman rank correlation; and
- standardised linear regression coefficients.

These two methods assess different aspects of the input-output relationship and are well-suited to the often non-linear and complex behaviour of hydrogeological systems. They are commonly used in hydrological and environmental modelling due to their simplicity, interpretability and relatively low computational demand (Saltelli et al., 2008; Pianosi et al., 2016).

6.2.1 Data Aggregation and Standardisation

Pilot points were excluded from the sensitivity analysis to reduce parameter dimensionality since they are highly spatially correlated parameters, which can obscure the identification of key model controls and violate assumptions of parameter independence. The analysis therefore focused on primary hydrogeological parameters to better represent conceptual model behaviour rather than calibration-specific detail.

Parameter and observation data were pre-processed and standardised. Parameters using a log normal distribution were converted to $\log_{10}$ values.

Calibration performance was assessed using Mean Residual for this analysis because it aligns more closely with linear regression interpretation than other statistics that use squaring or absolute functions that change the linear relationship of parameter changes and calibration metrics.

For predictive sensitivity, predictive data included four groups: total alluvium take, total area with drawdown > 1 m, mine groundwater inflow (active mining) and total river take.



Parameter values (one group), calibration data (two groups) and prediction data (four groups) were standardised (zero mean, unit variance) independently (i.e. per group) to enable consistent comparison across variables and groups.

6.2.2 Spearman Rank Correlation Coefficient

Spearman rank correlation measures the monotonic relationship between input parameters and model outputs. It identifies whether changes in a parameter consistently increase or decrease a model output, regardless of the exact functional form of the relationship. This is especially useful in groundwater models where non-linearities are common due to boundary conditions, storage terms or non-linear recharge responses (van Griensven et al., 2006).

Given a parameter vector X and a model response vector Y, Spearman's rank correlation coefficient ρ is calculated as:

$$\rho = 1 - \frac{6\sum_{i=1}^{n}(R_i - S_i)^2}{n(n^2-1)}$$

where: R_i = rank of parameter X for sample *i*

S_i = rank of the corresponding model output Y

N = number of realisations

6.2.3 Linear Regression Sensitivity Coefficient

Linear regression sensitivity quantifies how much the output changes *on average* with a unit change in a parameter, assuming a linear relationship. It describes the *magnitude* of influence a parameter has on model outputs under the assumption of a linear relationship.

The relationship is represented as:

$$Y = X\beta + \epsilon$$

where: Y = model output

X = a matrix of standardized parameter values

β = vector of estimated sensitivity coefficients

ϵ = model error

The coefficient β represents the average change in model output (Y) for a one standard deviation change in model parameter (X) and is interpreted as a direct measure of sensitivity magnitude, specifically how the variance of the parameter uncertainty contributes to the variance of the predictive or calibration uncertainty. This method assumes linearity and additivity but remains useful as a first-order sensitivity metric (Helton et al., 2006).

6.2.4 Interpretation

There is no single universally accepted threshold for Spearman or regression coefficients in sensitivity analysis. However, some thresholds are often used as pragmatic benchmarks based on the practical significance of parameter influence rather than strict statistical cutoffs. For this analysis, moderate sensitivity was selected for an absolute ρ score > 0.2 and for an absolute β value > 0.1.

This dual-method framework supports robust sensitivity diagnostics by capturing both the consistency and strength of parameter influence. The combined use of both metrics enables us to distinguish between parameters that:

- have a strong and consistent effect;
- have an effect only in a narrow range (local sensitivity); and/or



- behave non-monotonically and inconsistently.

A comparison of the interpretive value of each method is provided in **Table 6-1**.

Table 6-1 Comparison of Spearman and Regression in Sensitivity Analysis

Sensitivity Scenario (S)	Impact of Parameter Changes on Model Outcome	Spearman	Regression	Interpretation
S1	Strong, consistent linear effect	> 0.2	> 0.1	Parameter is influential and predictable
S2	Consistent but nonlinear effect	> 0.2	< 0.1	Parameter is influential but not well described by linear models
S3	Local or inconsistent effect	< 0.2	> 0.1	Large effect in a narrow range
S4	Non-influential	< 0.2	< 0.1	Parameter has minimal influence

6.3 Results

The results are presented as bar charts in **Appendix E** and discussed in **Section 6.3.1** and **Section 6.3.2** for both Spearman rank correlation coefficient and Linear regression sensitivity coefficient.

6.3.1 Calibration Sensitivity (Parameter Conditioning)

Parameter with a ρ score > 0.2 and/or a β value > 0.1 (scenarios S1, S2 or S3 in **Table 6-1**) are likely to be conditioned through the calibration process.

As presented on **Appendix E** the calibration process is likely to be conditioning:

- Horizontal hydraulic conductivity (Kx) of the Clematis Group, Rewan formation (upper and middle), interburden, Pollux seam (lower) and tailings; as well as spatial locations associated with pilot points.
- Vertical hydraulic conductivity (Kz) of the interburden and tailings; as well as spatial locations associated with pilot points.
- Specific yield (Sy) of the Rewan Formation (upper); as well as spatial locations associated with pilot points.
- Riverbed Kz (Riv_vk) of the Humboldt Creek and tributaries.
- ET coefficient (evt) for the spoil and depth (exdp) for the alluvium.

The calibration process in unlikely to be conditioning the majority of:

- Recharge coefficients (rch).
- ET coefficient and depth (evt and exdp).
- Spoil hydraulic properties (spl_kx, spl_kz, spl_ss and spl_sy).

6.3.2 Predictive Sensitivity

Parameters with a ρ score > 0.2 and/or a β value > 0.1 (scenarios S1, S2 or S3 in **Table 6-1**) are likely to influence model predictions.



As presented in **Appendix E,** these parameters are:

- **For Mine associated drawdown:** Horizontal hydraulic conductivity of the regolith, Rewan formation (lower, middle and upper) and interburden; vertical hydraulic conductivity of the coal seams (lower); storage of the Rewan Formation (upper), interburden, coal seams, and spoil; recharge over the alluvium, regolith and weathered Clematis zones and spoil; ET rate and depth for the alluvium and regolith.
- **For Mine groundwater inflow (active mining):** Horizontal hydraulic conductivity of the regolith and Burngrove formation; vertical hydraulic conductivity of the coal seams, Burngrove formation and spoil; storage of regolith, Rewan formation, underburden and spoil; recharge over the weathered Clematis and weathered Permian zone, riverbed conductance of the Rockland Creek and tributaries.
- **For alluvium take:** Horizontal hydraulic conductivity of the alluvium, regolith, Clematis, Rewan formation (upper), overburden, interburden, underburden, Burngrove formation and spoil; vertical hydraulic conductivity of interburden, interburden, and Burngrove formation; storage of regolith, Clematis, overburden, interburden, coal seams, Burngrove formation, and spoil; recharge over the alluvium, regolith, and weathered Permian zones; ET depth for the alluvium, regolith, weathered Clematis and weathered Permian zones.
- **For River take:** Horizontal hydraulic conductivity of the alluvium, regolith, Rewan formation (upper and lower), overburden, interburden, Castor coal seam, and Burngrove formation; vertical hydraulic conductivity of the Rewan formation (middle and lower), interburden, coal seams, underburden and Burngrove formation; storage of regolith, Rewan formation, overburden, coal seams, underburden and spoil; recharge over the regolith and weathered Permian zones; ET depth for the alluvium; riverbed conductance of the Blackwater main stream and small streams.

6.3.3 Type I-IV Analysis

The Murray Darling Basin Commission (MDBC) Groundwater Flow Modelling Guideline (MDBC, 2001) recommends classifying sensitivity by the resultant changes (or contribution) to the model calibration and predictions. According to this process models can be classified as one of the four main types:

- Type I: Insignificant changes to calibration (low calibration sensitivity) and prediction (low predictive sensitivity).
- Type II: Significant changes to calibration (high calibration sensitivity) – insignificant changes to predictions (low predictive sensitivity).
- Type III: Significant changes to calibration (high calibration sensitivity) – significant changes to predictions (high predictive sensitivity).
- Type IV: Insignificant changes to calibration (low calibration sensitivity) – significant changes to predictions (high predictive sensitivity).

Types I-III are of less concern, as these Types have an insignificant impact on model predictions or conditioned by calibration. Type IV is classed as ‘a cause for concern’ as non-uniqueness in a model input might allow a range of valid calibrations but the choice of value impacts significantly on a prediction (MDBC, 2001).

To classify the sensitivity contribution to the model calibration and predictions for each model parameter, the calibration and prediction sensitivities were compared against each other for each parameter.



To allow comparing calibration and prediction sensitivity in one graph, a combined sensitivity value was calculated for each sensitivity group as:

$$Combined_{(i,g)} = 0.5 * | \beta_{(i,g)} | + 0.5 * | \rho_{(i,g)} |$$

where: $\beta_{(i,g)}$ = standardised regression coefficient for parameter *i* and group *g*.

$\rho_{(i,g)}$ = Spearman rank correlation coefficient between parameter and group *g*.

For this analysis, the threshold value for a sensitive parameter was set at 0.15, as the average of the threshold for *β and ρ* (see **Section 6.2.4**).

Comparison plots are presented for the alluvium take (**Figure 6-1**), drawdown (**Figure 6-2**) and mine groundwater inflow (active mining) (**Figure 6-3**), and Isaac River take (**Figure 6-4**). Type IV parameters are summarised in **Table 6-2.**

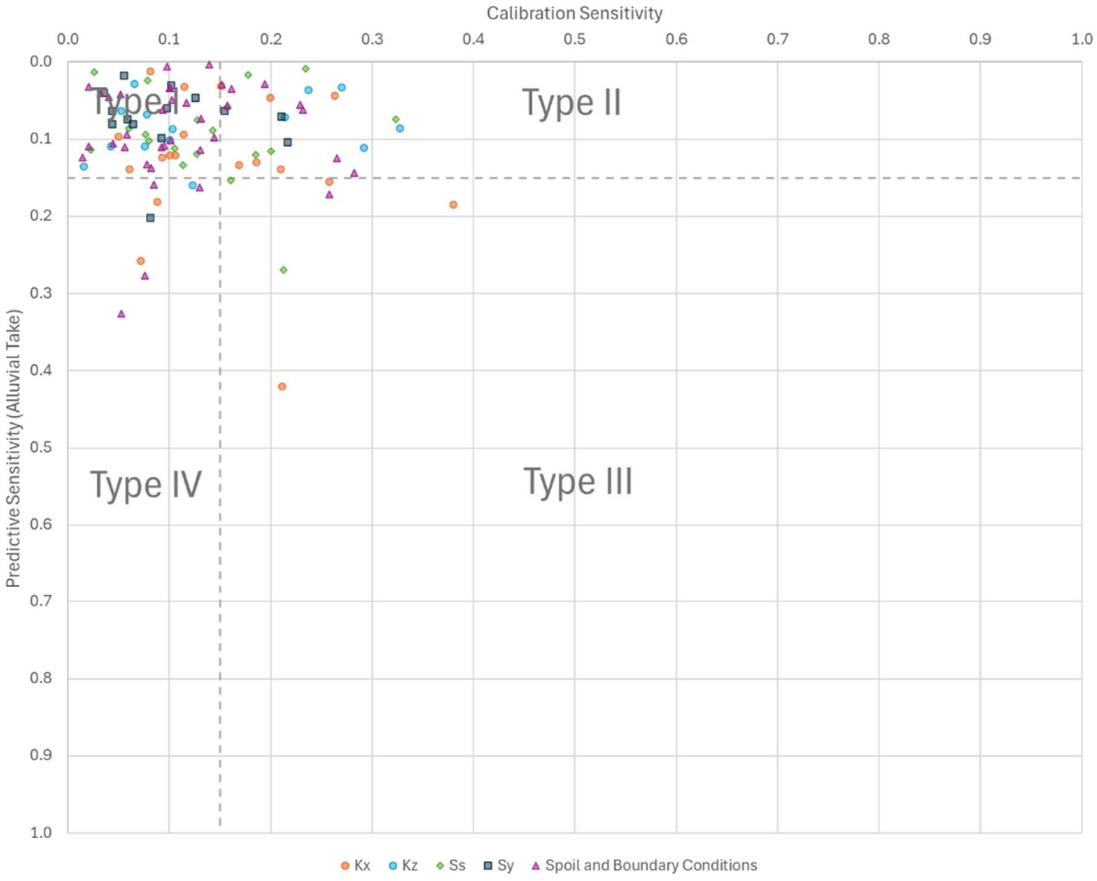


Figure 6-1 Predictive Sensitivity (Alluvium Take) Versus Calibration Sensitivity

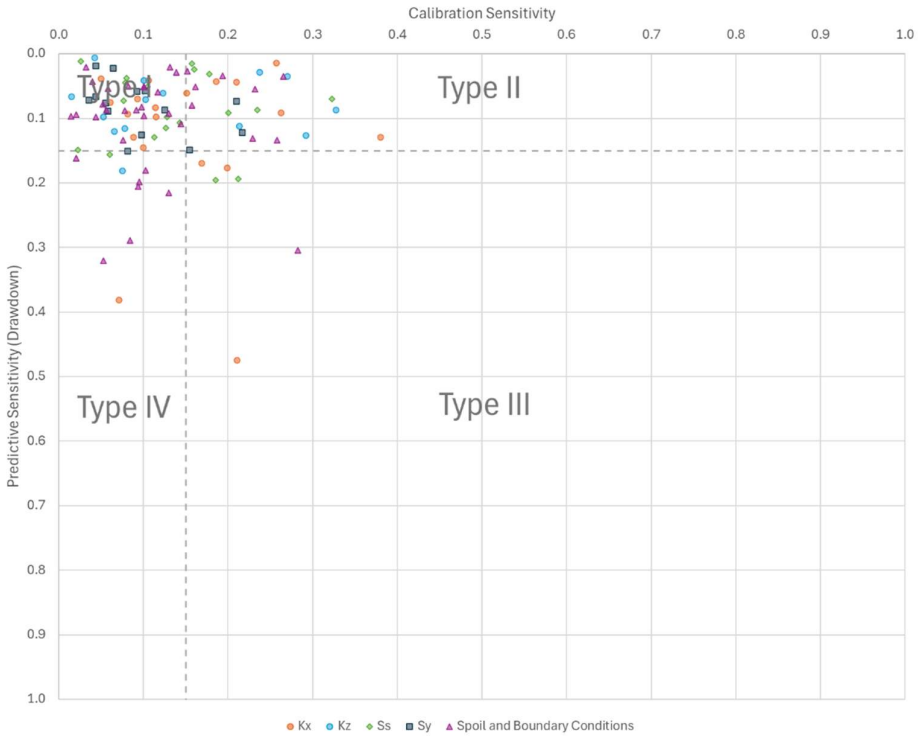


Figure 6-2 Predictive Sensitivity (Drawdown) Versus Calibration Sensitivity

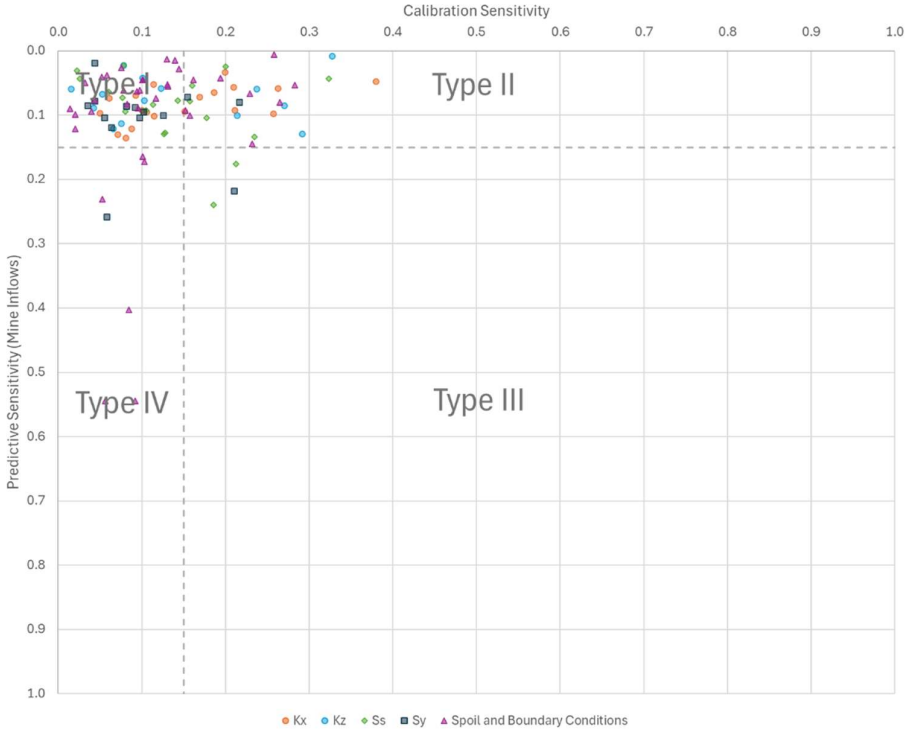


Figure 6-3 Predictive Sensitivity (Mine Inflow) Versus Calibration Sensitivity

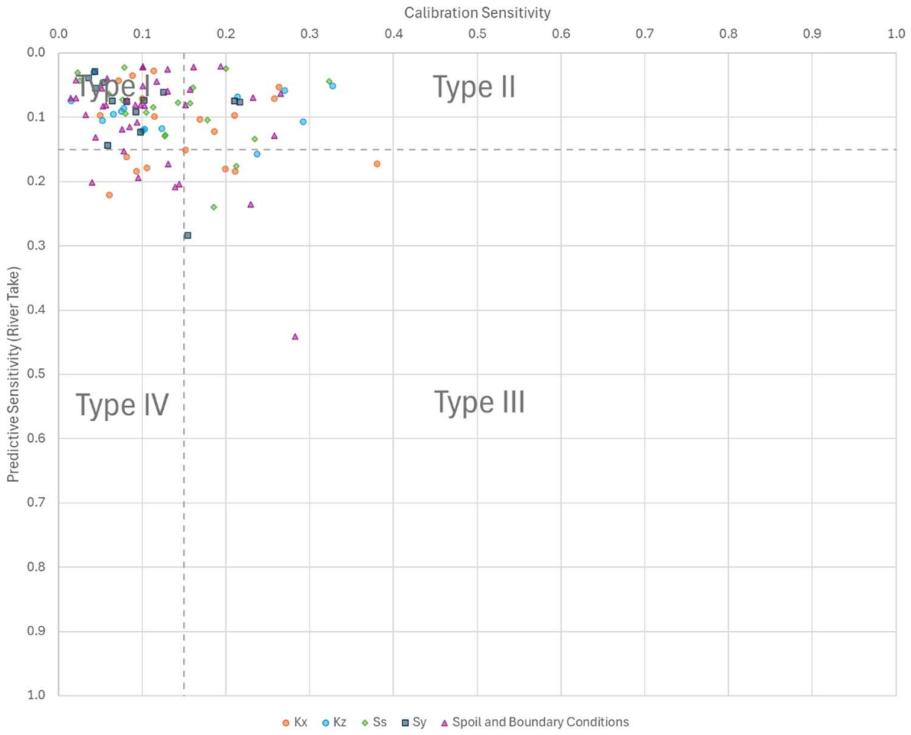


Figure 6-4 Predictive Sensitivity (River Take) Versus Calibration Sensitivity

Table 6-2 Type IV Parameters

Parameter	Description	Associated Prediction
kx_z04	Weathered zone	Alluvium Take, Drawdown
kzf_z18	Burngrove formation	Drawdown
rchf_z03	Weathered Clematis	Drawdown, Mine Inflow
rchf_z04	Weathered Permian	Alluvium Take, Drawdown, Mine Inflow
rivk_z02	Blackwater tributaries	Drawdown
rivk_z10	Tanny Foil dam	Drawdown
spl_rchf_z01	Spoil	Alluvium Take, Drawdown
spl_sy_z01	Spoil	Alluvium Take, Drawdown, Mine Inflow
ss_z02	Tertiary	Drawdown
sy_z13	Interburden	Alluvium Take, Drawdown
tl_rchf_z01	Tailing	Drawdown, River Take
exdp_z02	Regolith	Alluvium Take
kx_z18	Burngrove formation	Alluvium Take
kzf_z15	Interburden	Alluvium Take
rivk_z04	Rockland Creek and tributories	Mine Inflow
spl_kx_z01	Spoil	Mine Inflow
spl_kz_z01	Spoil	Mine Inflow
evtf_z02	Regolith	River Take
kx_z02	Tertiary	River Take
kx_z03	Alluvium	River Take

Parameter	Description	Associated Prediction
kx_z11	Interburden	River Take
kx_z19	Fair Hill formation	River Take
rchf_z02	Regolith	River Take
rivk_z01	Blackwater mainstream	River Take
rivk_z07	Small streams	River Take
spl_ss_z01	Spoil	River Take
ss_z04	Weathered zone	River Take
ss_z08	Rewan lower	River Take
ss_z10	Aries seam	River Take
sy_z09	Overburden	River Take

6.3.4 Conclusion

The sensitivity analysis suggests that most parameters in the model are adequately constrained by the calibration process. It also highlighted several parameters that contribute to predictive uncertainty and that are less conditioned by the calibration process (Type IV parameters).



6.4 Mine Inflows

Following peer review, it was noted that the modelled inflows (**Section 4.5**) were higher than observed pit inflows. These observations were typically 2.25 ML/day (Engeny Australia Pty Ltd, 2025), which are lower than the average cumulative mine inflow rate (2025 to 2093) of 5,139 ML/year (14.1 ML/day) (**Section 4.5**).

The peer reviewer requested that a couple of sensitivity simulations be conducted to test the sensitivity of the predicted mine inflows to the timing setup of when TVM activates the changes in parameters from host material properties to post-mining properties (i.e. spoil or void).

The model results presented outside this section use what will be referred to herein in the sensitivity assessment as the TVM3 setup. The TVM3 setup has hydraulic conductivity (Kx and Kz) change within the stress period when mining (DRN) is activated, and storage properties are activated in the stress period when DRNs become inactive.

MODFLOW USG does not instantaneously change parameter values at the beginning of the activated stress period. Instead, it either linearly or on a log transform basis changes the parameters over the stress period length such that only at the end of the stress period is the full change implemented. An example for how TVM3 is implemented would be:

- Assume a mining DRN cell becomes active in stress period 50 and is active for 1 stress period (i.e. is inactive in stress period 51).
- Hydraulic conductivity values would be transformed (SLR uses the log transform option) over the duration of stress period 50 such that by the end of mining the hydraulic properties would be equal to the spoil properties and therefore full spoil properties for the beginning of stress period 51 when DRNs are inactive.
- Storage properties would not begin to change until stress period 51 and would be fully transformed by the end of stress period 51, one year after mining was completed.

The peer reviewer requested two sensitivity simulations that vary the start timing of the TVM operations.

- TVM2 – this option has all parameters begin to change in the stress period following the mining. In the above example, this would mean no change to how storage was handled but would push the change of hydraulic conductivity values to begin the stress period after mining has ceased (stress period 51) with full implementation of the changes by the end of stress period 51.
- TVM1 - this option has all parameters begin to change in the stress period when the mining is activated. In the above example, this would mean no change to how hydraulic conductivities were handled but would push the change of storage values to begin the stress period when mining commences (stress period 50) with full implementation of the changes by the end of stress period 50.

The results for estimated total pit inflows are provided for TVM2 and TVM3 in **Figure 6-5**. The results for TVM1 were exactly the same as those for TVM3 and therefore are not explicitly represented in **Figure 6-5**.

The predicted mine inflows are insensitive to the timing of when storage properties are changed.

The predicted mine inflows are sensitive to the timing of when hydraulic conductivity properties are changed. By delaying when the hydraulic properties are changed to the year after mining was completed reduces predicted pit inflows. The reduction in inflows is closer to the observed values; however, it is noted that neither model result has been corrected for



evaporation that would occur on the highwalls and pit floors, and as such would be expected to be greater than observed ingress and or values estimated from operational site water balance models.

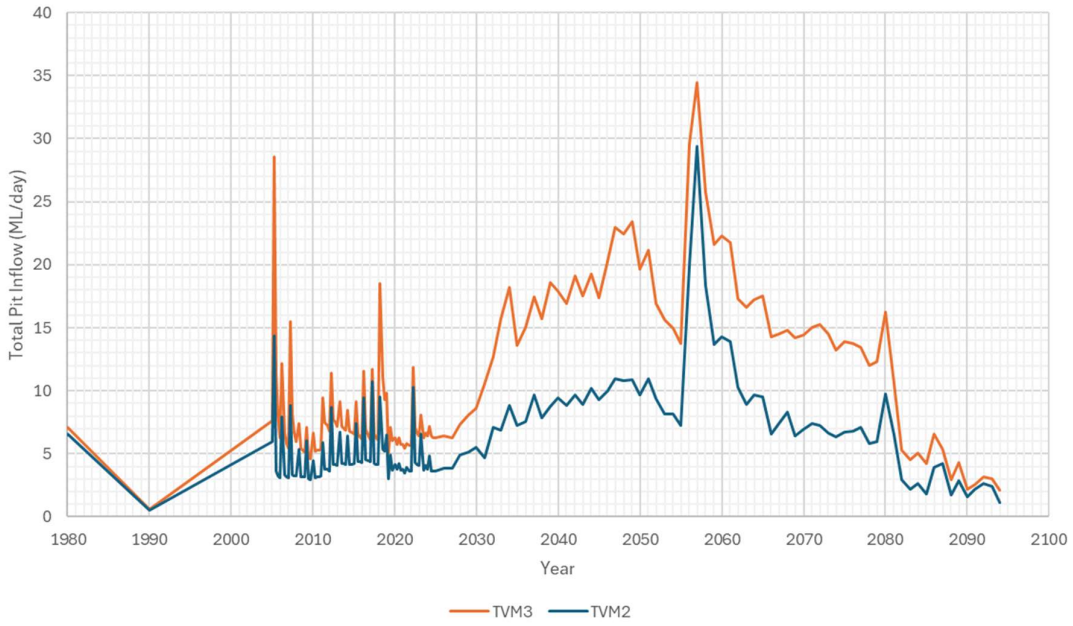


Figure 6-5 TVM Sensitivity Analysis – Predicted Cumulative Mine Inflows

7.0 Uncertainty Analysis

A Type 3 Monte Carlo uncertainty analysis was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis. This approach is consistent with guidance provided by the Independent Expert Scientific Committee (IESC) (2018) for uncertainty analysis within a groundwater modelling risk management framework.

The first step in Monte Carlo analysis is to define the parameter distribution and range. For this project, the software PESTPP-IES (part of the PEST suite) was used to generate parameter ensembles based on a provided range of plausible value. The parameter distributions for the sampled prior and the calibrated ensemble are shown in **Appendix F**.

PESTPP-IES uses an “ensemble smoother” method that enable optimising each realisation in order to obtain an ensemble (suite of realisations) that:

- covers the range of plausible parameters distribution; and
- is calibrated to historical water level data.

As discussed in **Section 3.1**, a total of 75 calibrated realisations were selected from the last iteration and regarded as sufficient.

The predictions included in the uncertainty analysis were:

- maximum drawdown;
- predicted open cut mine inflow;
- alluvium water take; and
- change in river baseflow.

7.1 Uncertainty Convergence

SLR conducted statistical analyses of predictive results to assess if additional realisations were likely to provide results that would significantly change reported results. SLR calculated the 95% confidence interval for the predictive results.

The confidence intervals are presented sequentially as more realisations are added. For example, the confidence interval of the predicted alluvium take and total dewatering rates was calculated using the results from two realisations, three realisations, sequentially up to the total number of realisations.

Figure 7-1 and **Figure 7-2** show the median and maximum confidence intervals of alluvium take and total dewatering rates respectively, as well as the variance of the confidence intervals as more realisations are added. To calculate the statistics shown, the following steps are taken:

1 The model results of interest, total dewatering rates for this example, are first processed for all realisations.

2 The 95% confidence interval is then calculated sequentially as more realisations (i.e. results) are added, creating a sequential progression of confidence intervals as new realisations are added.

3 Median and maximum values of confidence intervals are then calculated at each interval of realisations being added.

4 Variance is calculated from the confidence intervals at each interval of realisations being added.

As indicated in **Figure 7-1** and **Figure 7-2**, additional realisations are unlikely to significantly increase or decrease the confidence intervals of predictions. This conclusion is drawn based upon the combination of two factors:

1 The rate of change per additional realisation is small.

2 The magnitudes of the confidence interval are small and well below reasonable expectation of the predictive ability of a numerical model.



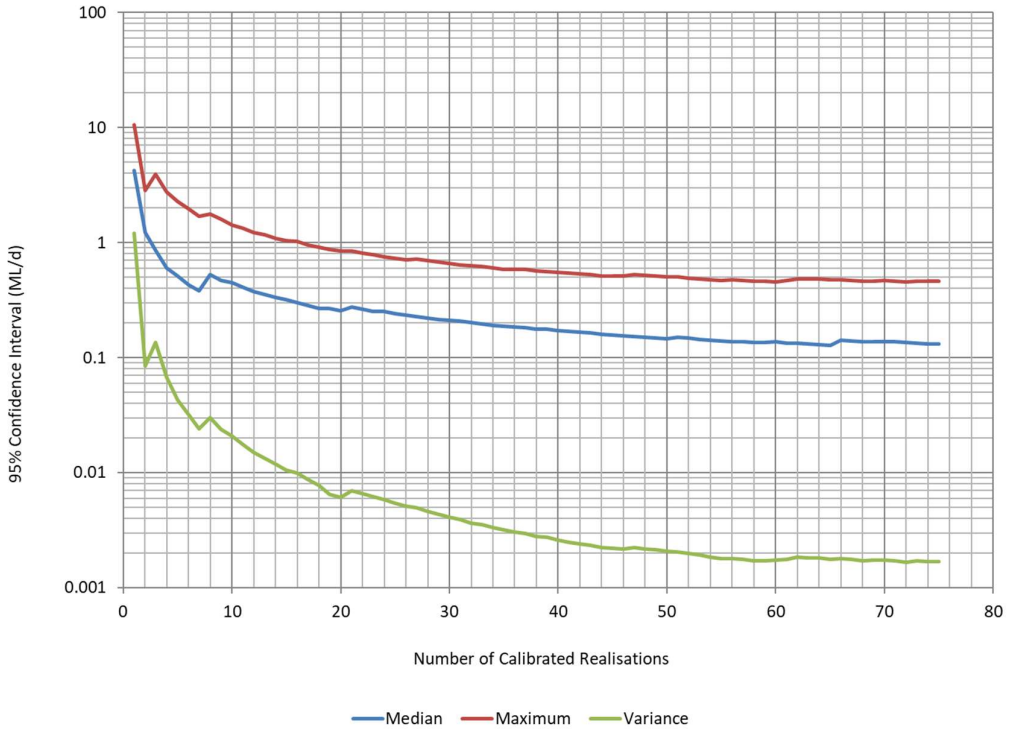


Figure 7-1 Predictive Uncertainty Convergence – Alluvium Take

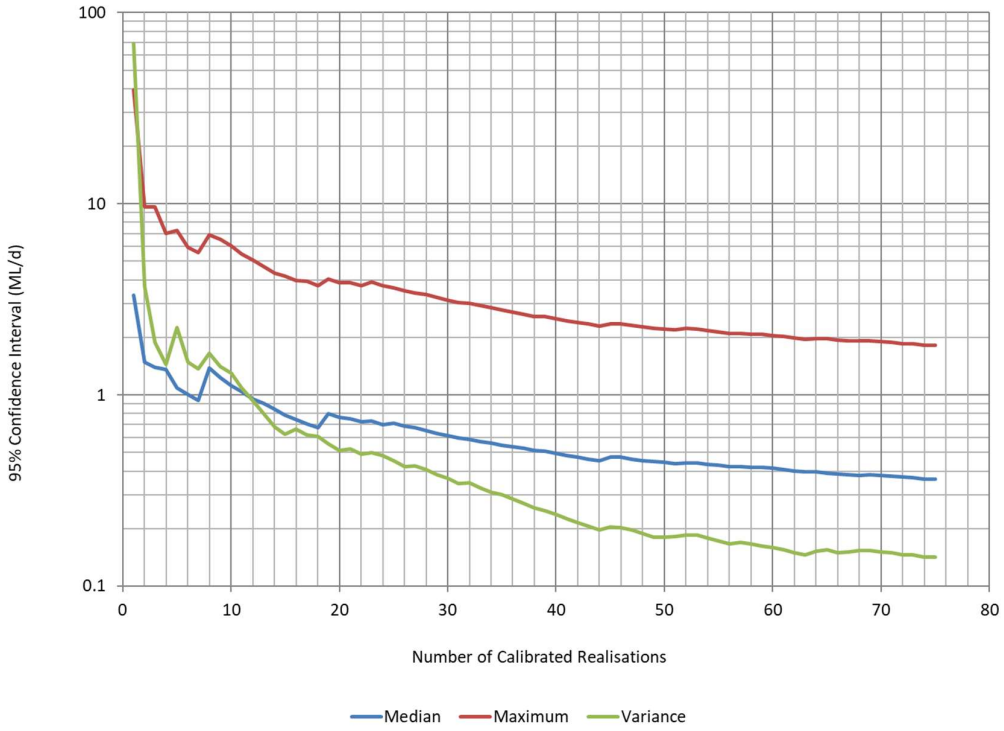


Figure 7-2 Predictive Uncertainty Convergence – Dewatering Rate

The “converged” values shown in **Figure 7-1** to **Figure 7-2** for alluvium take and total dewatering rate do not represent physical dewatering or water take rates at a specific point in time. Instead, they reflect the reduction in predictive uncertainty as more realizations are included. In other words, convergence indicates that additional realizations do not significantly change the spread of model predictions. Therefore, this value is a statistical measure of prediction stability rather than an actual pumping rate.

7.2 Uncertainty Results

7.2.1 Uncertainty in Mine Inflows

The uncertainty in groundwater inflow into the open cut mine (active take) from the start of the predictive model (2025) to the end of mining (2093), is shown for the cumulative Scenario (**Figure 7-3**). The predicted inflows are shown for the BCM and different percentiles prediction ranges. These represent the:

- Minimum to 5th percentile indicates it is very likely the outcome is larger than this range.
- 5th – 33th indicates it is likely that the outcome is larger than this range.
- Median indicate it is as likely as not that the outcome is larger or smaller than this value.
- 33th - 67th indicates it is likely that the outcome is within that range.
- 67th – 95th indicates it is unlikely that the outcome is larger than this range.
- 95th percentile indicates it is very unlikely the outcome is larger than this value.

Overall, the results indicate that the BCM is representative of the median estimated mine inflows. From 2056, the BCM is more representative of the 67th to 95th percentile band.

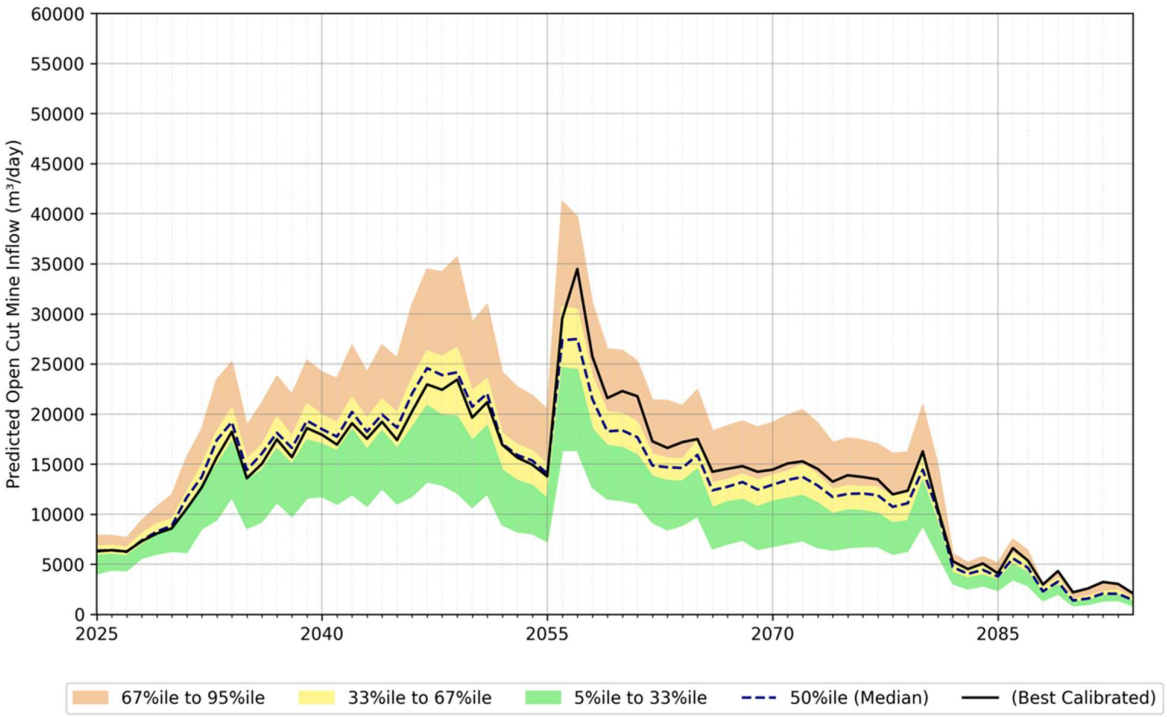


Figure 7-3 Predicted Open Cut Inflow Uncertainty - Cumulative Scenario

7.2.2 Uncertainty in Alluvium Take

The uncertainty in alluvium take for the alluvium associated with the Blackwater Creek is shown for the incremental scenario (**Figure 7-4**) and the cumulative scenario (**Figure 7-5**). Negative values indicate a reduction in alluvium take while positive values indicate an increase in alluvium take.

The BCM is representative of the median for the incremental alluvium take and the 5th to 33th percentile for the cumulative alluvium take.

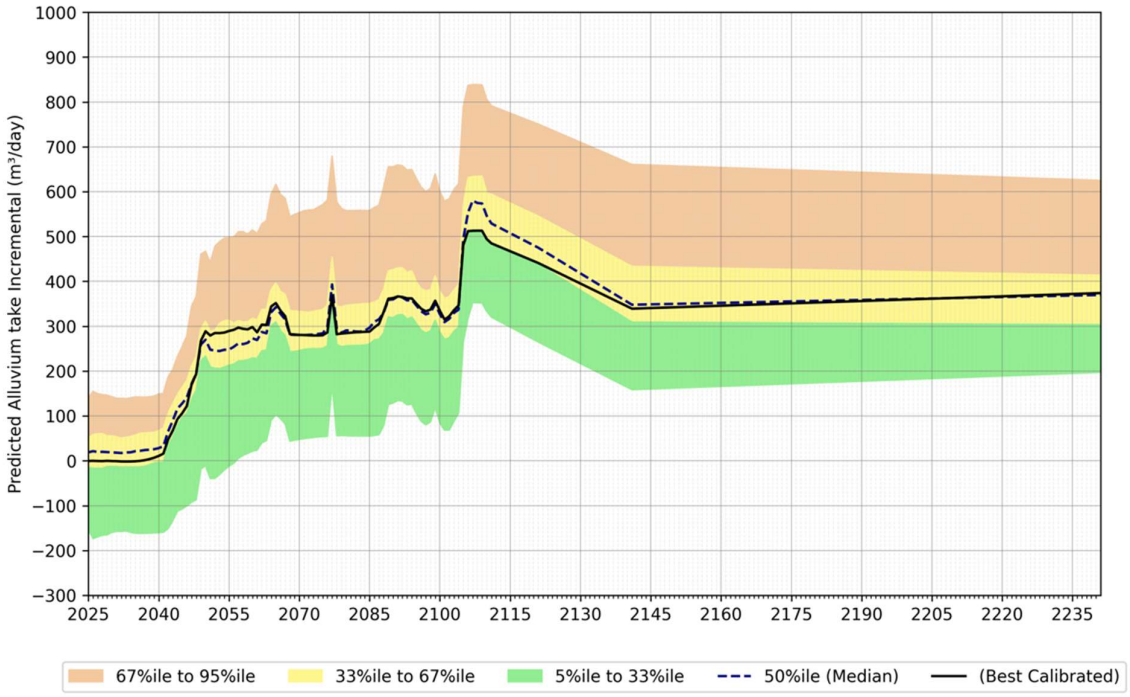


Figure 7-4 Uncertainty in Incremental Alluvium Take

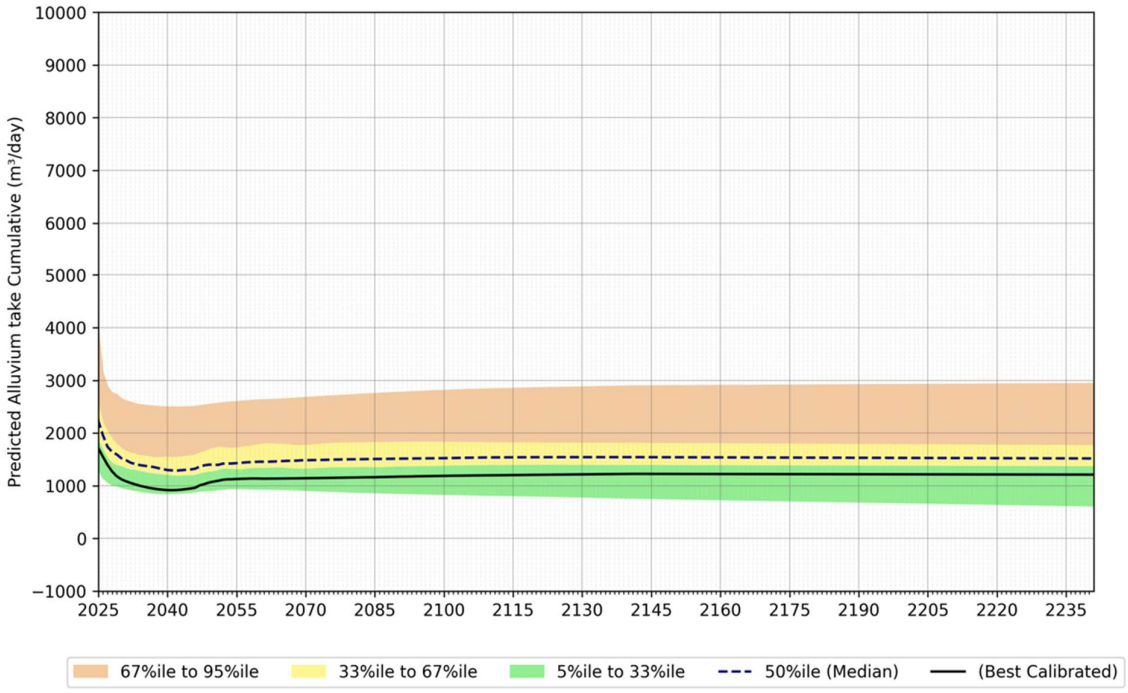


Figure 7-5 Uncertainty in Cumulative Alluvium Take

7.2.3 Uncertainty on Surface Water Flow

The change in groundwater flow to Blackwater Creek due to the Project was calculated by comparing the river flow budgets for Blackwater Creek in the Cumulative scenario against the Approved scenario.

The uncertainty in change in groundwater flow to Blackwater Creek is shown for the incremental scenario on **Figure 7-6**. Negative values indicate an increase in groundwater fluxes to Blackwater Creek while positive values indicate a decrease in groundwater fluxes to Blackwater Creek. The BCM is representative of the median.

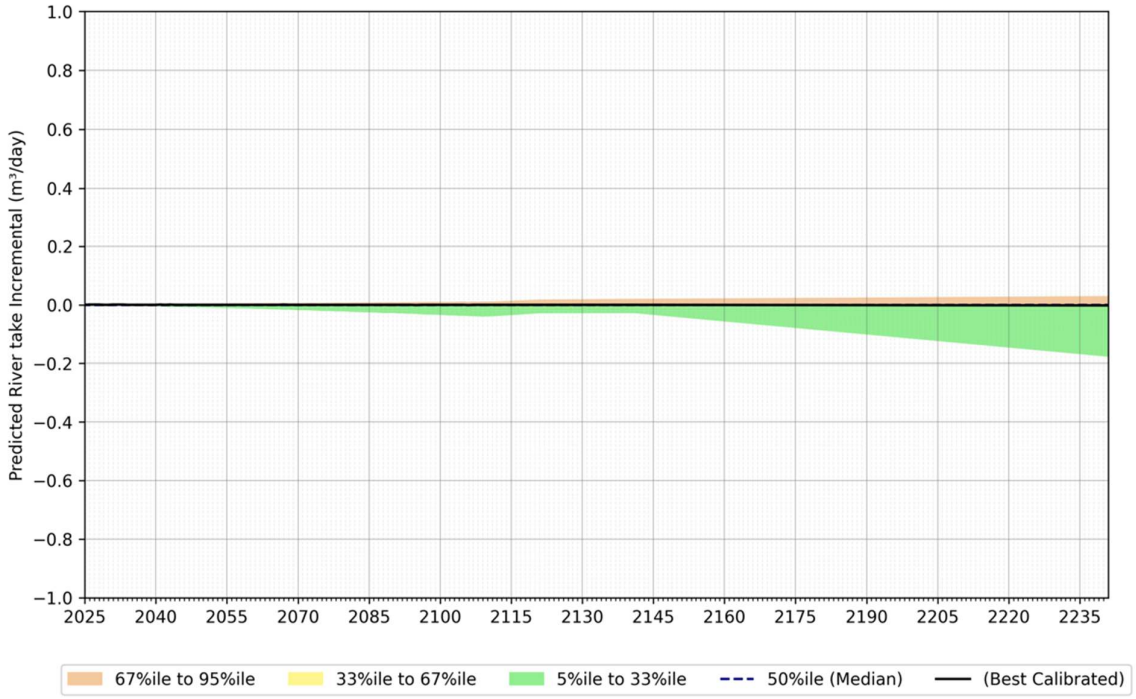


Figure 7-6 Uncertainty in Incremental River Baseflow Loss

7.2.4 Uncertainty in Drawdown

To illustrate the level of uncertainty in the extent of predicted mine induced drawdown (1 m contours), the 50th percentile maximum drawdown extent were compared to the maximum drawdown extent for the 5th and 95th percentiles (**Appendix G**). Both cumulative and incremental drawdown were calculated to demonstrate the impacts of mining on groundwater levels across different model layers. Incremental drawdown is generally limited in extent within model layers 1 and 2; however, the 95th percentile drawdown extent expands to the model boundary in the deeper layers.

8.0 Model Confidence and Limitations

The groundwater modelling was conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012), the MDBC Groundwater Flow Modelling Guideline (MDBC, 2001) and the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023).

The model confidence level (Class 1, Class 2 or Class 3 in order of increasing confidence) based on the Australian Groundwater Modelling Guidelines (Barnett et al., 2012) was previously widely used in the industry. The latest version of the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023) introduces a new concept on how model confidence can be assessed. The document also indicates that this change will follow in the next iteration of the Australian Modelling Guidelines and the new concept for assessing model confidence is hence applied for this model.

The latest version of the IESC Explanatory Note for Uncertainty Analysis defines a model fit for purpose when model results are:

- **Usable:** Relevant to the decision-making process, providing information about the uncertainty in conceptualisations and modelling simulations in a way that allows decision-makers to understand the effects of uncertainty on project objectives and the effects of potential bias. The relevant QoIs in this context are the groundwater inflows (active mining and final voids), drawdown due to mining and fluxes changes due to mining.
- **Reliable:** Demonstrate that the range of model outcomes is consistent with the system knowledge and honours historical observations, and provides objective evidence that uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated. The calibration performance was deemed acceptable, and a rigorous uncertainty analysis was undertaken to further improve confidence in the modelling outputs.
- **Feasible:** Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the project. This study is an update of a 2021 model variation, which shows that there are several model revisions and the latest data has been included. The model has been peer reviewed for each revision. This model build and associated review process is deemed commensurate with the Project related risk to the groundwater environment.

In order to assess these three points above, the four sources of scientific uncertainty (structural, parametrisation, measurement error, predictions) have been qualitatively assessed with regards key aspects of the BWM groundwater model, as presented in **Table 8-1**.

Overall, the model captures depressurisation due to active mining. The model is numerically stable with an acceptable mass balance error. The model shows a good fit between observed and modelled groundwater levels. A depth dependence function was used for hydraulic conductivity. Overall, the model is considered fit for purpose to achieve the objectives outlined in **Section 1** based on the data provided and the Project timeframe. Updates could be conducted in future to further refine the model, but this would be dependent on the purpose of the modelling and availability of data to inform future changes.

The model sensitivity was explored for an array of parameters. This showed that these parameters were generally well constrained by the calibration. Parameters are likely to contribute the most to predictive uncertainty (Type IV) were also identified.

The uncertainty analysis was undertaken to add a likelihood estimate to the prediction for the quantities of interest.



Table 8-1 Groundwater Model and Data Limitations

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	The model has an unstructured Voronoi grid that includes detailed cell refinement around site, neighbouring mines and along drainage features.
	Layers	Fit for purpose	Top of layer 1 incorporates site Light Detection and Ranging data.
		Fit for purpose	Representation of alluvium based on the CSIRO Regolith mapping Wilford et al (2016) and refined based on site drill data.
	Conceptualisation – Geological Structure	Fit for purpose, future improvements possible where new data collected	The local structure of the geology is based on detailed data at site (BWM geology model), and regional model geometry (outside of site) interpolated based on publicly available data, such as geological mapping and the CSIRO Regolith data set. Geophysical surveys across the Project area have identified minor faulting in the BWM area. Faulting is typically confined to the coal seams of the RCM. The minor faults show a displacement of up to 5 m. Hence, no geological structures (i.e. faults) have been included within the Project area in the model other than through layer displacements from the site geological model. The main regional fault (shot over fault) was included as the eastern model boundary. Displacements of up to 3,000 m are reported at this fault. The Permian coal measures outcrop along the western edge of the site. Therefore, how this is captured within the model influences the model predictions. The structure of the coal seams was checked to ensure it matches observed and mapped geology. The predictions of drawdown adjacent to mining was checked and the model shows a good fit between modelled and observed trends.
	Conceptualisation – GDEs	Fit for purpose, future improvements possible	A GDE conceptualisation is provided in SLR (2026).
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose	The groundwater - surface water interactions are conceptualised as limited. Due to the gauged creeks to be classified as ephemeral (SLR, 2026), no long-term baseflow contribution from the groundwater is expected. Rather, surface water is expected to recharge the groundwater and after such recharge events, some minor baseflow contributions back into the creeks is possible.



Type	Part	Status	Comment
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose future improvements possible	Site monitoring network includes one bore mapped within alluvium that was used to inform saturated extent of alluvium locally at site and for calibration targets. However, the alluvium in the area was found dry at this location. Other attempts to drill into the alluvium were abandoned, as either no alluvium was found or the alluvium was dry, or the bores were installed into the Rewan instead. The modelled groundwater levels in alluvium have hence no comparison available.
Parameterisation	Hydraulic Conductivity – Shallow layers	Fit for purpose	Spatial variability of hydraulic parameters in the Alluvium and Regolith have been incorporated in this model version by adding pilot points in both layer 1 and 2. This enhancement has allowed representing the heterogeneity in the alluvial system, improving the model's ability to replicate water level measurements in these units.
	Hydraulic Conductivity – Depth Dependence	Fit for purpose	Field testing of hydraulic conductivity (horizontal and to a lesser extent vertical) has been conducted in the area. Hydraulic conductivity test results from the other sites within the model domain were also considered. The data shows a general decline in hydraulic conductivity with depth that is replicated in the model.
	Spoil Properties	Fit for purpose, future improvements possible	Limited site-specific data is available for the spoil. Spoil properties were adopted using the previous studies.
	Rivers	Fit for purpose, future improvements possible	Blackwater Creek stage height is changed temporally in the historical calibration model based on observed levels from site stream gauges, and long term annual average level assumed in the predictive model. Blackwater Creek records flow only for a few days per year. The simulation of river stage height involves representing it as the average stage over the entire model stress period. However, since the stress periods (i.e., time slices) in the model are quarterly or annual, the stage height for Blackwater Creek persists in the model for a much longer period than it does in reality. This conservative design approach results in the simulation of what is naturally an ephemeral river reach as a perennial river in the model. Consequently, this leads to an overprediction of water levels in the alluvium along Blackwater Creek. All other watercourses within and in the vicinity of the Project area are ephemeral and only flow briefly after rainfall. Therefore, river stage height of zero was assigned to these watercourses in the model.



Type	Part	Status	Comment
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and calibrated recharge rates.
Measurement Error	Observation Data Quality	Fit for purpose	Bore logs and construction details available for most site bores, and long-term site water level data available for various units.
	Landholder Bore Data Quality	Fit for purpose, future improvements possible	Impacts on registered landholder bores are influenced by the assumptions of the bore design, target geology and use. Verification of landholder bore details may be required in future.
	Temporal spread	Fit for purpose	Timeseries water level data from the site as well as for the tertiary and Permian coal measures.
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose	Transient warm-up (1970-2005) and transient (2005 to 2024) calibration model set up and a depth dependence function used and calibration to water levels conducted using automated (PEST) and manual methods.
	Predictive	Fit for purpose	Model captures approved and proposed open cut mining at BWM. The model also includes future mining at BWM South and Curragh mines, mainly based on publicly available data. The actual future mine progression for these sites may vary.
	Sensitivity and uncertainty	Fit for purpose	Uncertainty analysis has been conducted using PESTPP-IES. The uncertainty analysis quantified the variability in predictions with changes in maximum predicted drawdowns, mine inflows, impact on alluvium flow and impacts on surface water flow.



8.1 Conclusions

The numerical groundwater model developed for the Project successfully achieved the modelling objectives, as outlined in **Section 1**. Model calibration statistics are within suggested guidelines (Barnett et al., 2012) and mass balance errors remain low, through the model calibration and predictive modelling. Model construction considers all available data, including the current site mine plan and site geological model for the Project area. The uncertainty analysis has demonstrated a low likelihood for the Project to impact on alluvial water levels, with Project related drawdown primarily contained within the Project area. The model serves as a suitable representation of possible transient groundwater conditions within the Study Area, over the life of the Project, however, the uncertainty in predictions should be acknowledged.

Limited site-specific information on hydraulic conductivities and storage parameters were available during calibration. As more site-specific hydraulic data becomes available, new data should be compared with the calibrated parameters achieved and the validity of the model calibration should be assessed. Additional site-specific data is expected to “tighten” uncertainty bounds for model prediction results.

Predictive sensitivity indicates that mine inflows are sensitive to spoil hydraulic parameters. However, calibration sensitivity to these parameters is relatively low. Future work should consider opportunities to further constrain values of these parameters.



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Appendix A Calibration Residuals

Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

7 October 2026

ID	Easting	Northing	Layer	Average Residual	Min	Max
BG No.1 AP	684107	7387742	16	-6.37	-6.64	-6.21
BG No.2 BG	684414	7384622	16	0.77	-1.79	3.86
BWM_MB01_02	687411	7344932	10	-32.48	-33.38	-29.14
BWM_MB02_01	691791	7362760	7	4.28	3.43	4.73
BWM_MB02_02	691803	7362756	10	-19.82	-20.36	-19.34
BWM_MB03_02	692220	7381519	5	-9.80	-9.83	-9.74
BWM_MB04_01	686247	7350296	10	15.26	13.07	16.69
BWM_MB100_01	683897	7353255	2	10.95	10.95	10.95
BWM_MB106_01	684923	7352654	2	-3.17	-3.17	-3.17
BWM_MB107_04	685192	7352941	12	-17.47	-17.47	-17.47
BWM_MB108_04	685132	7353470	12	-21.74	-21.74	-21.74
BWM_MB109_02	684843	7353684	12	0.69	0.69	0.69
BWM_MB110_01	684722	7353488	11	-2.59	-2.59	-2.59
BWM_MB113_01	684003	7353042	2	1.37	1.37	1.37
BWM_MB114_01	683973	7352659	2	-2.47	-2.47	-2.47
BWM_MB116_02	683430	7351232	16	-7.23	-7.23	-7.23
BWM_MB117_01	683622	7350774	16	-4.44	-4.44	-4.44
BWM_MB117_02	683557	7350857	2	3.63	3.63	3.63
BWM_MB118_02	683708	7350621	16	-2.75	-2.75	-2.75
BWM_MB11_01_R01	691468	7360018	7	-27.53	-30.77	-24.28
BWM_MB11_02	691462	7360012	10	3.78	-2.49	10.05
BWM_MB11_03	691458	7360008	12	16.79	11.89	21.69
BWM_MB121_02	684196	7350960	16	16.79	16.79	16.79
BWM_MB122_01	684453	7351176	7	10.01	10.01	10.01
BWM_MB123_02	683946	7351056	16	6.89	6.89	6.89
BWM_MB126_02	684063	7351953	16	1.90	1.90	1.90
BWM_MB12_02	687969	7356097	10	-1.03	-1.81	-0.44
BWM_MB12_03	687977	7356091	12	-3.34	-3.38	-3.30
BWM_MB130_01	684963	7351640	7	-2.90	-2.90	-2.90
BWM_MB130_02	684959	7351646	12	1.77	1.77	1.77
BWM_MB131_02	684803	7351242	16	6.65	6.65	6.65
BWM_MB132_02	684591	7351283	16	4.75	4.75	4.75
BWM_MB134_02	684943	7351085	16	7.27	7.27	7.27
BWM_MB135_02	684899	7350805	14	-7.49	-7.49	-7.49
BWM_MB136_02	684603	7350311	16	-5.65	-5.65	-5.65



ID	Easting	Northing	Layer	Average Residual	Min	Max
BWM_MB137_02	685185	7350987	16	9.19	9.19	9.19
BWM_MB138_02	684736	7350972	13	2.42	2.42	2.42
BWM_MB15_01	686794	7347807	2	25.82	25.78	25.90
BWM_MB15_02	686779	7347804	12	-11.83	-17.56	-6.11
BWM_MB15_03	686768	7347802	10	-15.47	-19.04	-11.90
BWM_MB164_01	683816	7350493	2	4.01	4.01	4.01
BWM_MB16_01	682882	7340174	2	0.79	-0.11	1.25
BWM_MB16_02	682883	7340184	10	-9.65	-9.85	-9.31
BWM_MB16_03	682875	7340188	12	-8.73	-8.93	-8.35
BWM_MB17_02	684119	7343373	2	0.56	-1.34	0.92
BWM_MB17_03	684111	7343371	2	-7.25	-7.43	-6.95
BWM_MB19_01	683803	7350482	16	-17.23	-17.23	-17.23
BWM_MB21_02	686043	7342140	8	-22.34	-22.79	-21.89
BWM_MB21_03	686041	7342148	12	-22.97	-23.38	-22.60
BWM_MB22_01	687412	7344924	2	5.12	5.02	5.18
BWM_P4	684098	7352908	2	-2.13	-2.95	-1.12
BWM_P7	684002	7352973	2	-0.75	-1.03	-0.55
FY16_PZ_2	686714	7387555	12	-2.03	-2.78	-1.18
FY16_PZ_3	686322	7388372	12	-11.22	-12.19	-6.15
FY16_PZ_4	686206	7389577	12	-7.77	-8.13	-7.47
FY16_PZ_5	685482	7389168	12	-2.78	-3.12	-2.52
MB1	686528	7387172	8	-6.22	-10.85	-1.07
MB15	688772	7354180	7	0.31	-4.92	4.89
MB16	687966	7352289	7	-13.18	-25.78	4.22
MB17	691280	7370333	7	-11.70	-14.22	-10.07
MB18	691528	7370782	7	-7.71	-12.53	-3.55
MB19BWM01P	690024	7390277	8	-6.82	-7.22	-6.32
MB19BWM02A	690112	7390183	6	-0.60	-1.13	0.02
MB19BWM03P	688442	7383483	8	-7.40	-10.97	-3.31
MB19BWM04R	688307	7383595	6	-16.58	-17.11	-16.27
MB19BWM06P	687694	7379464	8	9.68	8.96	10.74
MB19BWM08P	691544	7370740	8	8.63	8.45	9.15
MB19BWM25P	689262	7376881	6	-5.66	-6.01	-5.16
MB19BWM27P	689070	7376739	8	1.30	0.98	1.71
MB19BWM_10P	684383	7342058	12	-13.09	-13.22	-12.97



ID	Easting	Northing	Layer	Average Residual	Min	Max
MB19BWM_15P	669194	7338140	8	-5.94	-7.40	-5.09
MB19BWM_16R	669188	7338156	6	-10.61	-12.19	-9.15
MB19BWM_18P	677019	7338061	8	-11.22	-13.01	-10.33
MB19BWM_24P	670211	7342228	8	-11.82	-11.95	-11.69
MB19BWM_25P_B	683532	7333206	8	3.15	3.04	3.34
MB20BWM02P2	686321	7388395	10	-15.11	-17.87	-5.71
MB20BWM03P1	686489	7387296	10	-12.75	-13.20	-12.53
MB20BWM03P2	686490	7387289	12	-10.62	-12.21	-9.73
MB23	683792	7350850	16	-0.59	-0.77	-0.36
MB3	688026	7373479	8	3.12	0.11	7.54
MB4	692072	7366435	7	-19.36	-20.81	-12.30
MB6	686881	7347723	7	25.74	20.88	30.20
MB8	681544	7373895	2	1.56	-0.75	4.19
MB9	682318	7372602	16	7.38	6.97	7.67
RGS_PZ2-3	683745	7351052	2	3.20	3.00	3.41
RGS_PZ6-2	683925	7350731	2	8.53	7.91	9.78
TMB1-D	681252	7372802	16	-0.02	-0.12	0.07
TMB1-S	681249	7372800	2	3.95	3.82	4.05
TMB5-S	683230	7373039	2	11.23	10.85	11.80
TMB6-S	682831	7373037	16	1.31	1.08	1.51
TMB7-S	681358	7373521	16	4.09	4.09	4.09
TMB8-S	682254	7374255	16	-5.18	-5.27	-5.06
VWP19BWM01-2	689179	7376894	6	-3.66	-5.83	2.95
VWP19BWM01-4	689179	7376894	7	4.08	-0.20	5.27
VWP19BWM01-5	689179	7376894	9	2.18	1.51	3.09
VWP19BWM02-1	691840	7365921	7	-27.96	-34.15	-19.66
VWP19BWM02-2	691840	7365921	9	-13.04	-15.10	-9.05
VWP19BWM02-3	691840	7365921	11	-10.18	-12.01	-6.05
VWP19BWM02-4	691840	7365921	12	-11.87	-14.27	-8.33
VWP19BWM02-5	691840	7365921	14	-7.06	-12.05	-0.77
VWP19BWM03-2	672843	7334855	7	-23.30	-23.97	-21.56
VWP19BWM03-4	672843	7334855	9	-20.39	-22.05	-18.40
VWP19BWM03-5	672843	7334855	12	-18.64	-20.24	-16.54
VWP19BWM04-1	682417	7330805	6	-22.83	-24.10	-20.93
VWP19BWM04-2	682417	7330805	7	-12.17	-13.11	-11.01



ID	Easting	Northing	Layer	Average Residual	Min	Max
VWP19BWM04-3	682417	7330805	8	9.38	8.91	9.94
VWP19BWM04-4	682417	7330805	11	8.25	7.18	9.59
VWP19BWM04-5	682417	7330805	12	9.52	9.11	10.32

Appendix B Calibration Hydrographs

Blackwater North Extension Project

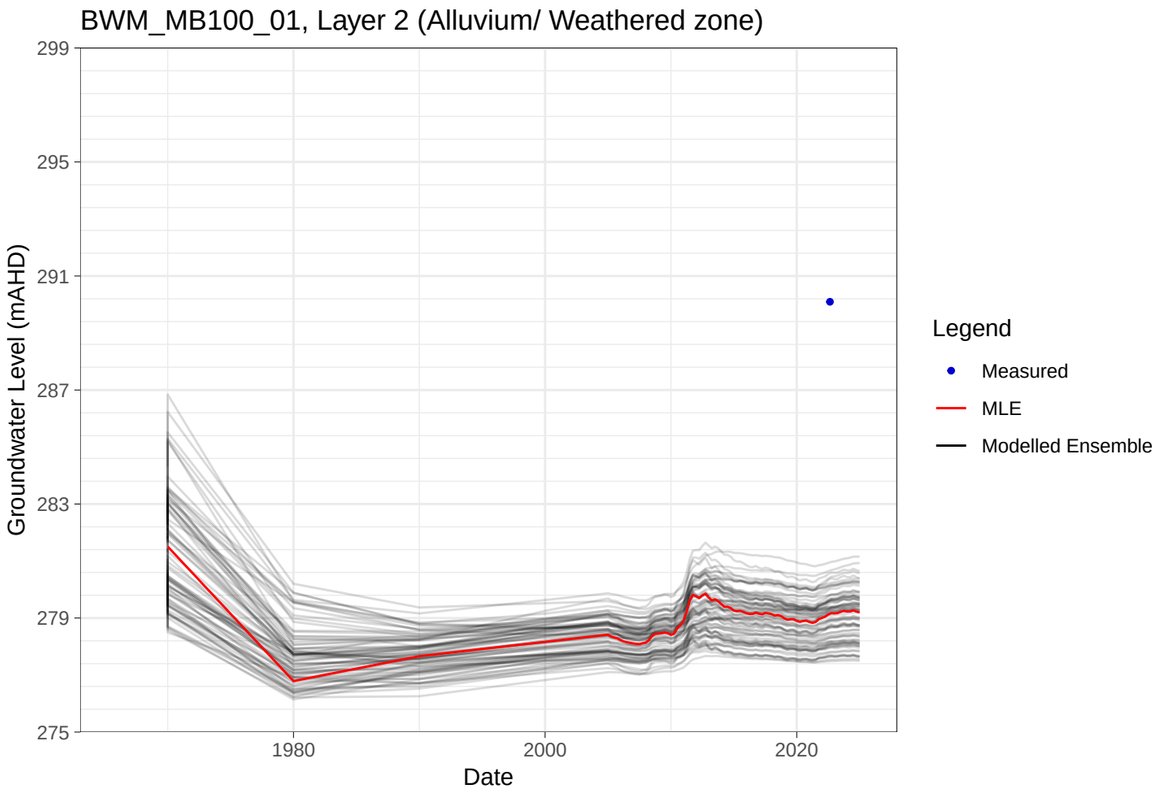
Groundwater Modelling Technical Report

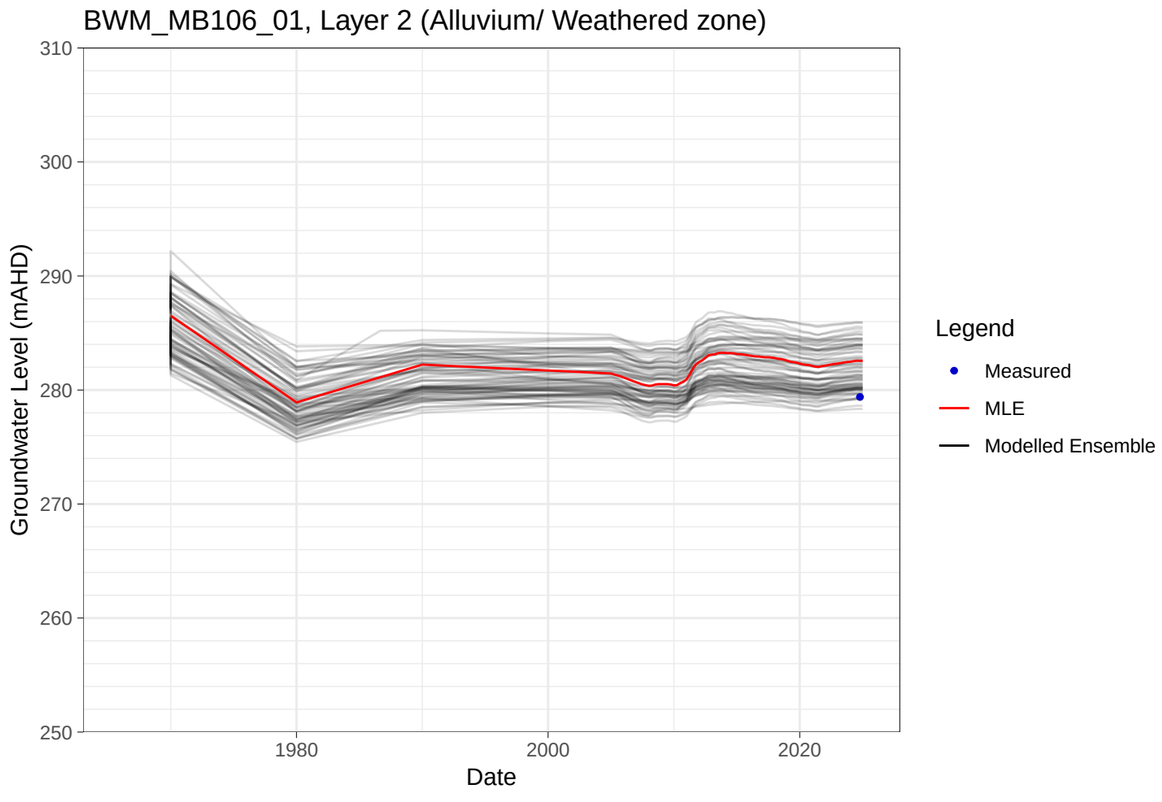
Whitehaven Blackwater Pty Ltd

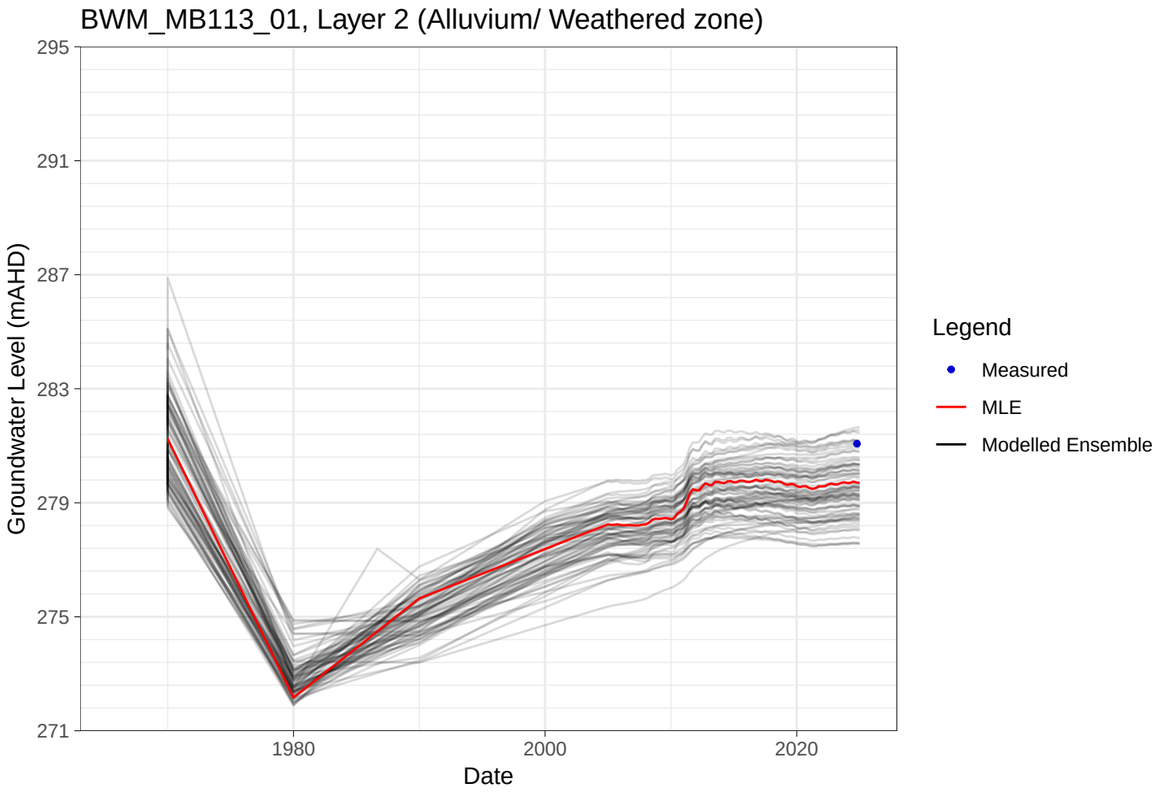
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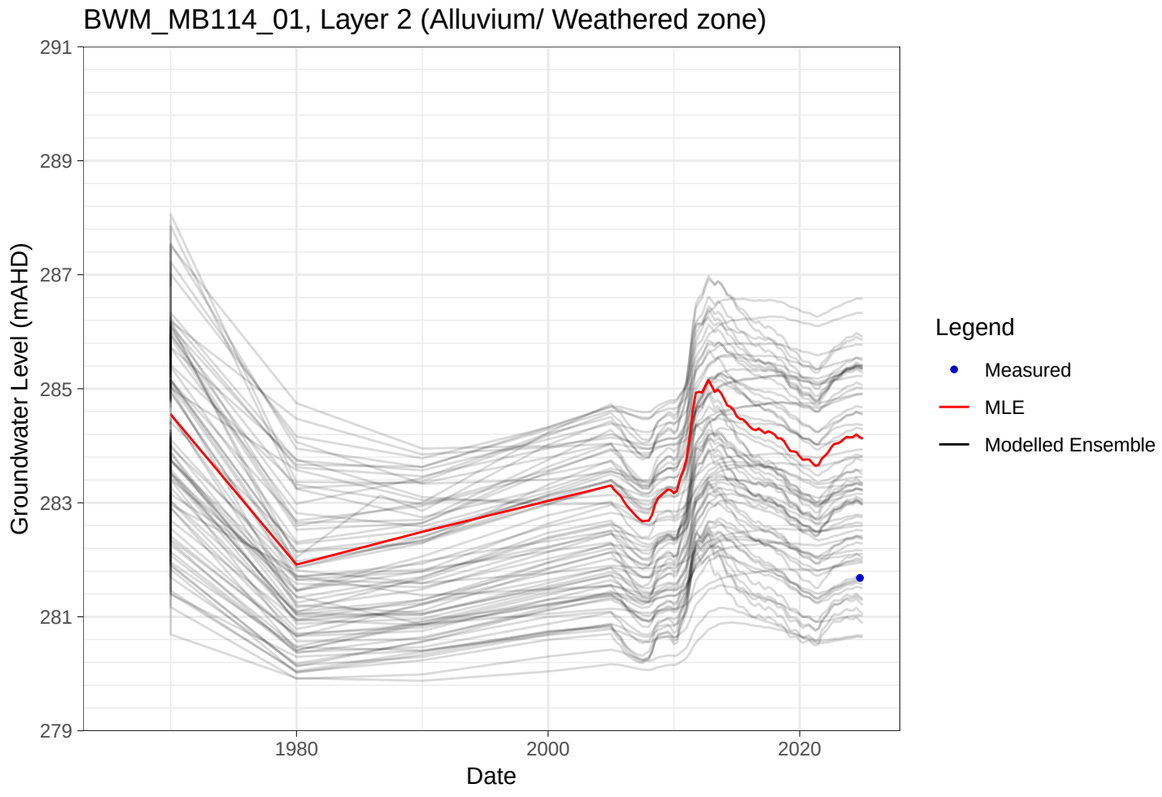
7 October 2026

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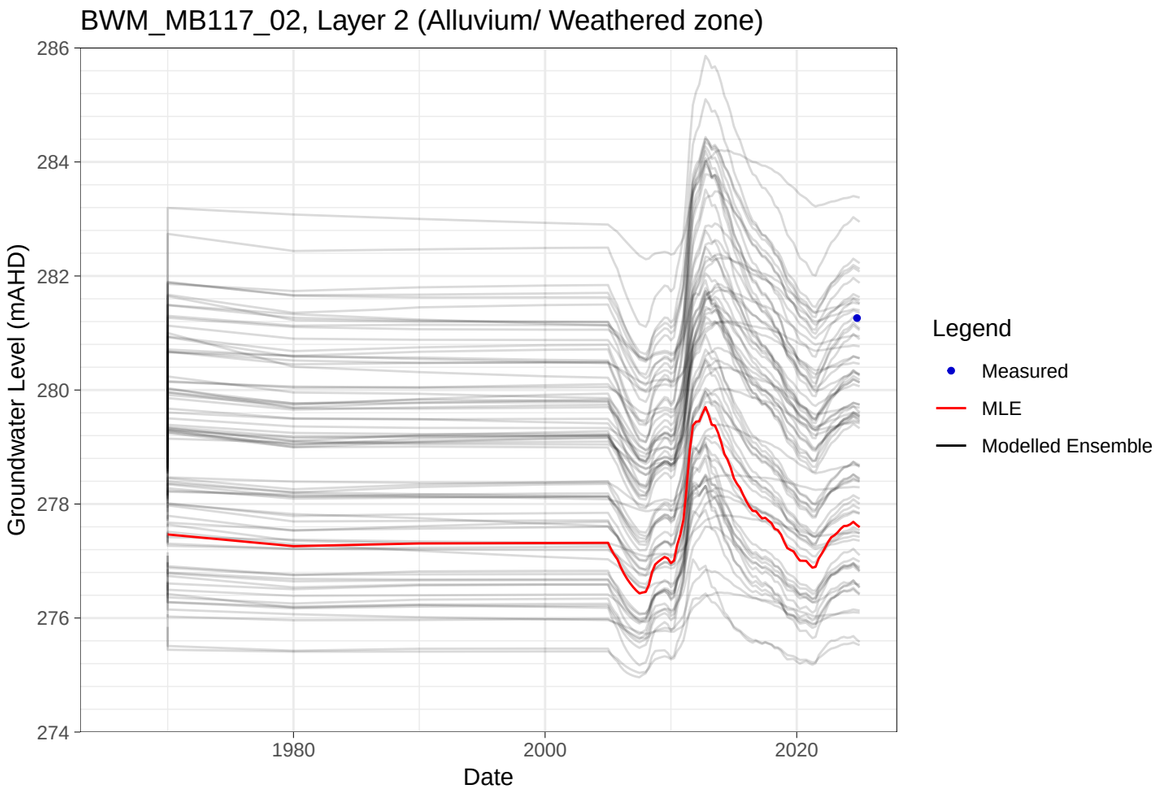

BWM_MB100_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
299
295
291
287
283
279
275
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

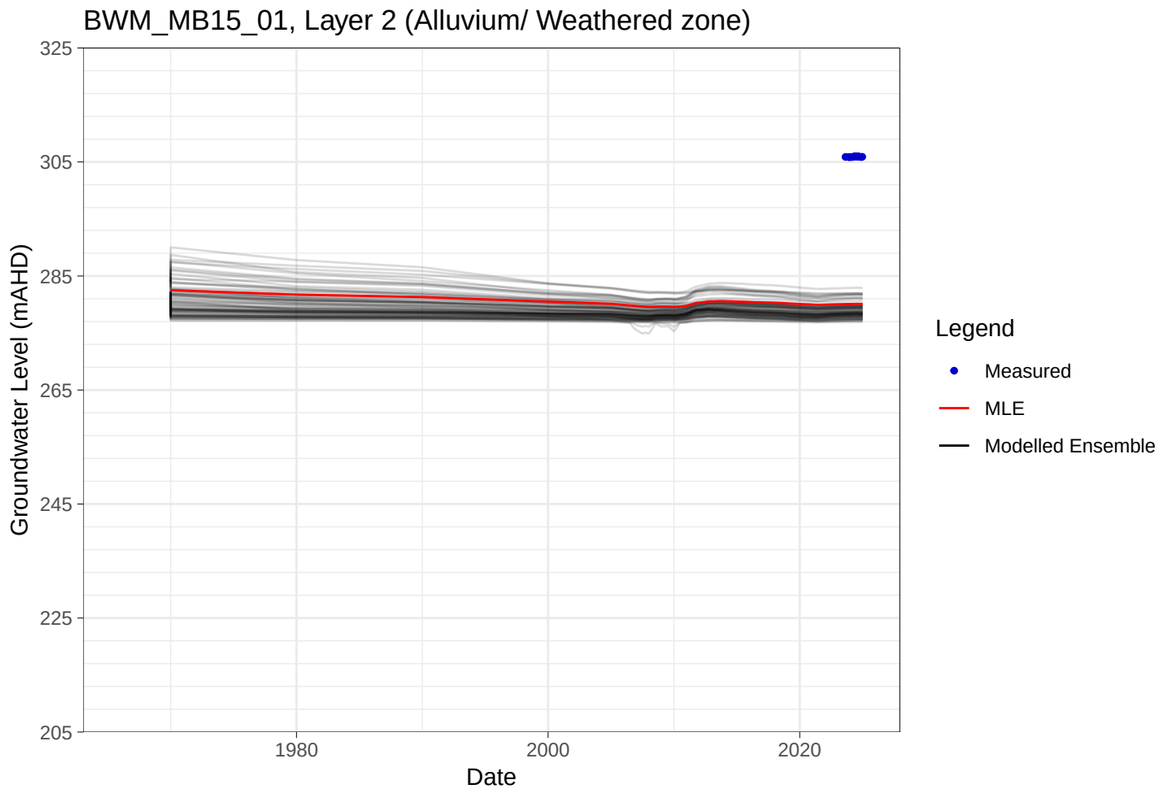

BWM_MB106_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
310
300
290
280
270
260
250
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

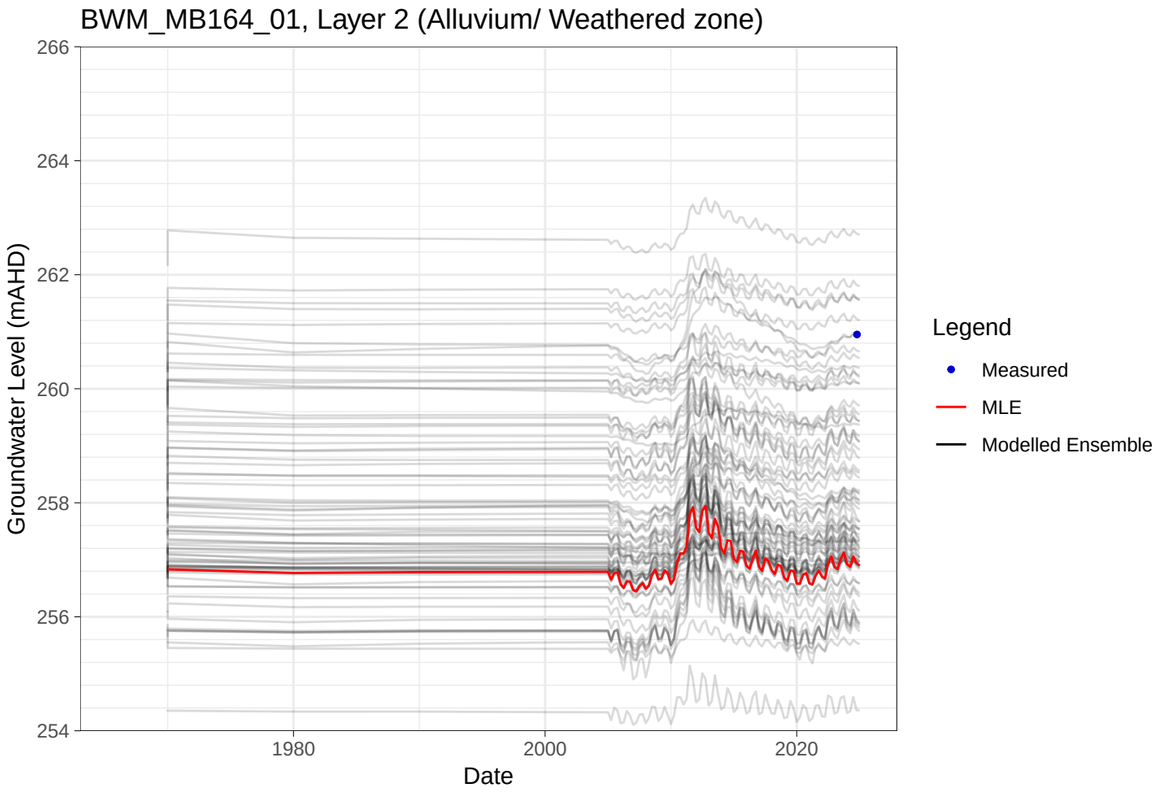

BWM_MB113_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
295
291
287
283
279
275
271
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

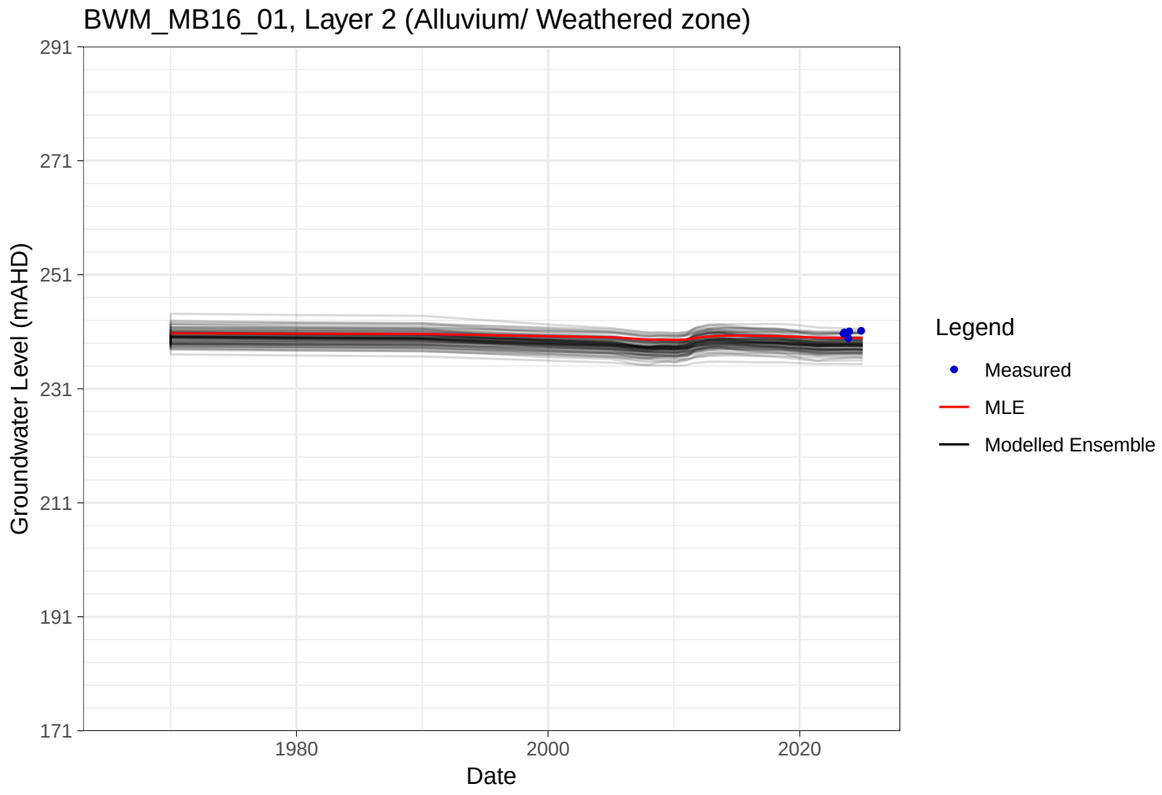

BWM_MB114_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
291
289
287
285
283
281
279
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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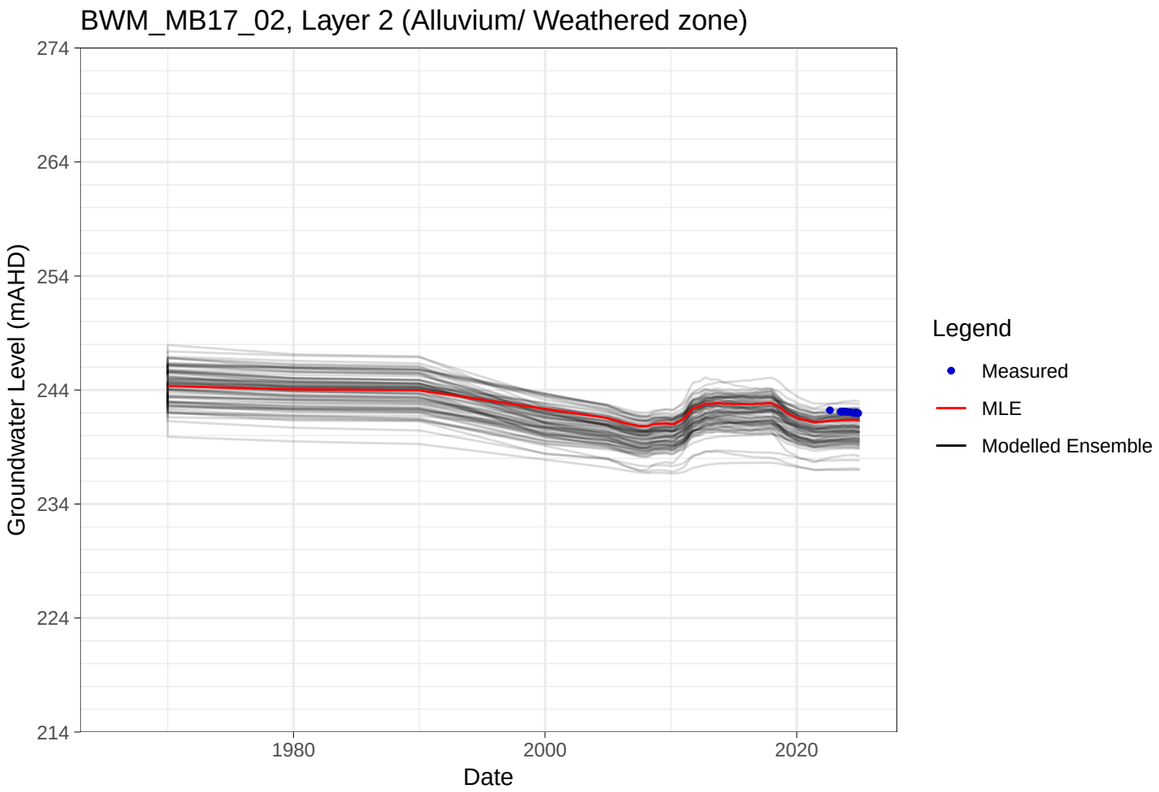

BWM_MB117_02, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
286
284
282
280
278
276
274
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

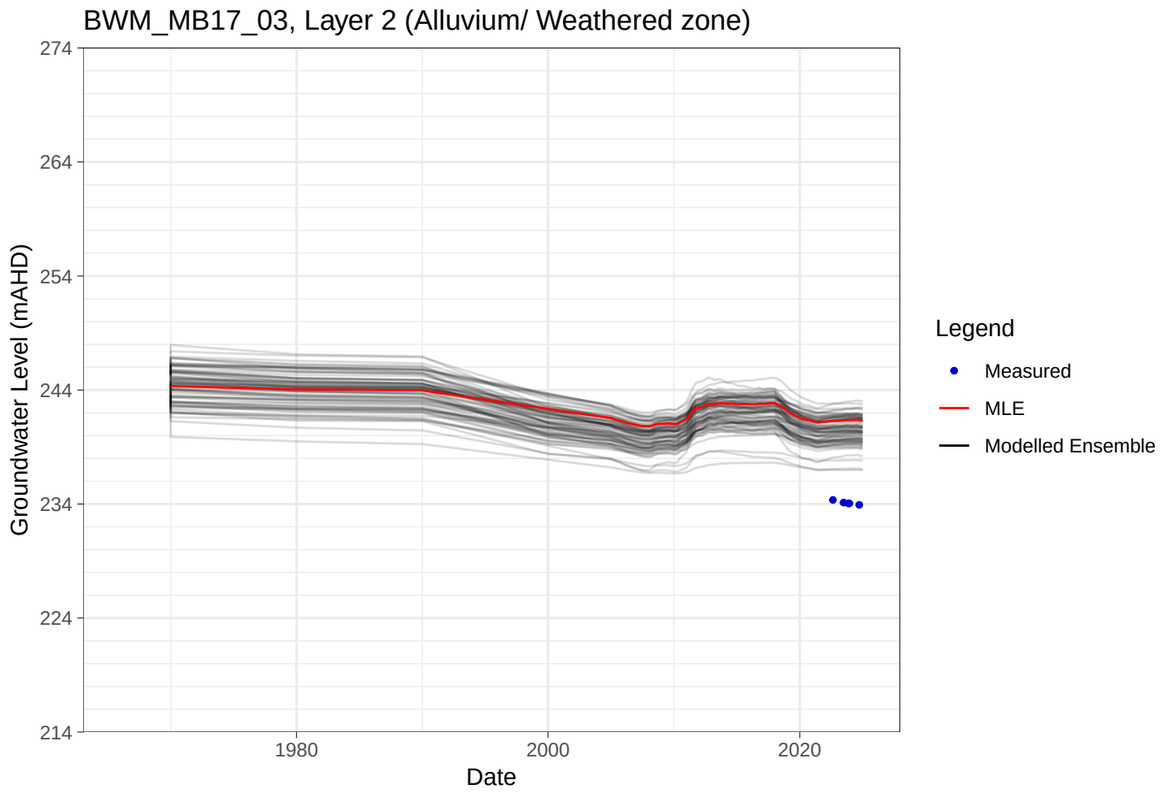

BWM_MB15_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
325
305
285
265
245
225
205
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

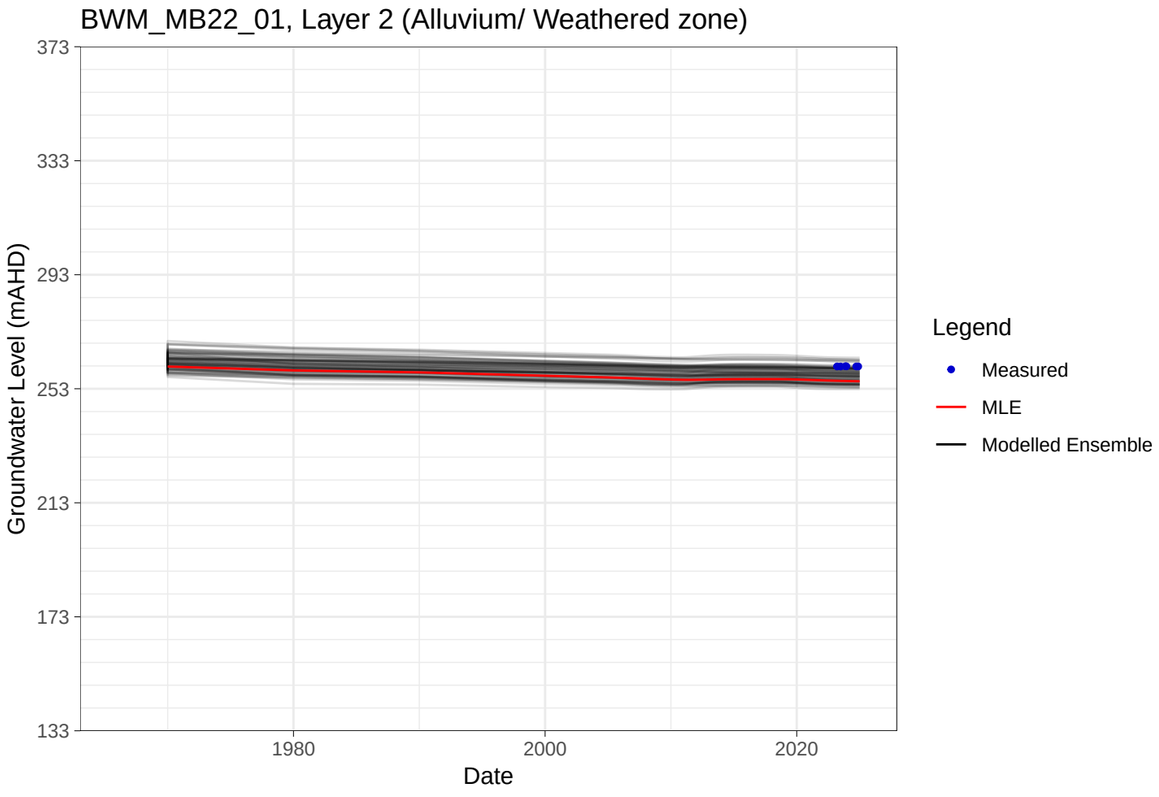

BWM_MB164_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
266
264
262
260
258
256
254
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

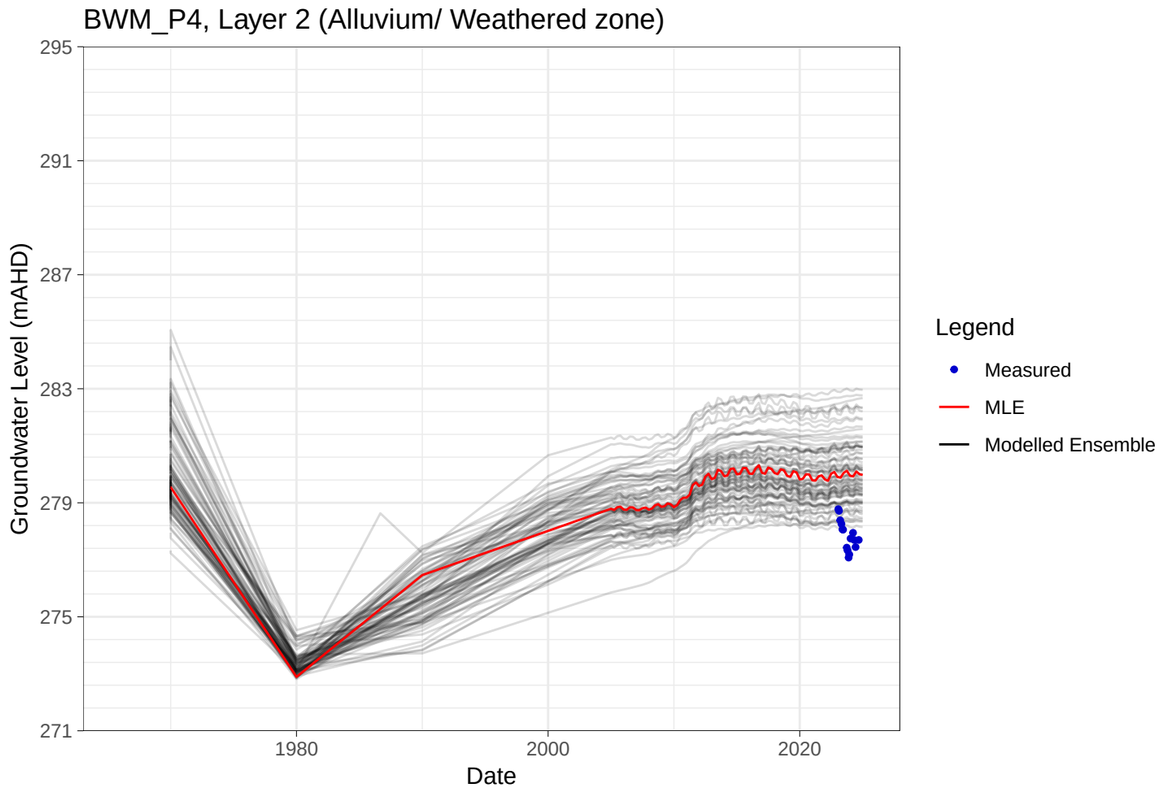

BWM_MB16_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
291
271
251
231
211
191
171
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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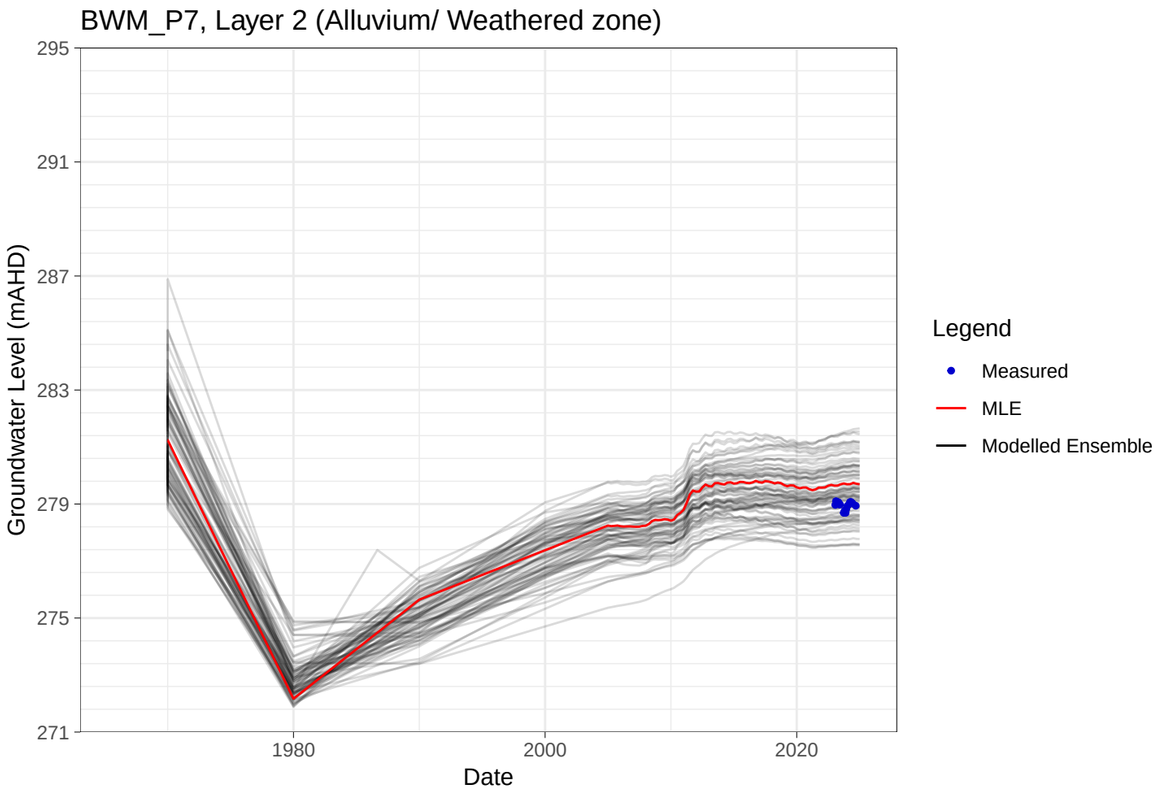

BWM_MB17_02, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
274
264
254
244
234
224
214
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

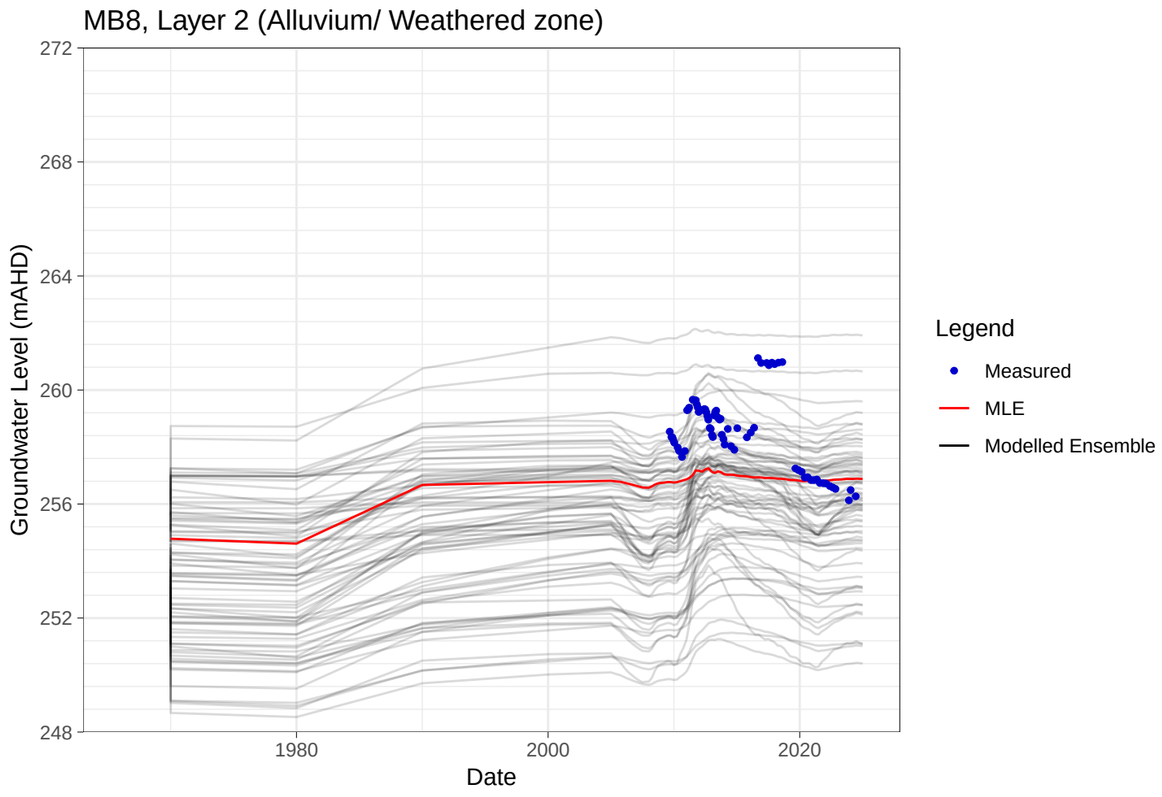

BWM_MB17_03, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
274
264
254
244
234
224
214
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

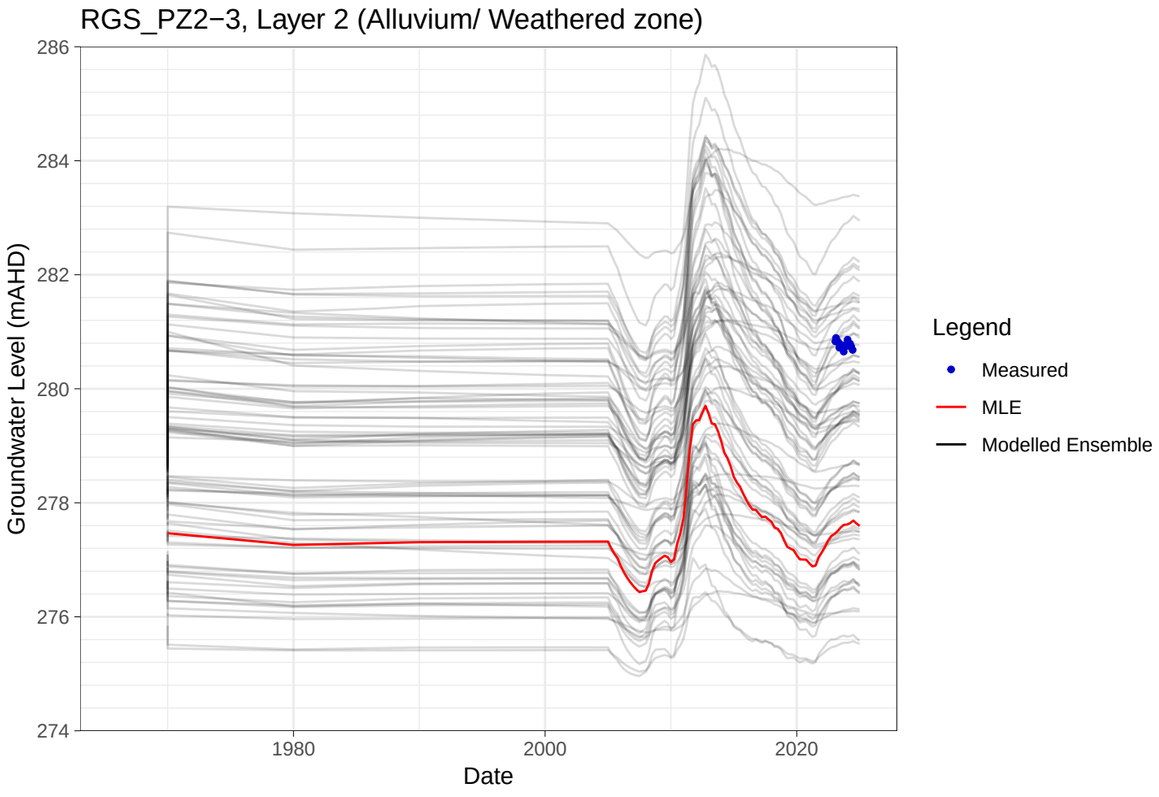

BWM_MB22_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
373
333
293
253
213
173
133
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

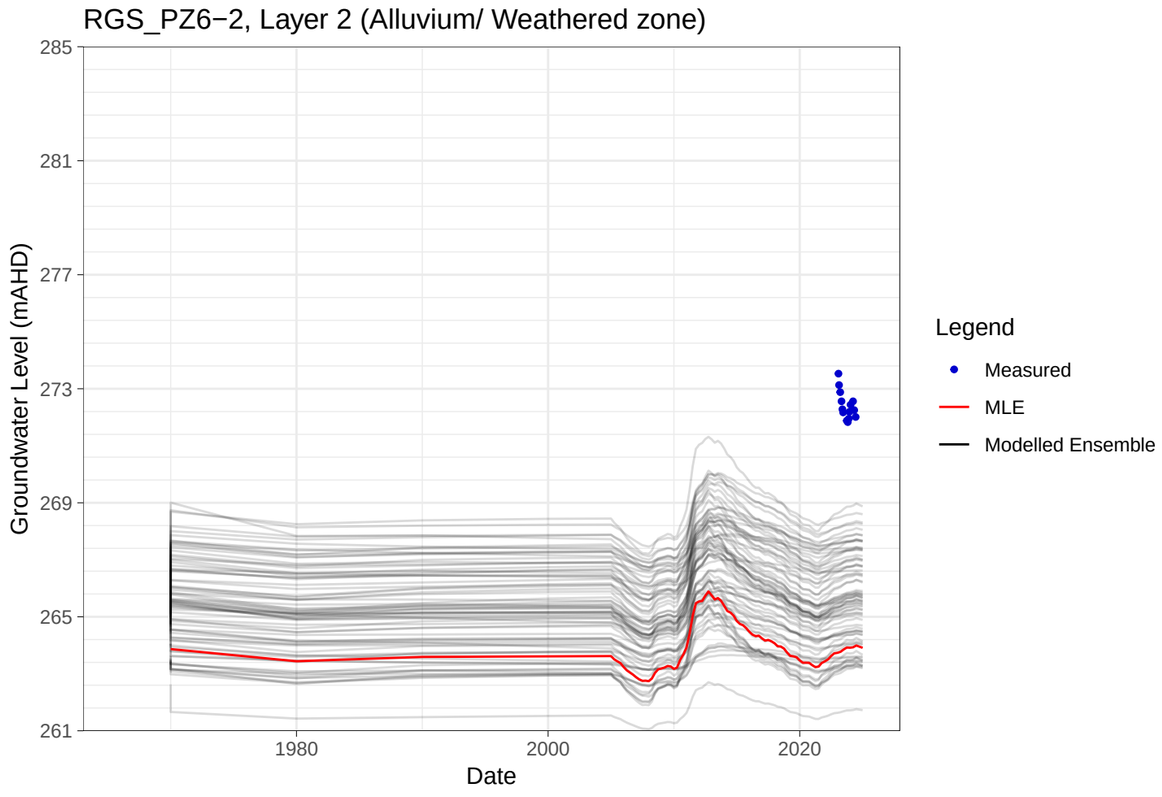

BWM_P4, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
295
291
287
283
279
275
271
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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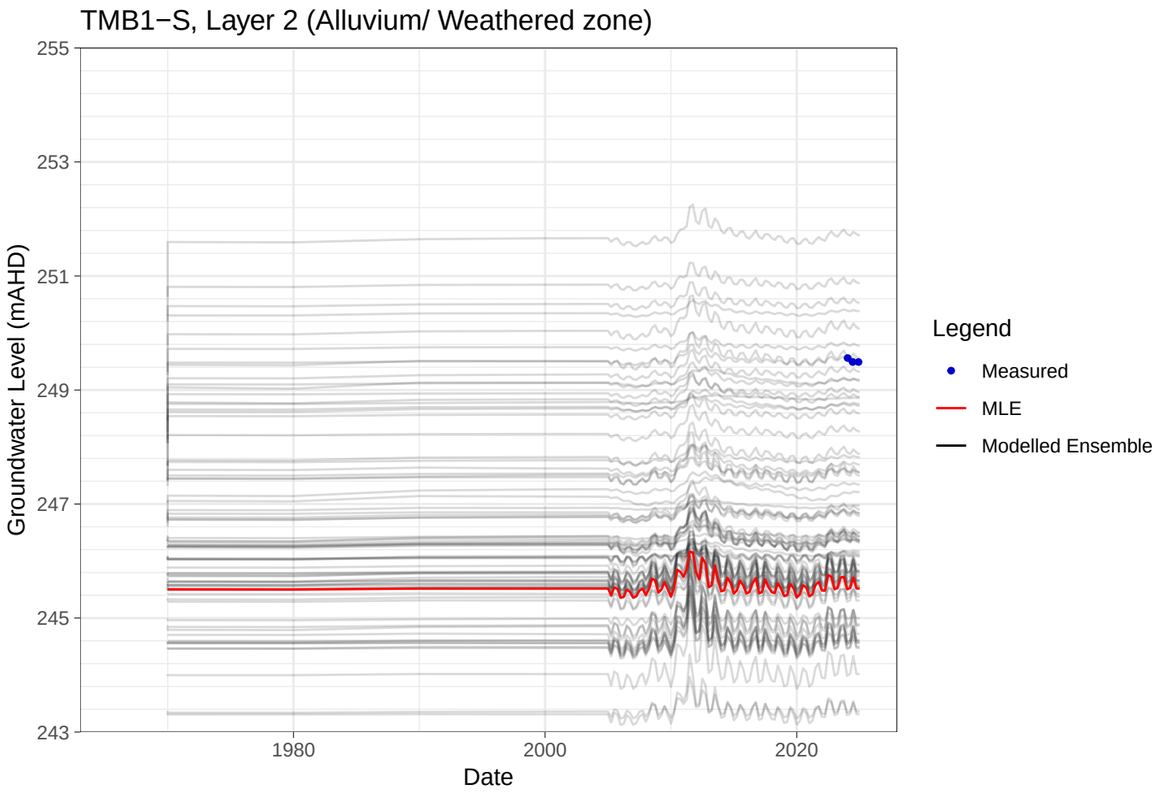

BWM_P7, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
295
291
287
283
279
275
271
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

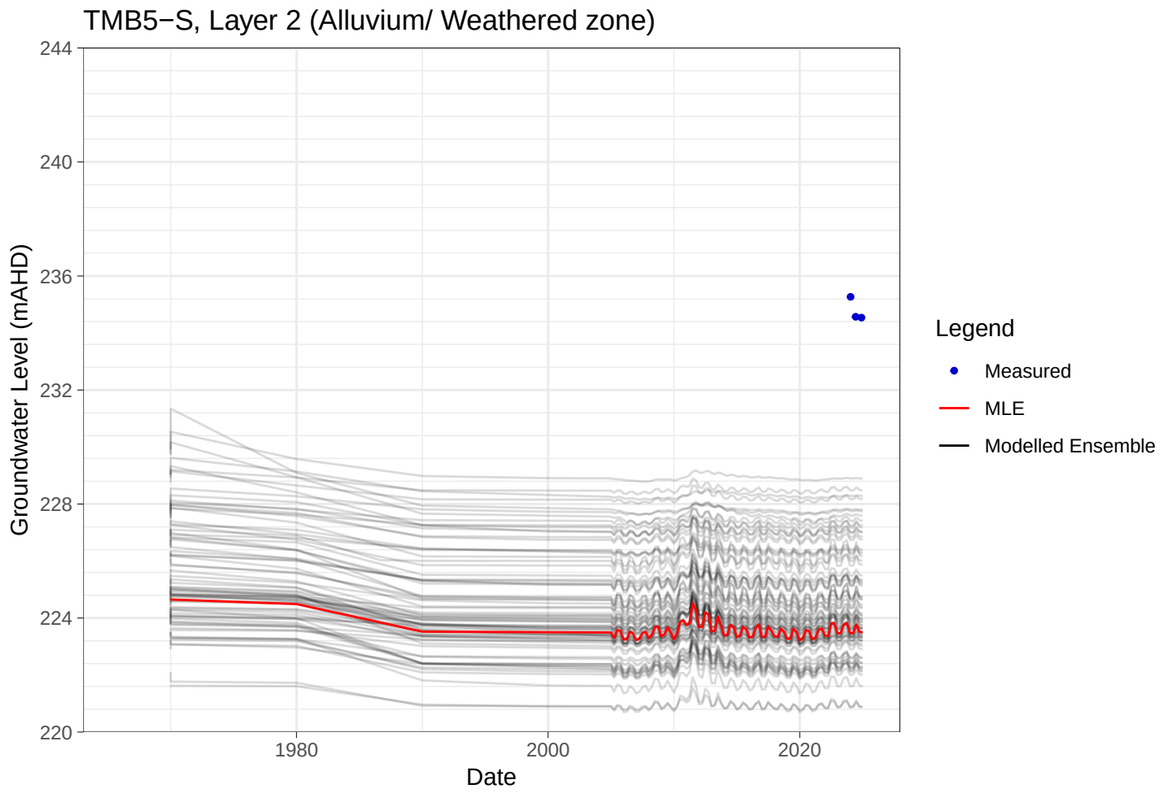

MB8, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
272
268
264
260
256
252
248
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

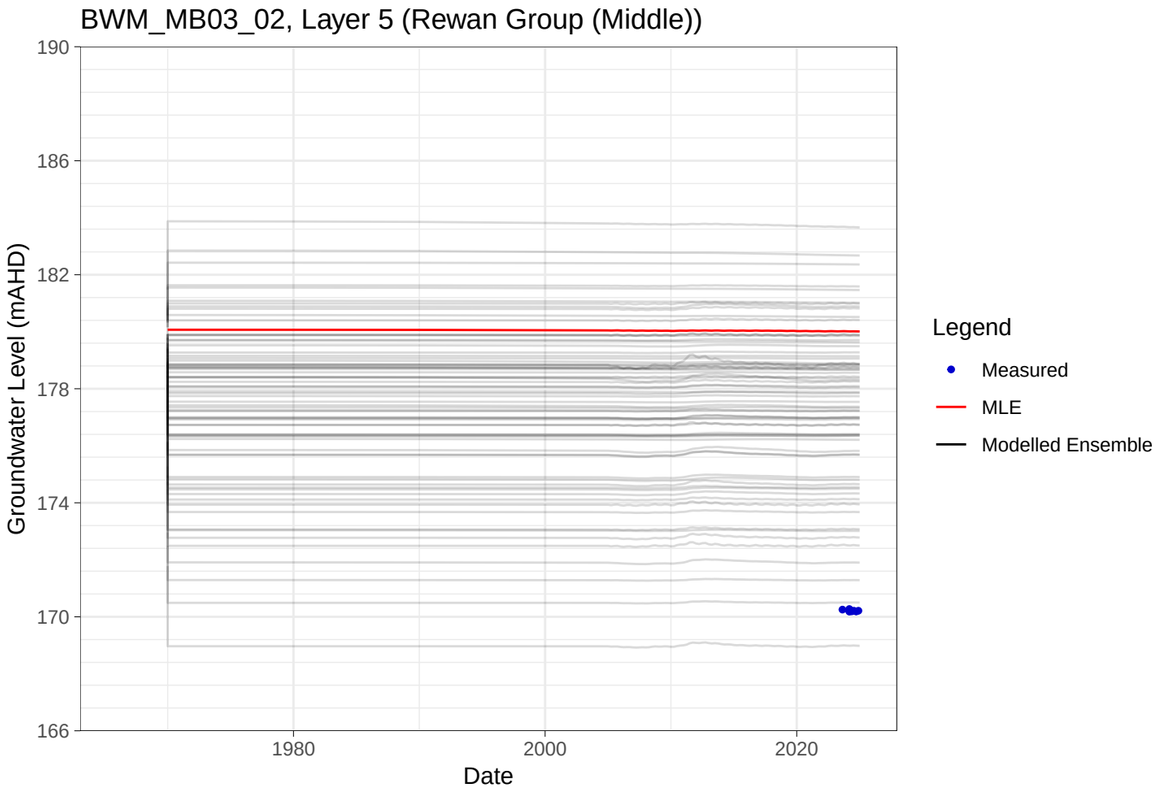

RGS_PZ2−3, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
286
284
282
280
278
276
274
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

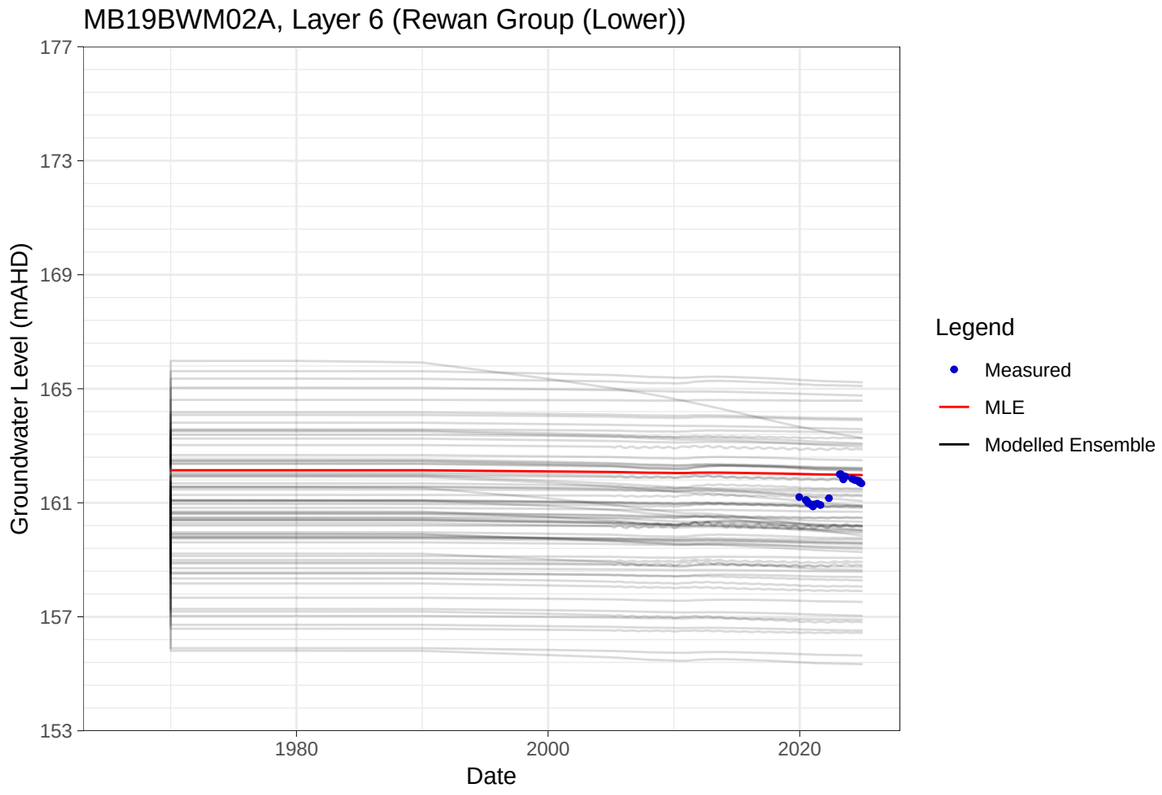

RGS_PZ6−2, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
285
281
277
273
269
265
261
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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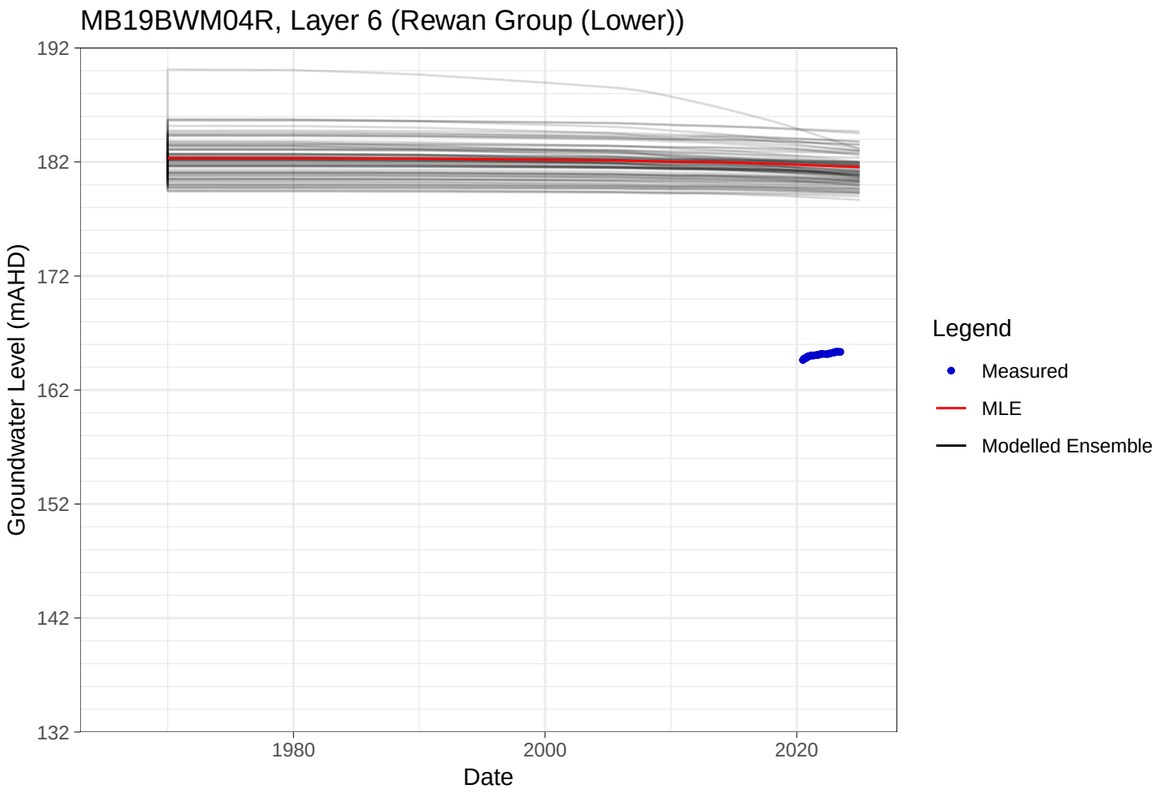

TMB1−S, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
255
253
251
249
247
245
243
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

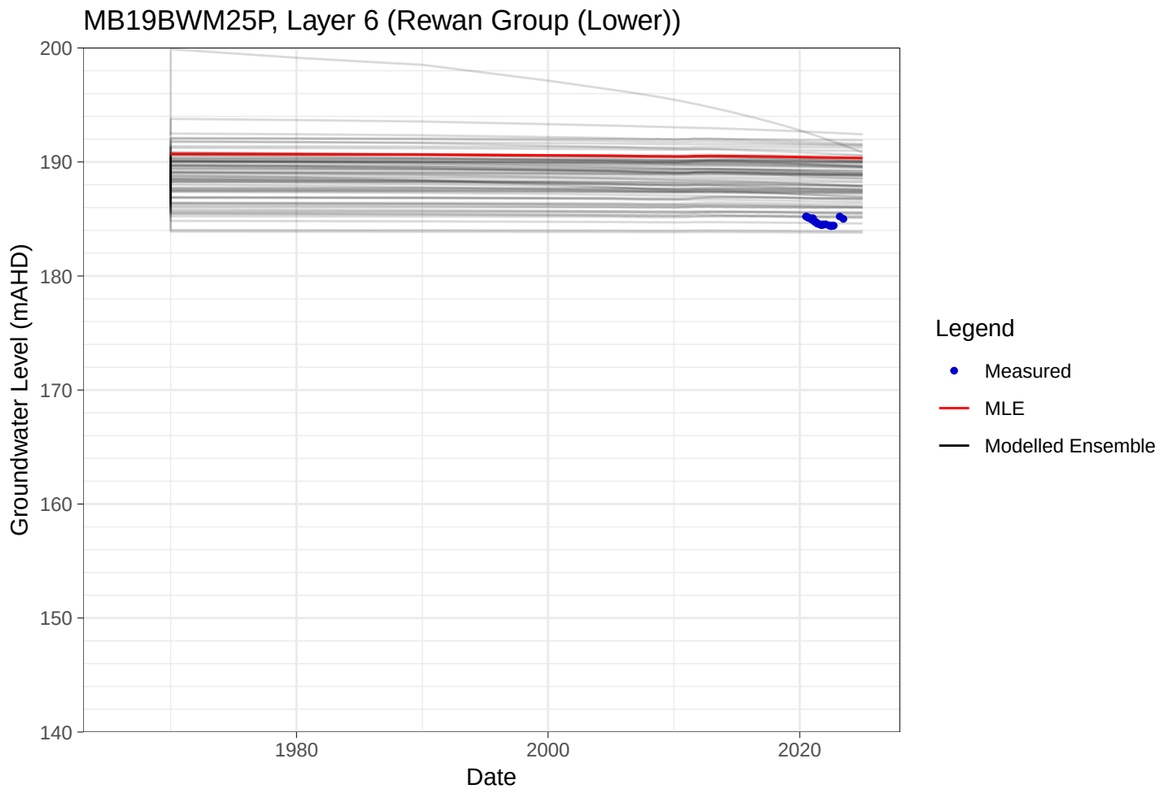

TMB5−S, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
244
240
236
232
228
224
220
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

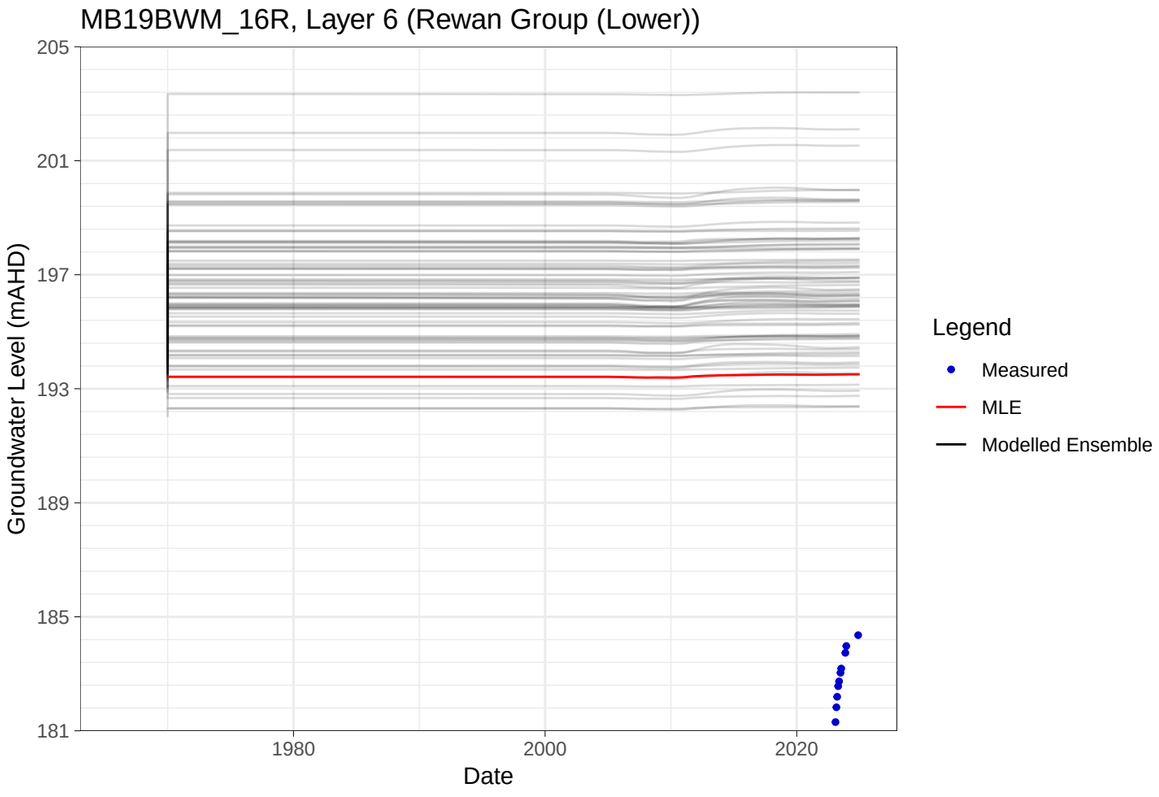

BWM_MB03_02, Layer 5 (Rewan Group (Middle))
Groundwater Level (mAHD)
190
186
182
178
174
170
166
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

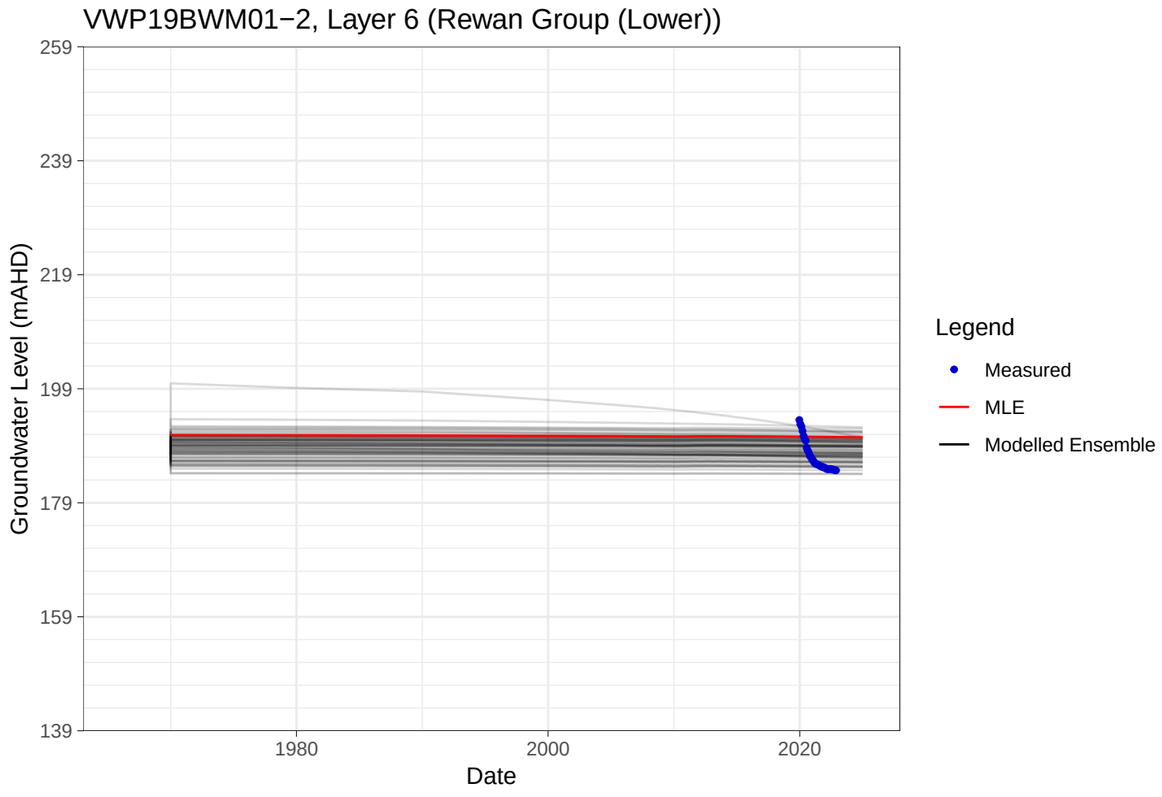

MB19BWM02A, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
177
173
169
165
161
157
153
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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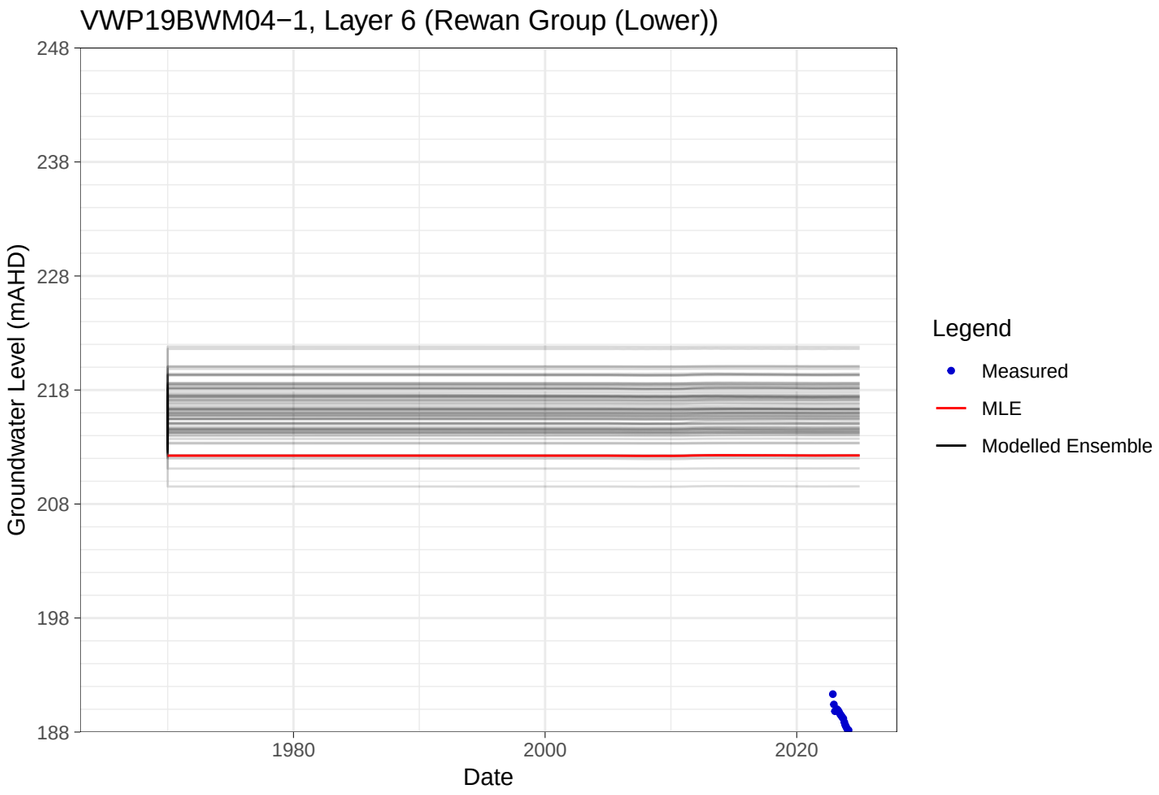

MB19BWM04R, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
192
182
172
162
152
142
132
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

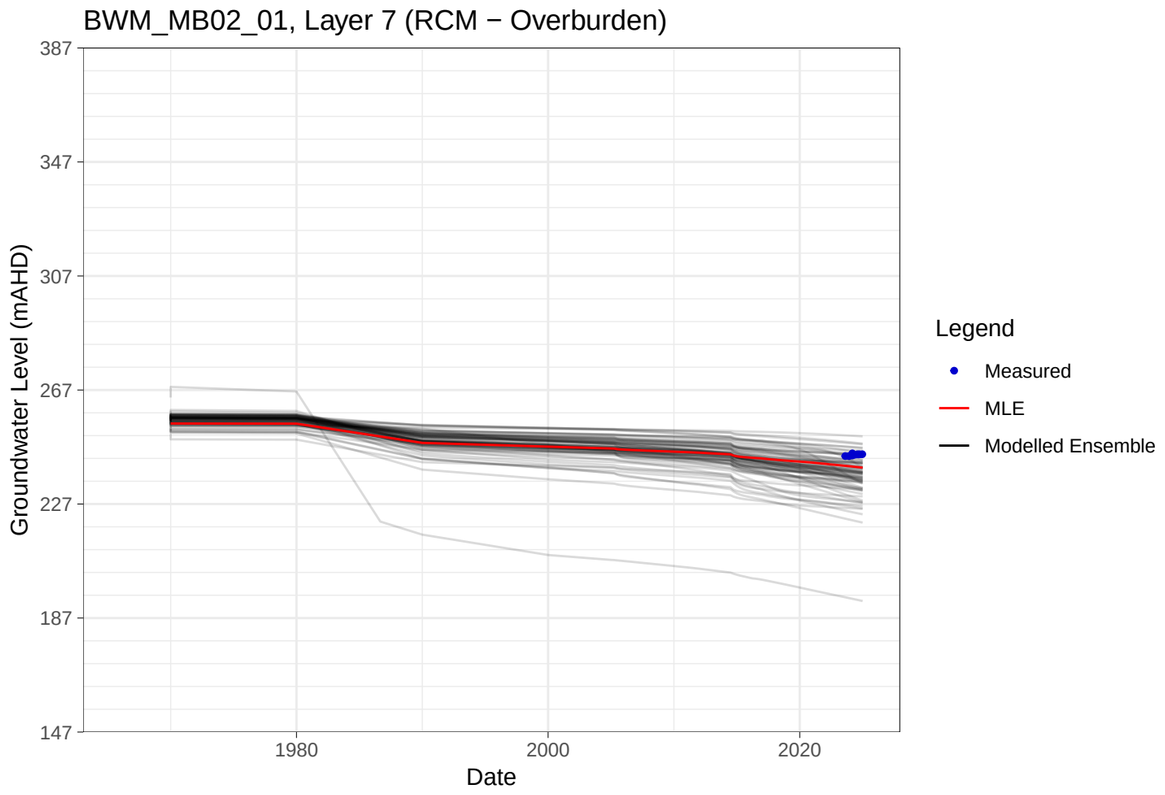

MB19BWM25P, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
200
190
180
170
160
150
140
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

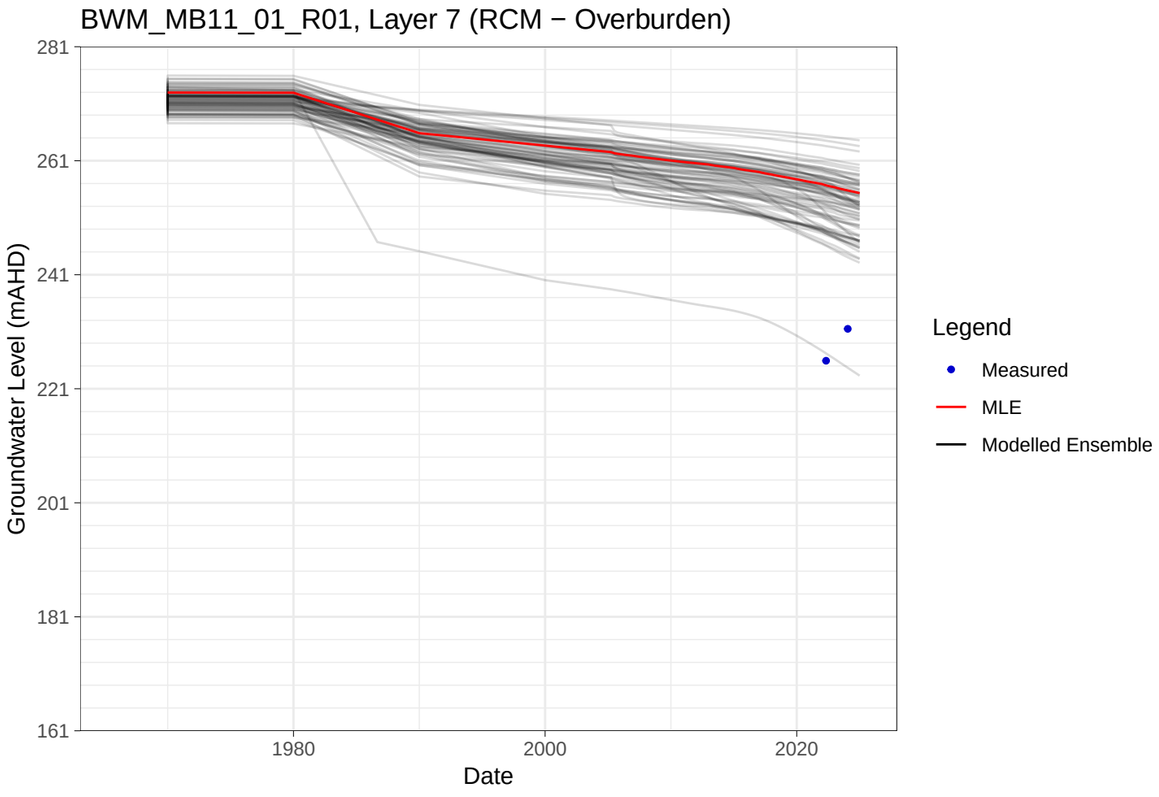

MB19BWM_16R, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
205
201
197
193
189
185
181
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

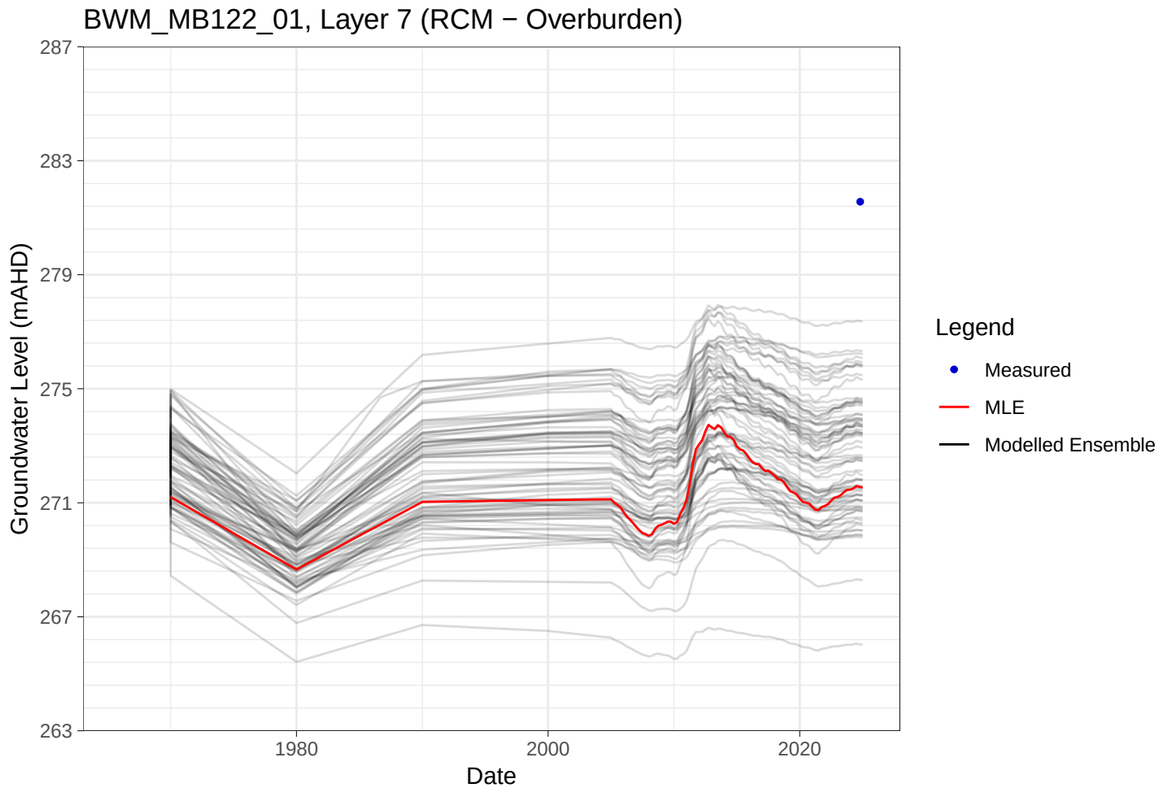

VWP19BWM01−2, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
259
239
219
199
179
159
139
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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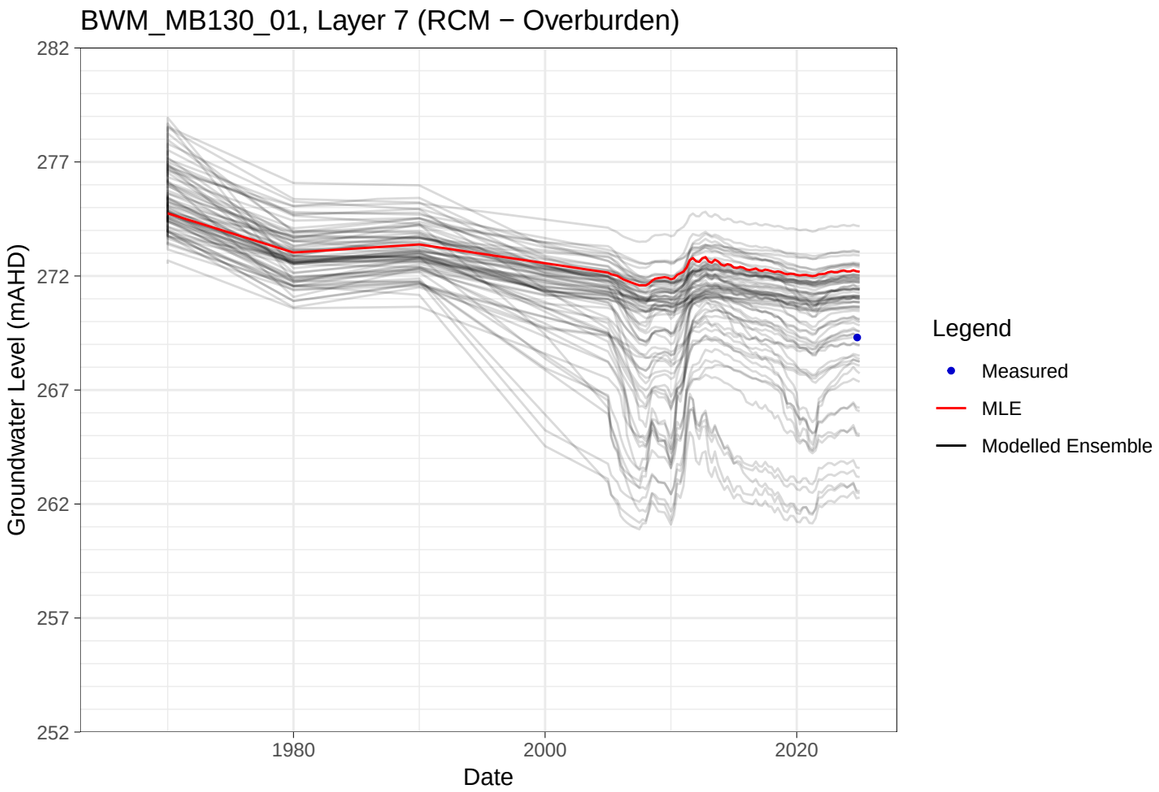

VWP19BWM04−1, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
248
238
228
218
208
198
188
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

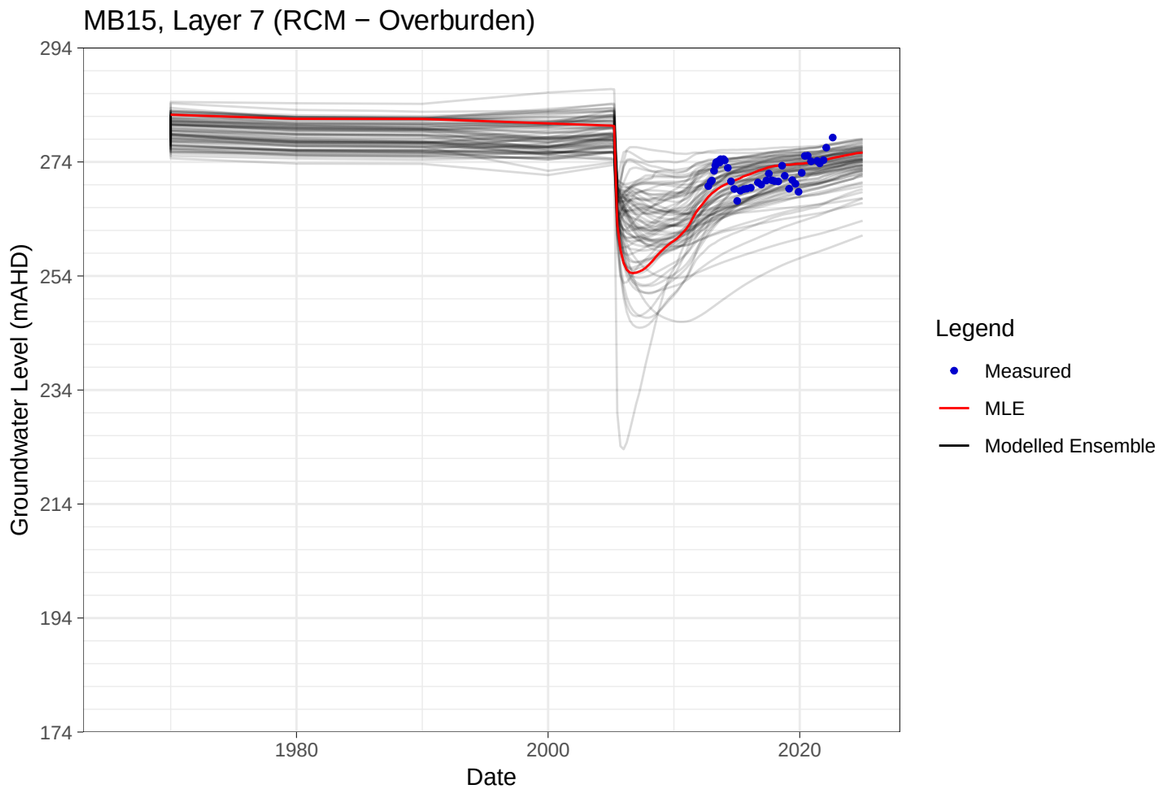

BWM_MB02_01, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
387
347
307
267
227
187
147
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

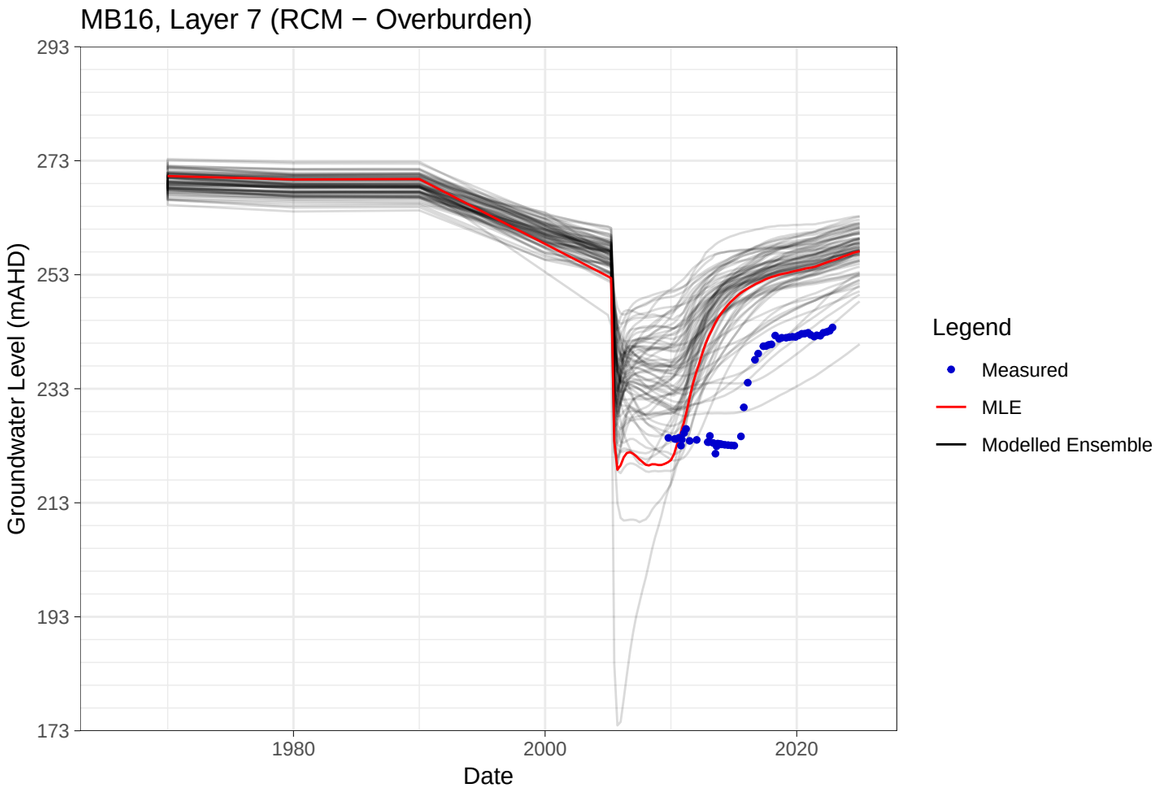

BWM_MB11_01_R01, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
281
261
241
221
201
181
161
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

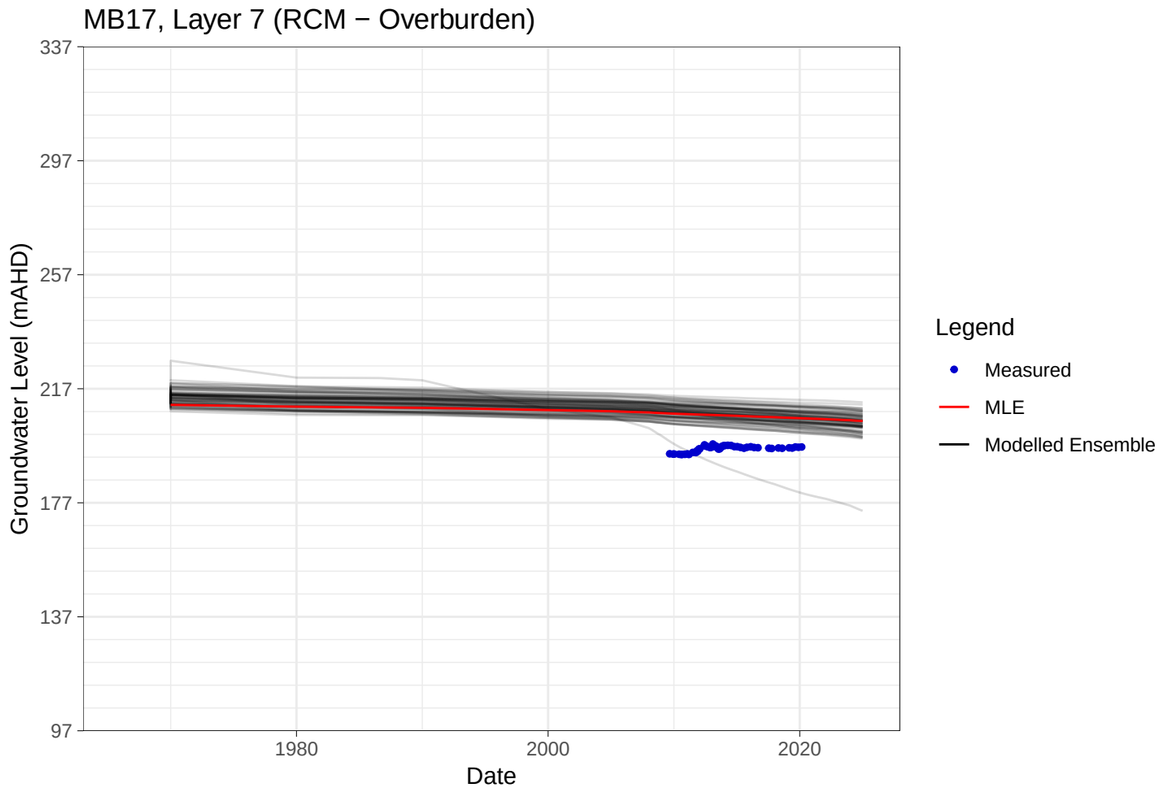

BWM_MB122_01, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
287
283
279
275
271
267
263
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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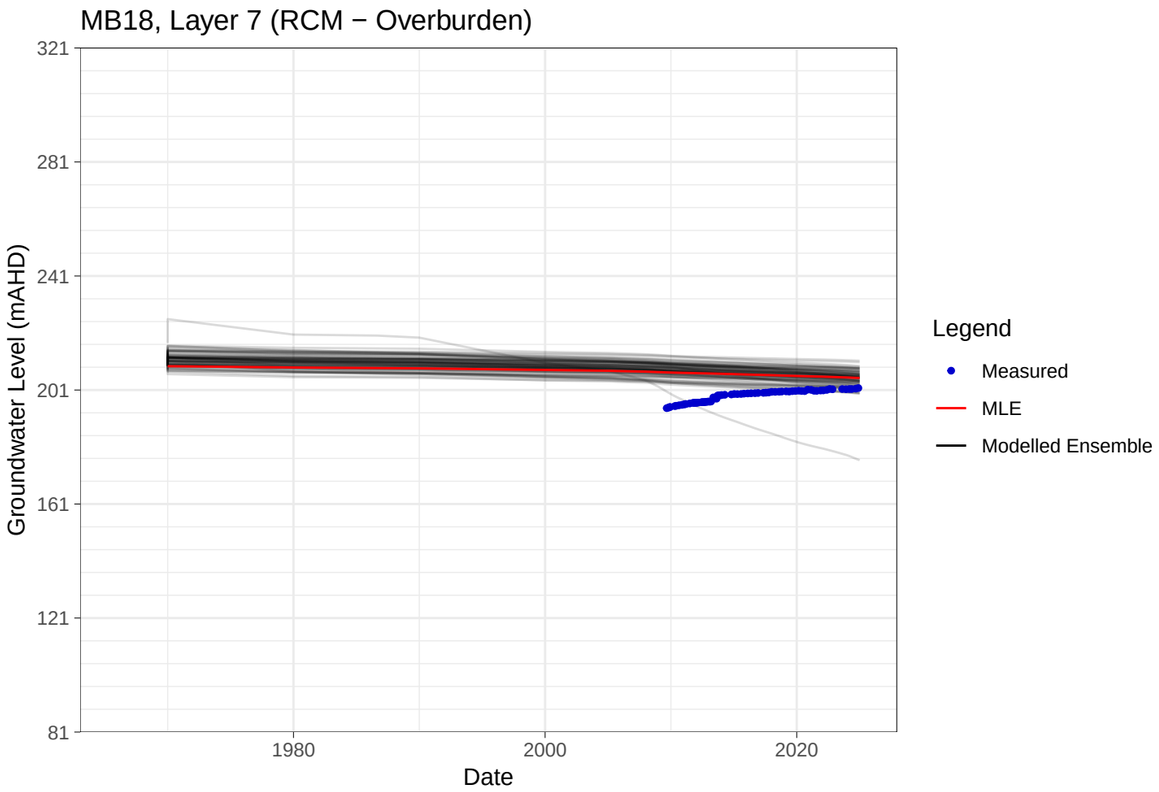

BWM_MB130_01, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
282
277
272
267
262
257
252
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

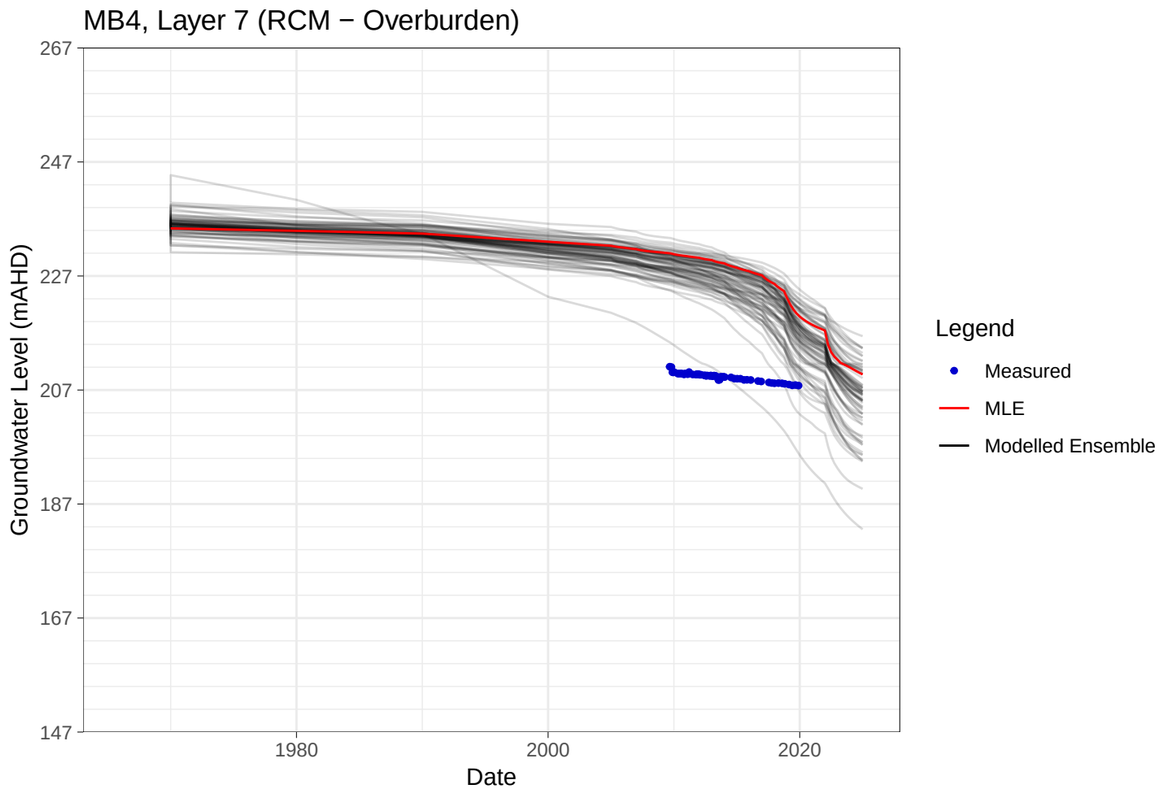

MB15, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
294
274
254
234
214
194
174
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

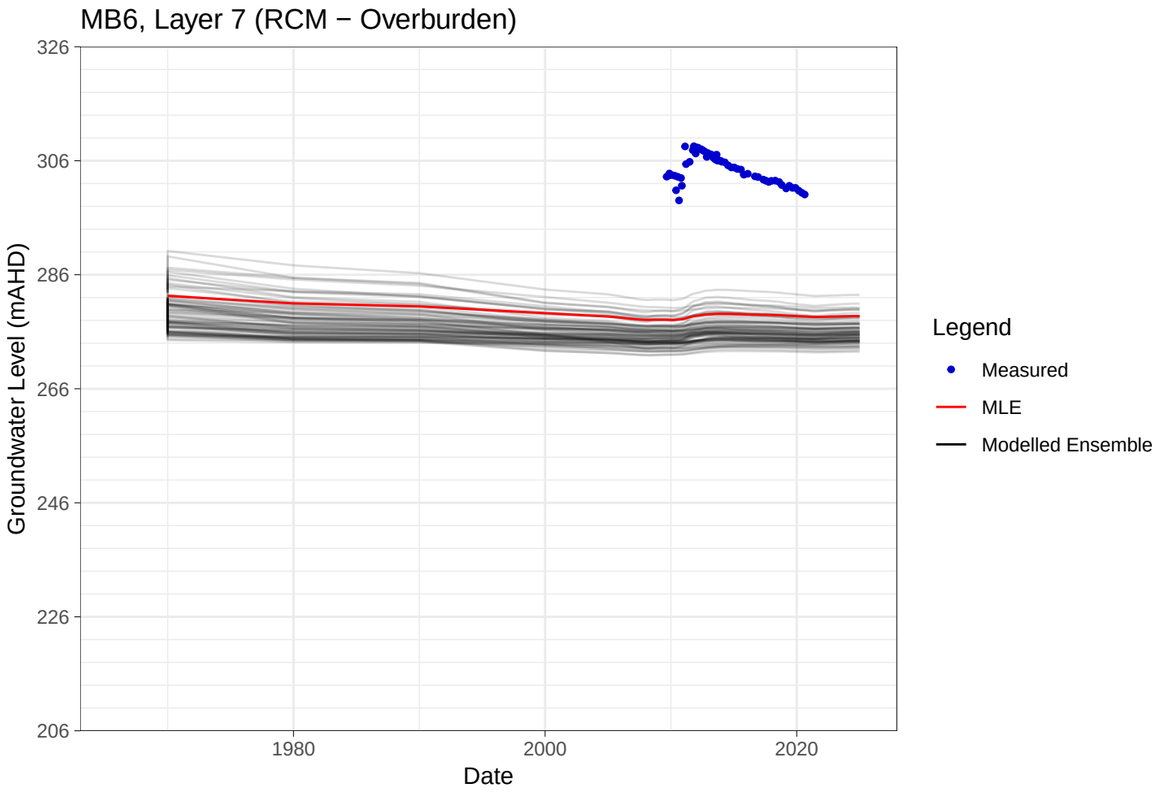

MB16, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
293
273
253
233
213
193
173
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

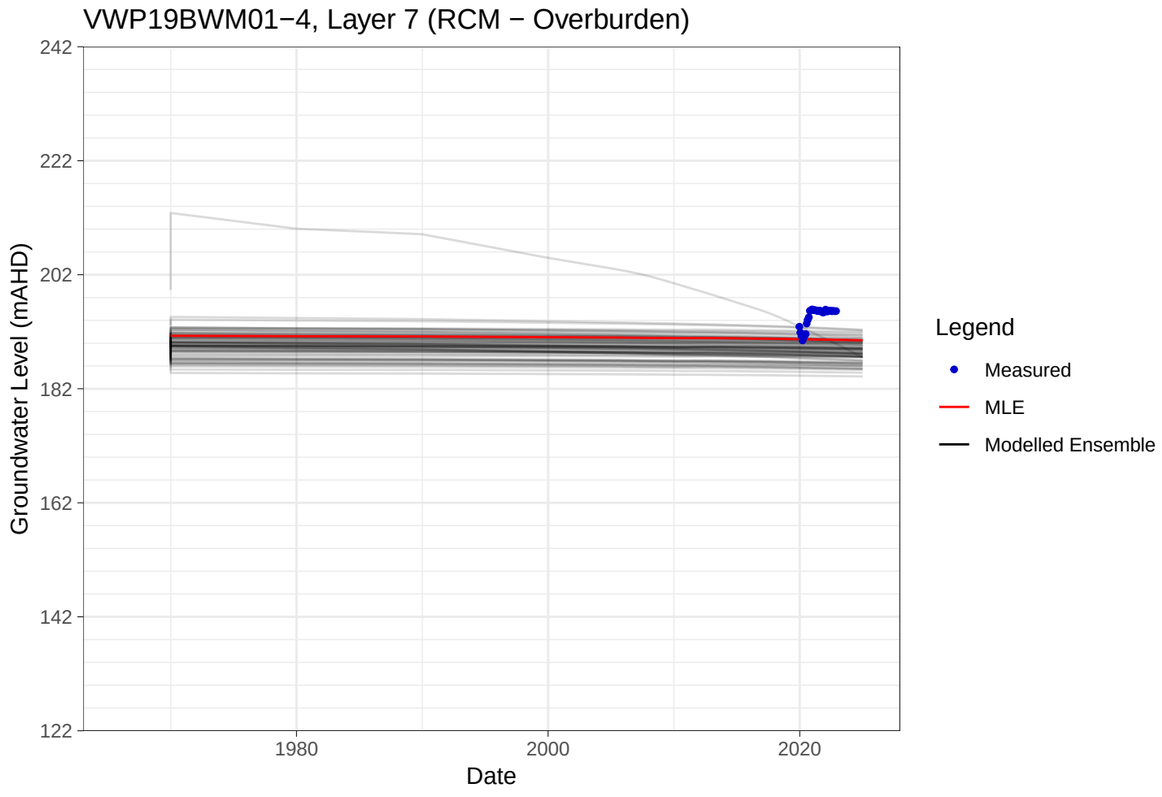

MB17, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
337
297
257
217
177
137
97
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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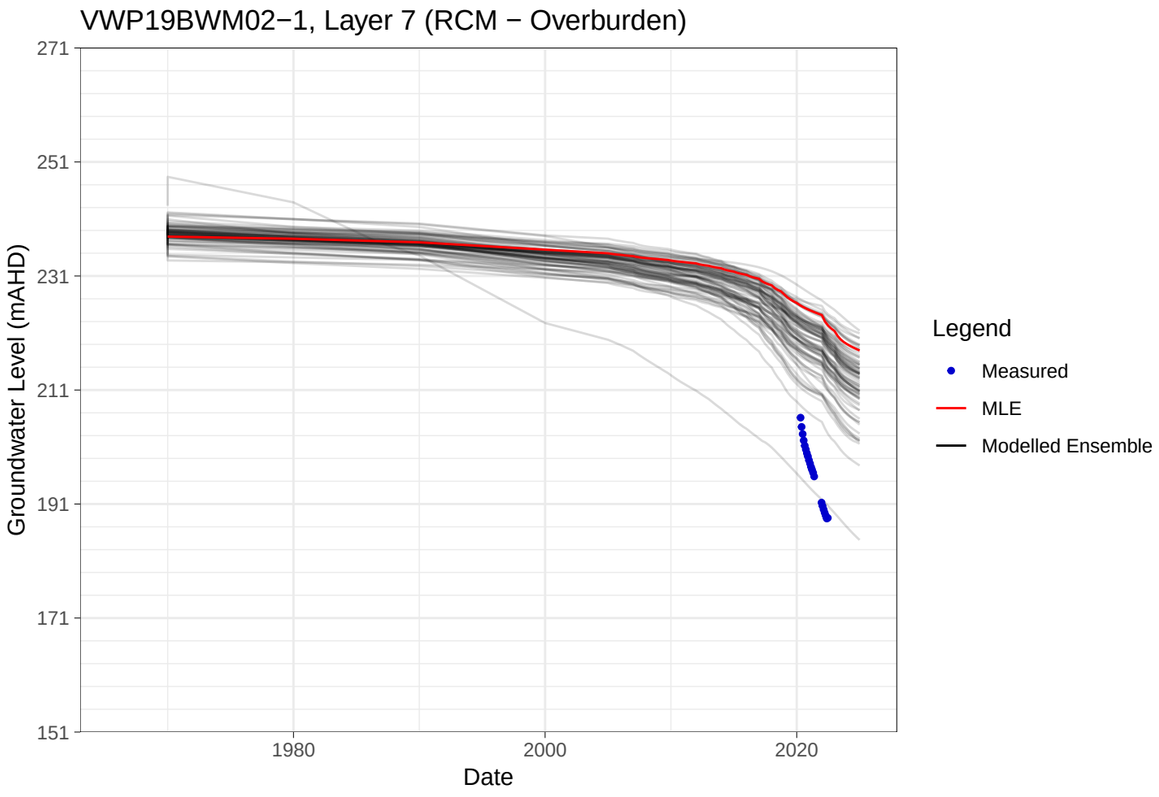

MB18, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
321
281
241
201
161
121
81
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

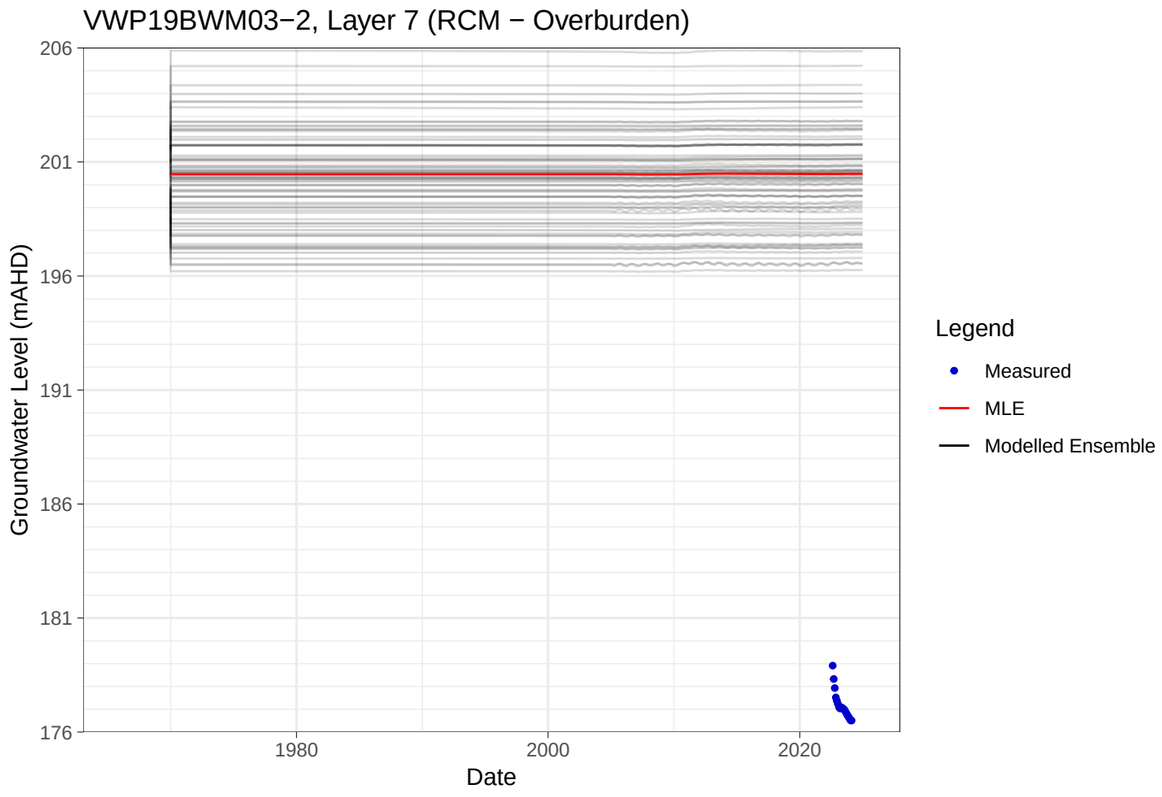

MB4, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
267
247
227
207
187
167
147
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

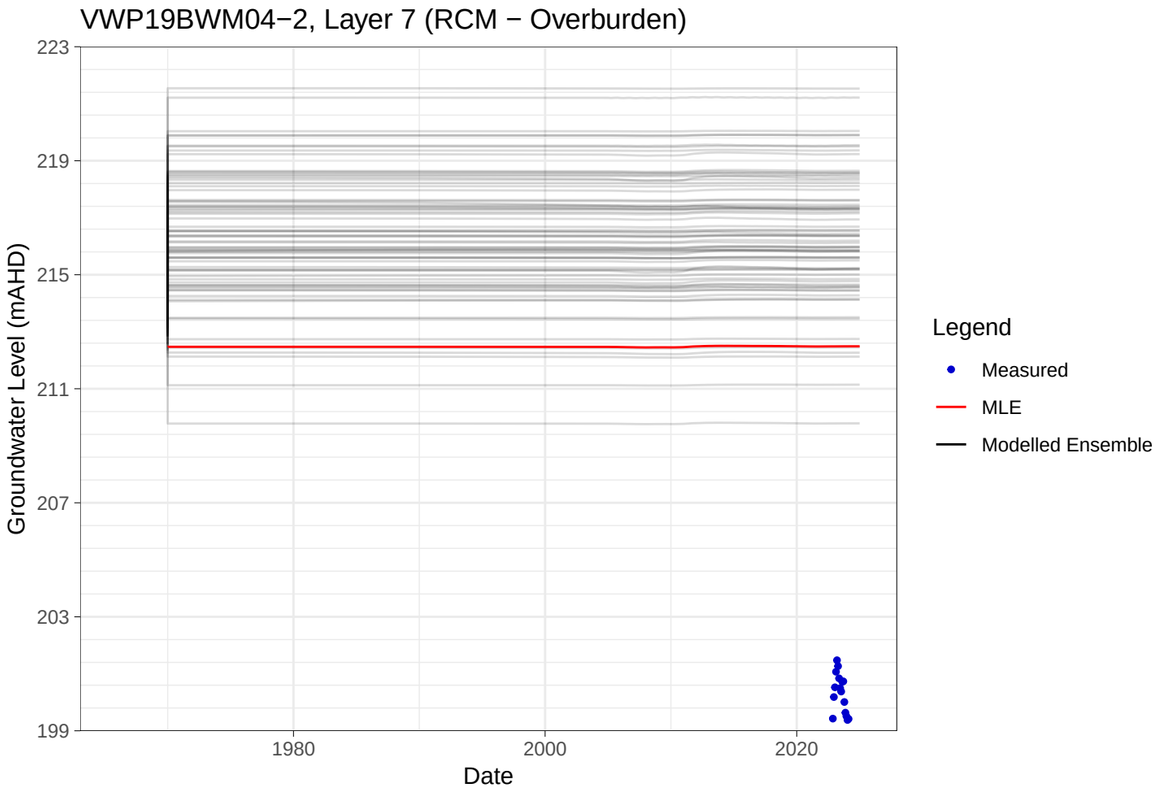

MB6, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
326
306
286
266
246
226
206
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

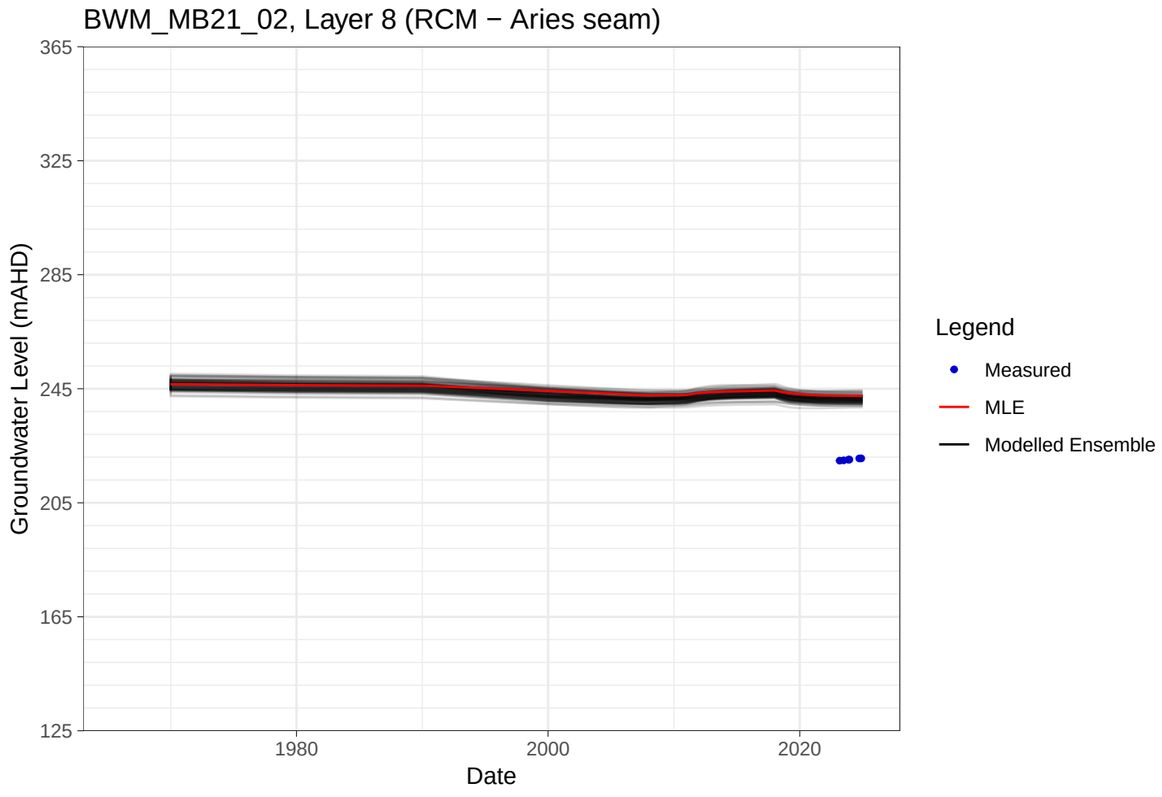

VWP19BWM01−4, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
242
222
202
182
162
142
122
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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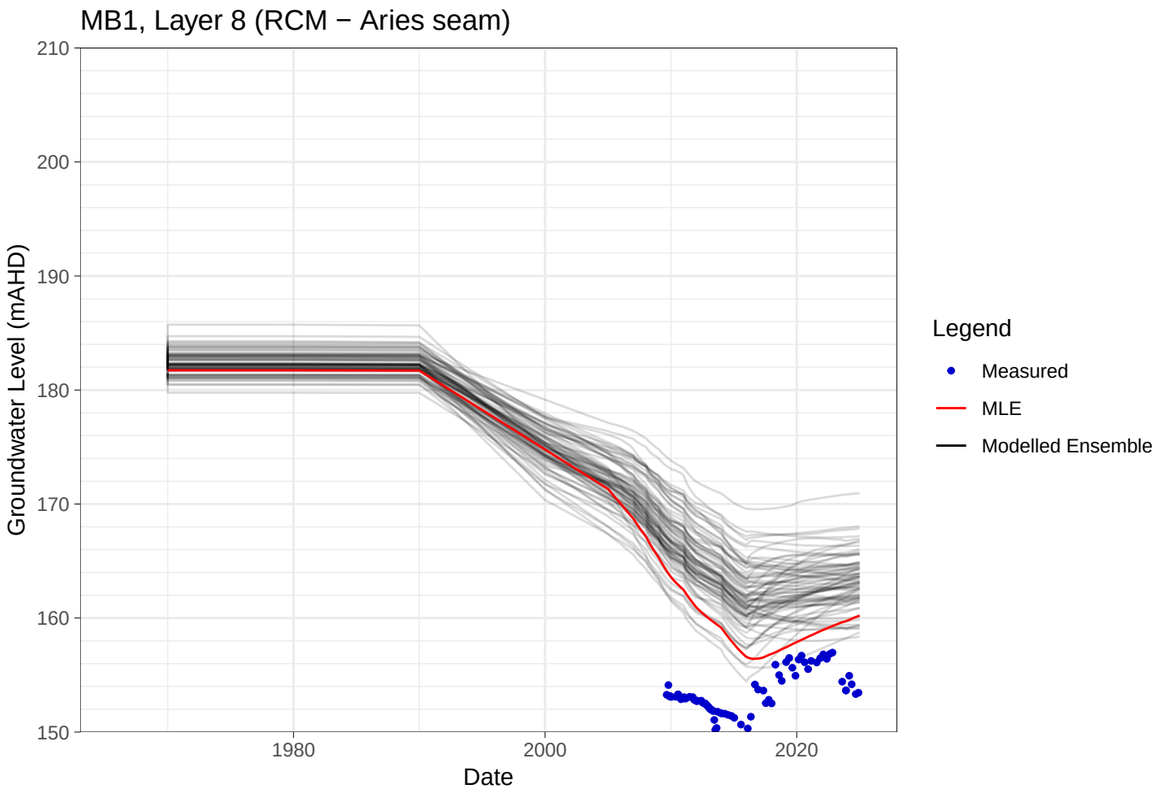

VWP19BWM02−1, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
271
251
231
211
191
171
151
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

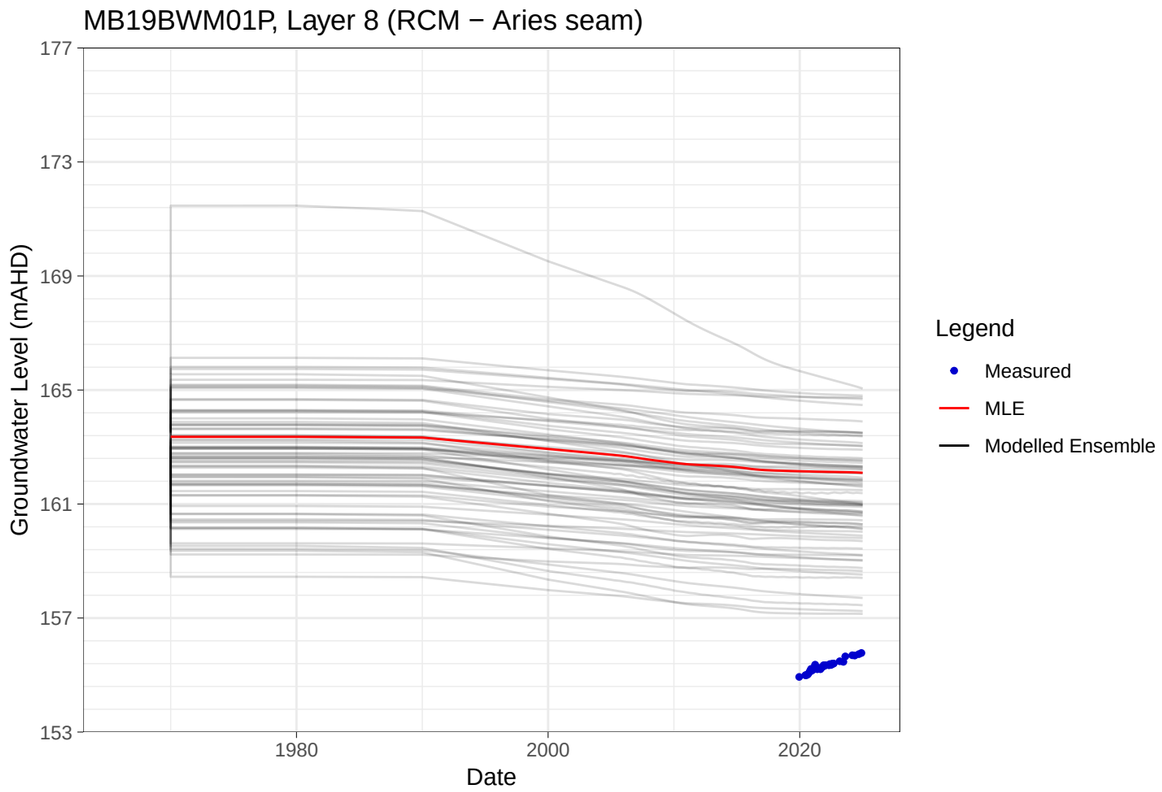

VWP19BWM03−2, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
206
201
196
191
186
181
176
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

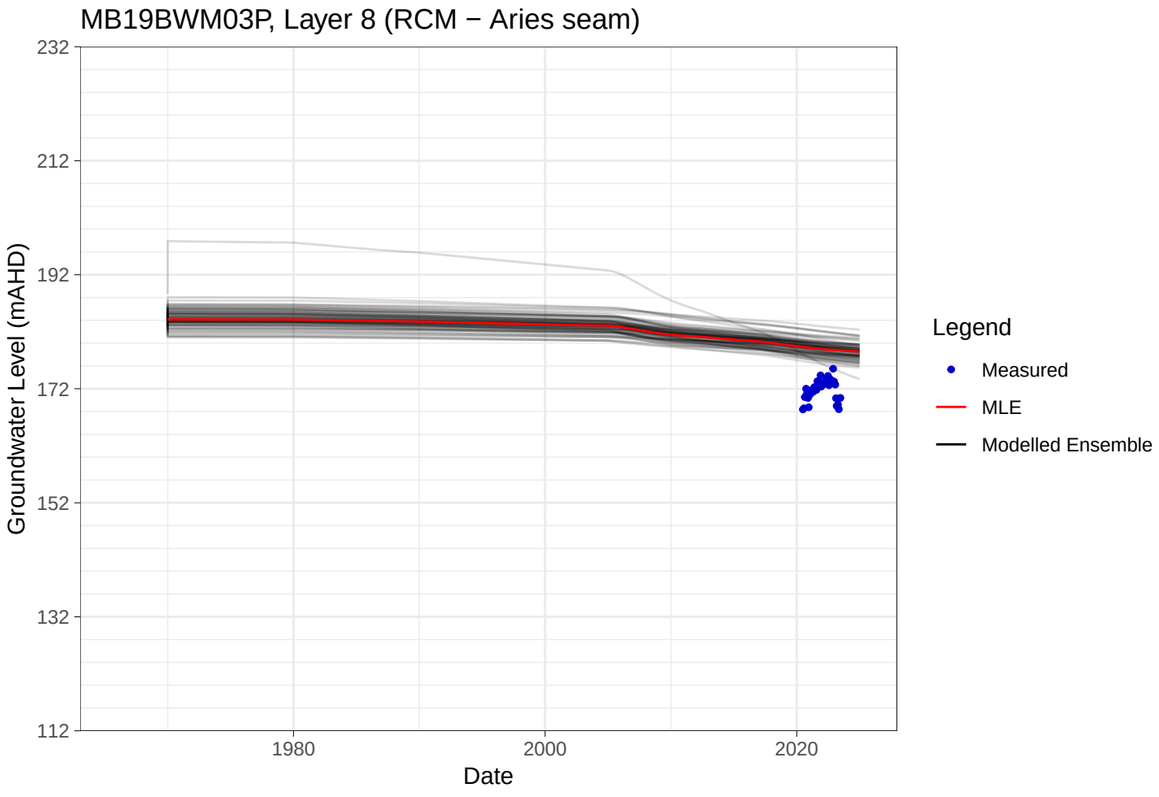

VWP19BWM04−2, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
223
219
215
211
207
203
199
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

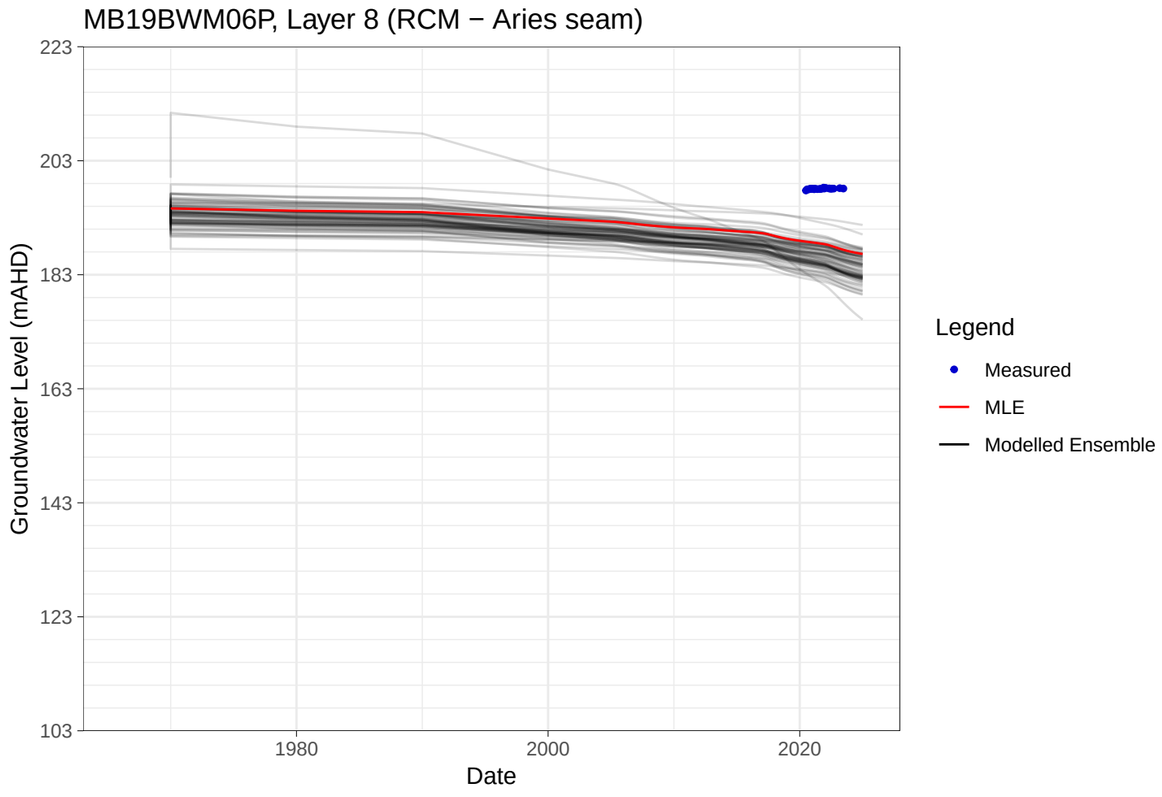

BWM_MB21_02, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
365
325
285
245
205
165
125
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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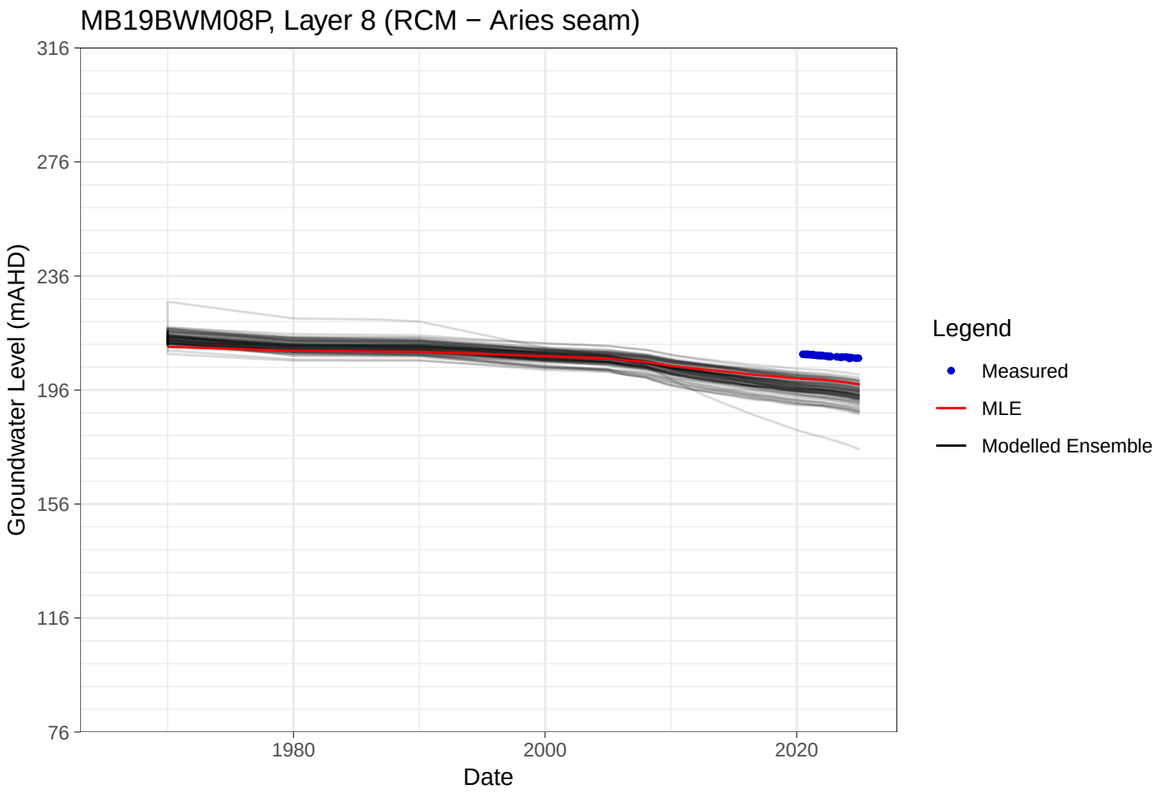

MB1, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
210
200
190
180
170
160
150
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

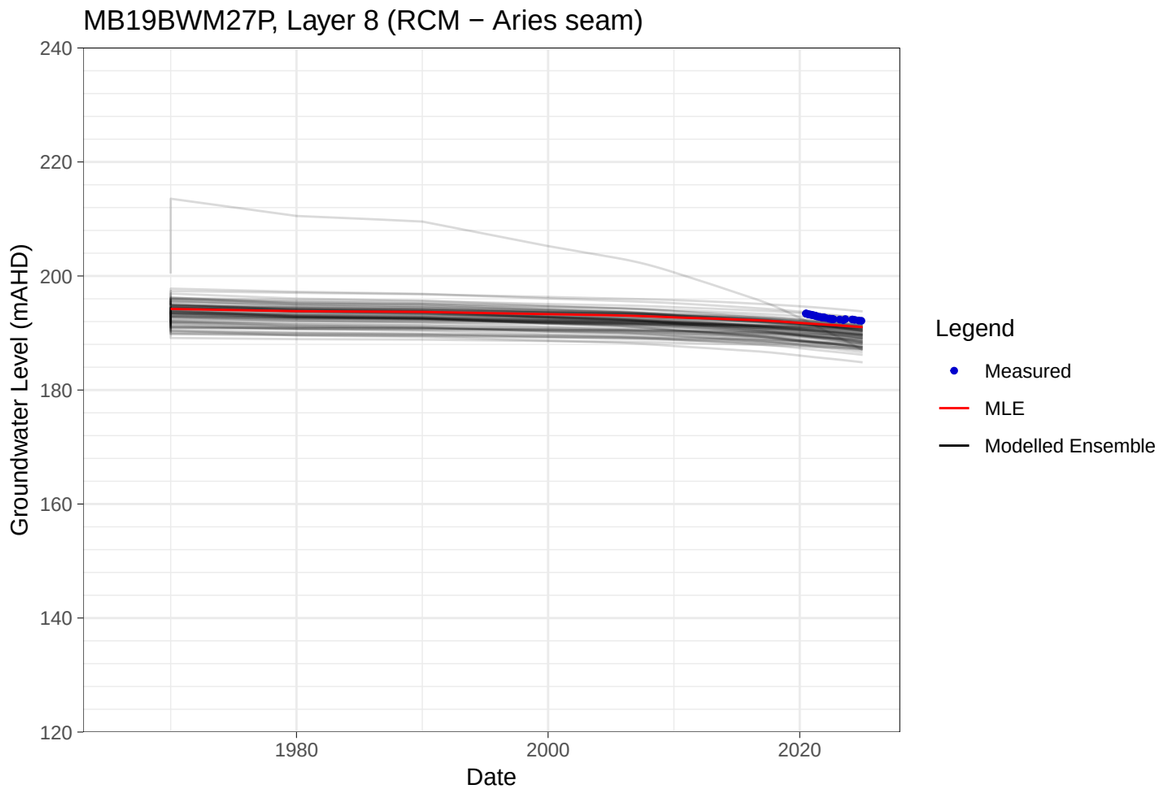

MB19BWM01P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
177
173
169
165
161
157
153
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

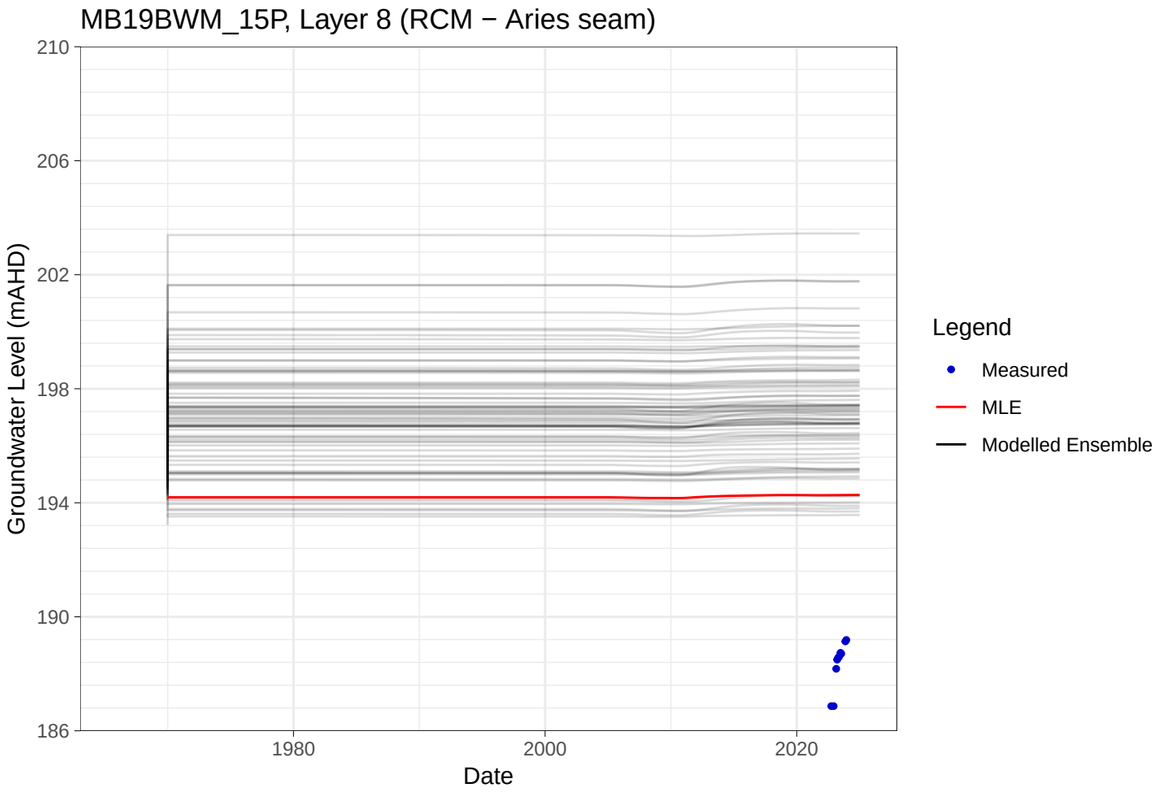

MB19BWM03P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
232
212
192
172
152
132
112
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

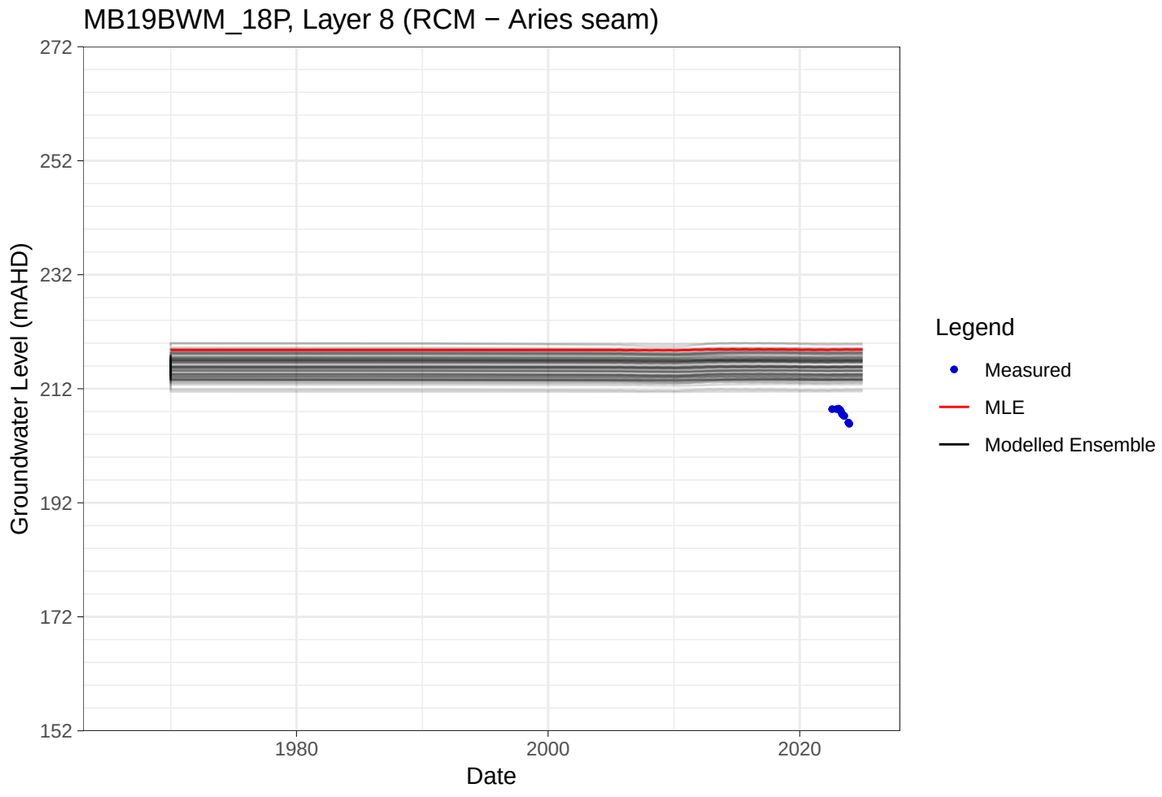

MB19BWM06P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
223
203
183
163
143
123
103
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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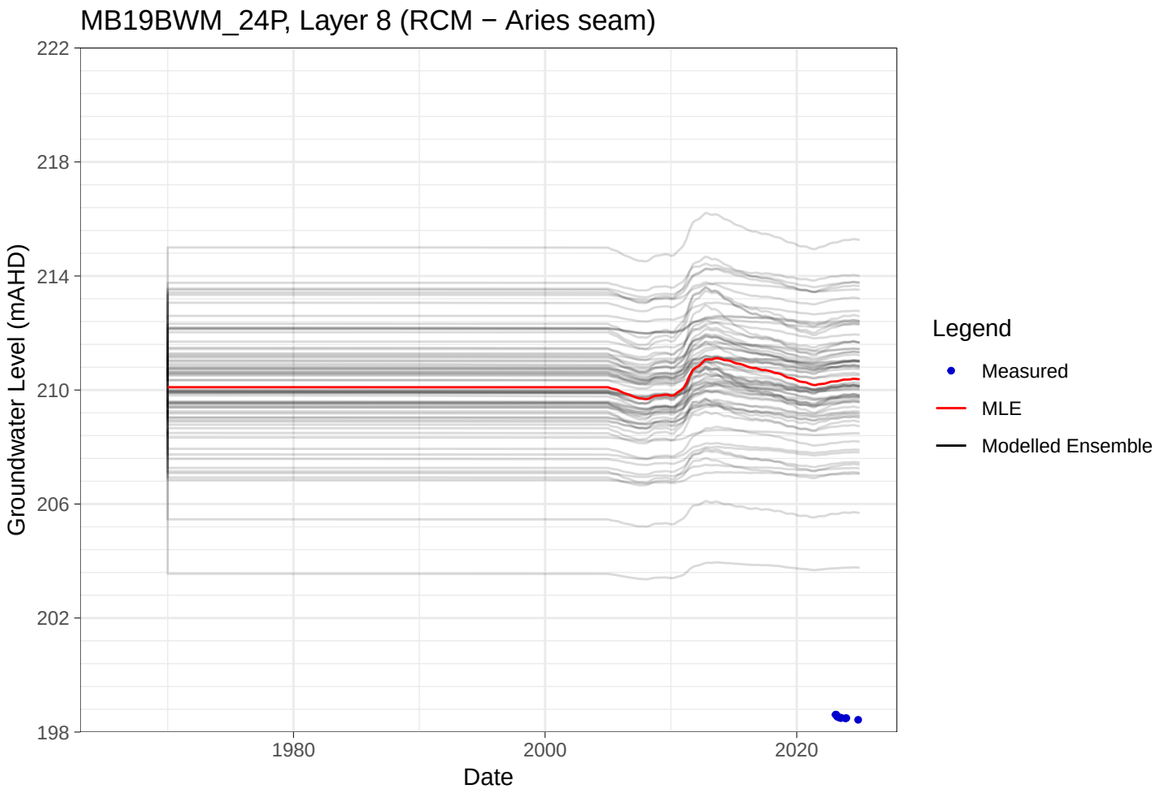

MB19BWM08P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
316
276
236
196
156
116
76
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

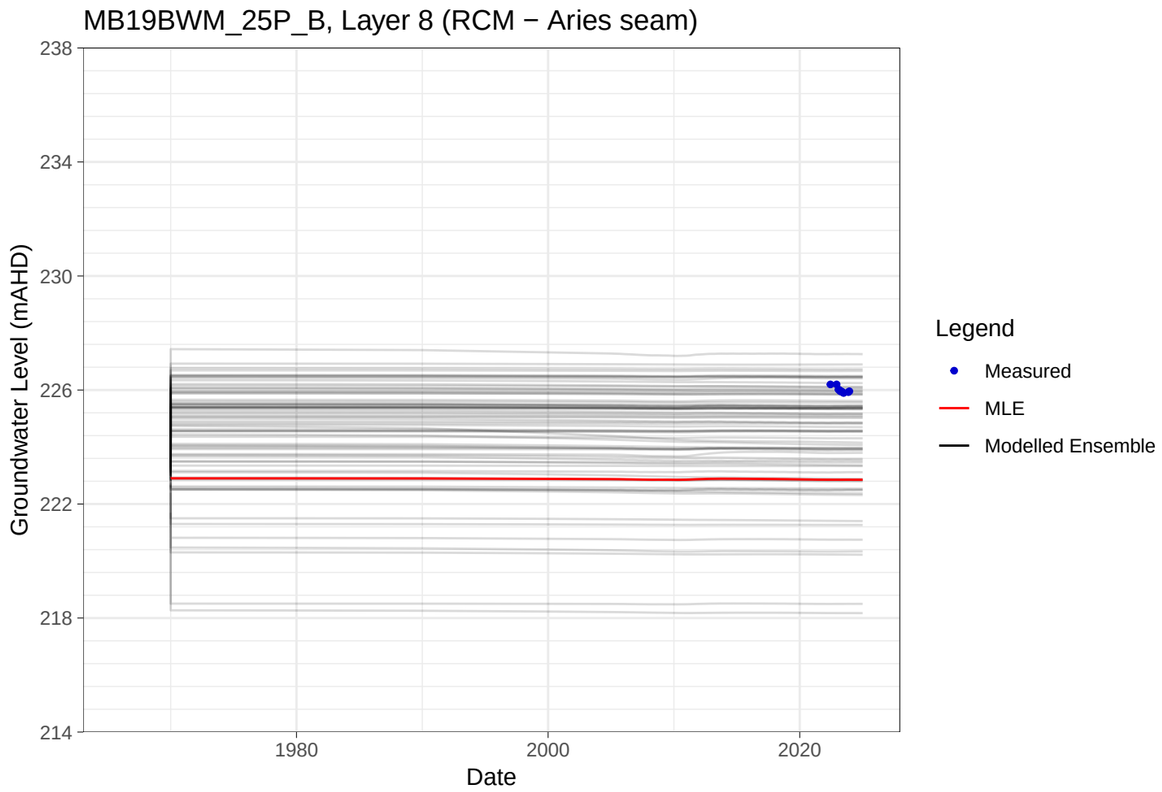

MB19BWM27P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
240
220
200
180
160
140
120
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

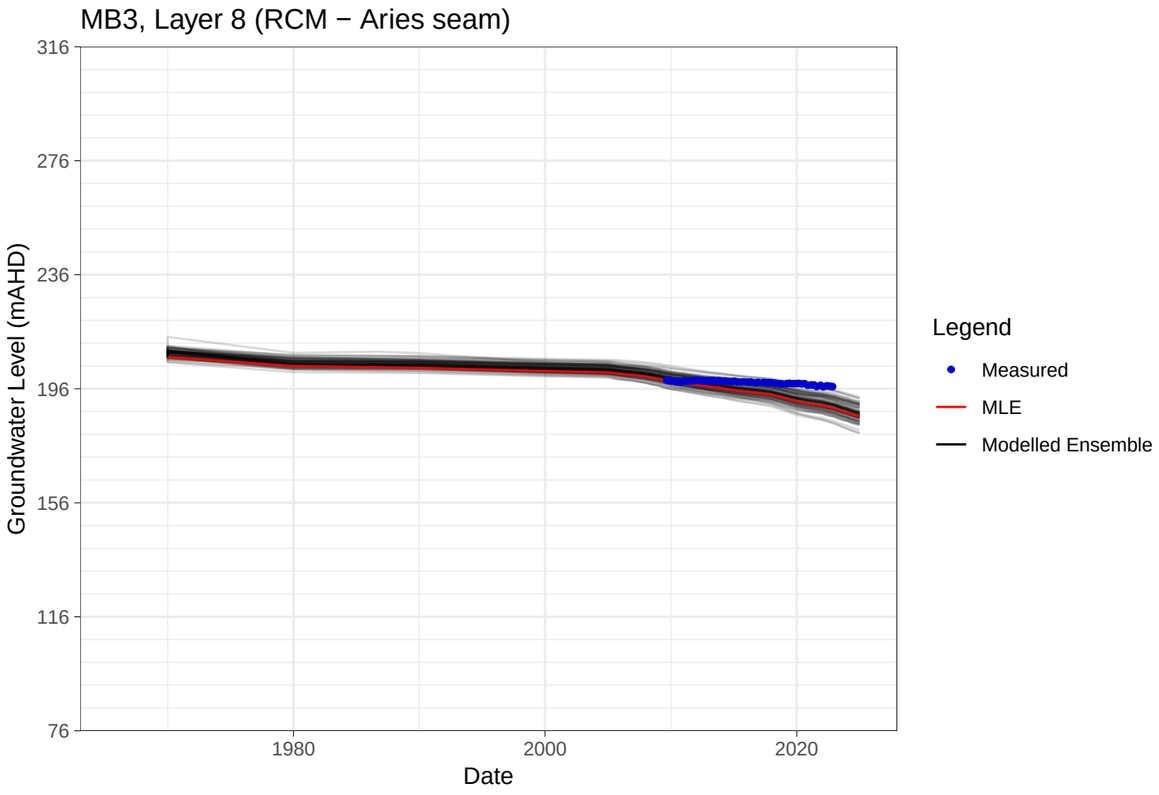

MB19BWM_15P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
210
206
202
198
194
190
186
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

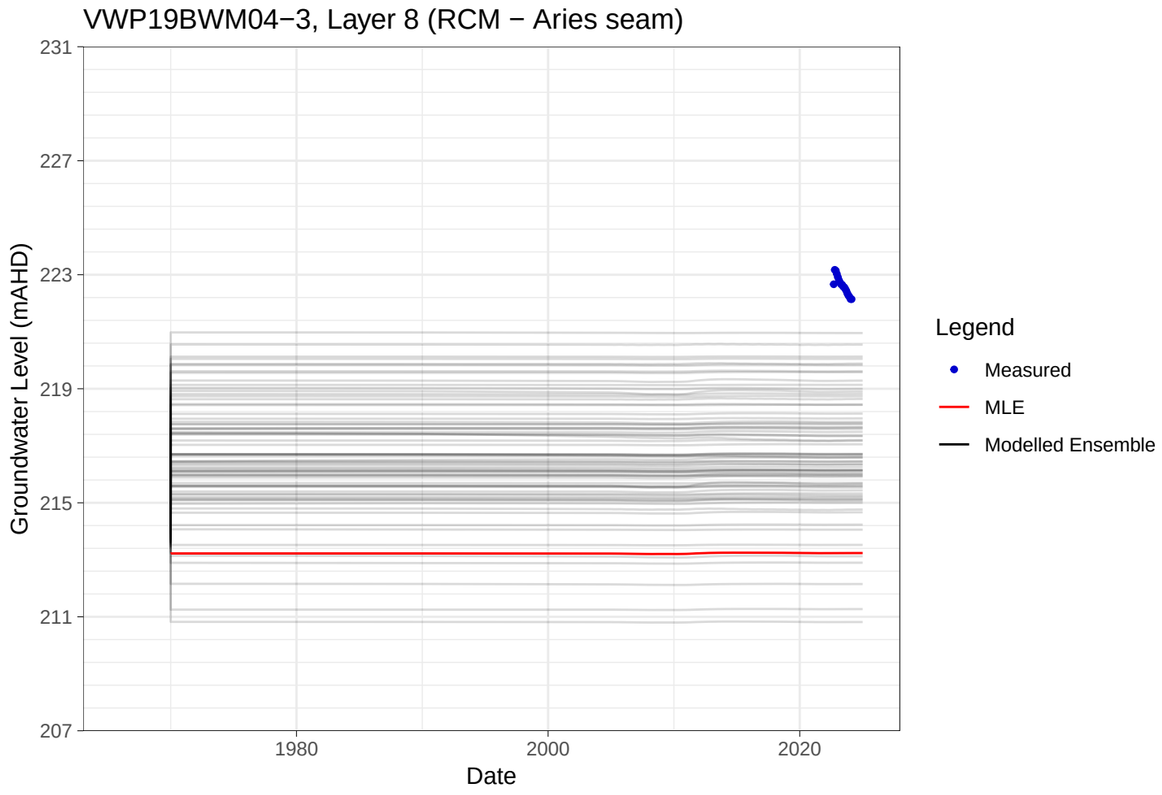

MB19BWM_18P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
272
252
232
212
192
172
152
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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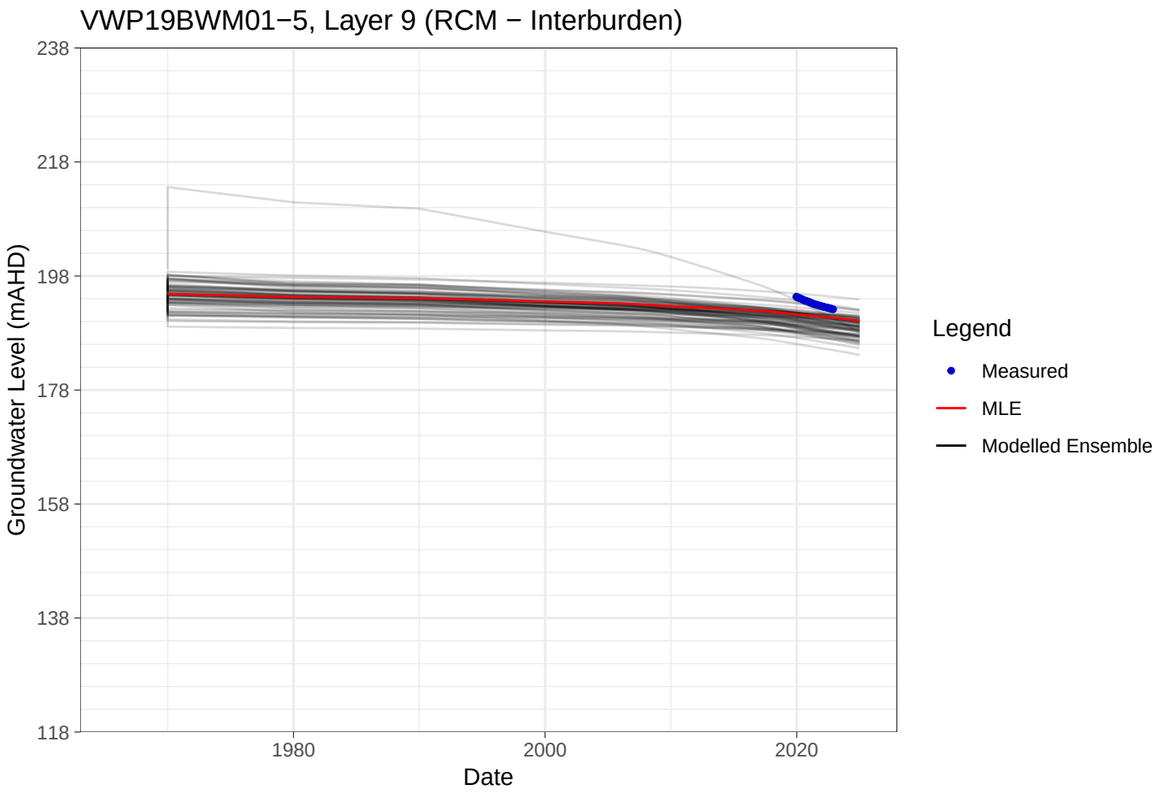

MB19BWM_24P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
222
218
214
210
206
202
198
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

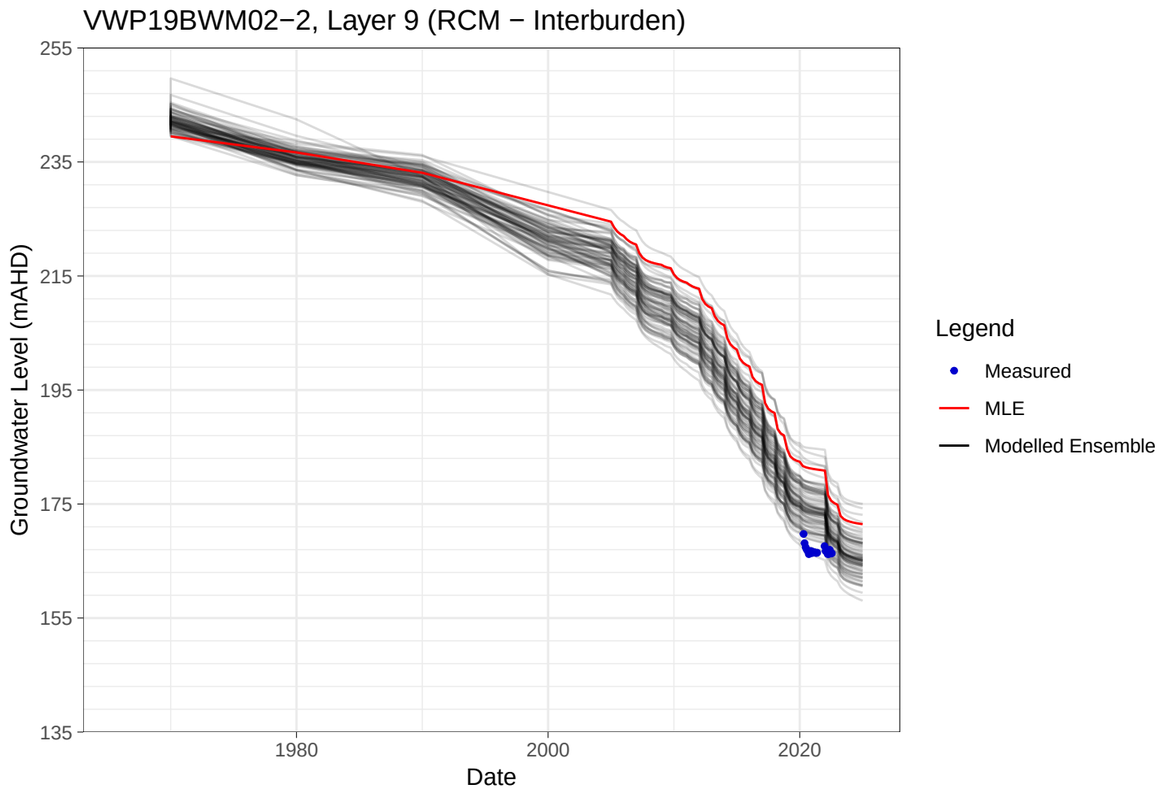

MB19BWM_25P_B, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
238
234
230
226
222
218
214
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

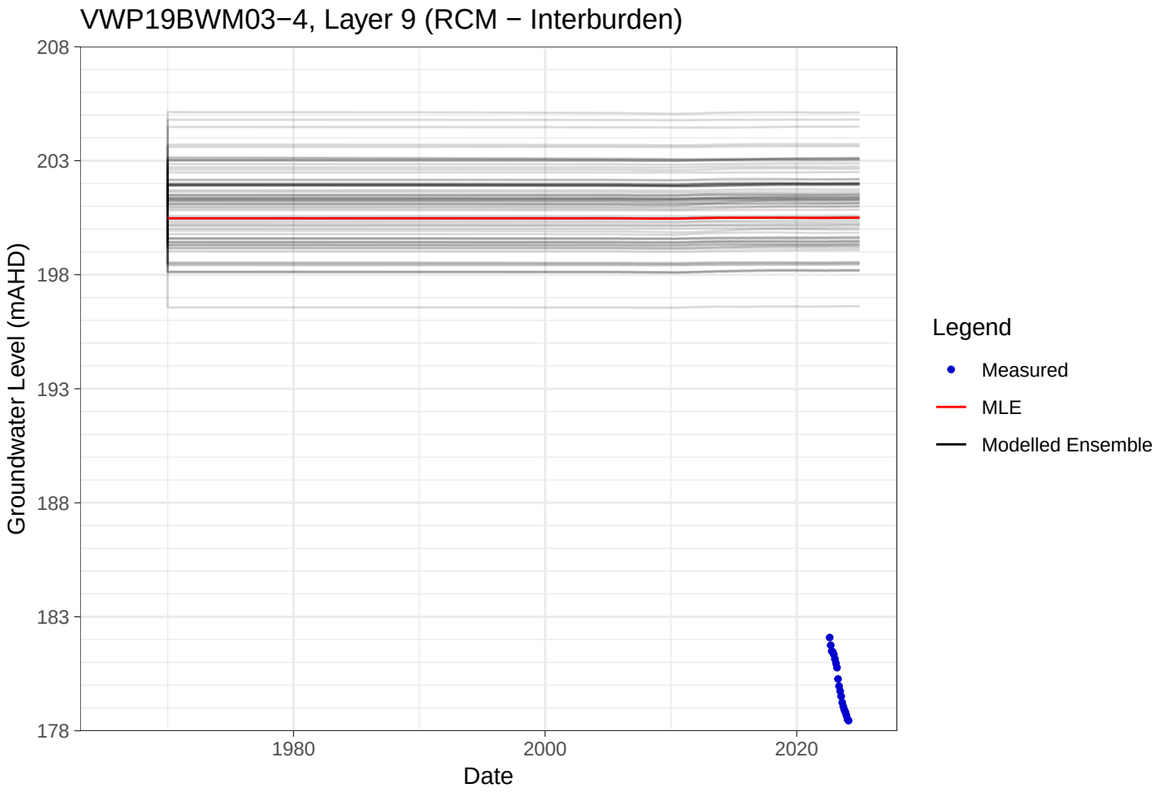

MB3, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
316
276
236
196
156
116
76
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

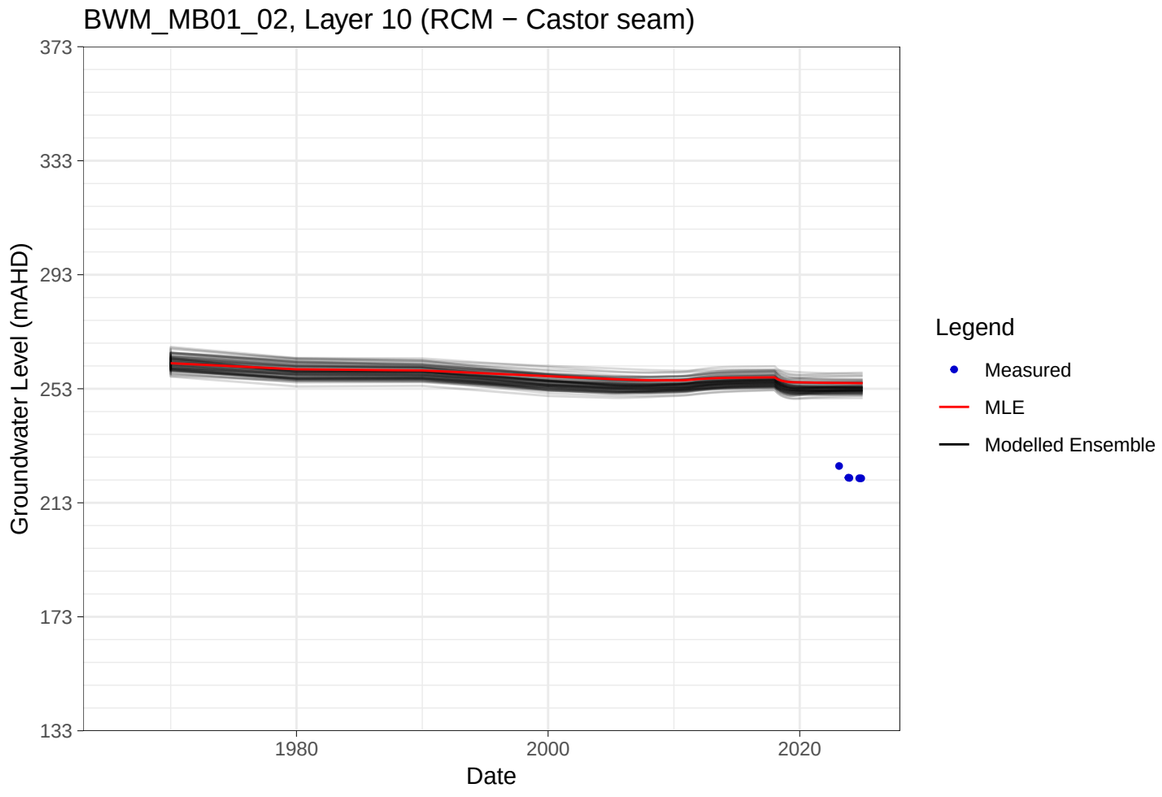

VWP19BWM04−3, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
231
227
223
219
215
211
207
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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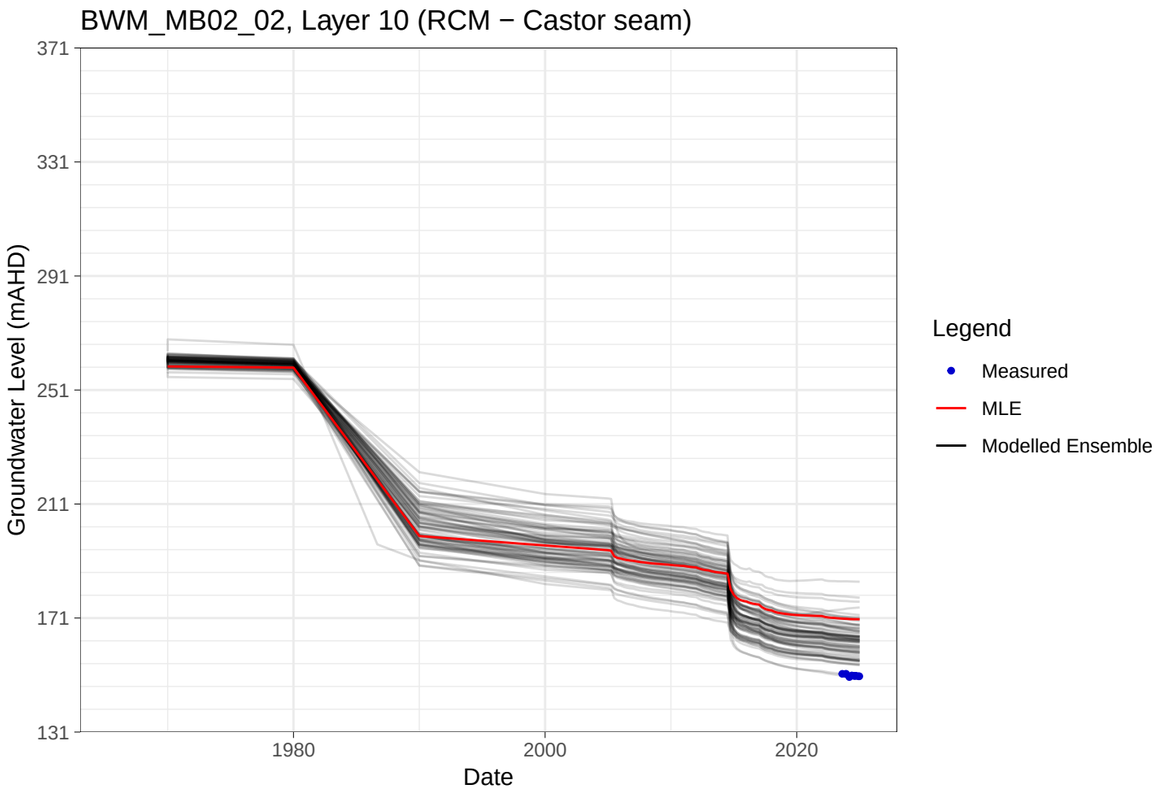

VWP19BWM01−5, Layer 9 (RCM − Interburden)
Groundwater Level (mAHD)
238
218
198
178
158
138
118
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

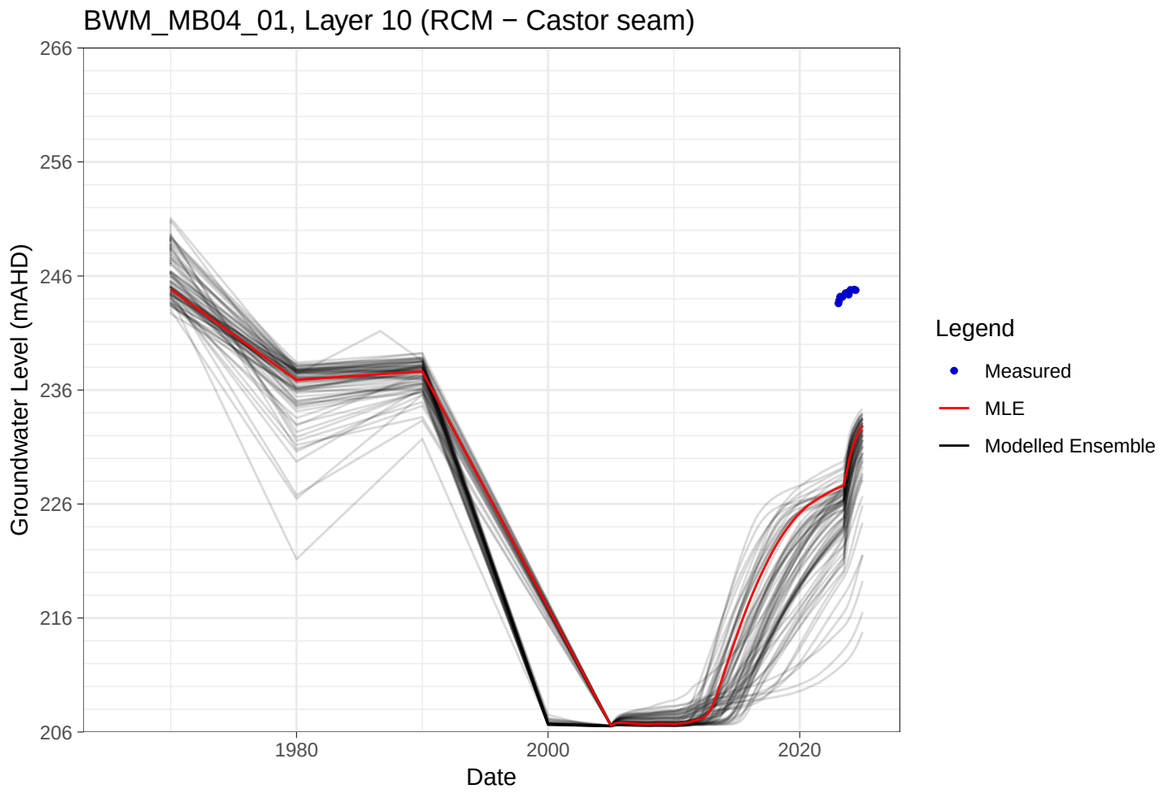

VWP19BWM02−2, Layer 9 (RCM − Interburden)
Groundwater Level (mAHD)
255
235
215
195
175
155
135
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

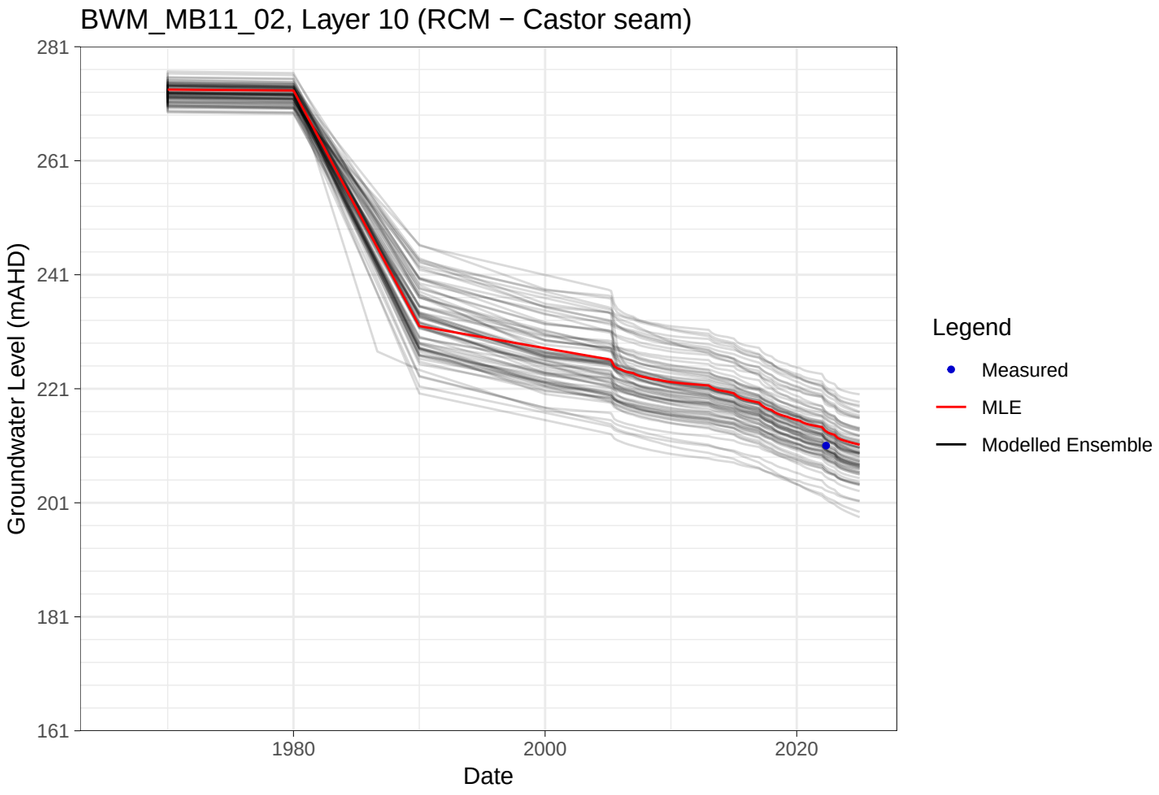

VWP19BWM03−4, Layer 9 (RCM − Interburden)
Groundwater Level (mAHD)
208
203
198
193
188
183
178
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

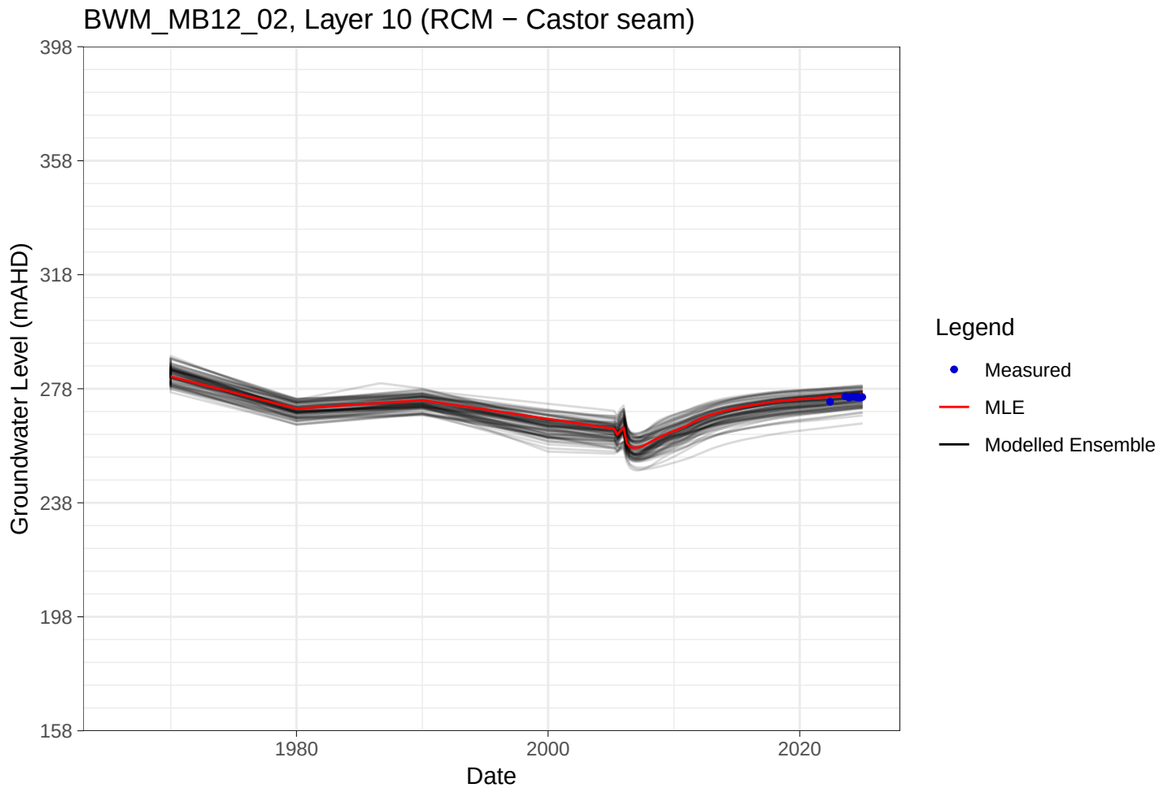

BWM_MB01_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
373
333
293
253
213
173
133
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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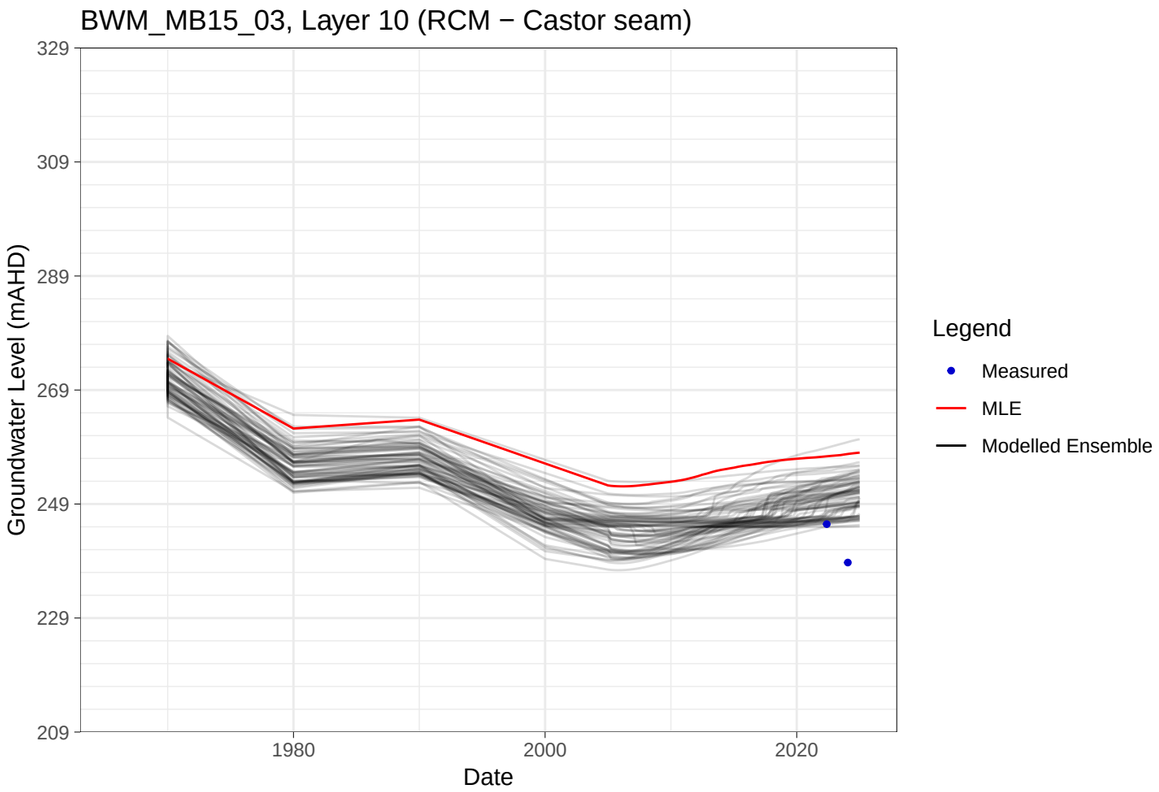

BWM_MB02_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
371
331
291
251
211
171
131
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

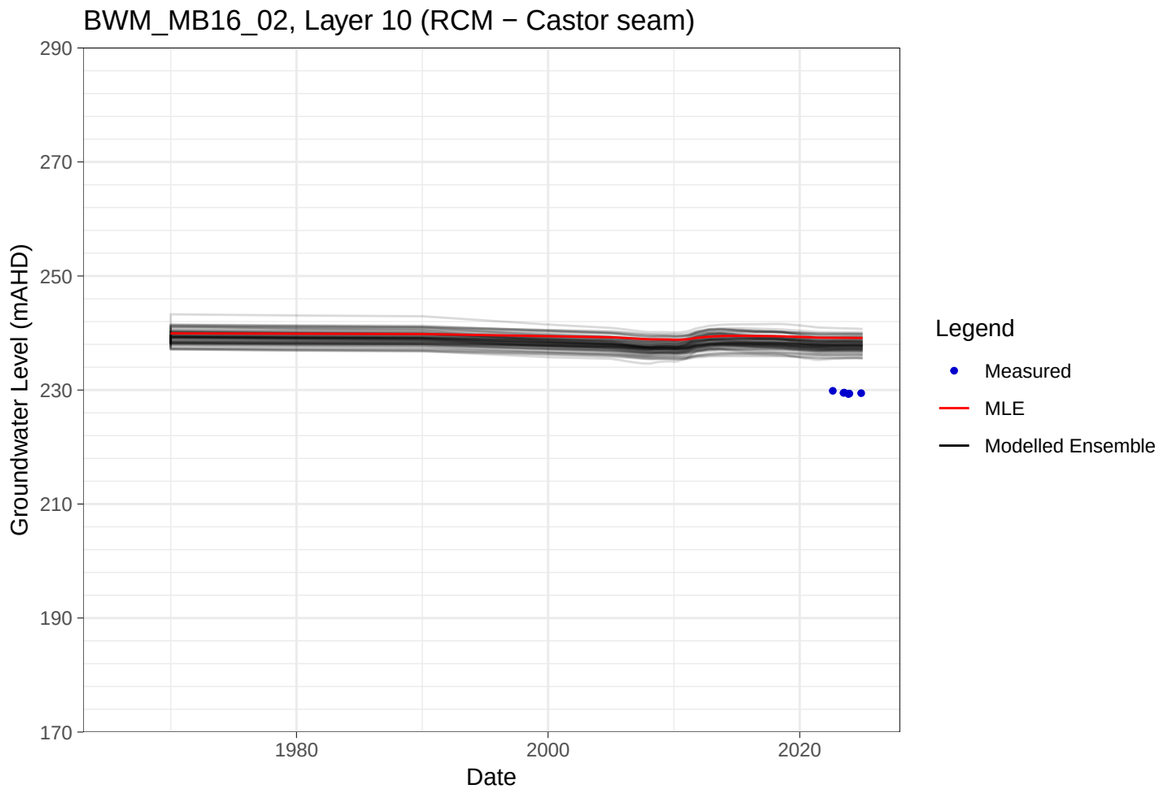

BWM_MB04_01, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
266
256
246
236
226
216
206
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

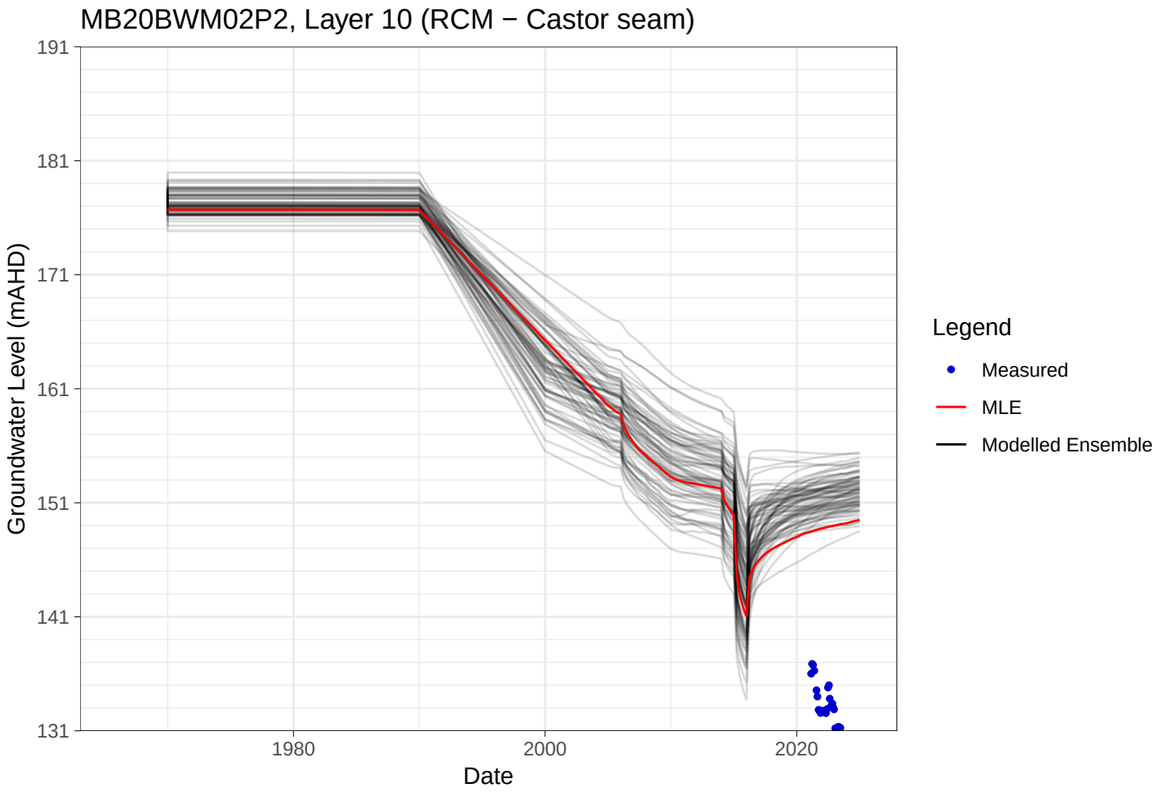

BWM_MB11_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
281
261
241
221
201
181
161
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

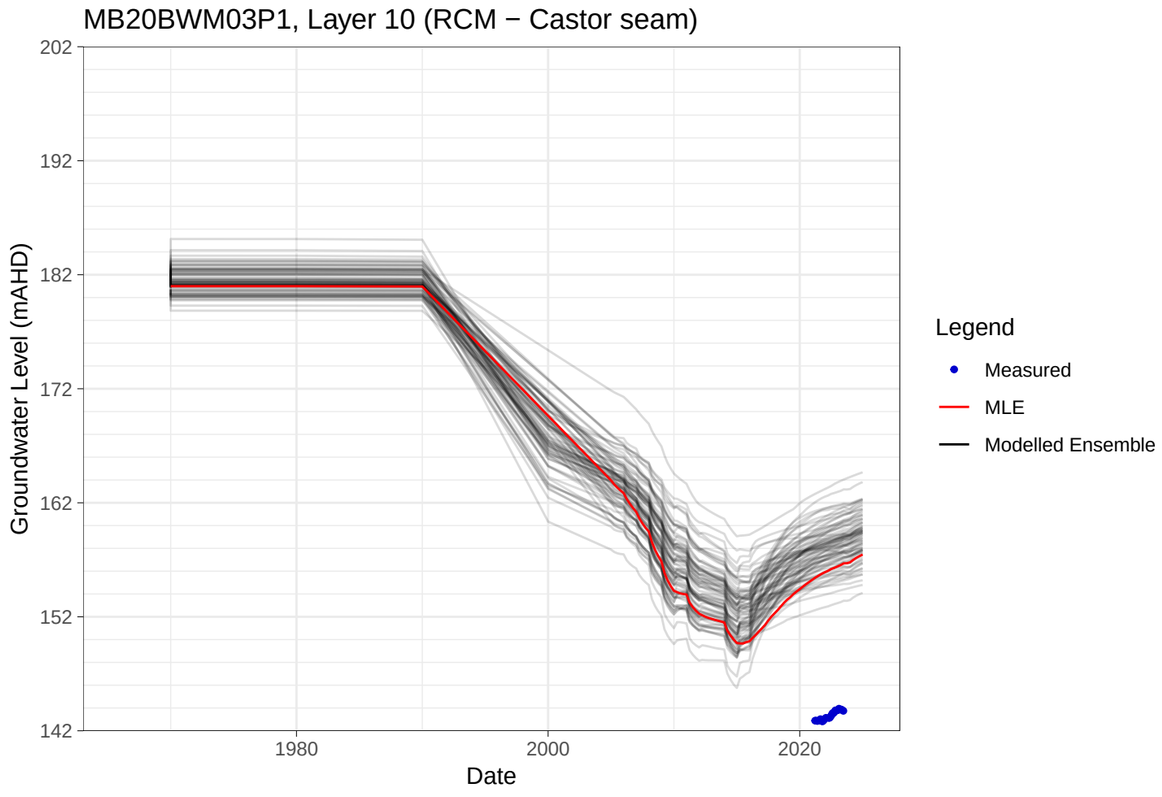

BWM_MB12_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
398
358
318
278
238
198
158
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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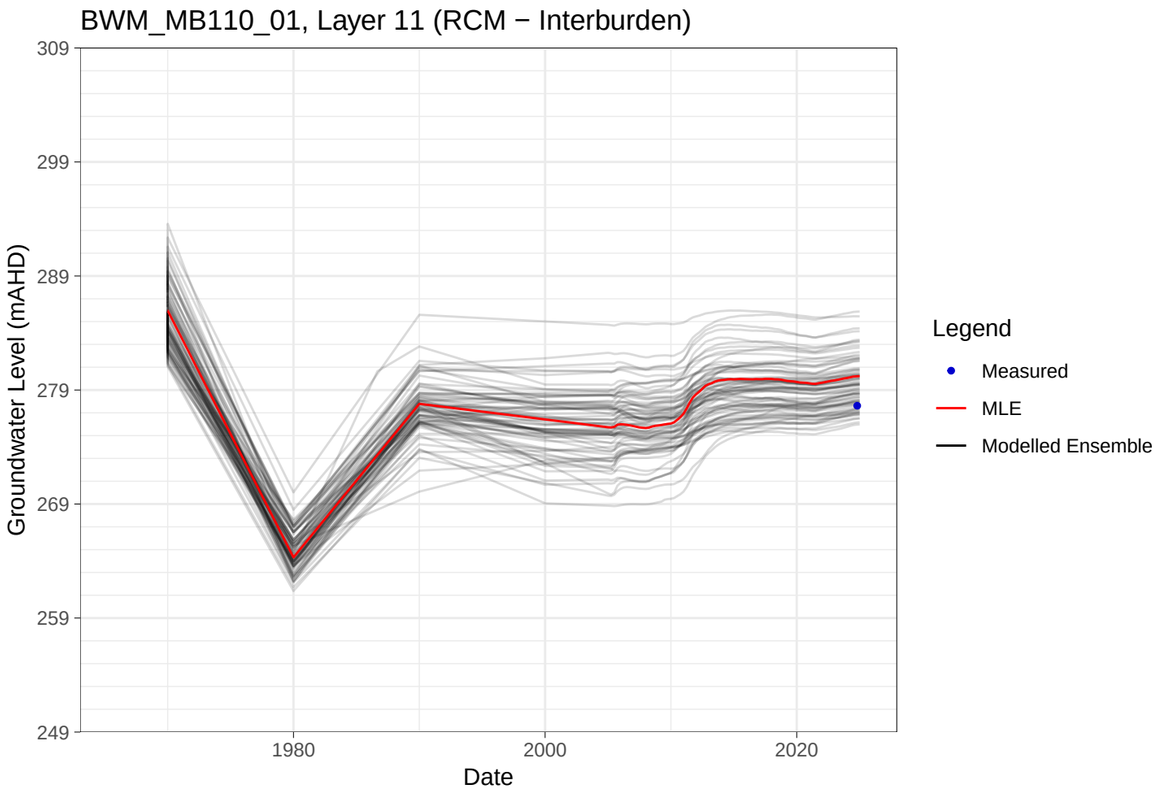

BWM_MB15_03, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
329
309
289
269
249
229
209
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

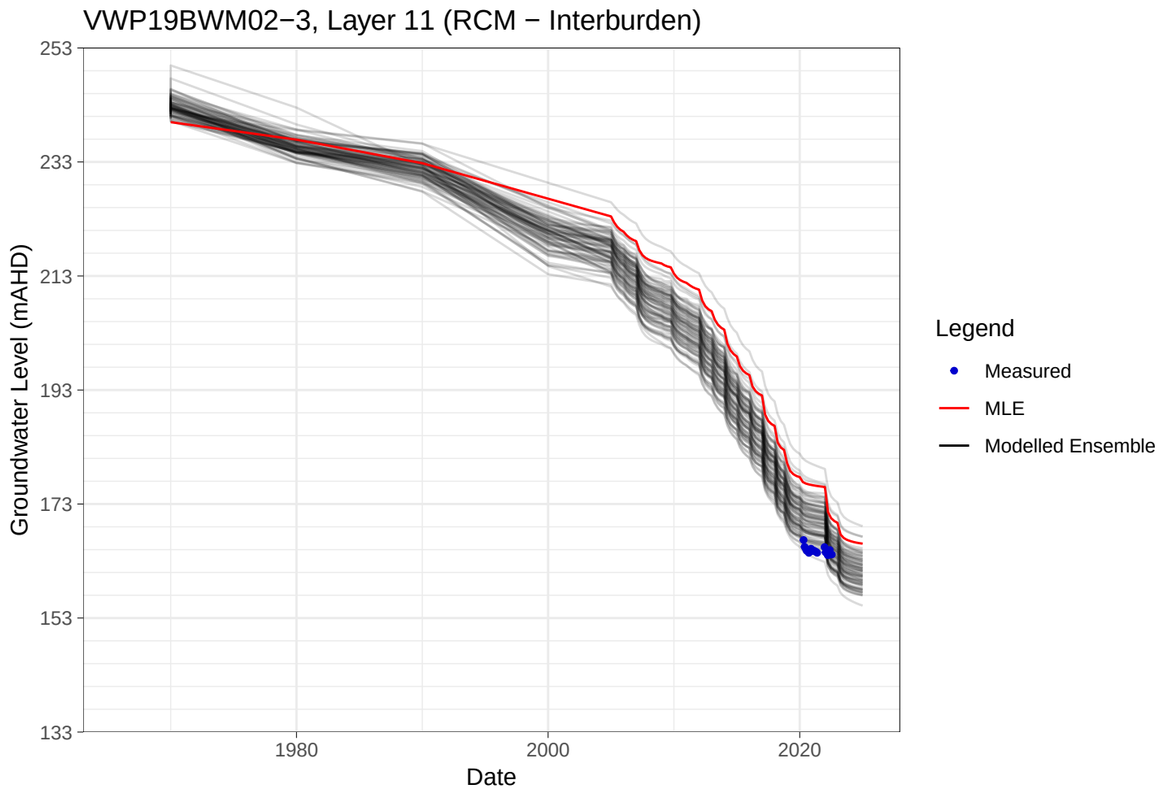

BWM_MB16_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
290
270
250
230
210
190
170
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

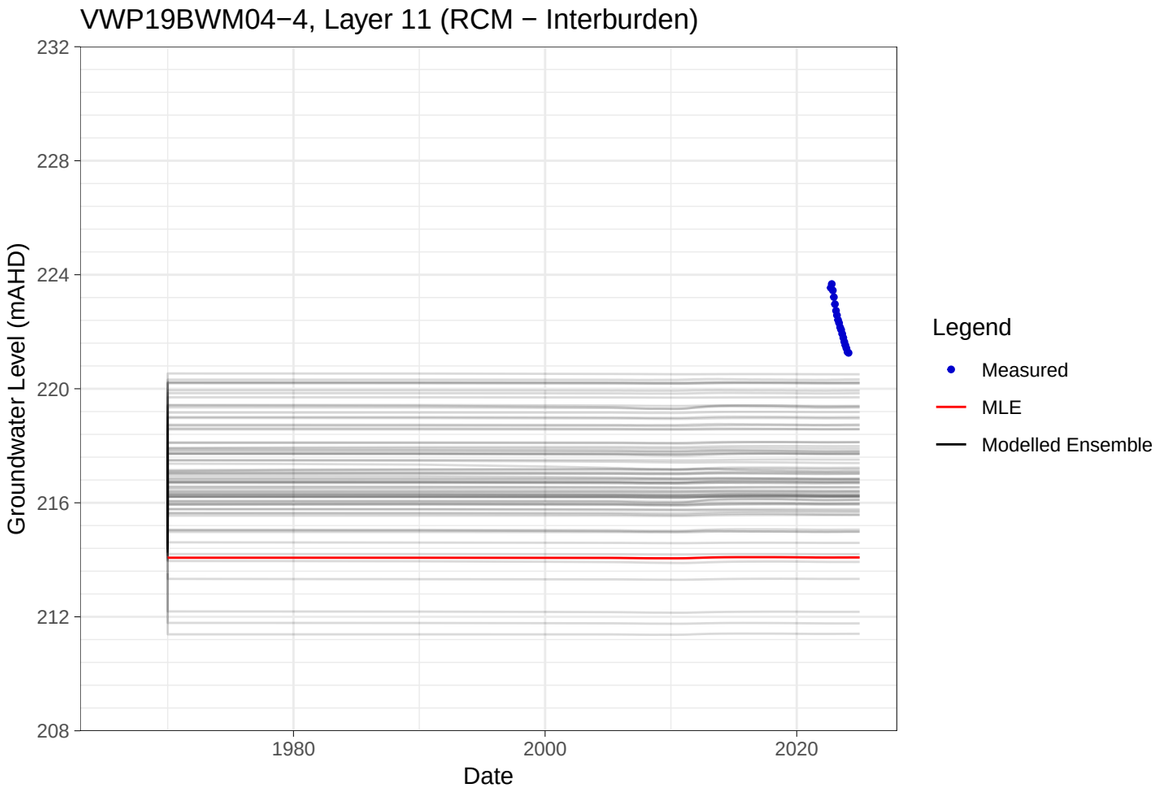

MB20BWM02P2, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
191
181
171
161
151
141
131
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

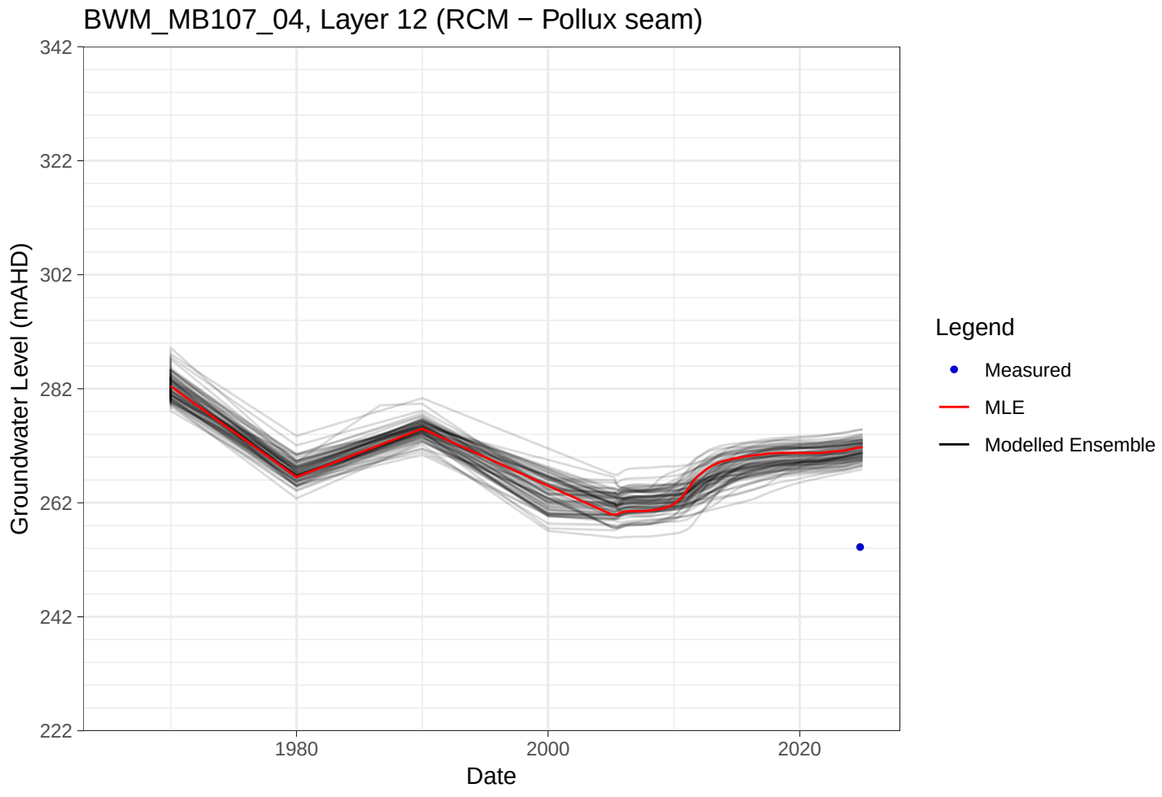

MB20BWM03P1, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
202
192
182
172
162
152
142
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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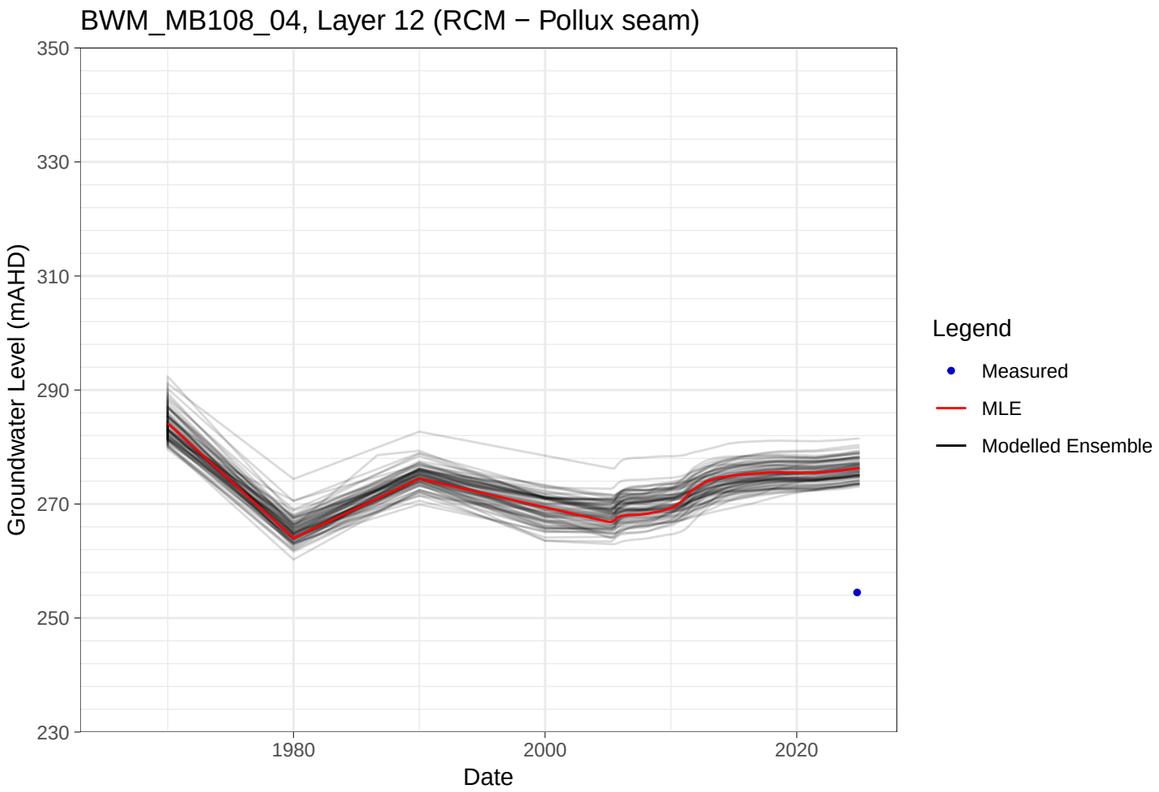

BWM_MB110_01, Layer 11 (RCM − Interburden)
Groundwater Level (mAHD)
309
299
289
279
269
259
249
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

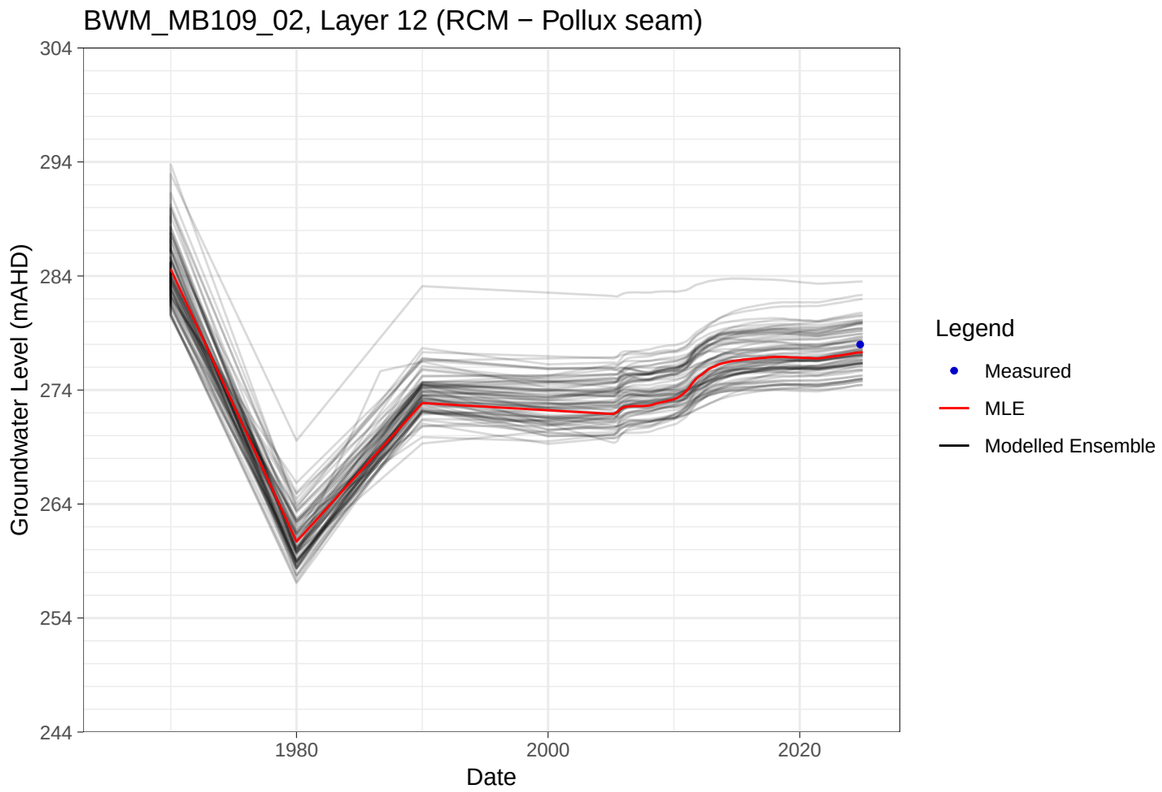

VWP19BWM02−3, Layer 11 (RCM − Interburden)
Groundwater Level (mAHD)
253
233
213
193
173
153
133
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

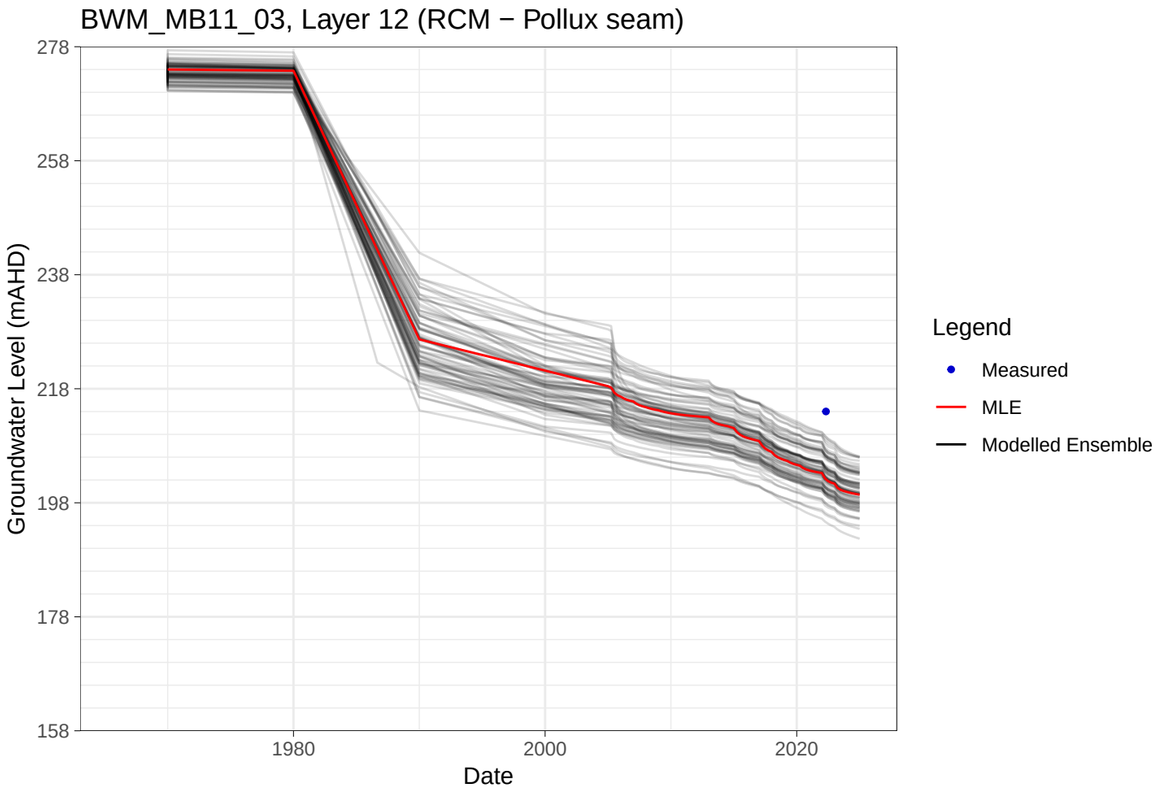

VWP19BWM04−4, Layer 11 (RCM − Interburden)
Groundwater Level (mAHD)
232
228
224
220
216
212
208
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

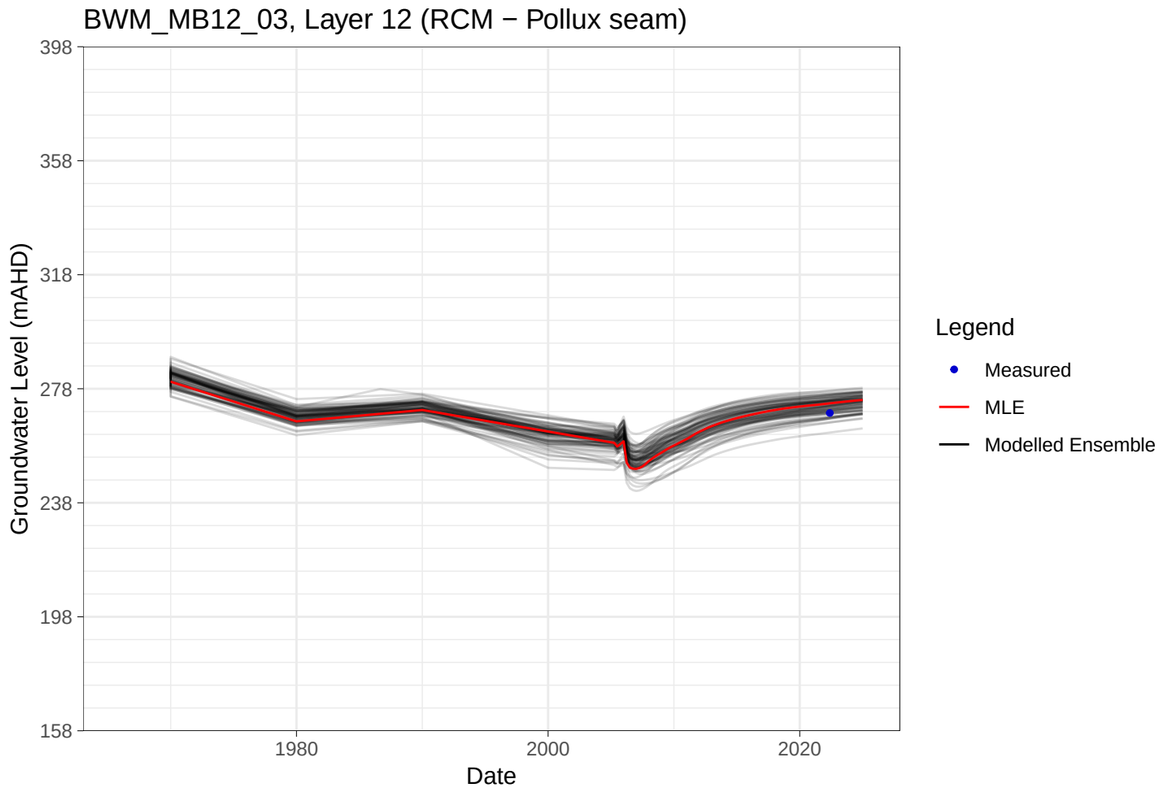

BWM_MB107_04, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
342
322
302
282
262
242
222
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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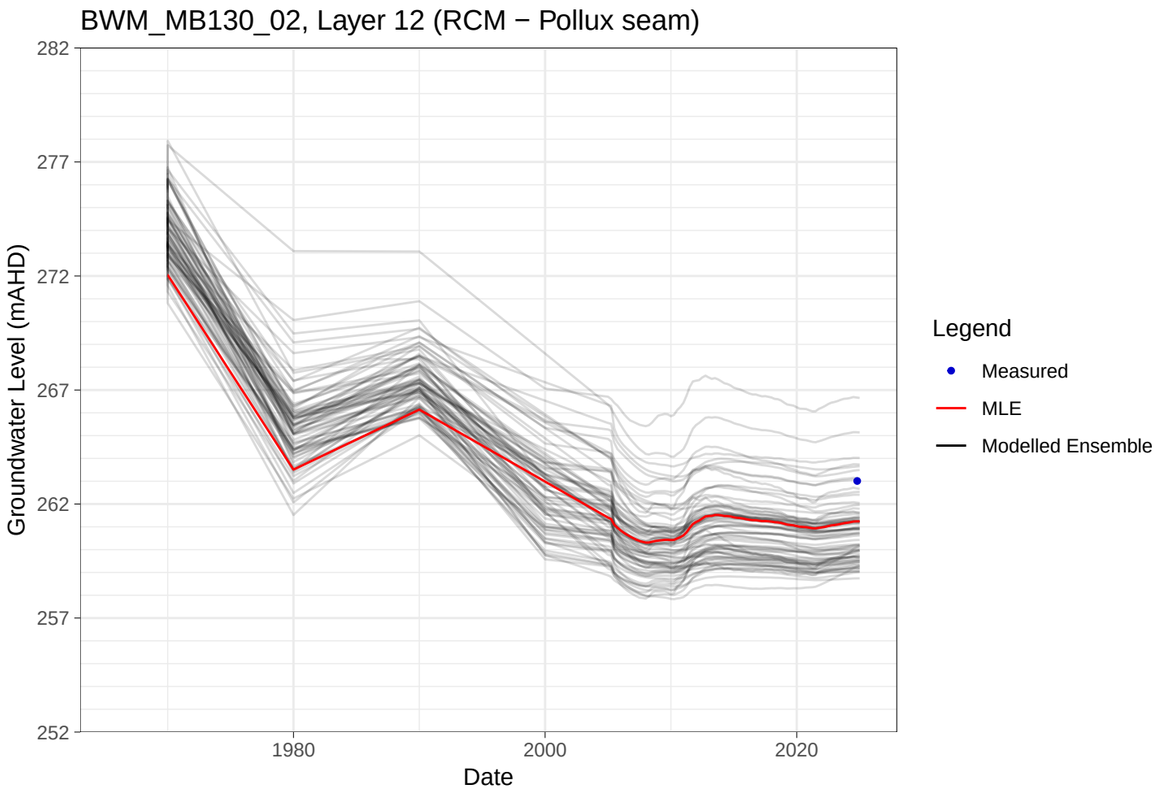

BWM_MB108_04, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
350
330
310
290
270
250
230
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

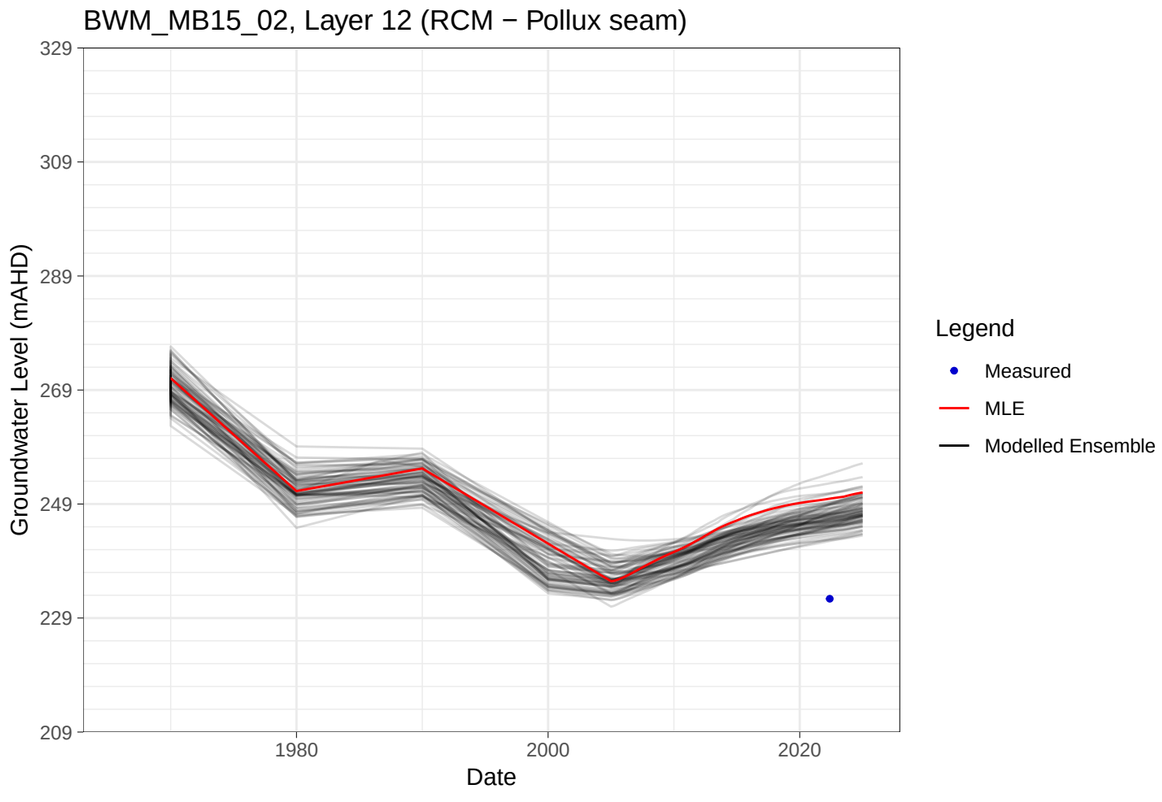

BWM_MB109_02, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
304
294
284
274
264
254
244
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

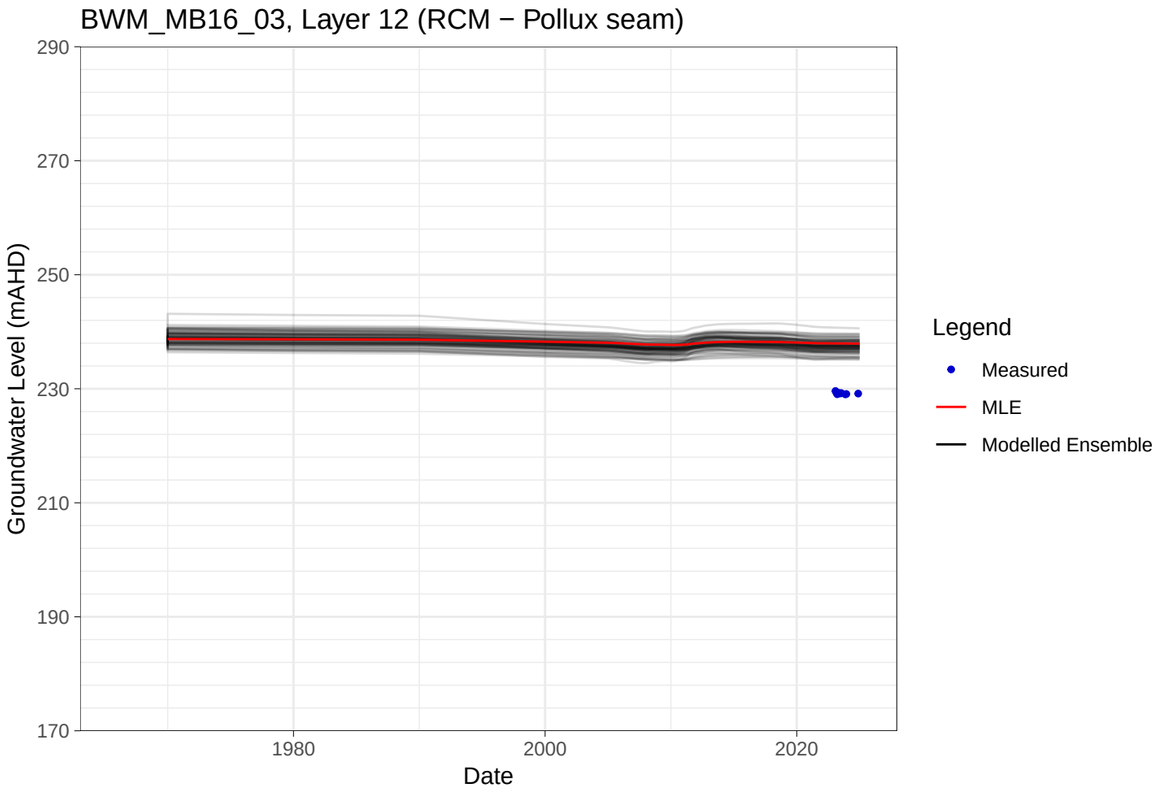

BWM_MB11_03, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
278
258
238
218
198
178
158
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

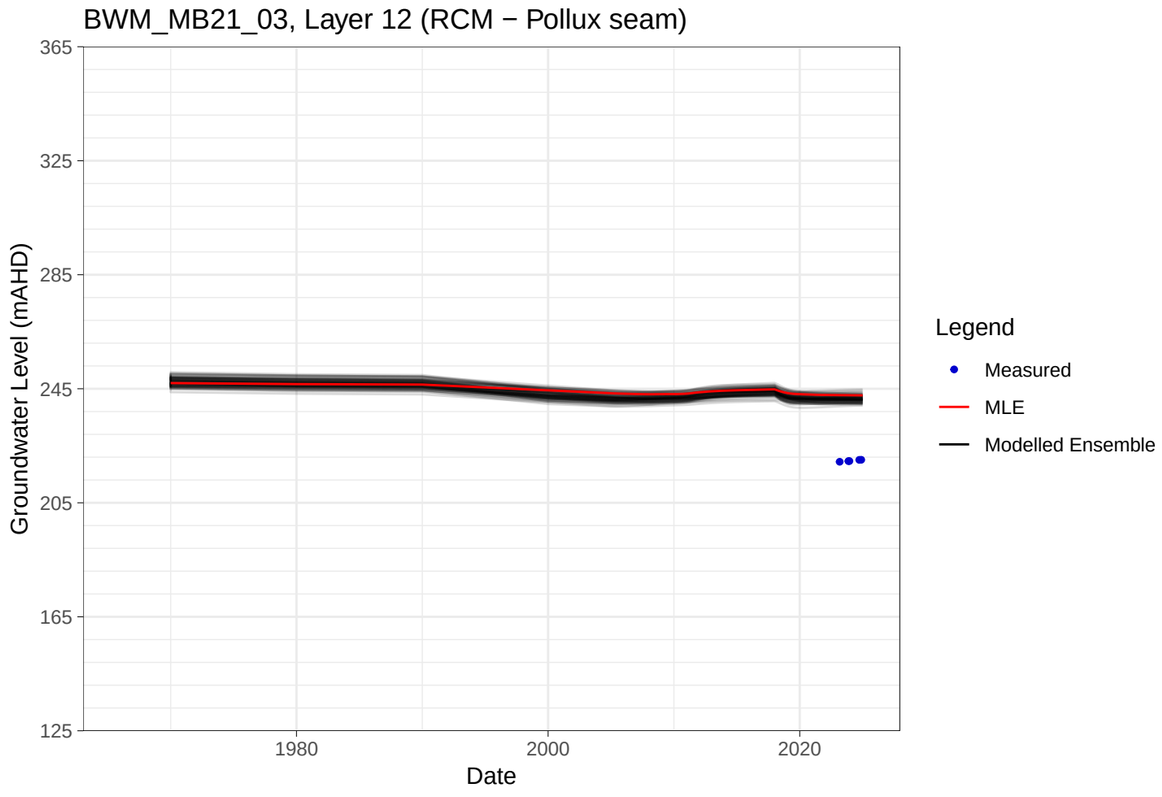

BWM_MB12_03, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
398
358
318
278
238
198
158
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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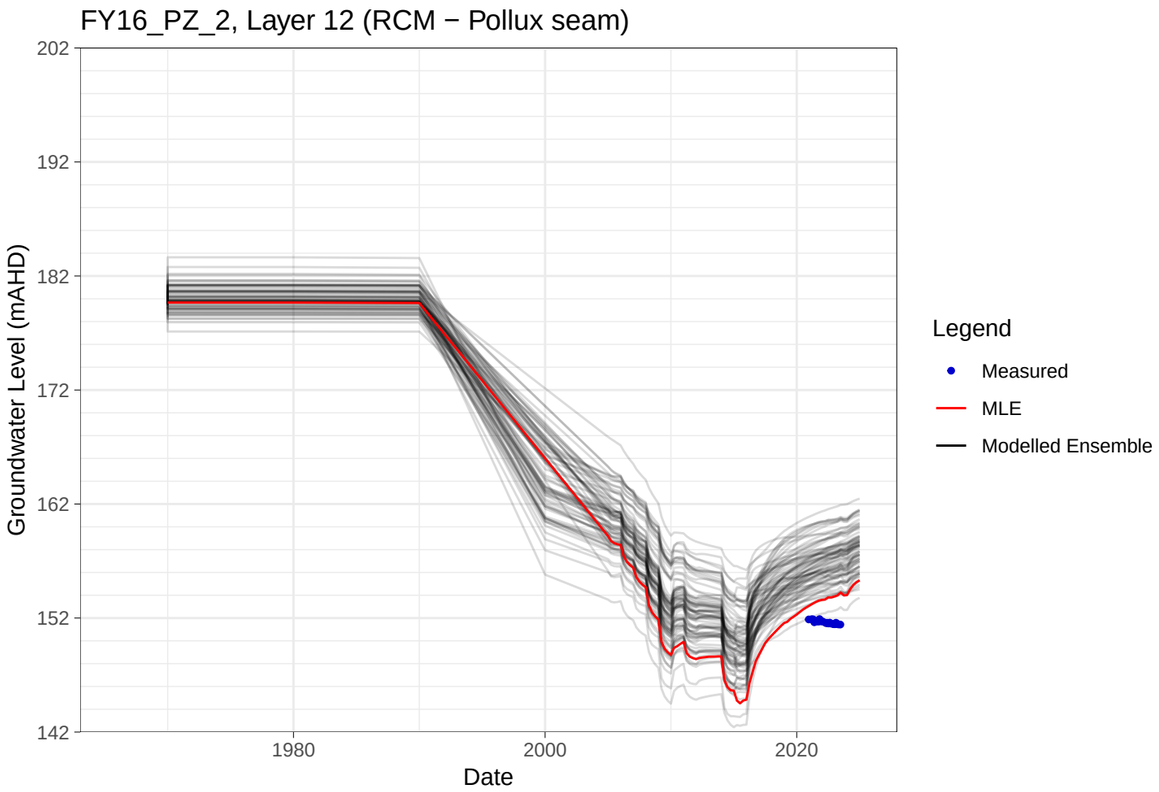

BWM_MB130_02, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
282
277
272
267
262
257
252
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

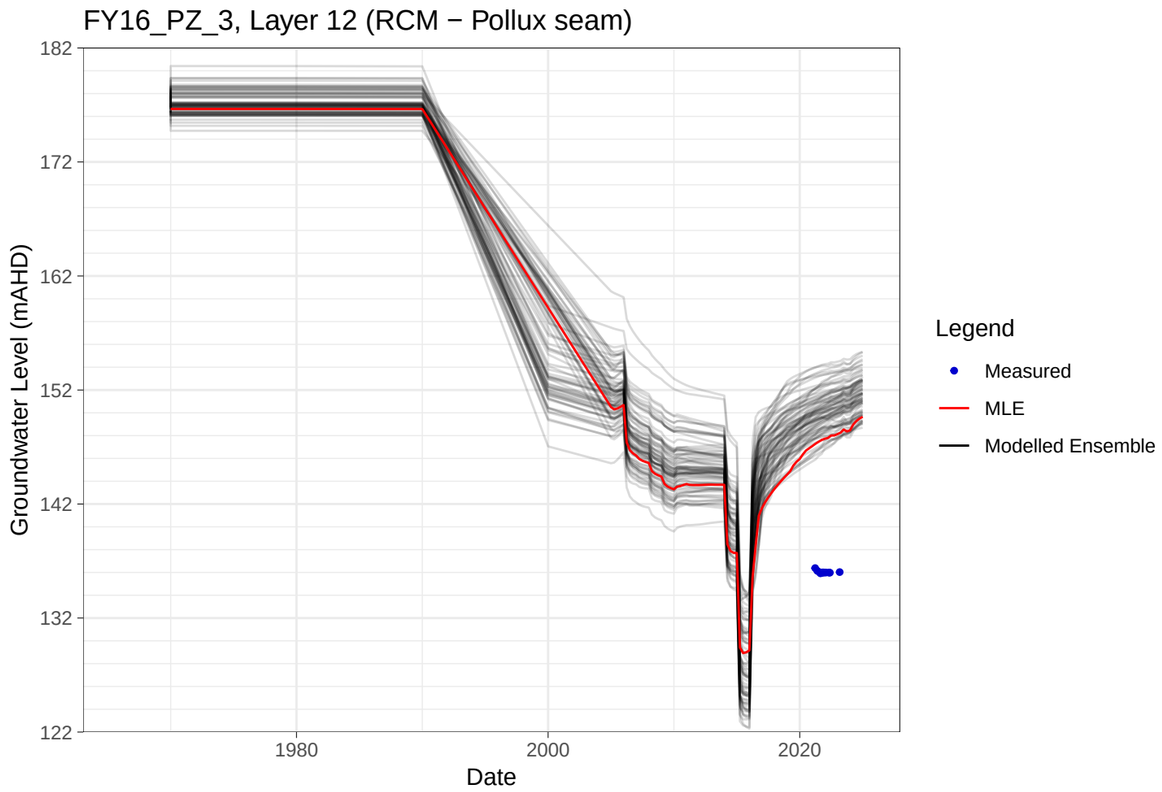

BWM_MB15_02, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
329
309
289
269
249
229
209
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

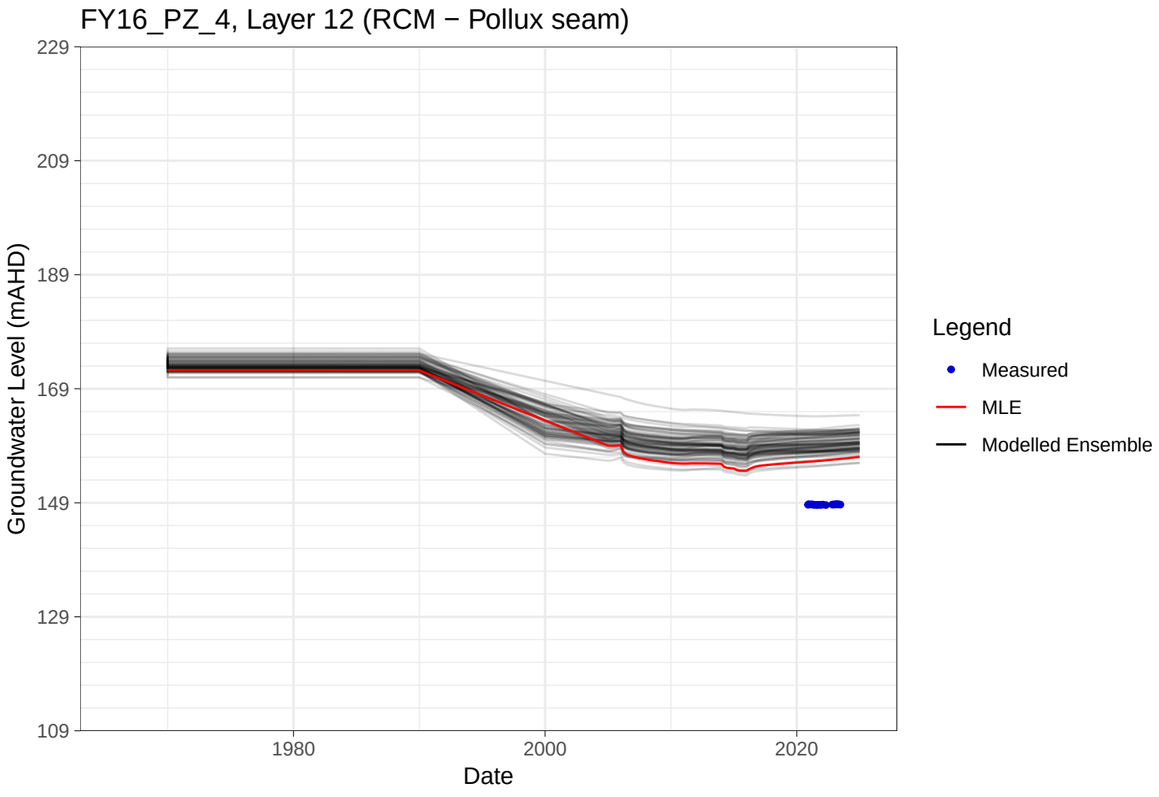

BWM_MB16_03, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
290
270
250
230
210
190
170
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

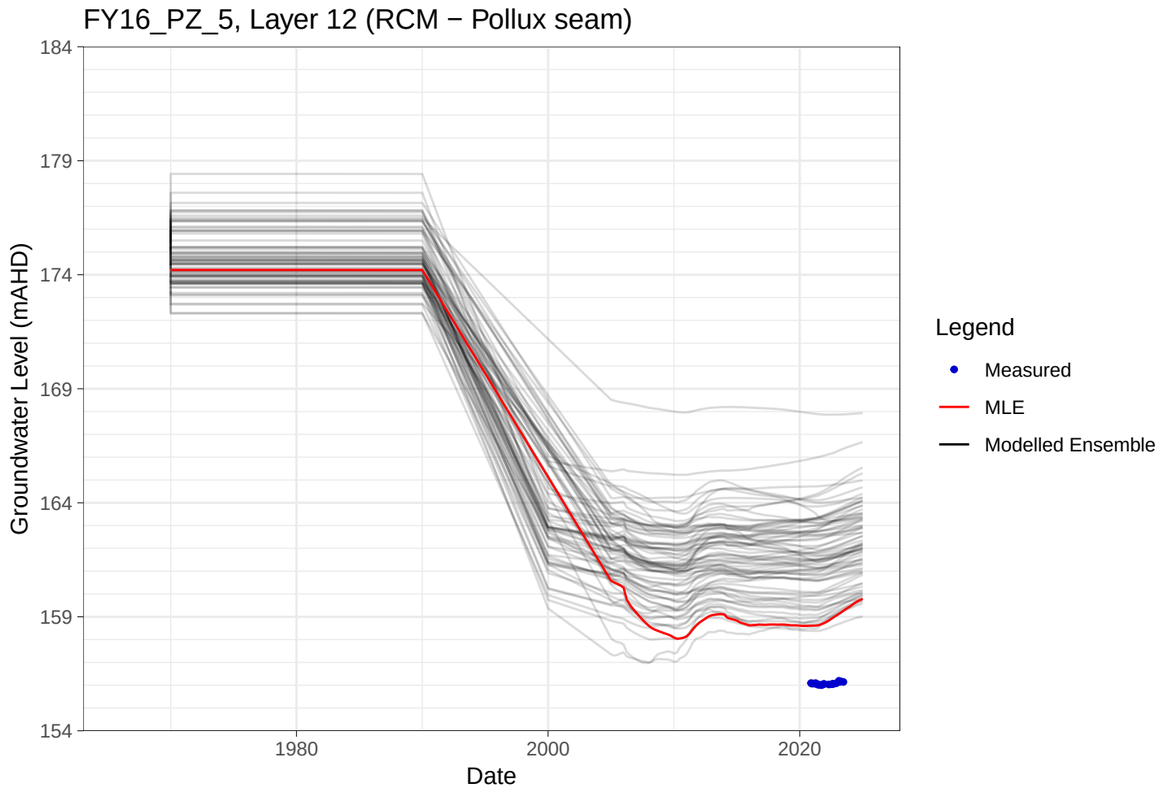

BWM_MB21_03, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
365
325
285
245
205
165
125
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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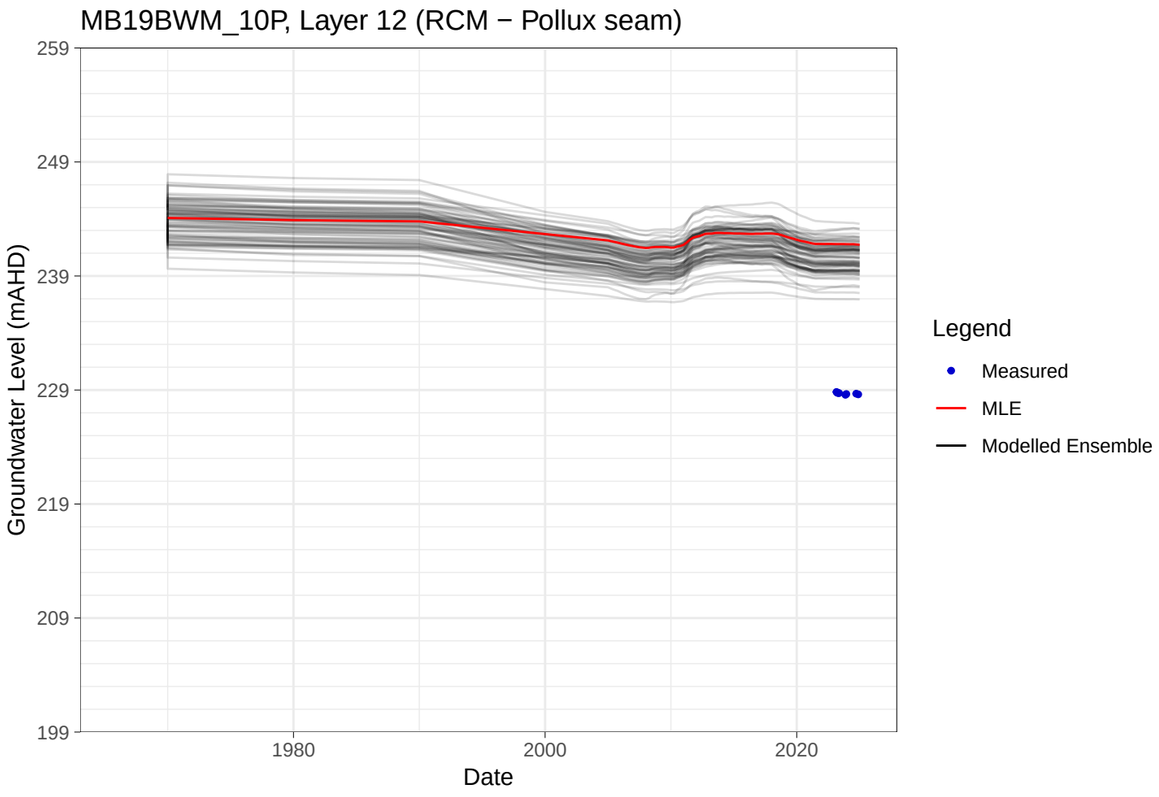

FY16_PZ_2, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
202
192
182
172
162
152
142
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

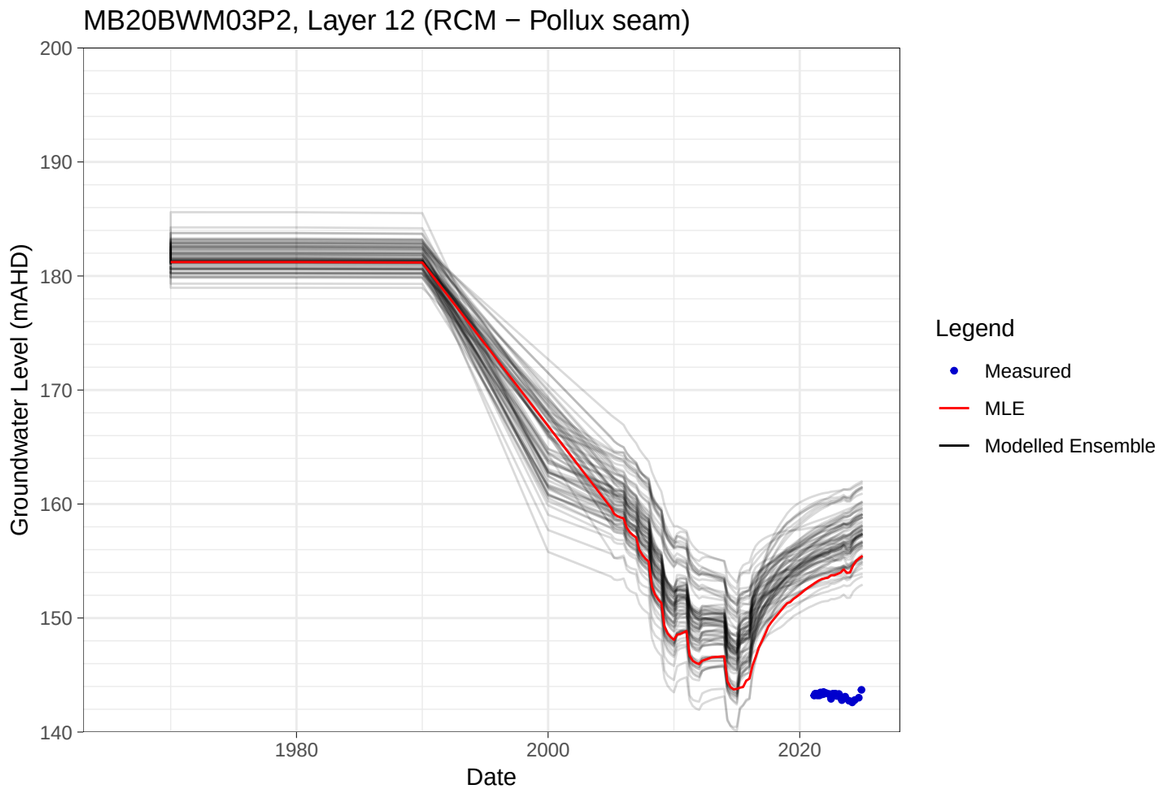

FY16_PZ_3, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
182
172
162
152
142
132
122
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

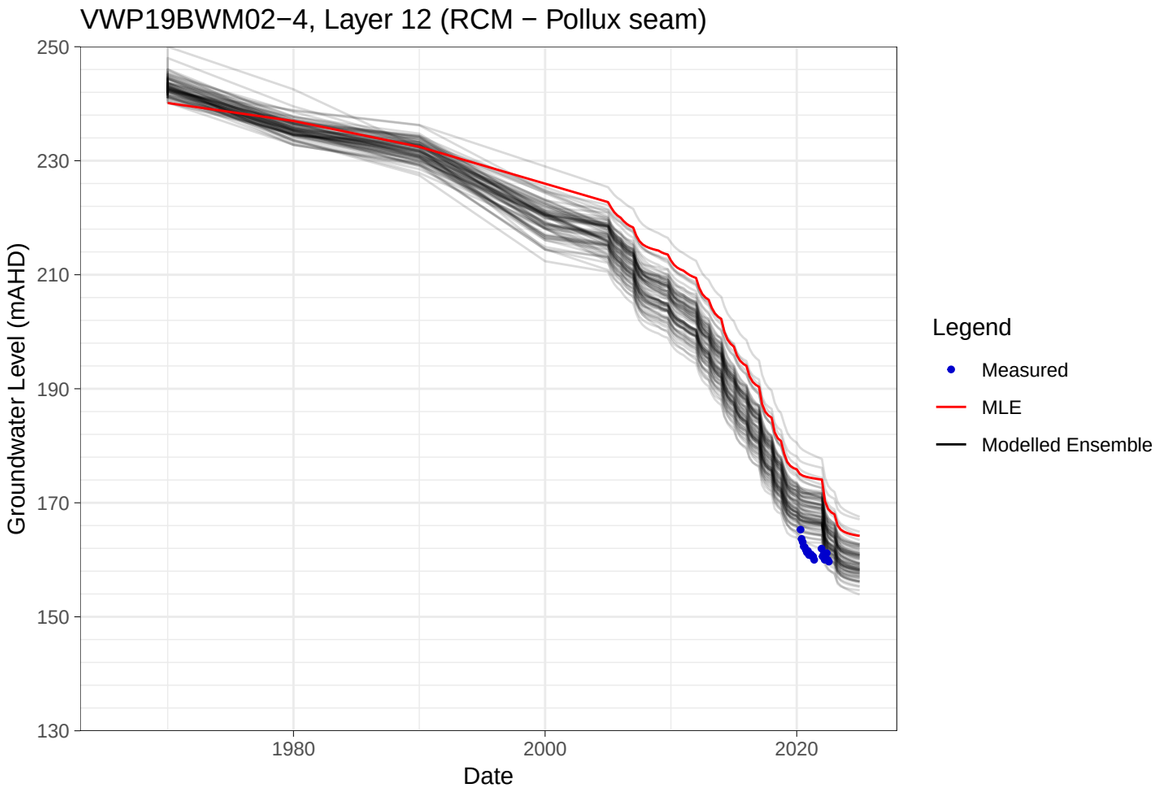

FY16_PZ_4, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
229
209
189
169
149
129
109
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

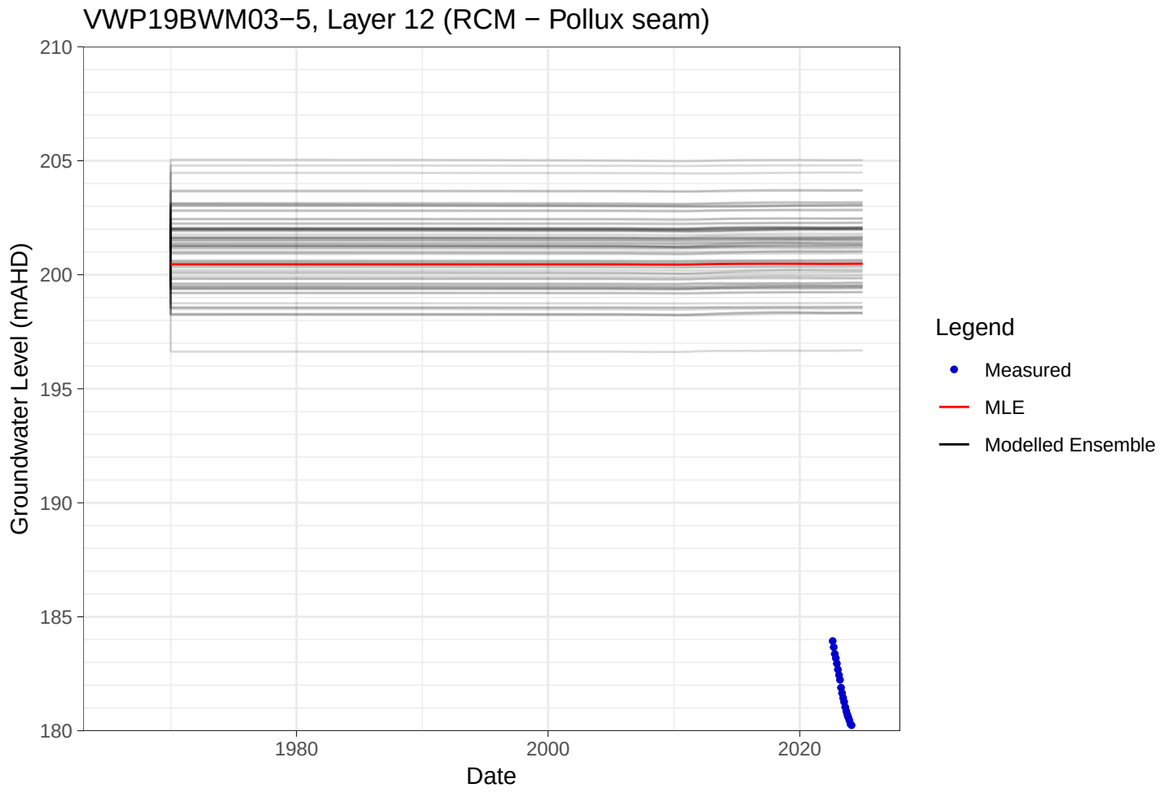

FY16_PZ_5, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
184
179
174
169
164
159
154
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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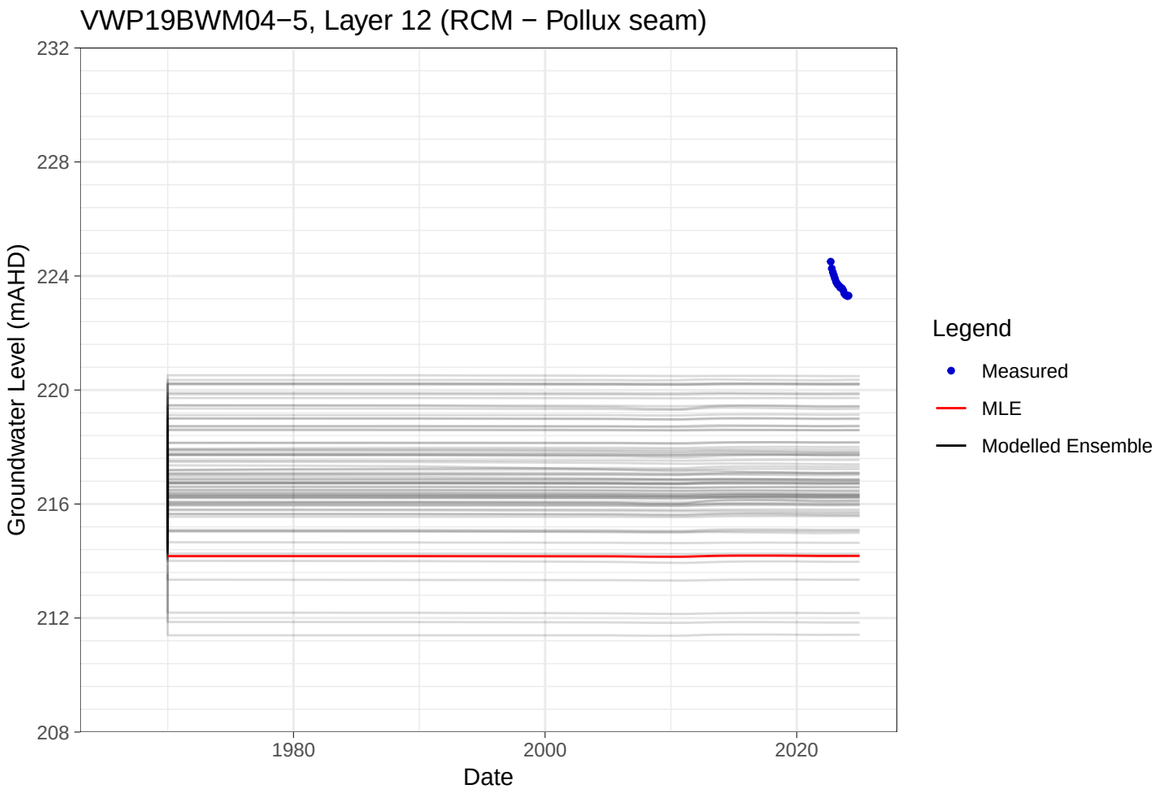

MB19BWM_10P, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
259
249
239
229
219
209
199
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

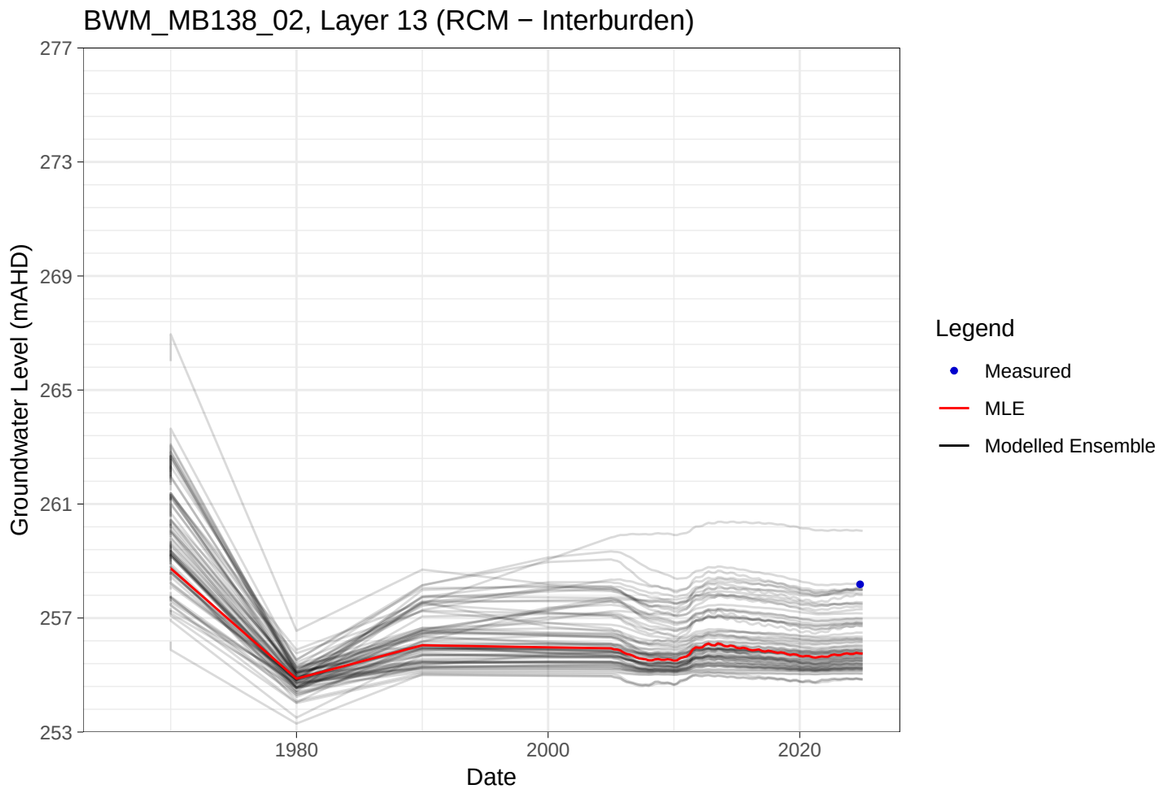

MB20BWM03P2, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
200
190
180
170
160
150
140
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

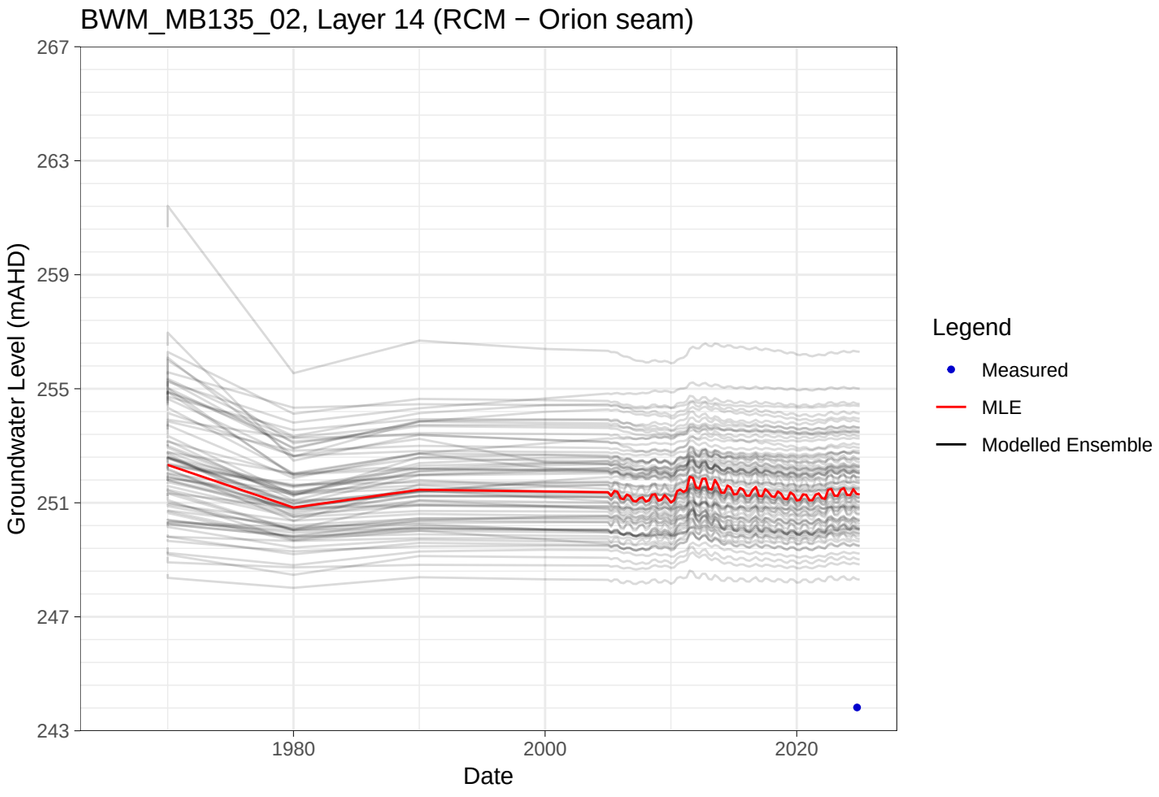

VWP19BWM02−4, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
250
230
210
190
170
150
130
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

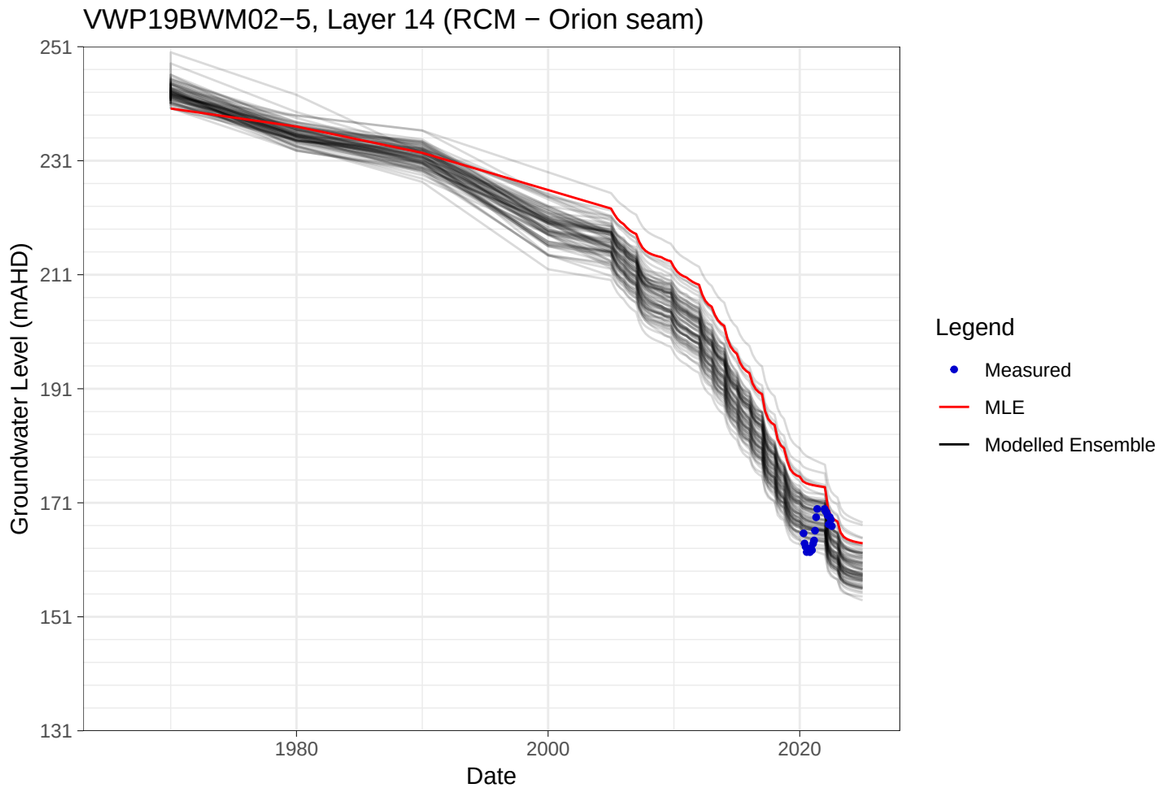

VWP19BWM03−5, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
210
205
200
195
190
185
180
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

,

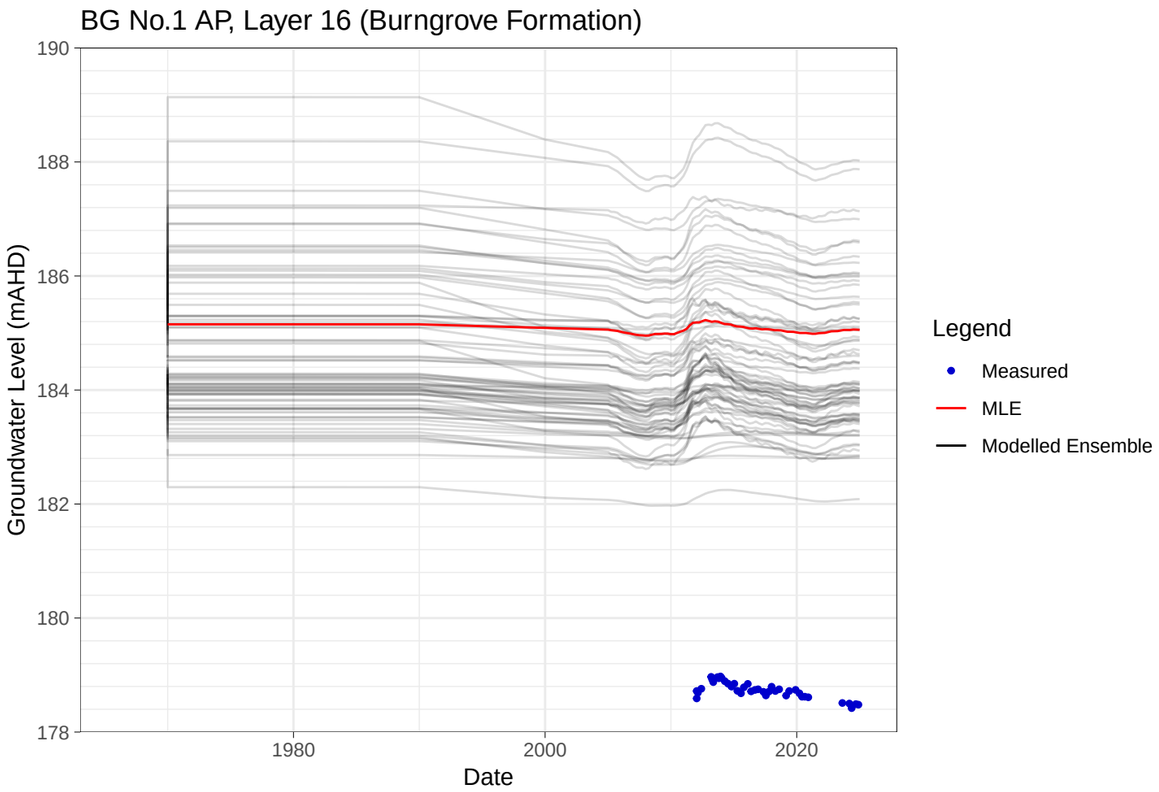

VWP19BWM04−5, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
232
228
224
220
216
212
208
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

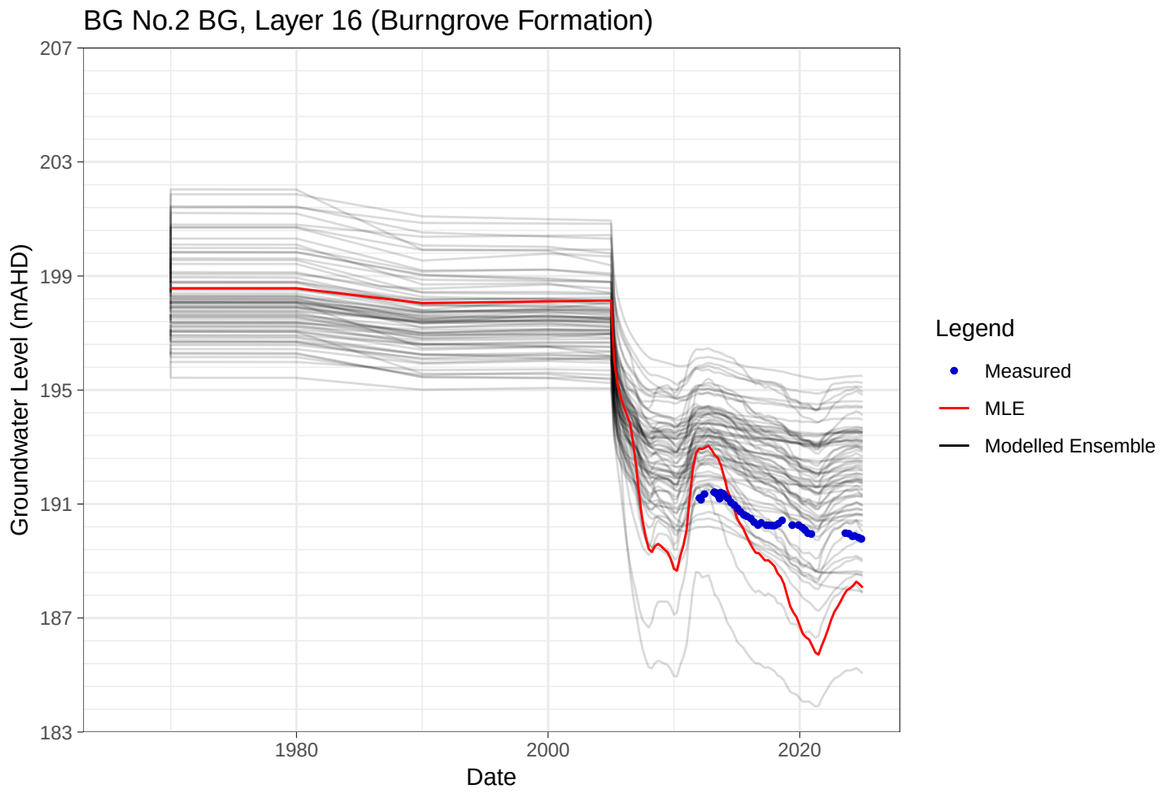

BWM_MB138_02, Layer 13 (RCM − Interburden)
Groundwater Level (mAHD)
277
273
269
265
261
257
253
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

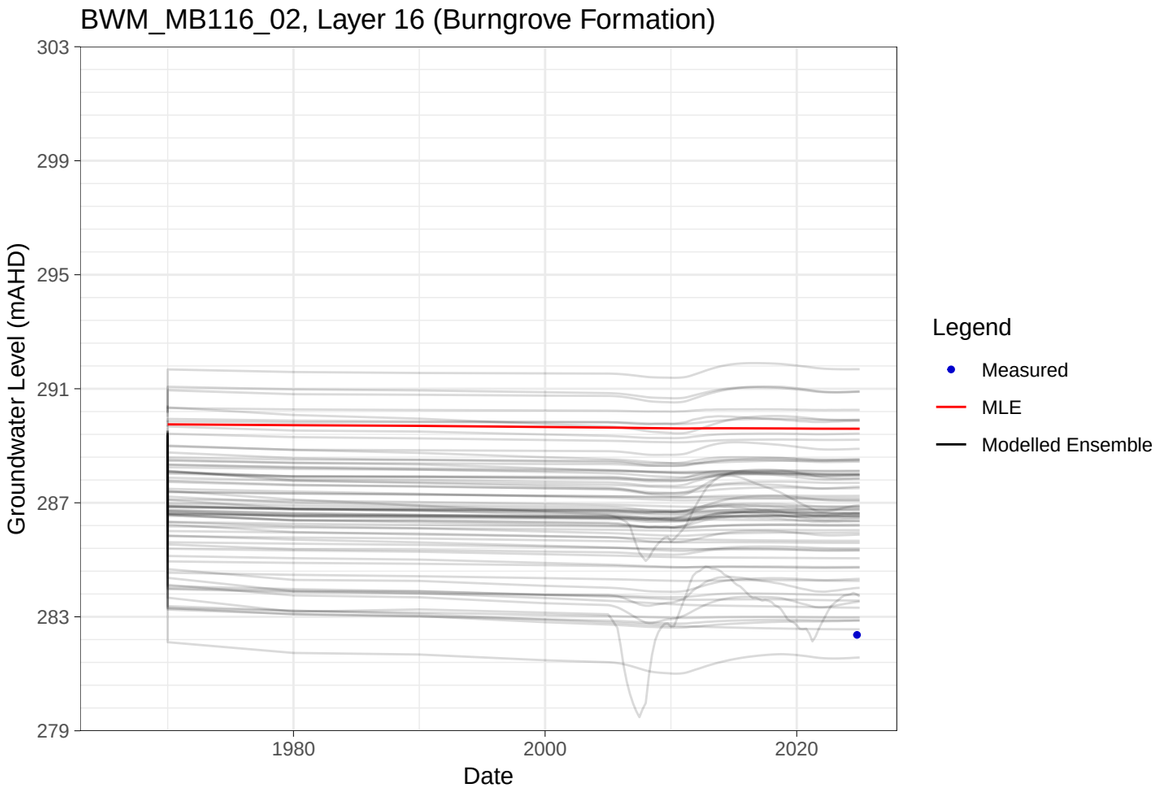

BWM_MB135_02, Layer 14 (RCM − Orion seam)
Groundwater Level (mAHD)
267
263
259
255
251
247
243
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

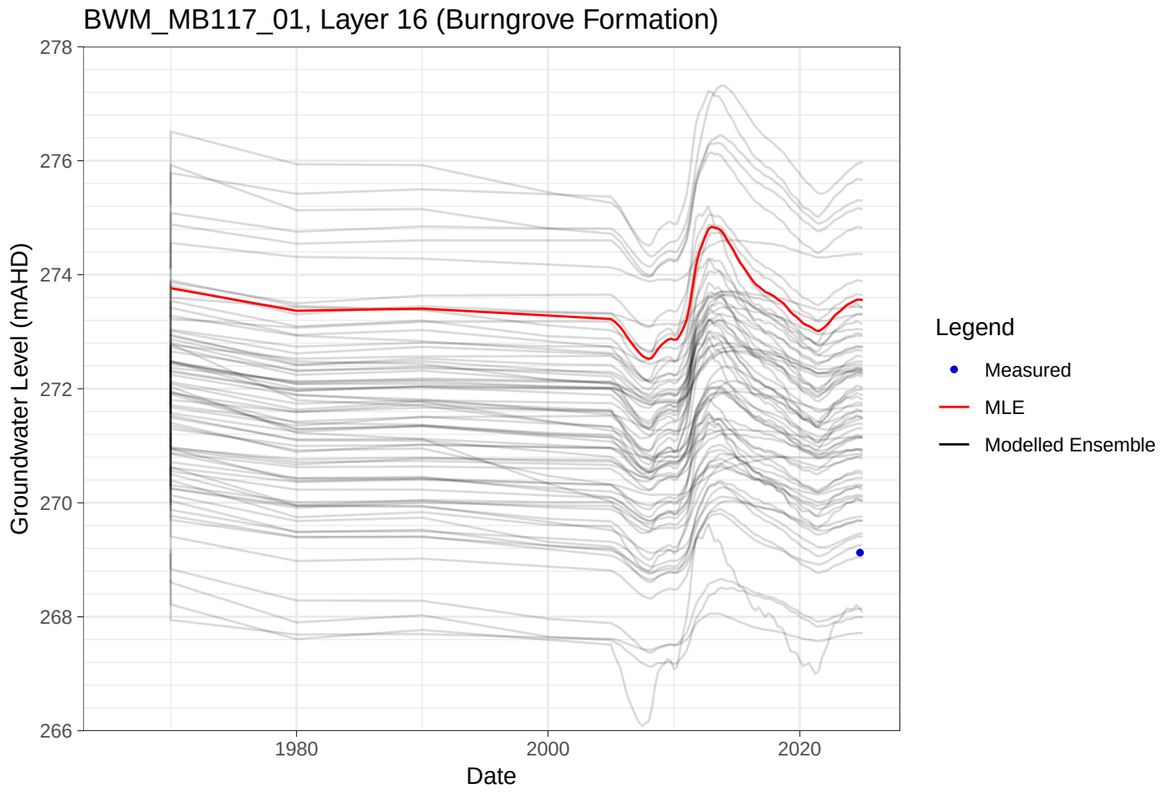

VWP19BWM02−5, Layer 14 (RCM − Orion seam)
Groundwater Level (mAHD)
251
231
211
191
171
151
131
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

,

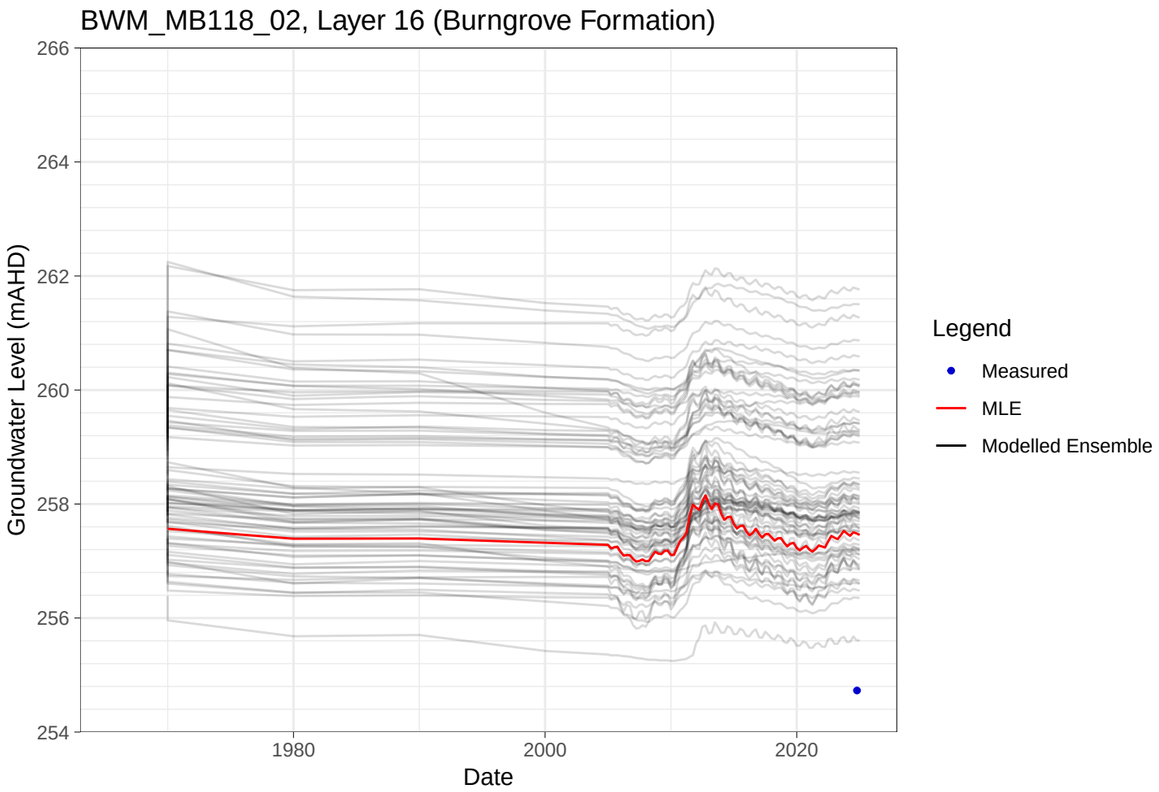

BG No.1 AP, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
190
188
186
184
182
180
178
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

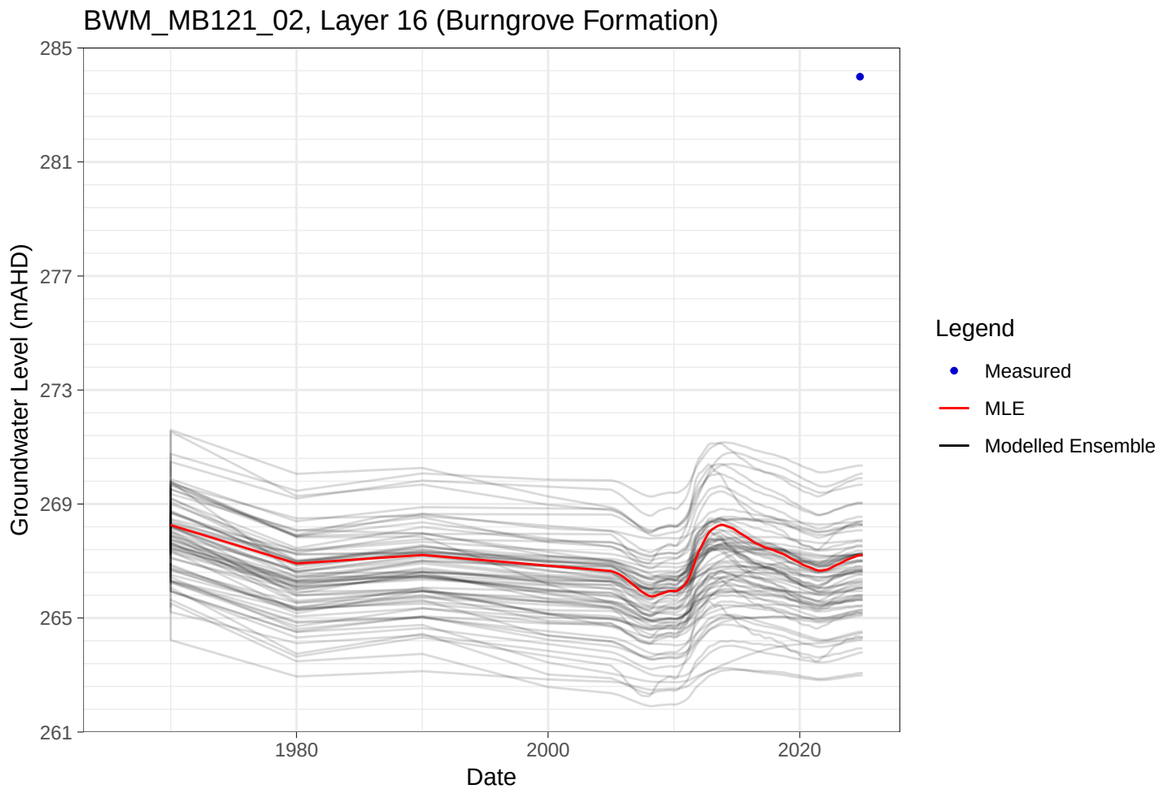

BG No.2 BG, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
207
203
199
195
191
187
183
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

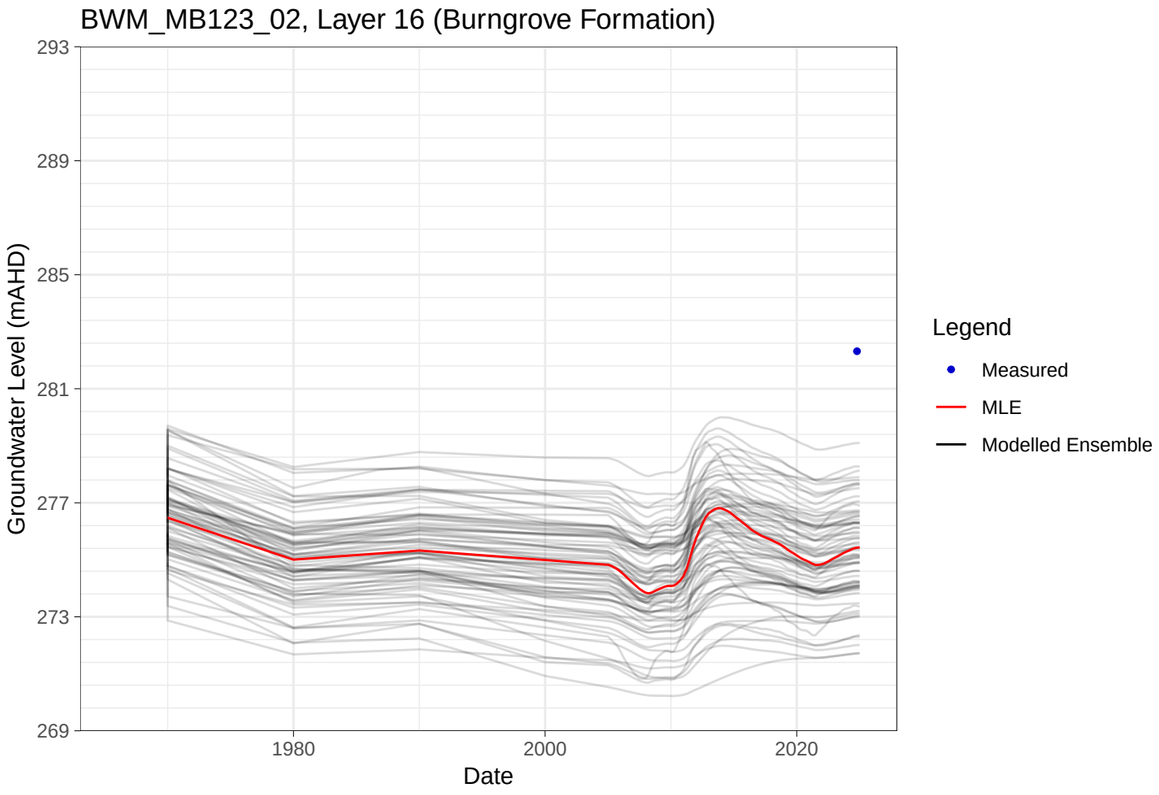

BWM_MB116_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
303
299
295
291
287
283
279
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

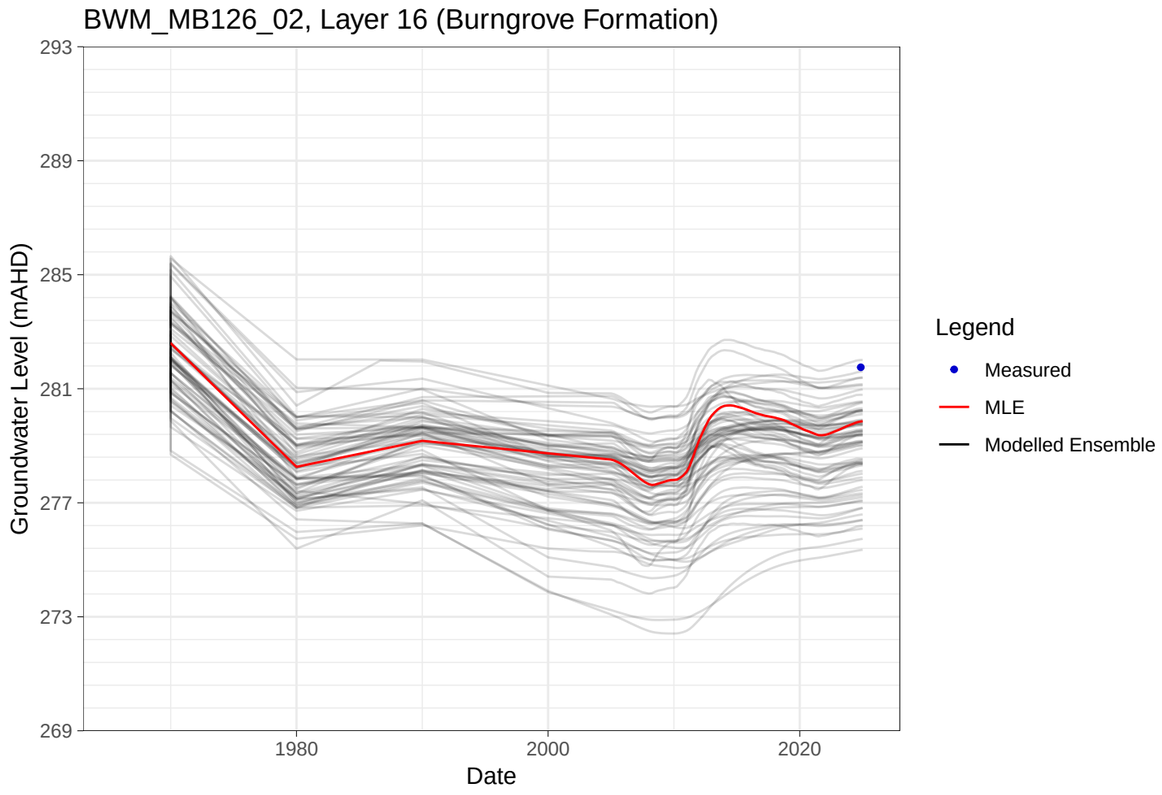

BWM_MB117_01, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
278
276
274
272
270
268
266
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

,

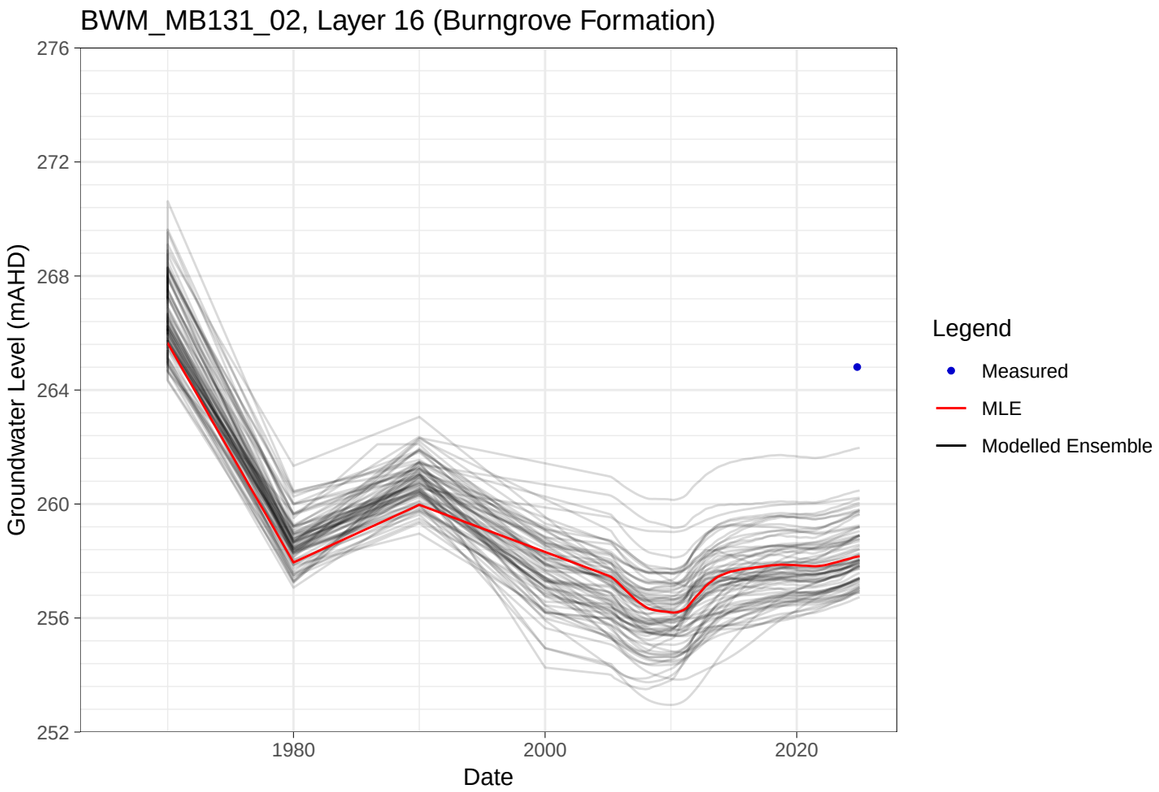

BWM_MB118_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
266
264
262
260
258
256
254
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

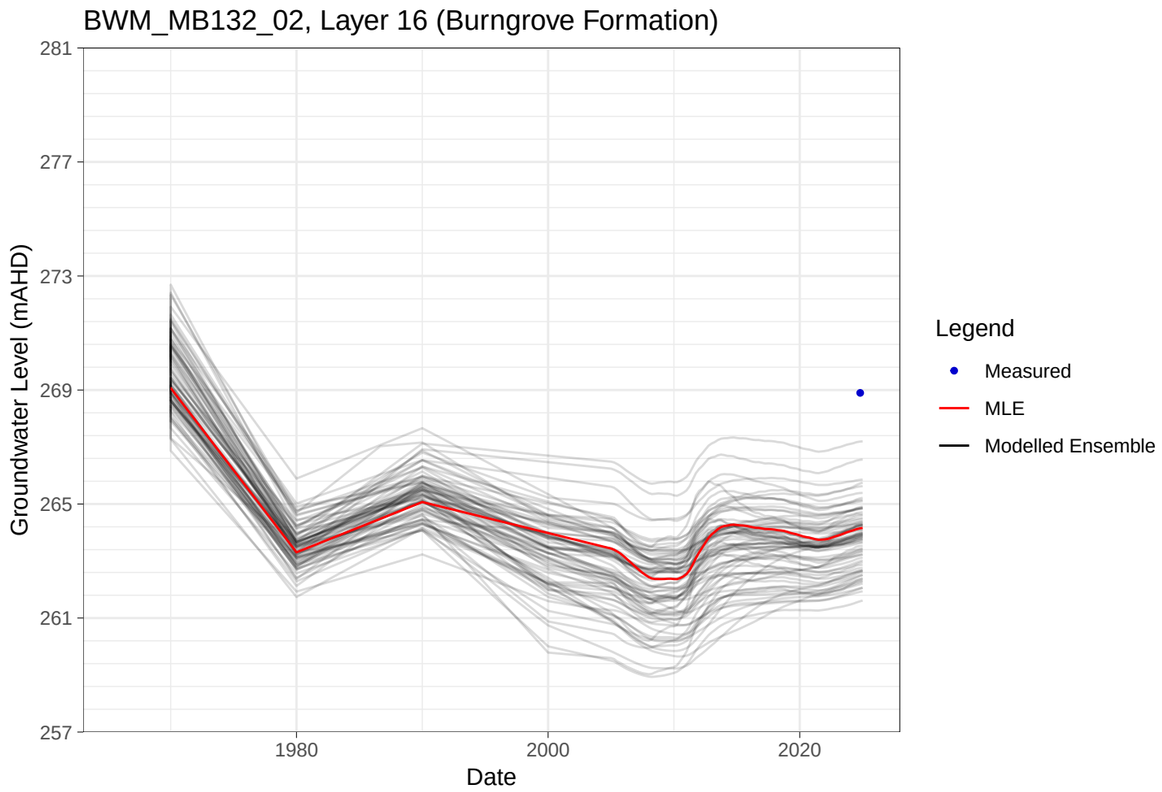

BWM_MB121_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
285
281
277
273
269
265
261
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

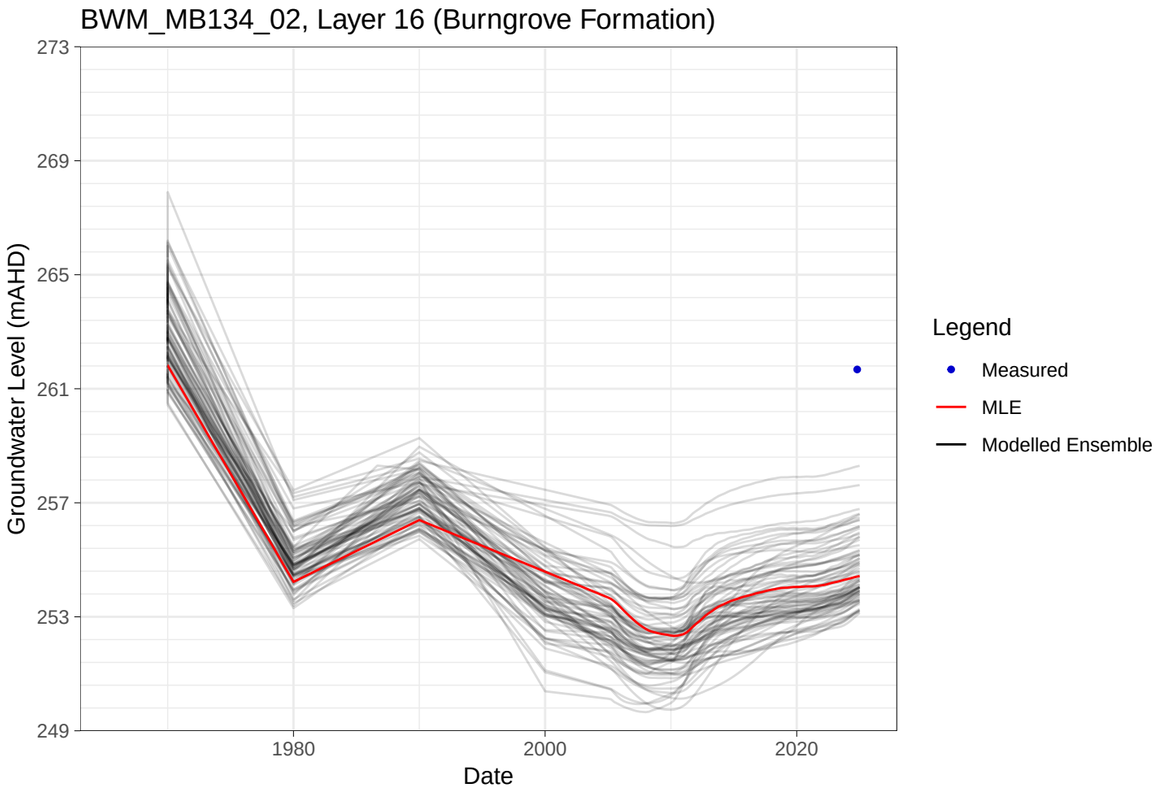

BWM_MB123_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
293
289
285
281
277
273
269
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

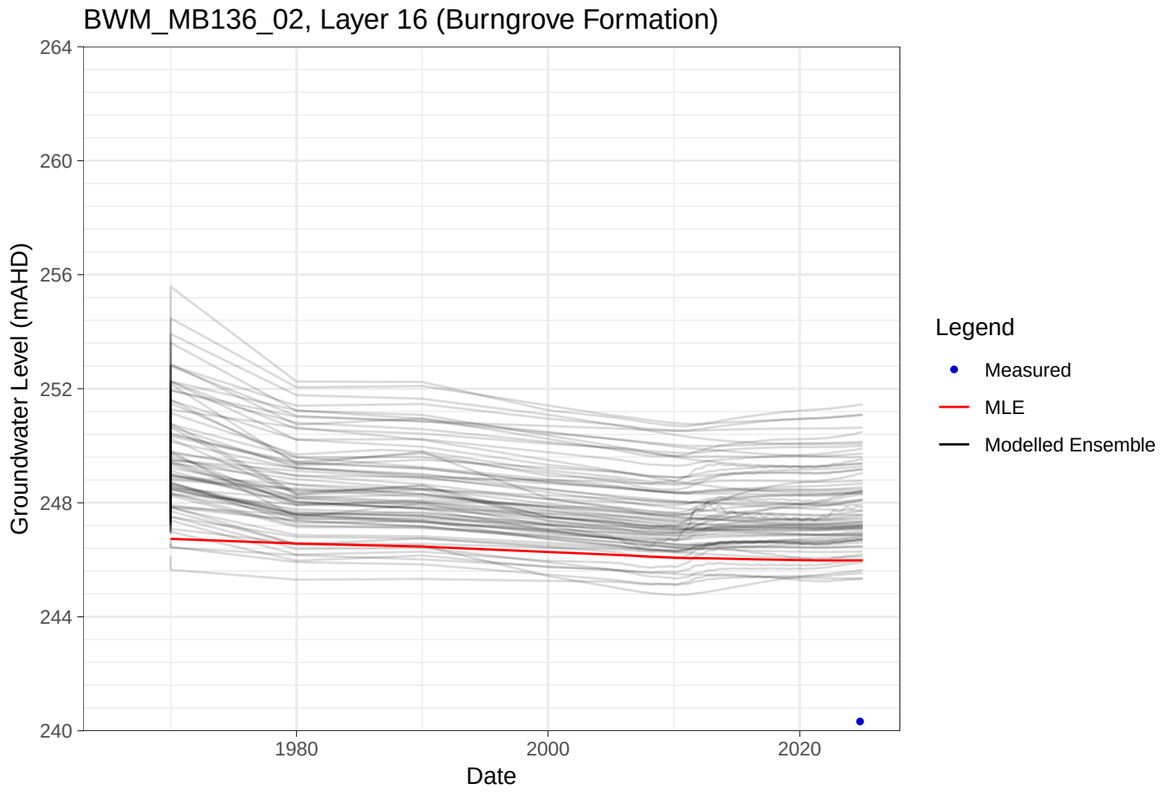

BWM_MB126_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
293
289
285
281
277
273
269
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

,

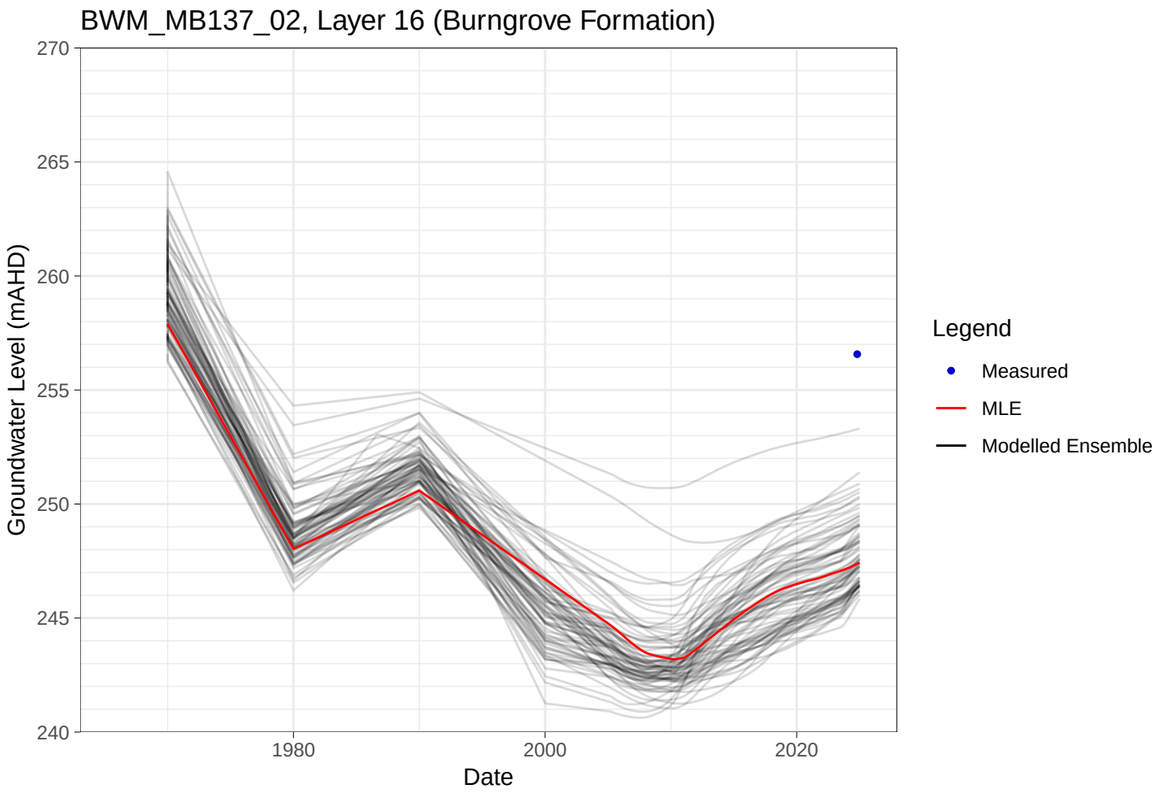

BWM_MB131_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
276
272
268
264
260
256
252
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

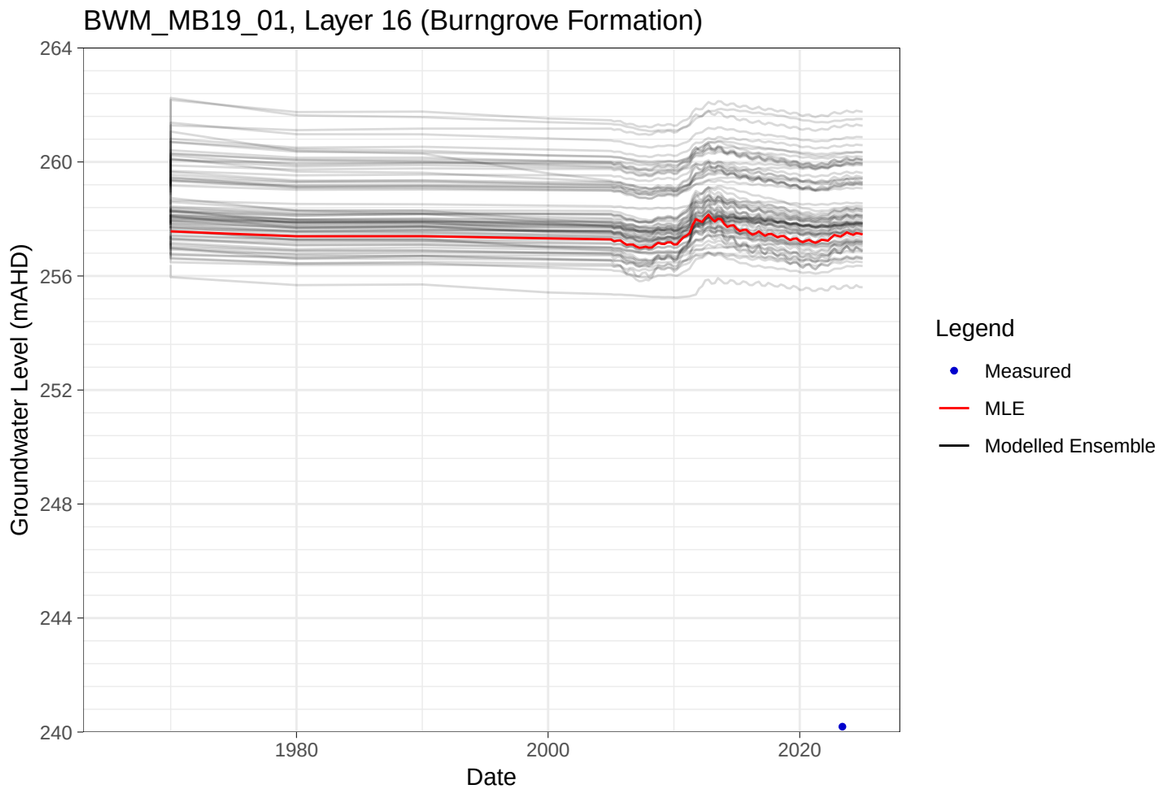

BWM_MB132_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
281
277
273
269
265
261
257
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

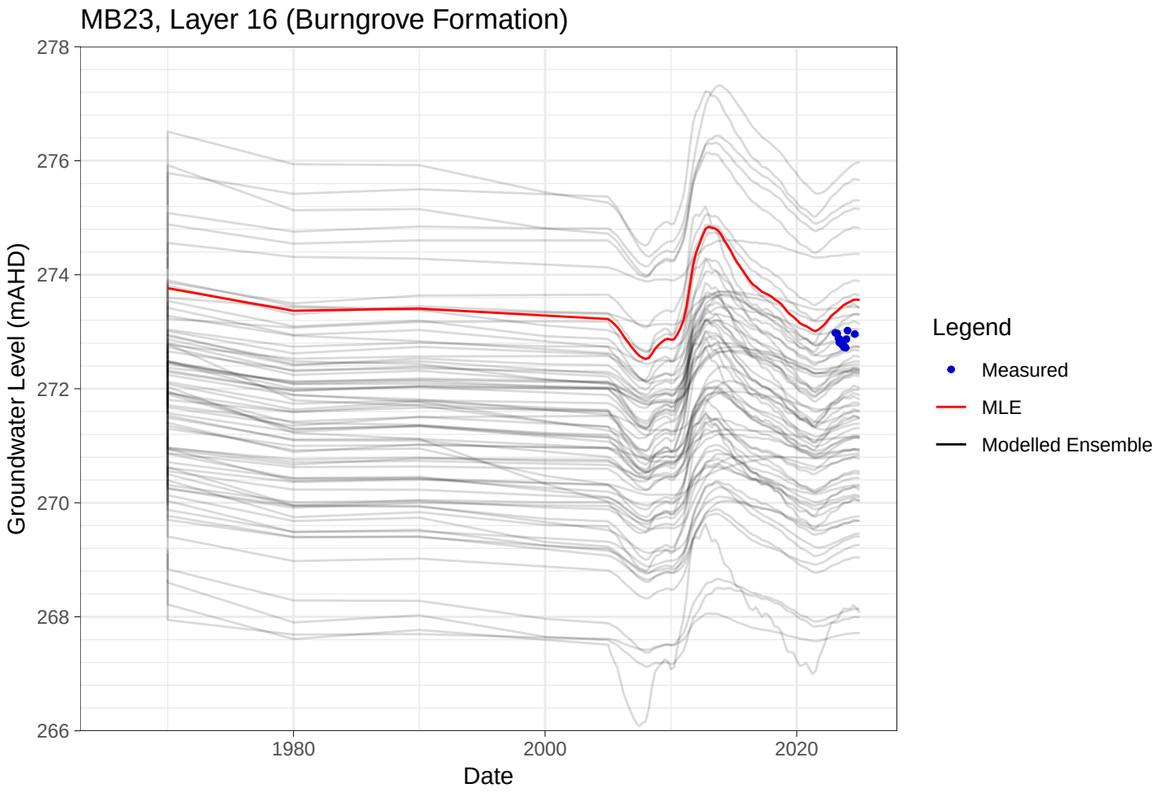

BWM_MB134_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
273
269
265
261
257
253
249
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

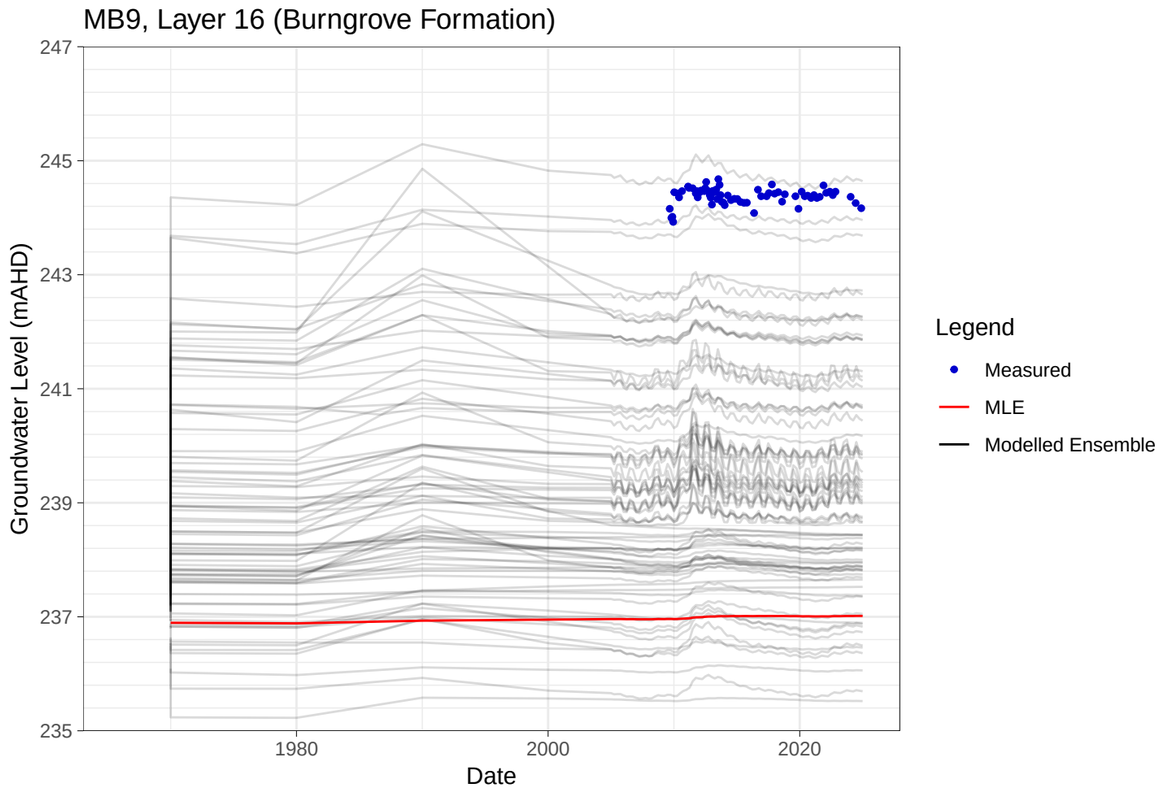

BWM_MB136_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
264
260
256
252
248
244
240
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

,

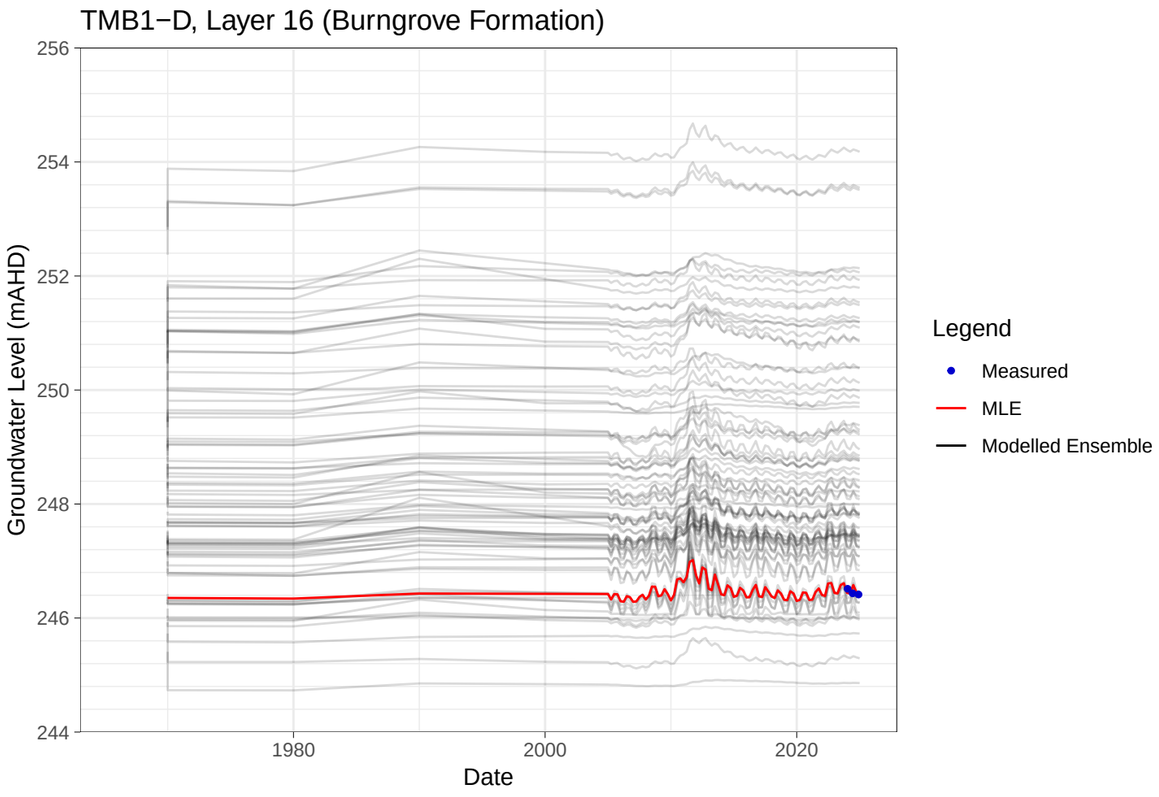

BWM_MB137_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
270
265
260
255
250
245
240
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

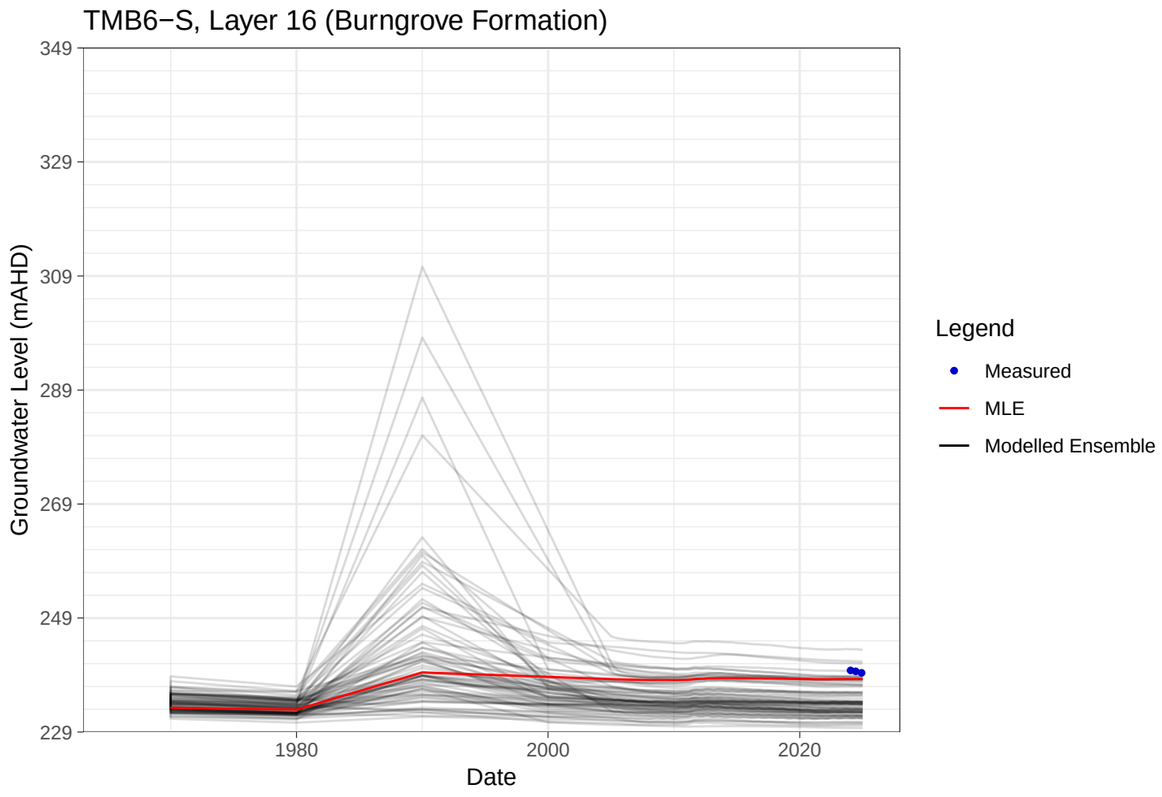

BWM_MB19_01, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
264
260
256
252
248
244
240
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

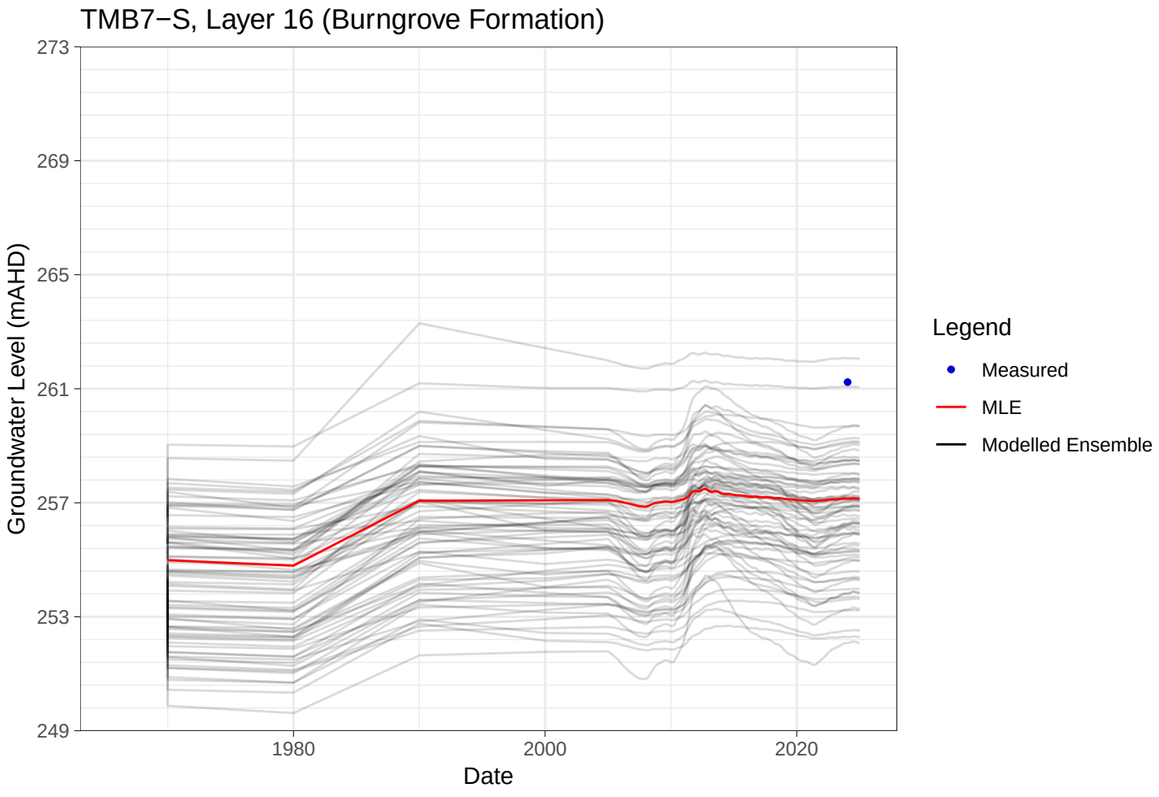

MB23, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
278
276
274
272
270
268
266
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

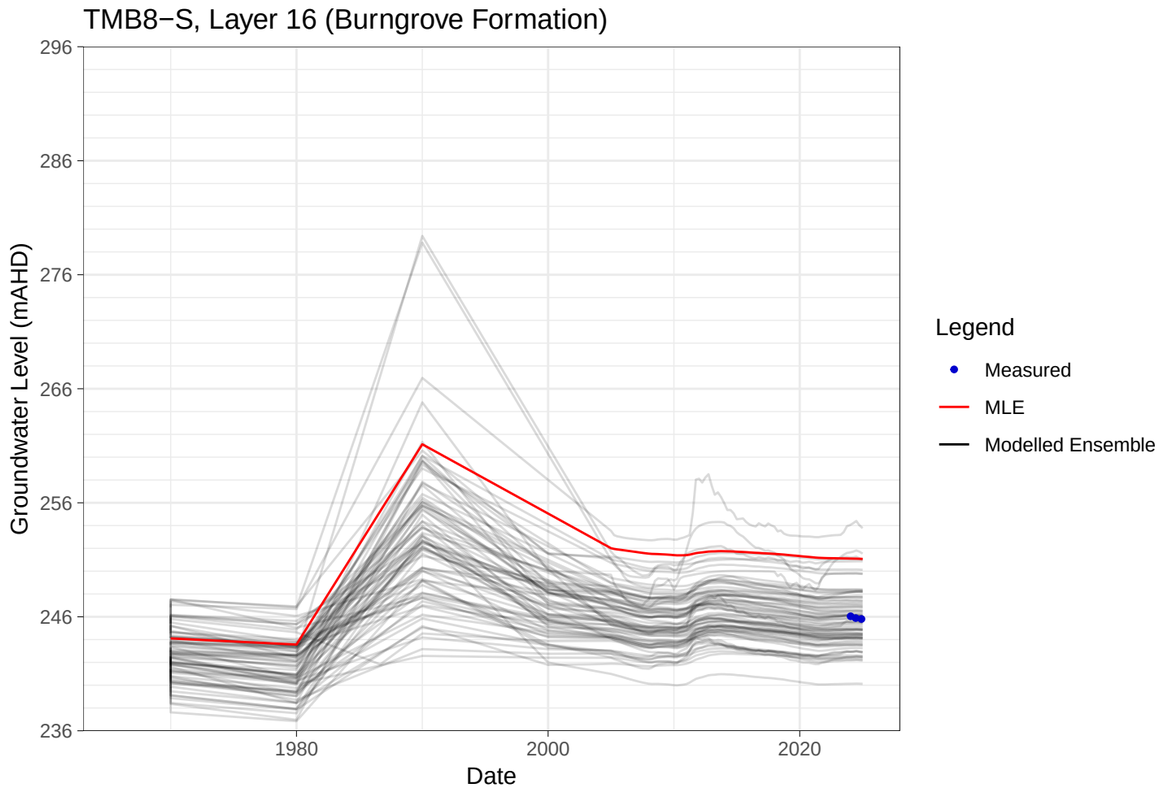

MB9, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
247
245
243
241
239
237
235
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

,


TMB1−D, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
256
254
252
250
248
246
244
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble


TMB6−S, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
349
329
309
289
269
249
229
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble


TMB7−S, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
273
269
265
261
257
253
249
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble


TMB8−S, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
296
286
276
266
256
246
236
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

Appendix C Predictive Period Timing

Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

7 October 2026

Interval	Stress Period	Date (from)	Date (to)	Blackwater North (OC)	Blackwater South (OC)	Cook Colliery (UG)
Annually	86	01-01-2025	31-12-2025	x	x	x
Annually	87	01-01-2026	31-12-2026	x	x	x
Annually	88	01-01-2027	31-12-2027	x	x	x
Annually	89	01-01-2028	31-12-2028	x	x	x
Annually	90	01-01-2029	31-12-2029	x	x	x
Annually	91	01-01-2030	31-12-2030	x	x	x
Annually	92	01-01-2031	31-12-2031	x	x	x
Annually	93	01-01-2032	31-12-2032	x	x	x
Annually	94	01-01-2033	31-12-2033	x	x	x
Annually	95	01-01-2034	31-12-2034	x	x	x
Annually	96	01-01-2035	31-12-2035	x	x	x
Annually	97	01-01-2036	31-12-2036	x	x	x
Annually	98	01-01-2037	31-12-2037	x	x	x
Annually	99	01-01-2038	31-12-2038	x	x	x
Annually	100	01-01-2039	31-12-2039	x	x	x
Annually	101	01-01-2040	31-12-2040	x	x	x
Annually	102	01-01-2041	31-12-2041	x	x	x
Annually	103	01-01-2042	31-12-2042	x	x	x
Annually	104	01-01-2043	31-12-2043	x	x	x
Annually	105	01-01-2044	31-12-2044	x	x	x
Annually	106	01-01-2045	31-12-2045	x	x	x
Annually	107	01-01-2046	31-12-2046	x	x	x
Annually	108	01-01-2047	31-12-2047	x	x	x
Annually	109	01-01-2048	31-12-2048	x	x	x
Annually	110	01-01-2049	31-12-2049	x	x	x
Annually	111	01-01-2050	31-12-2050	x	x	x
Annually	112	01-01-2051	31-12-2051	x	x	x
Annually	113	01-01-2052	31-12-2052	x	x	x
Annually	114	01-01-2053	31-12-2053	x	x	x
Annually	115	01-01-2054	31-12-2054	x	x	x
Annually	116	01-01-2055	31-12-2055	x	x	x
Annually	117	01-01-2056	31-12-2056		x	x
Annually	118	01-01-2057	31-12-2057		x	x
Annually	119	01-01-2058	31-12-2058		x	x
Annually	120	01-01-2059	31-12-2059		x	x
Annually	121	01-01-2060	31-12-2060		x	x



Interval	Stress Period	Date (from)	Date (to)	Blackwater North (OC)	Blackwater South (OC)	Cook Colliery (UG)
Annually	122	01-01-2061	31-12-2061		x	x
Annually	123	01-01-2062	31-12-2062		x	x
Annually	124	01-01-2063	31-12-2063		x	x
Annually	125	01-01-2064	31-12-2064		x	x
Annually	126	01-01-2065	31-12-2065		x	x
Annually	127	01-01-2066	31-12-2066		x	x
Annually	128	01-01-2067	31-12-2067		x	x
Annually	129	01-01-2068	31-12-2068		x	x
Annually	130	01-01-2069	31-12-2069		x	x
Annually	131	01-01-2070	31-12-2070		x	x
Annually	132	01-01-2071	31-12-2071		x	x
Annually	133	01-01-2072	31-12-2072		x	x
Annually	134	01-01-2073	31-12-2073		x	x
Annually	135	01-01-2074	31-12-2074		x	x
Annually	136	01-01-2075	31-12-2075		x	x
Annually	137	01-01-2076	31-12-2076		x	x
Annually	138	01-01-2077	31-12-2077		x	x
Annually	139	01-01-2078	31-12-2078		x	
Annually	140	01-01-2079	31-12-2079		x	
Annually	141	01-01-2080	31-12-2080		x	
Annually	142	01-01-2081	31-12-2081		x	
Annually	143	01-01-2082	31-12-2082		x	
Annually	144	01-01-2083	31-12-2083		x	
Annually	145	01-01-2084	31-12-2084		x	
Annually	146	01-01-2085	31-12-2085		x	
Annually	147	01-01-2086	31-12-2086		x	
Annually	148	01-01-2087	31-12-2087		x	
Annually	149	01-01-2088	31-12-2088		x	
Annually	150	01-01-2089	31-12-2089		x	
Annually	151	01-01-2090	31-12-2090		x	
Annually	152	01-01-2091	31-12-2091		x	
Annually	153	01-01-2092	31-12-2092		x	
Annually	154	01-01-2093	31-12-2093		x	

Appendix D Post-mining predicted water levels

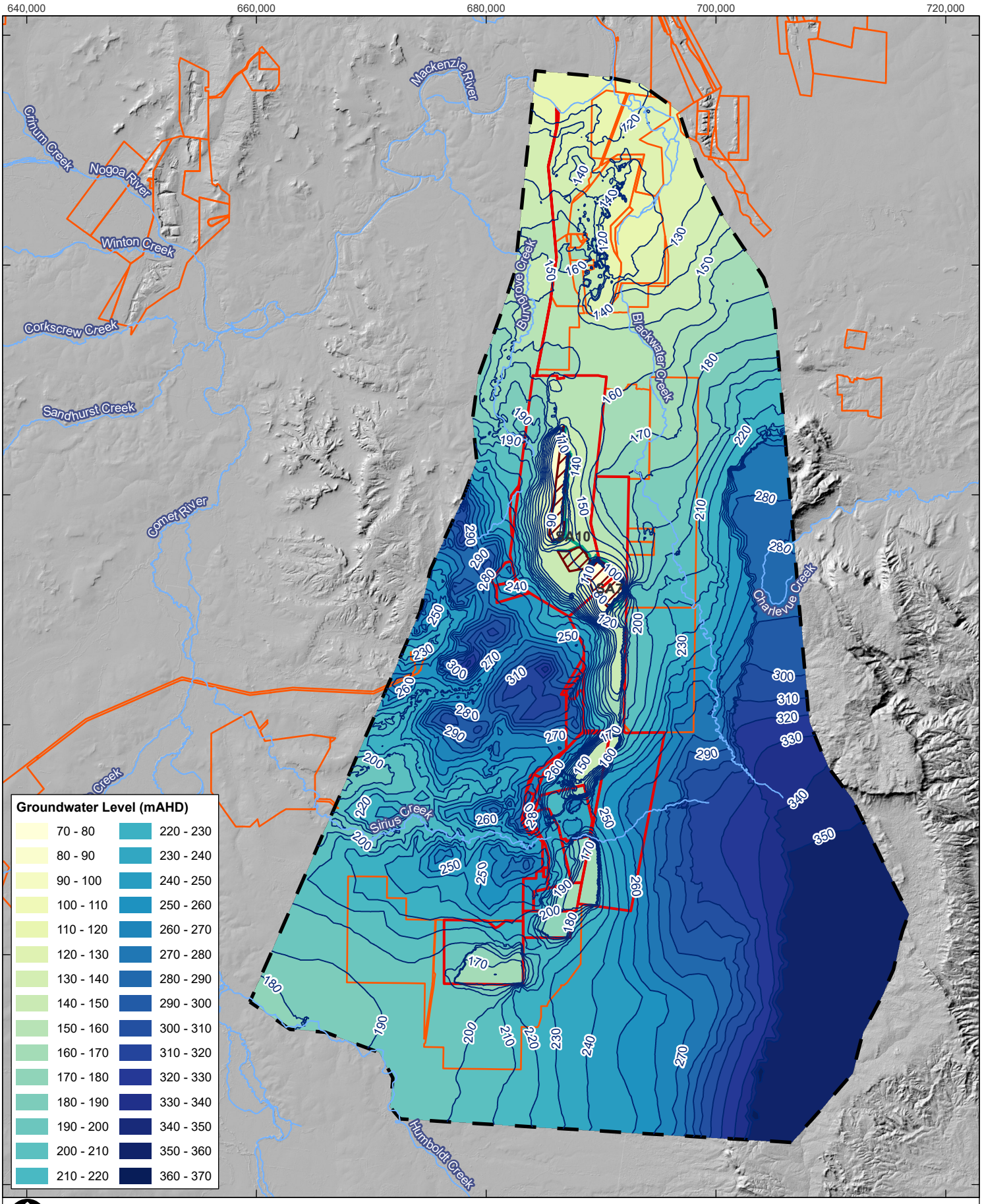
Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

7 October 2026



BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

GROUNDWATER TABLE RECOVERY (POST-MINING)

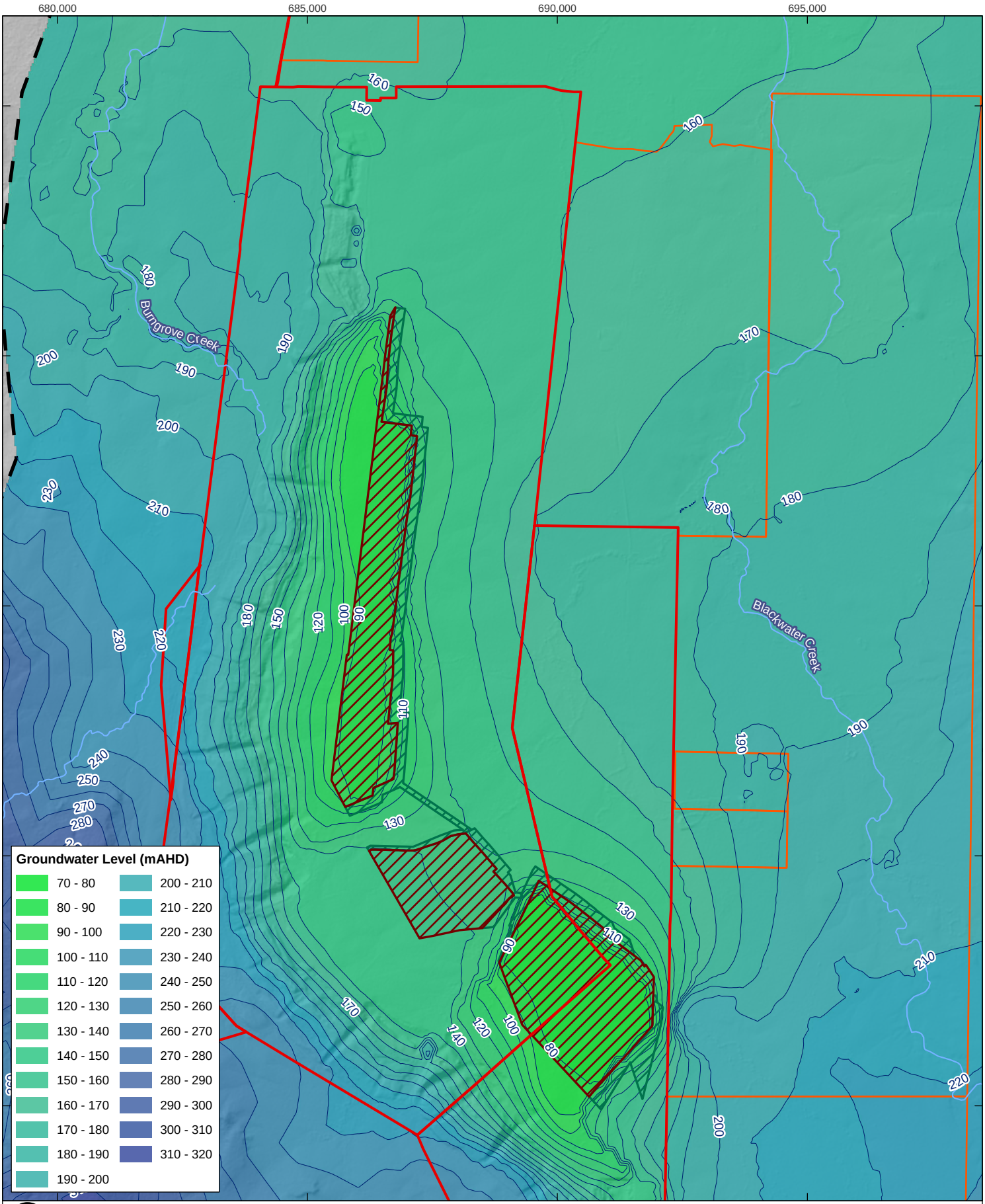
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:433,846 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

SLR

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FIGURE D-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_08_Groundwater Table Recovery (post-mining)



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	20-Aug-2026
Drawn by:	RB

LEGEND

- Groundwater Level Contour (m)
- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

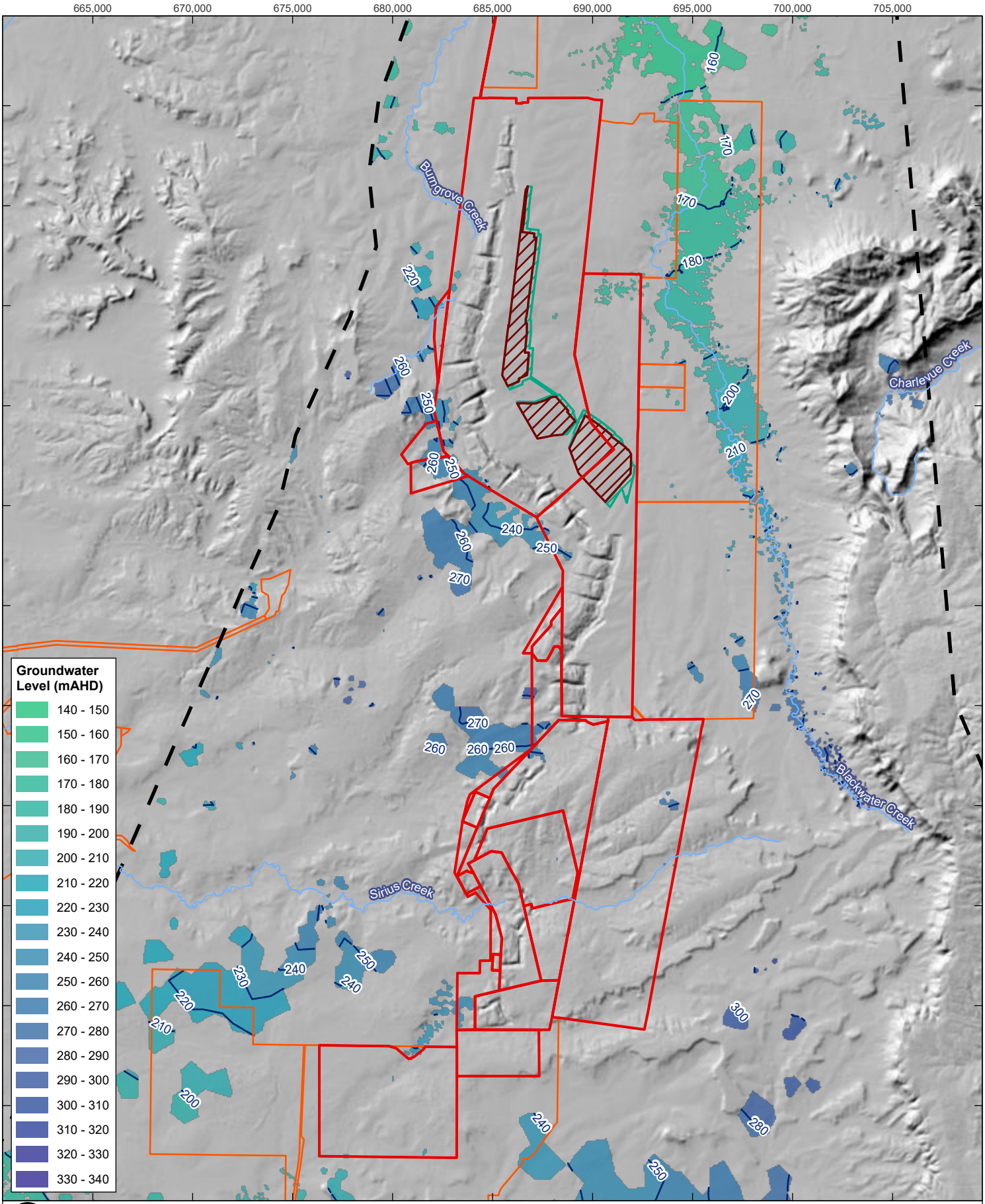
GROUNDWATER TABLE RECOVERY (POST-MINING) - NORTHERN VOIDS

SLR

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FIGURE D-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Groundwater Table Recovery (post-mining)



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	20-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

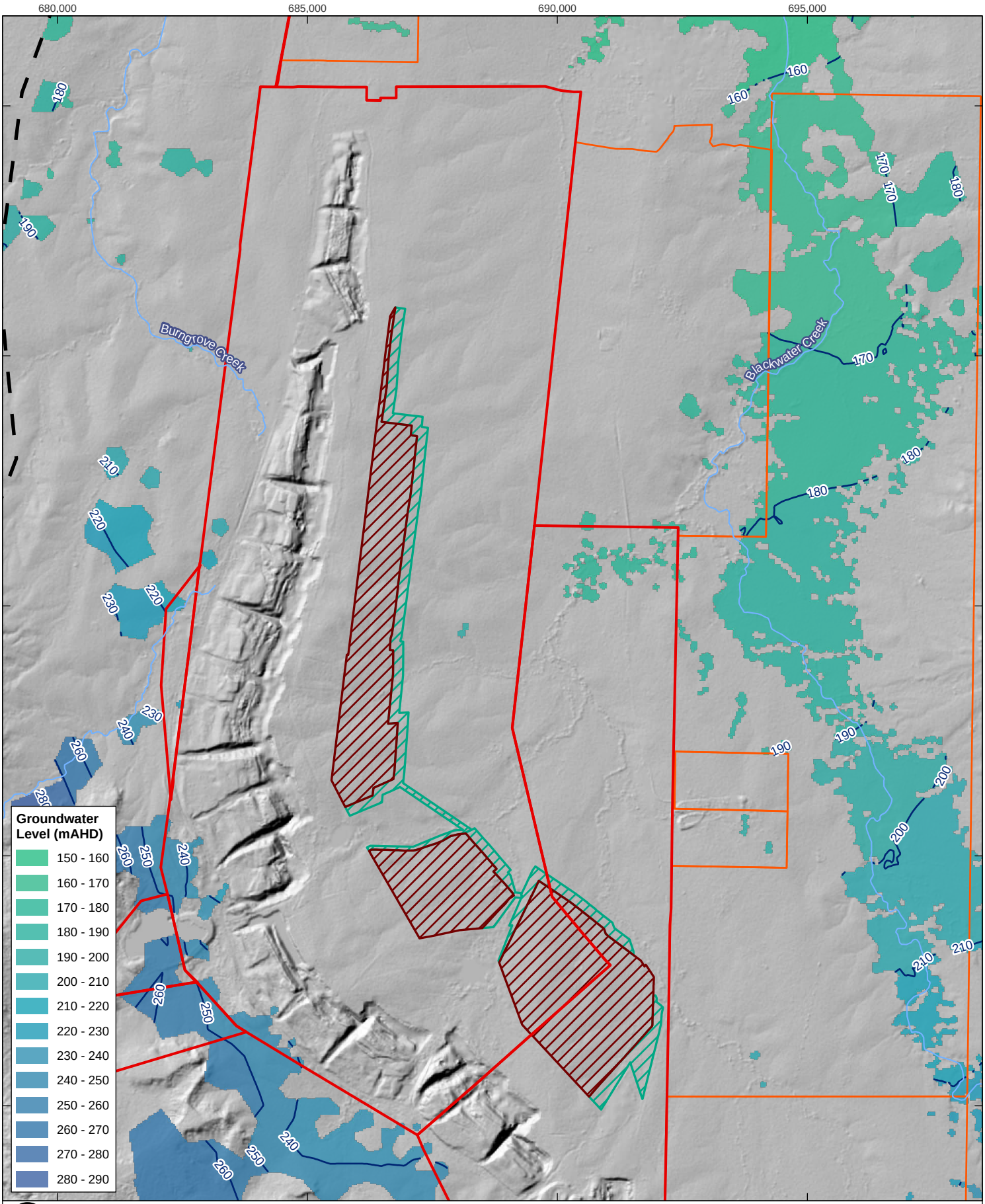
PREDICTED WATER LEVEL
WITHIN TERTIARY SEDIMENTS (LAYER 1)
AT POST-MINING EQUILIBRATED

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	19-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

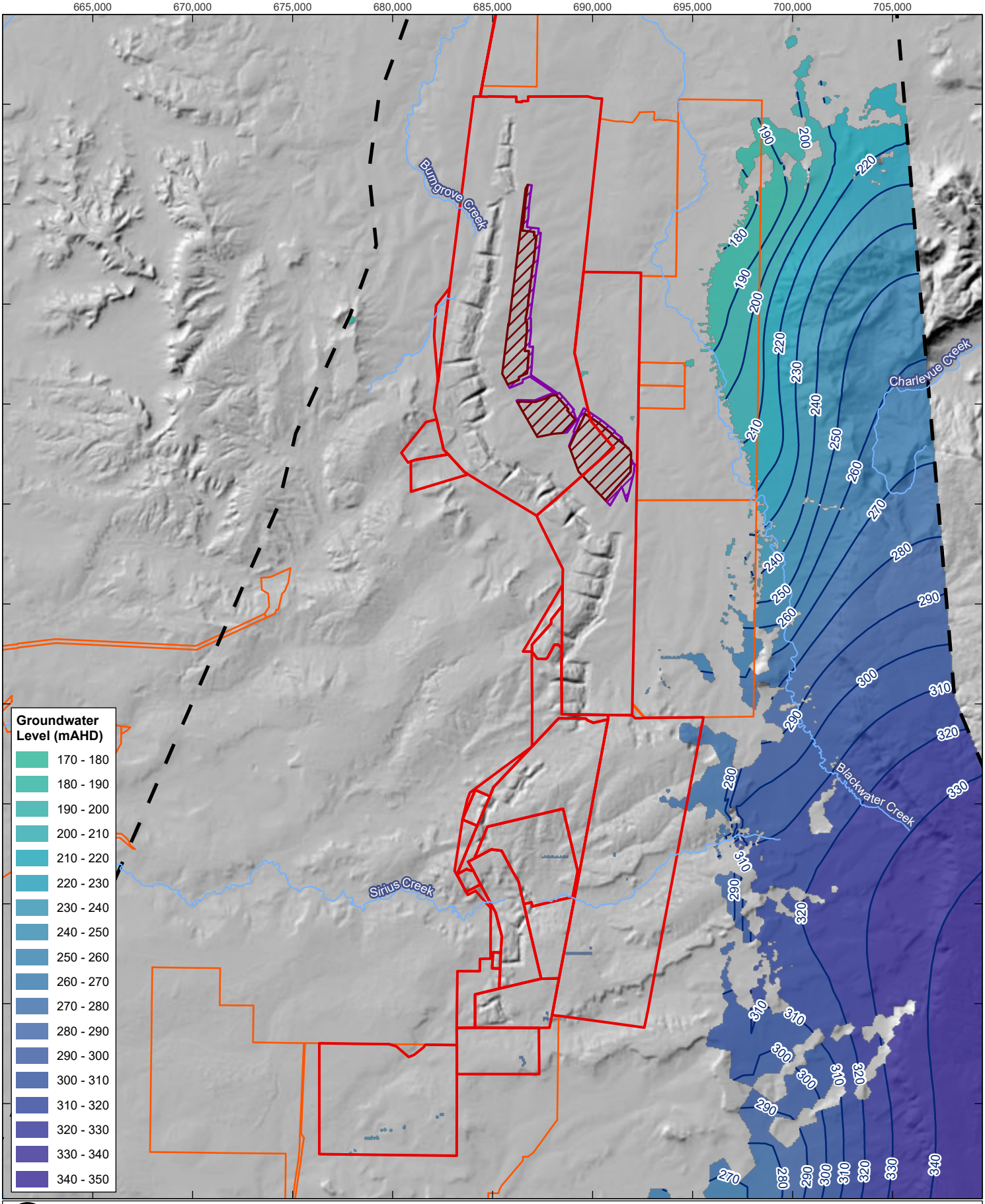
PREDICTED WATER LEVEL WITHIN TERTIARY SEDIMENTS (LAYER 1) AT POST-MINING EQUILIBRATED - NORTHERN VOIDS

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-4

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Predicted Water Level within Tertiary Sediments (Layer 1) at PME



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	20-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

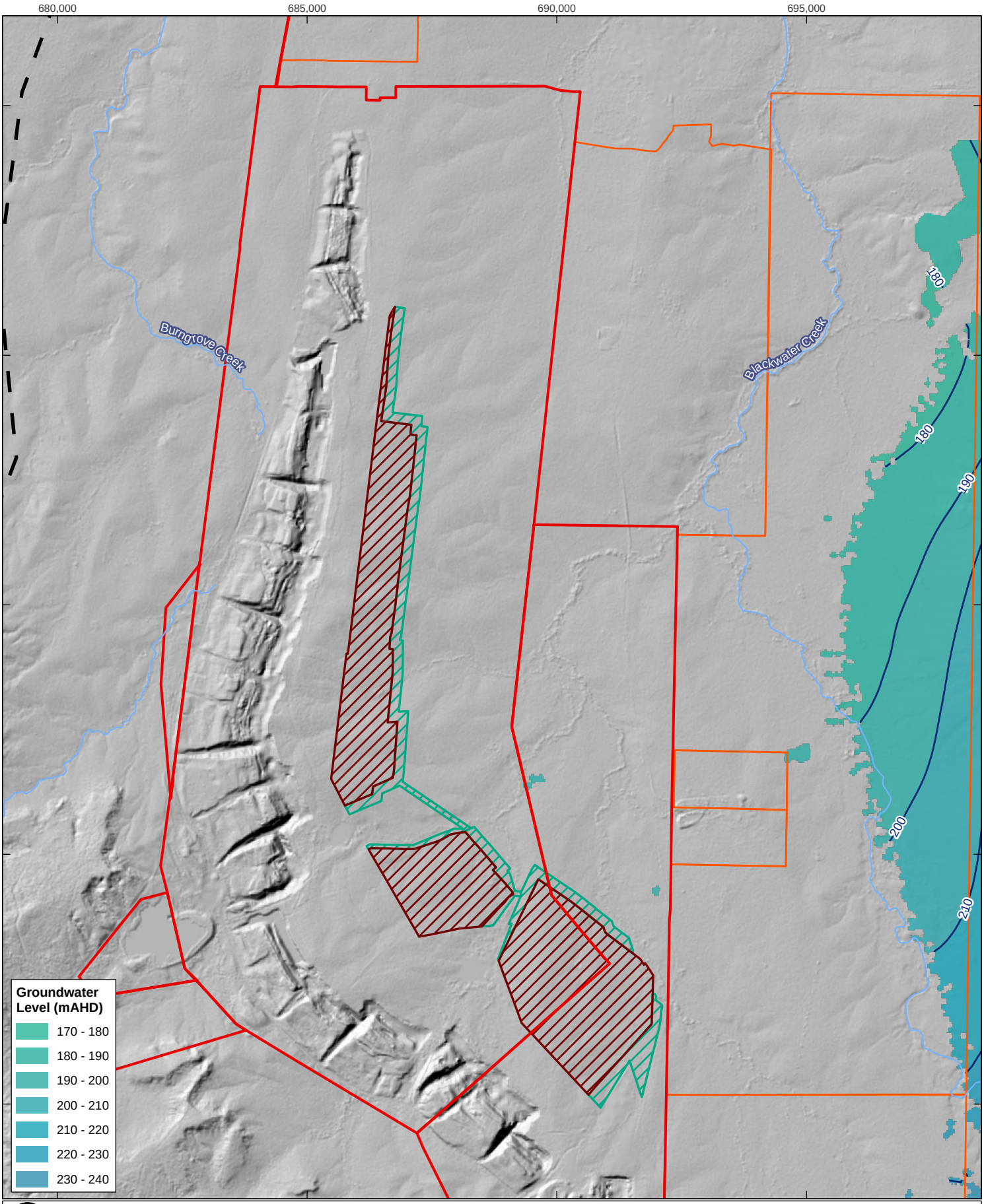
PREDICTED WATER LEVEL
WITHIN REWAN FORMATION - UPPER (LAYER 4)
AT POST-MINING EQUILIBRATED

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	19-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

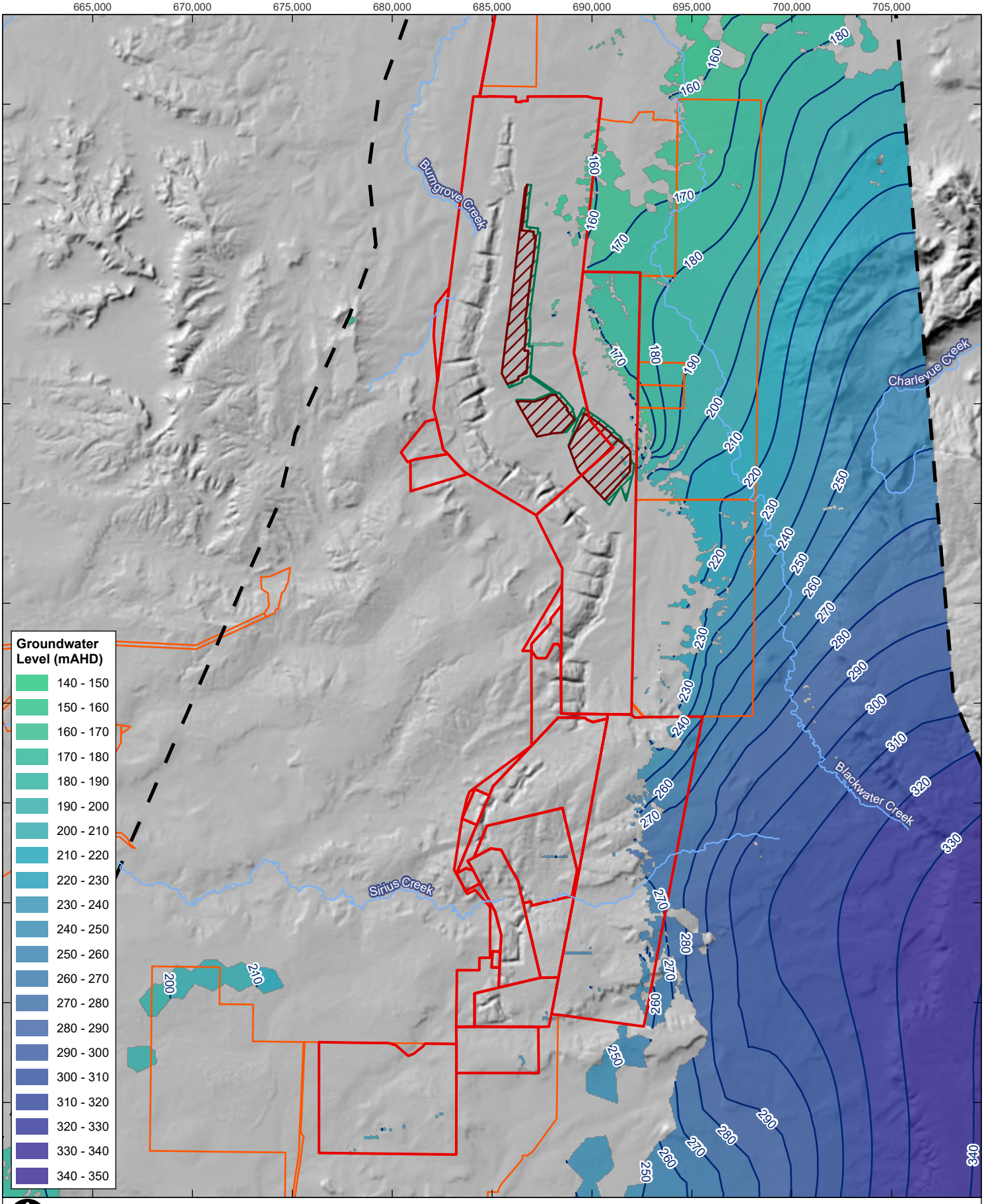
PREDICTED WATER LEVEL WITHIN REWAN FORMATION - UPPER (LAYER 4) AT POST-MINING EQUILIBRATED - NORTHERN VOIDS

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Predicted Water Level within Rewan Formation - Upper (Layer 4) at PME



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	20-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

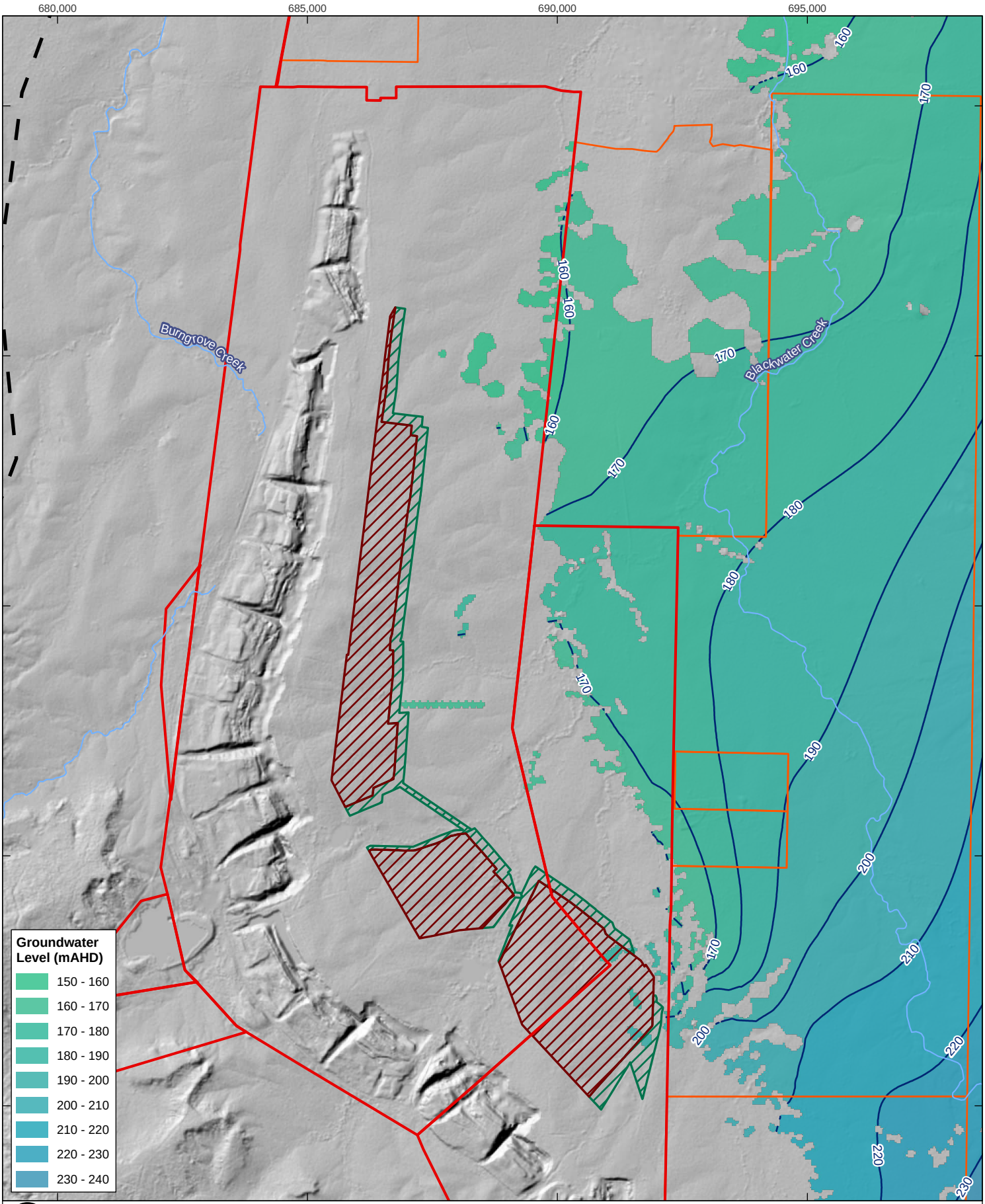
PREDICTED WATER LEVEL
WITHIN REWAN FORMATION - MIDDLE (LAYER 5)
AT POST-MINING EQUILIBRATED

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	19-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

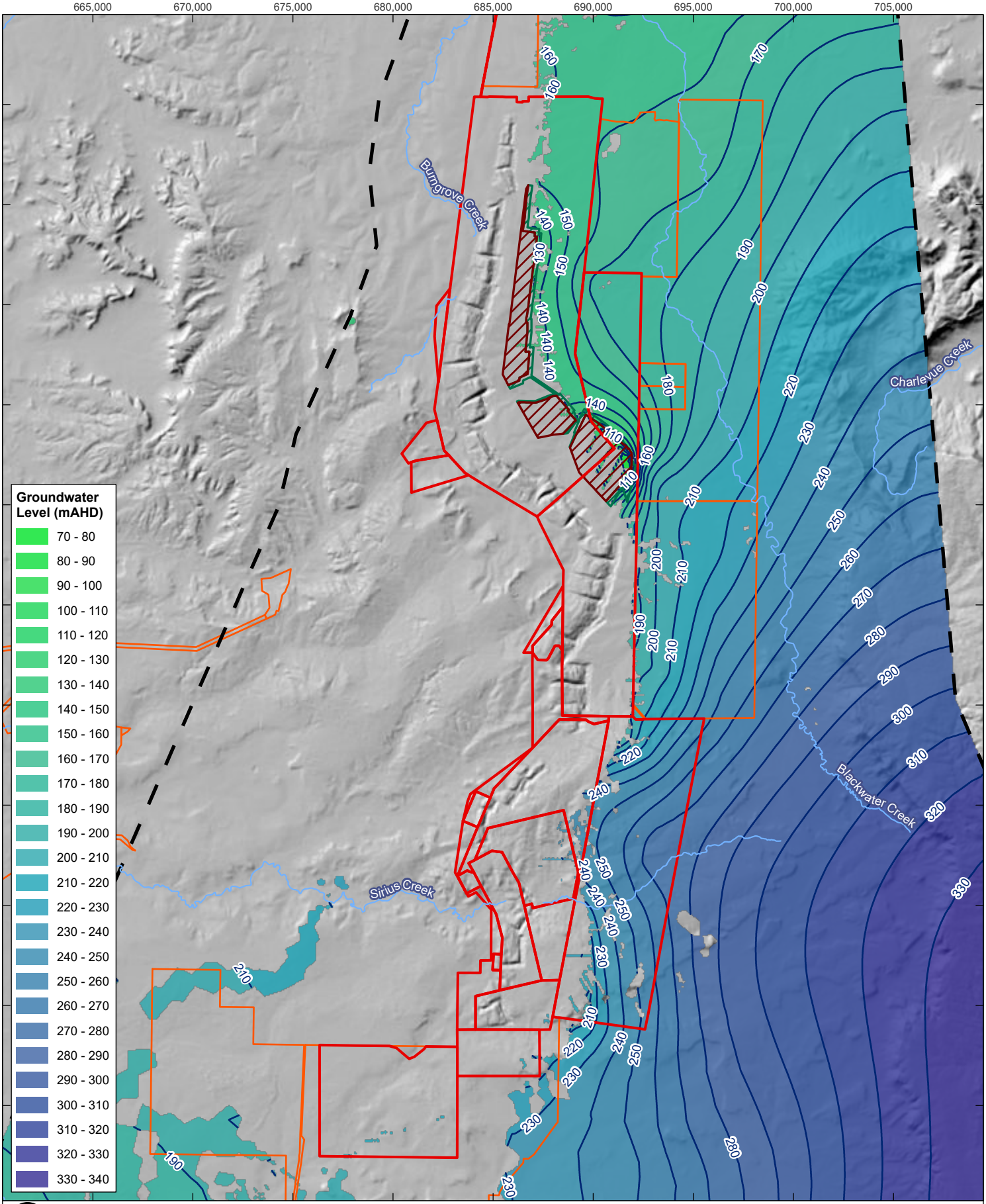
PREDICTED WATER LEVEL WITHIN REWAN FORMATION - MIDDLE (LAYER 5) AT POST-MINING EQUILIBRATED - NORTHERN VOIDS

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Predicted Water Level within Rewan Formation - Middle (Layer 5) at PME



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	20-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

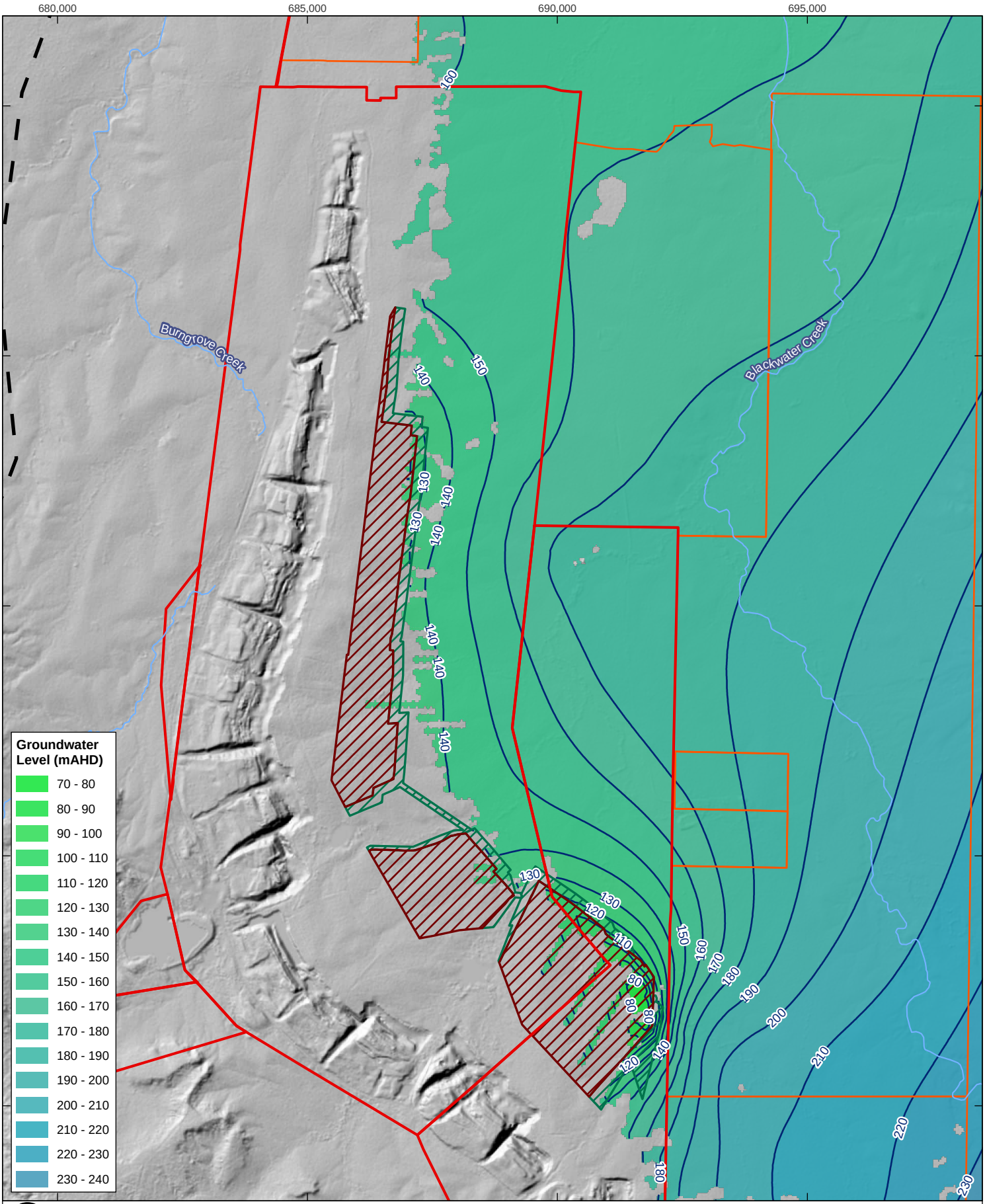
PREDICTED WATER LEVEL
WITHIN REWAN FORMATION - LOWER (LAYER 6)
AT POST-MINING EQUILIBRATED

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	19-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

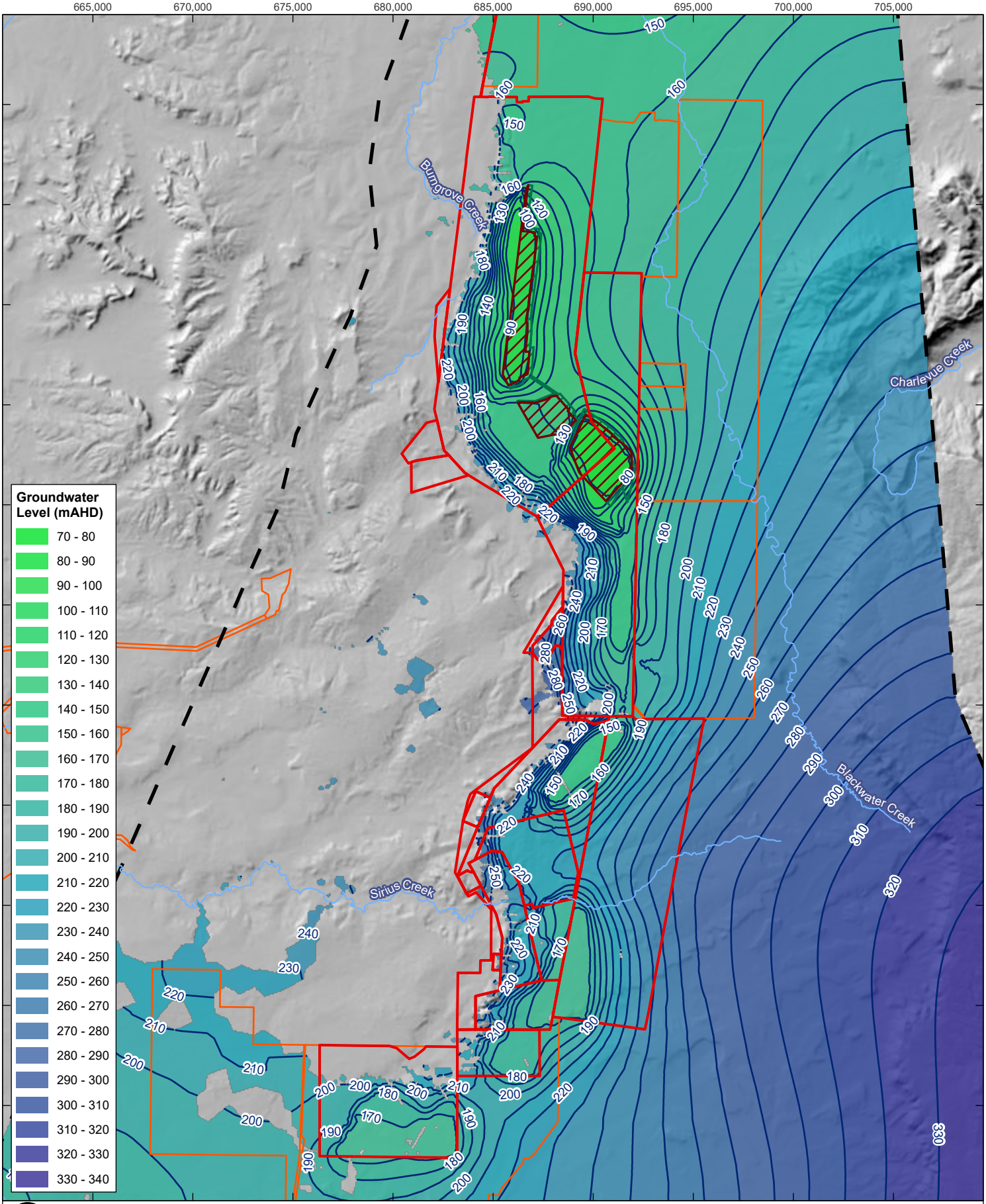
PREDICTED WATER LEVEL WITHIN REWAN FORMATION - LOWER (LAYER 6) AT POST-MINING EQUILIBRATED - NORTHERN VOIDS

SLR

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FIGURE D-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Predicted Water Level within Rewan Formation - Lower (Layer 6) at PME



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	20-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

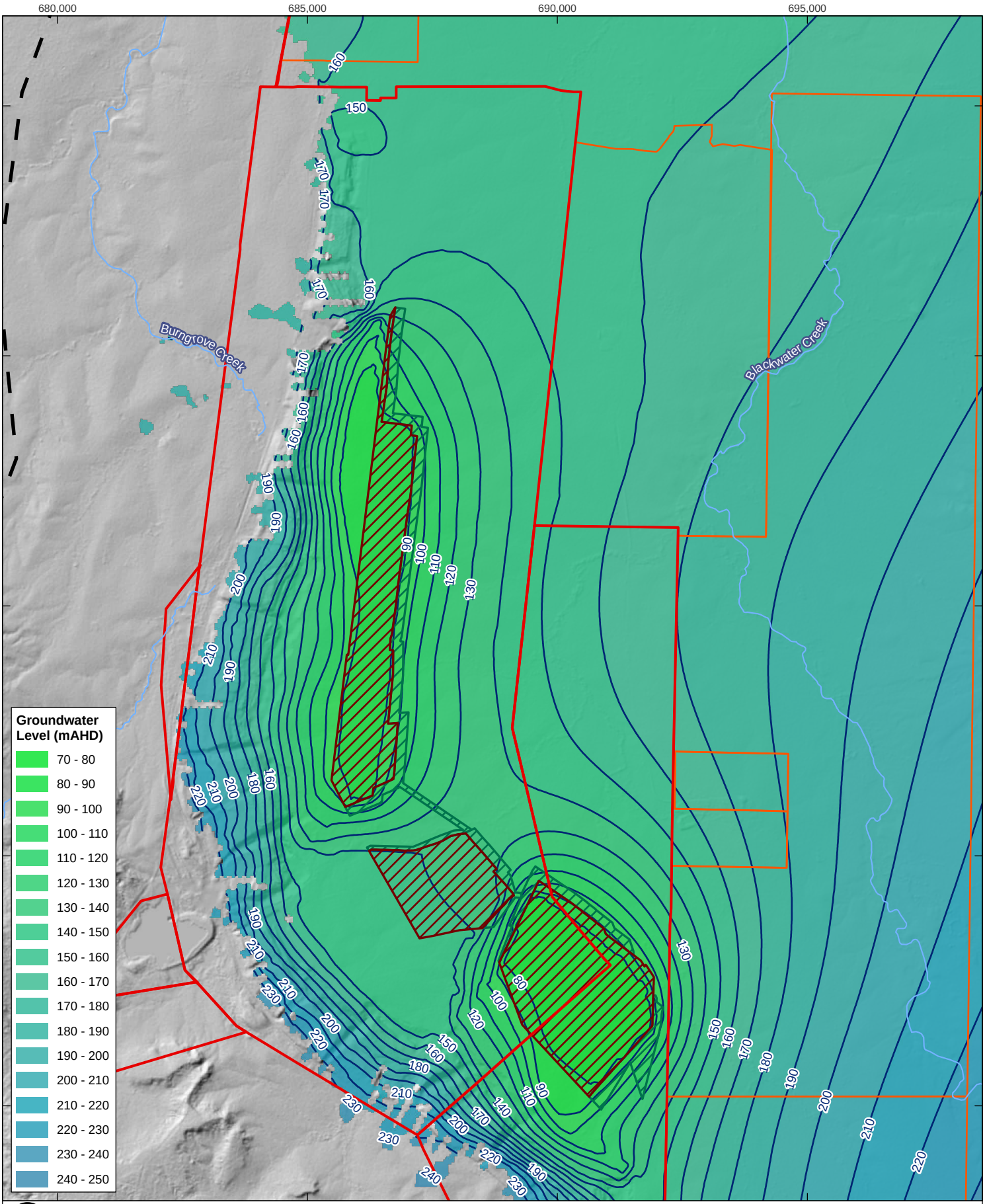
PREDICTED WATER LEVEL WITHIN RCM REPRESENTATIVE COAL SEAM (POLLUX) (LAYER 12) AT POST-MINING EQUILIBRATED

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-11

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	19-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

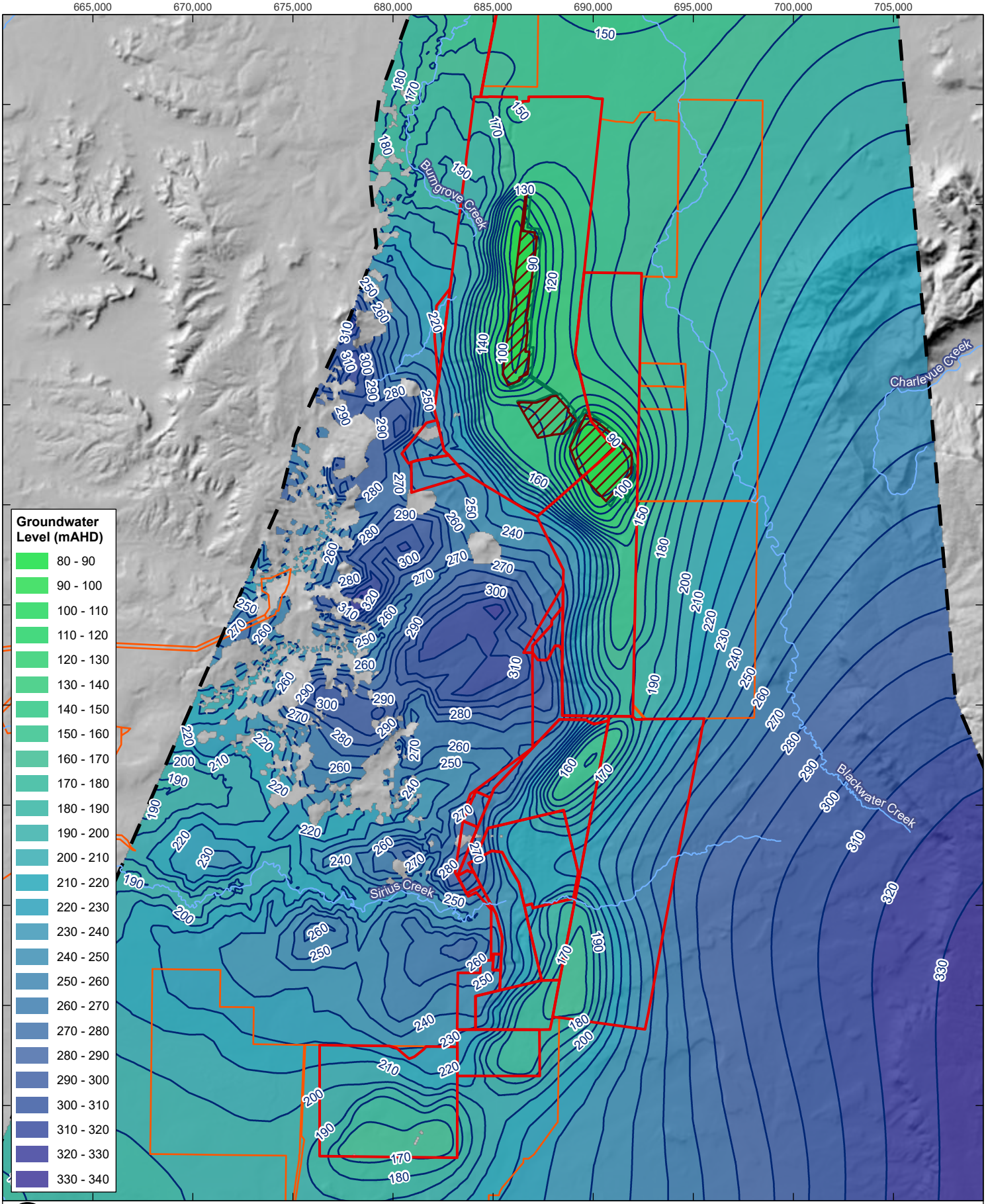
PREDICTED WATER LEVEL WITHIN RCM REPRESENTATIVE COAL SEAM (POLLUX) (LAYER 12) AT POST-MINING EQUILIBRATED - NORTHERN VOIDS

SLR

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FIGURE D-12

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Predicted Water Level within RCM Pollux (Layer 12) at PME



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	20-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

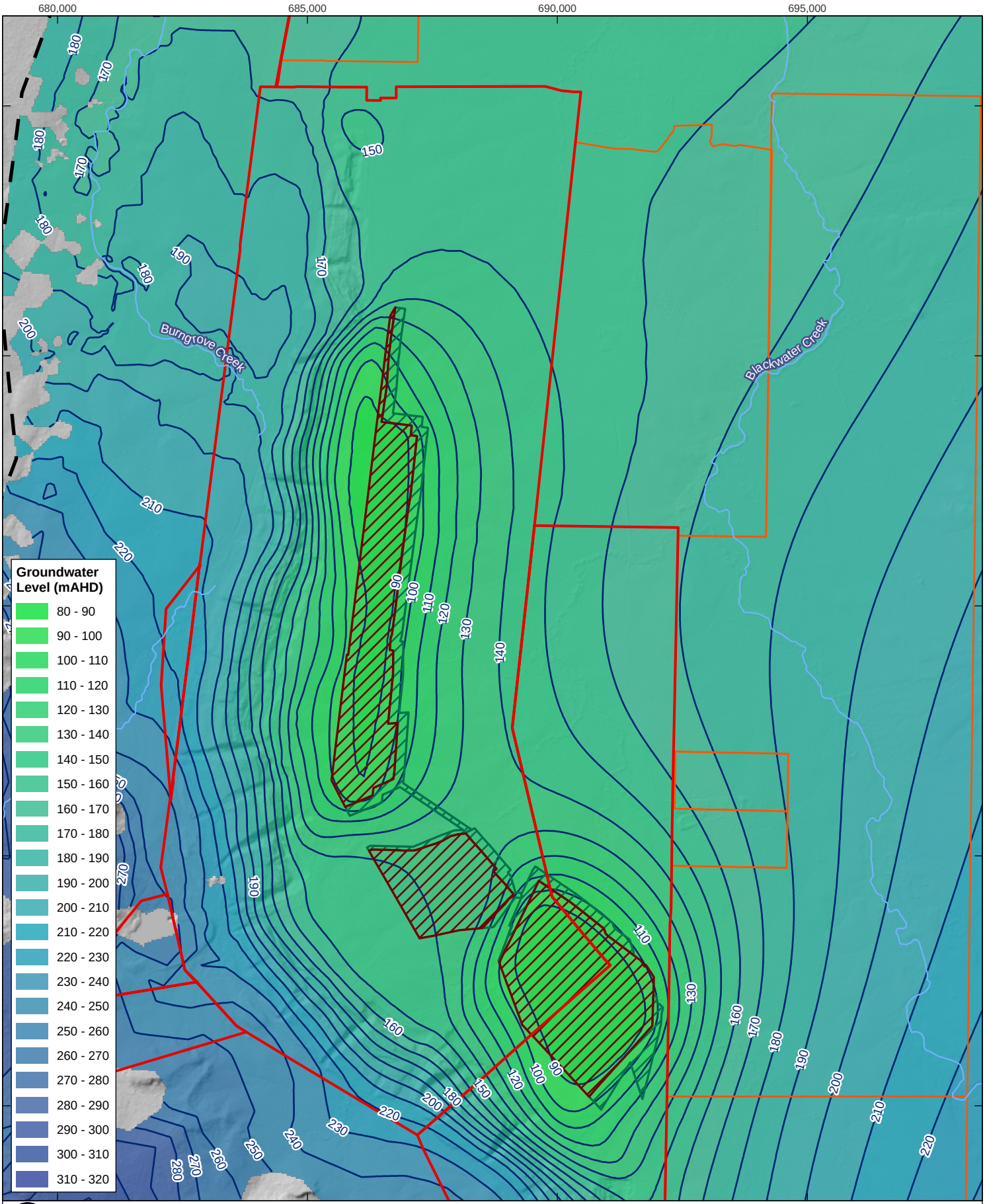
PREDICTED WATER LEVEL WITHIN BURNGROVE FORMATION (LAYER 16) AT POST-MINING EQUILIBRATED

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-13

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	19-Aug-2026
Drawn by:	AS

LEGEND

- Watercourse
- Groundwater Contour (mAHD)
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER LEVEL WITHIN BURNGROVE FORMATION (LAYER 16) AT POST-MINING EQUILIBRATED - NORTHERN VOIDS

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE D-14

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_FXX_Predicted Water Level within Burngrove Formation (Layer 16) at PME

Appendix E Parameter Distribution Plots for Sampled Prior and Calibrated Ensemble

Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

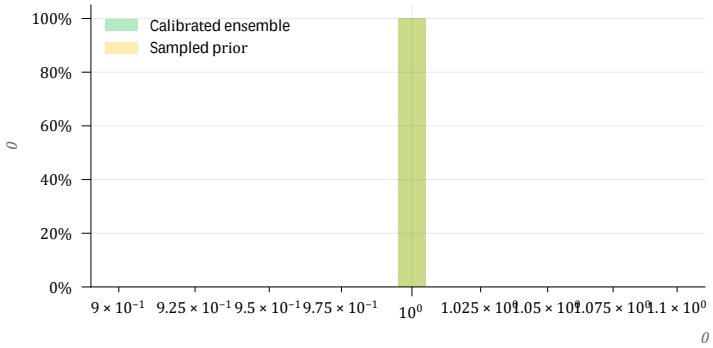
7 October 2026


evtf_z01
evtf_z02
evtf_z03
evtf_z04
exdp_z01
exdp_z02
exdp_z03
exdp_z04
kx_z01
kx_z02
Calibrated ensemble
Sampled prior
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Parameters

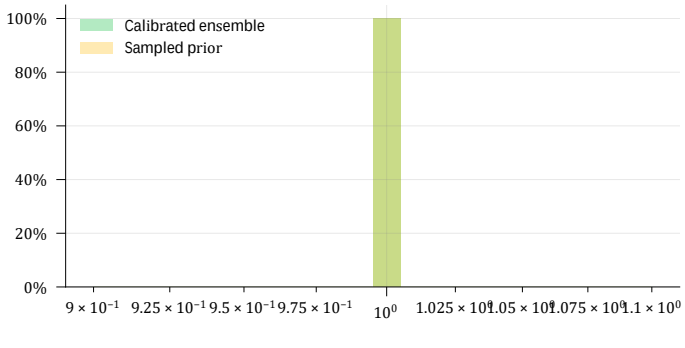

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kx_z04
kx_z05
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kx_z07
kx_z08
kx_z09
kx_z10
kx_z11
kx_z12
Calibrated ensemble
Sampled prior
0
Parameters


kx_z13
kx_z14
kx_z15
kx_z16
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Calibrated ensemble
Sampled prior
Parameters

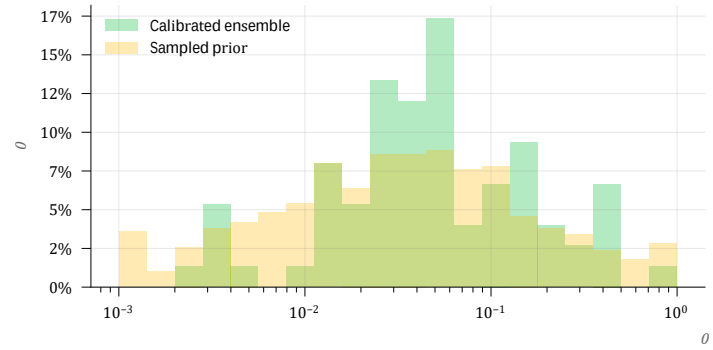
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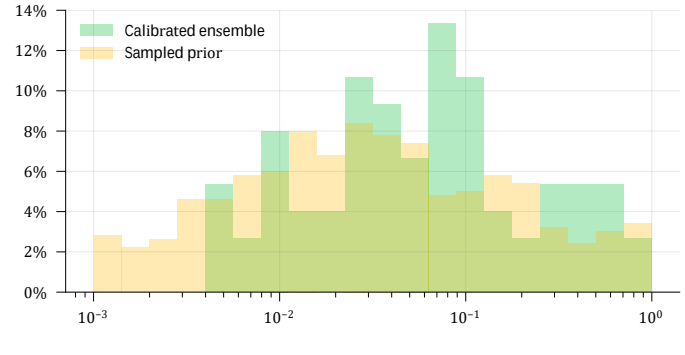
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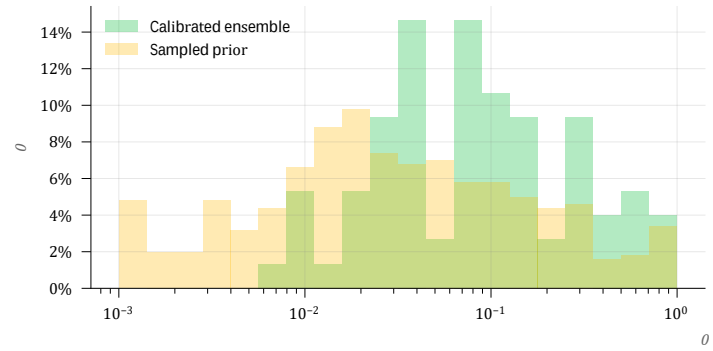
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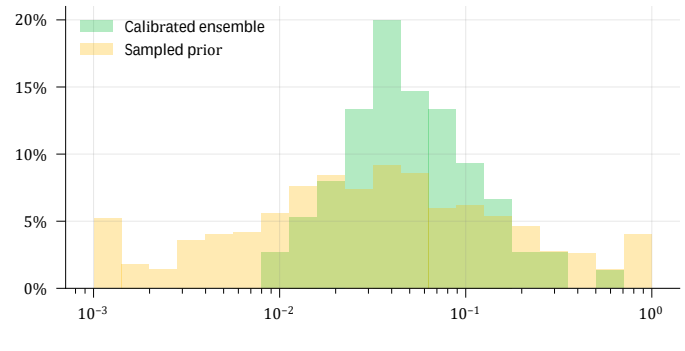
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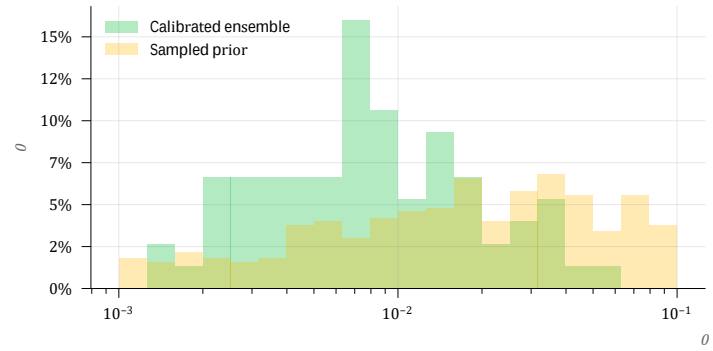
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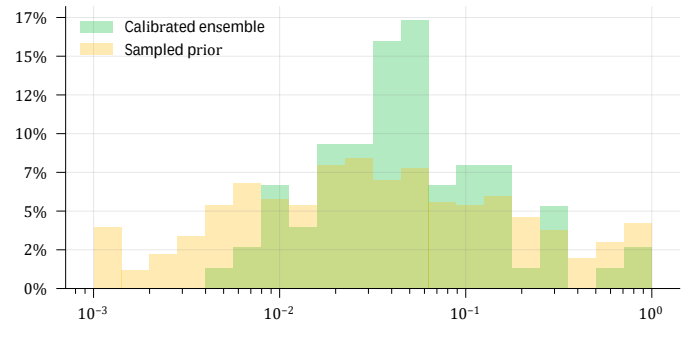
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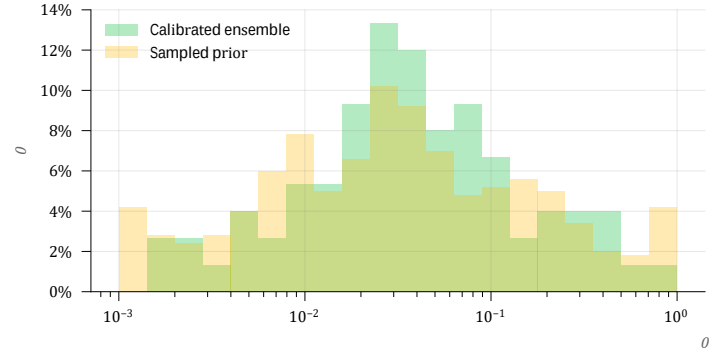
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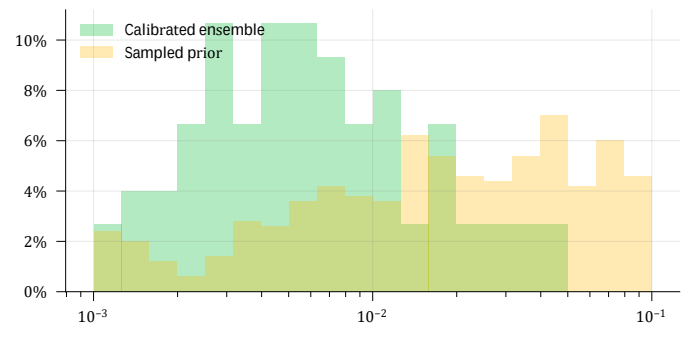
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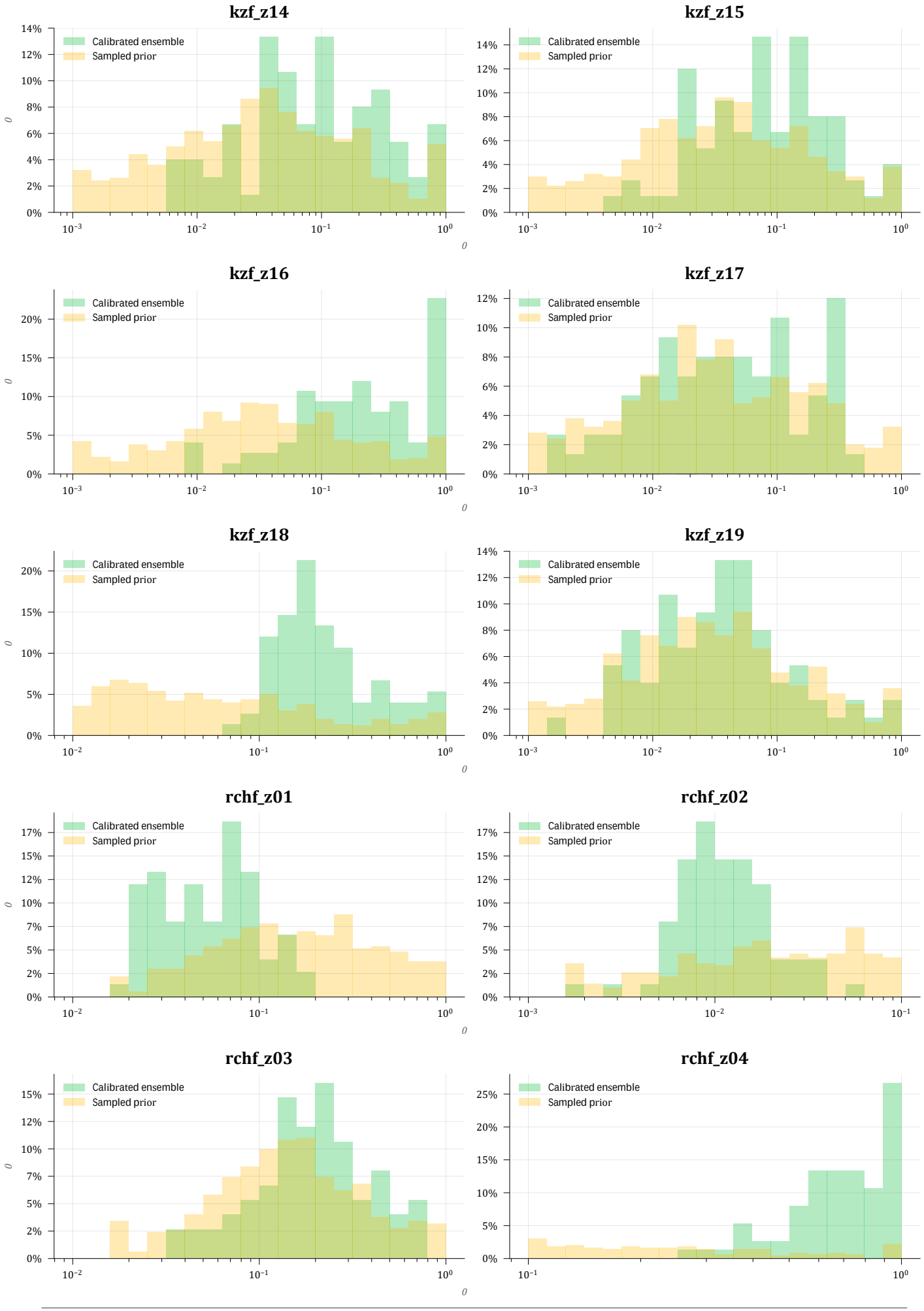


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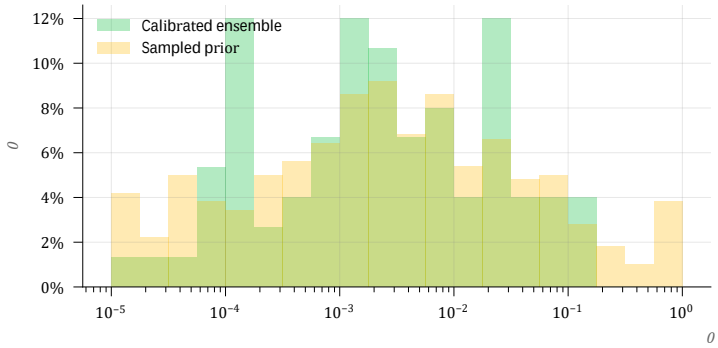


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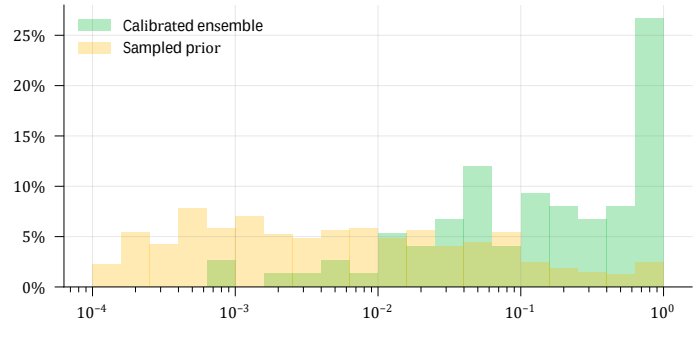



kzf_z14
kzf_z15
kzf_z16
kzf_z17
kzf_z18
kzf_z19
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rchf_z02
rchf_z03
rchf_z04
Calibrated ensemble
Sampled prior
Parameters

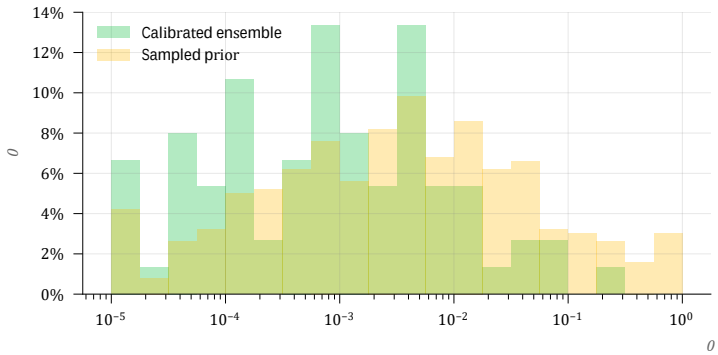
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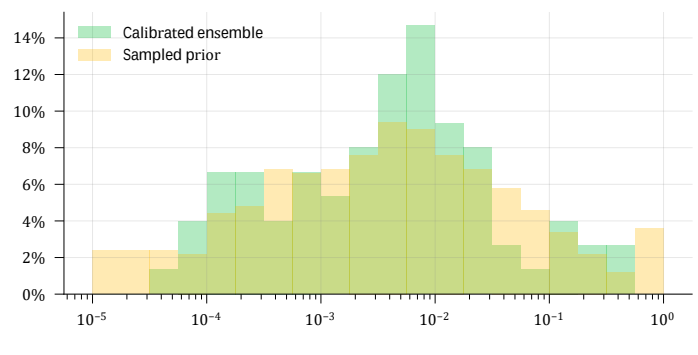
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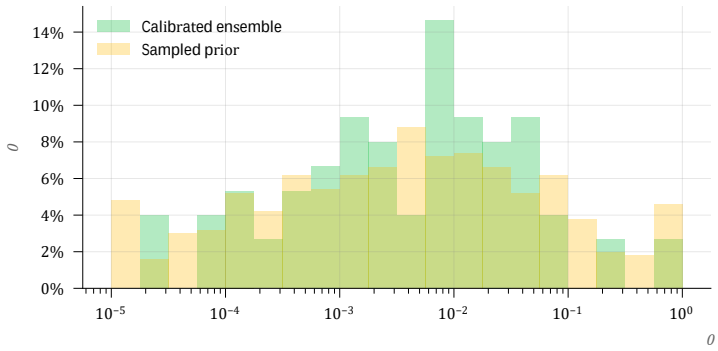
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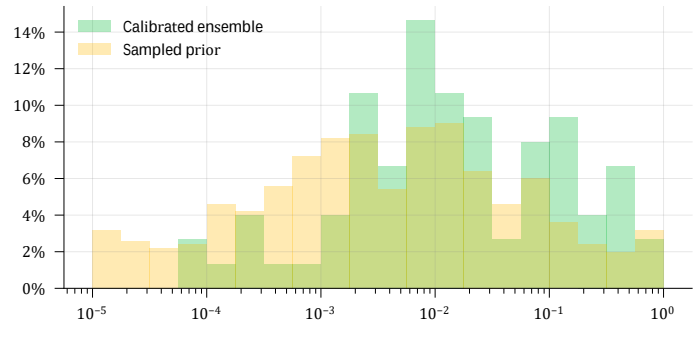
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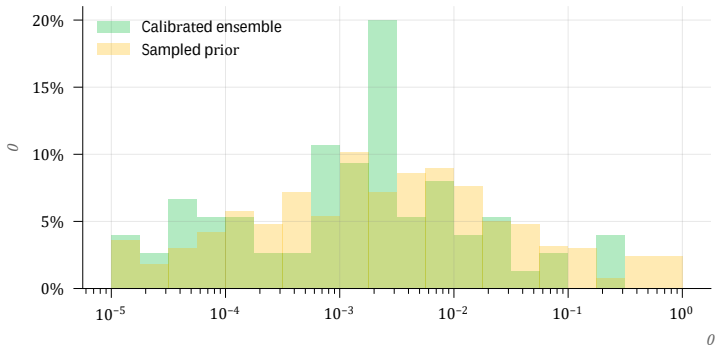
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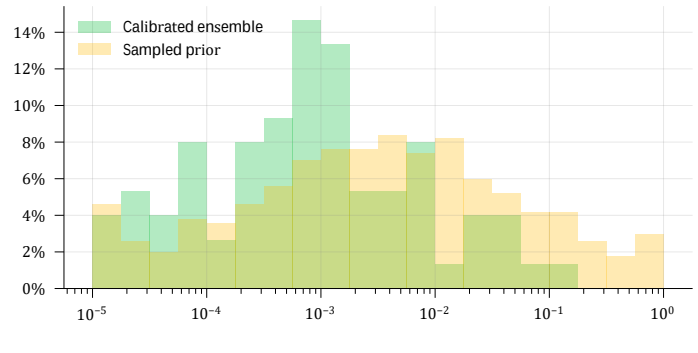
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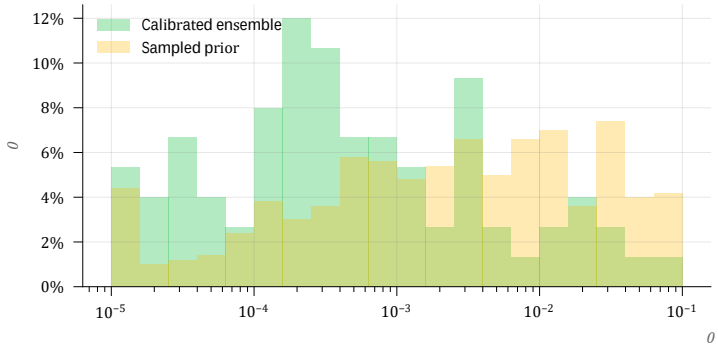
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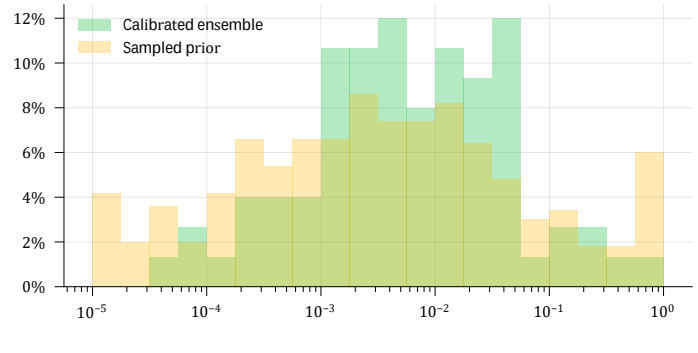
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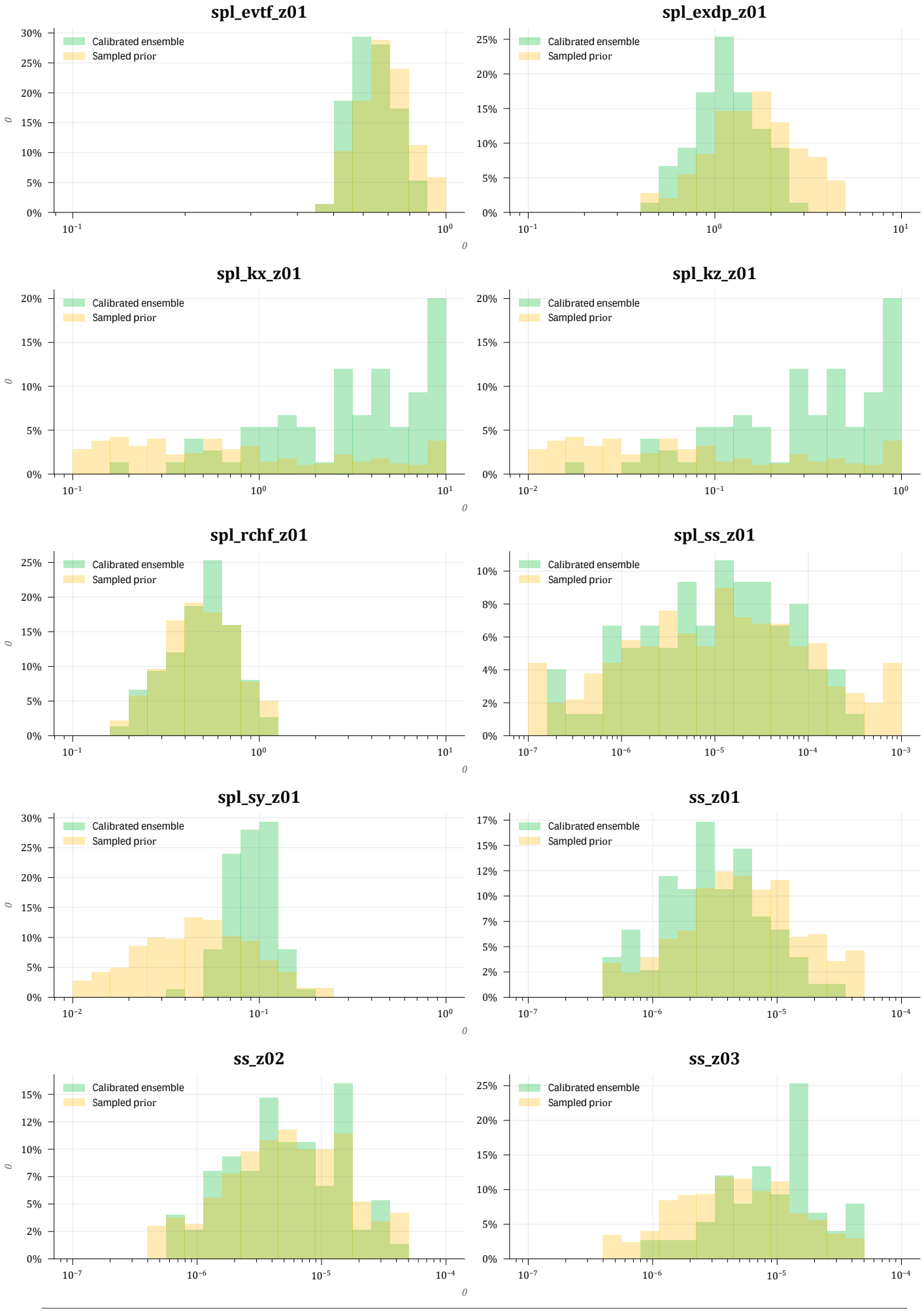


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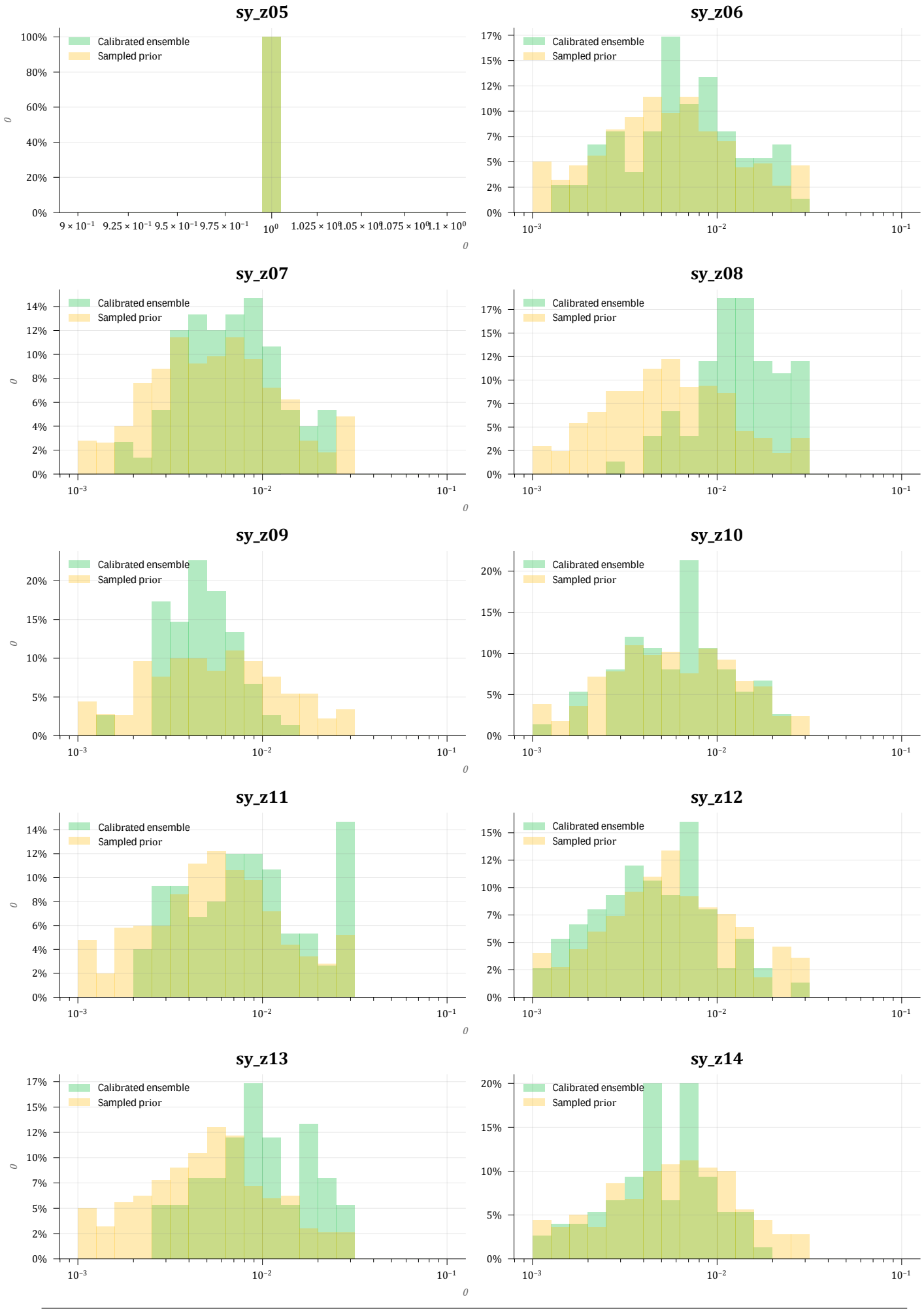
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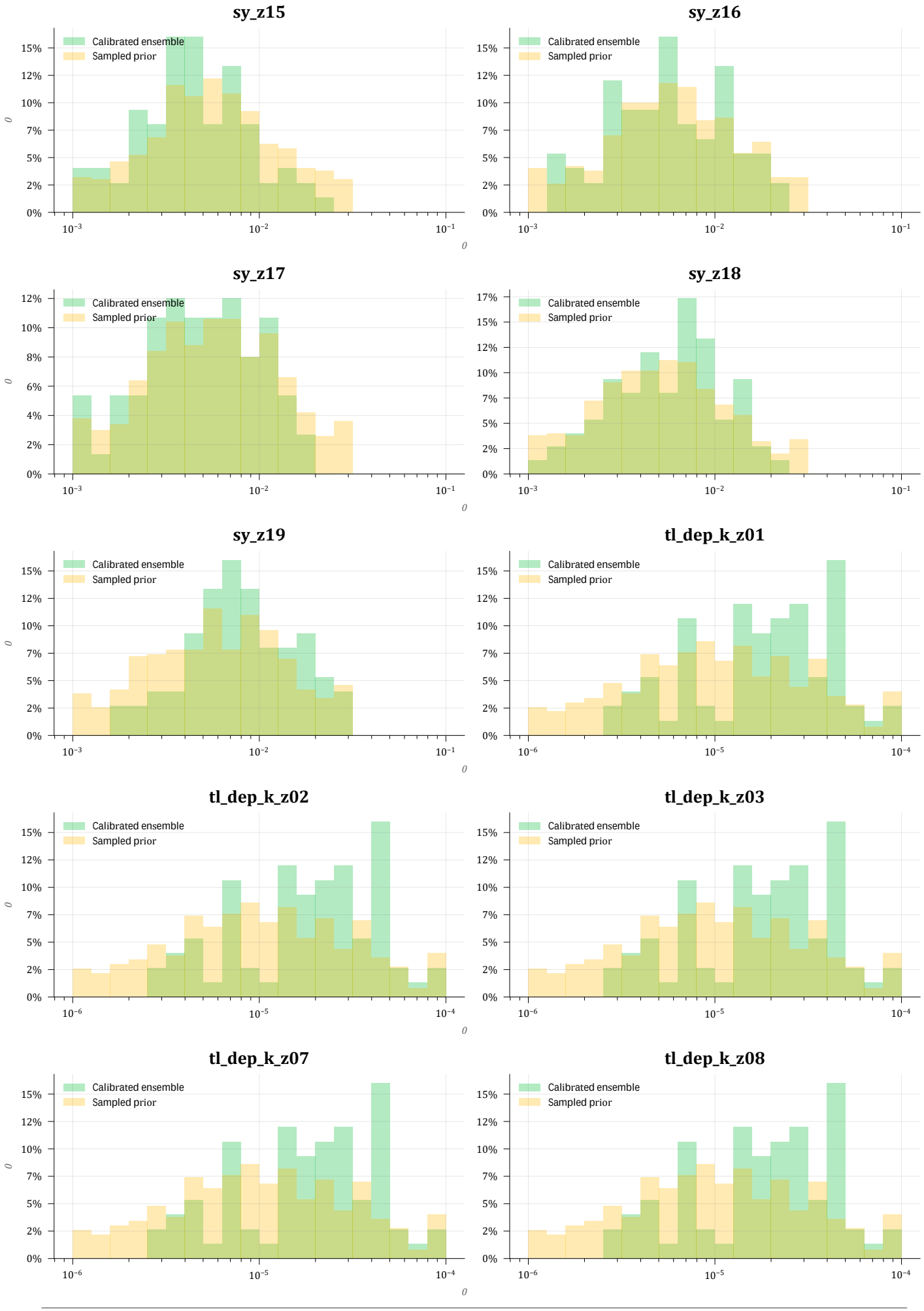


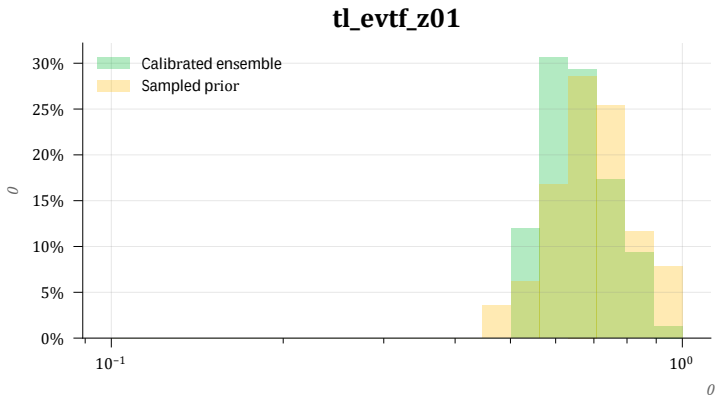

spl_evtf_z01
spl_exdp_z01
spl_kx_z01
spl_kz_z01
spl_rchf_z01
spl_ss_z01
spl_sy_z01
ss_z01
ss_z02
ss_z03
Calibrated ensemble
Sampled prior
0
Parameters

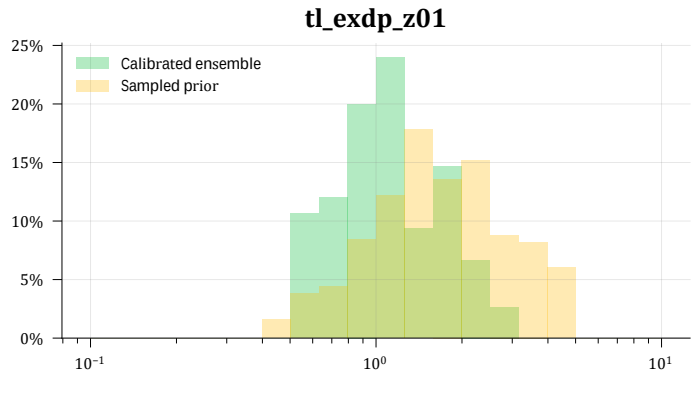

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ss_z05
ss_z06
ss_z07
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ss_z09
ss_z10
ss_z11
ss_z12
ss_z13
Calibrated ensemble
Sampled prior
0
Parameters

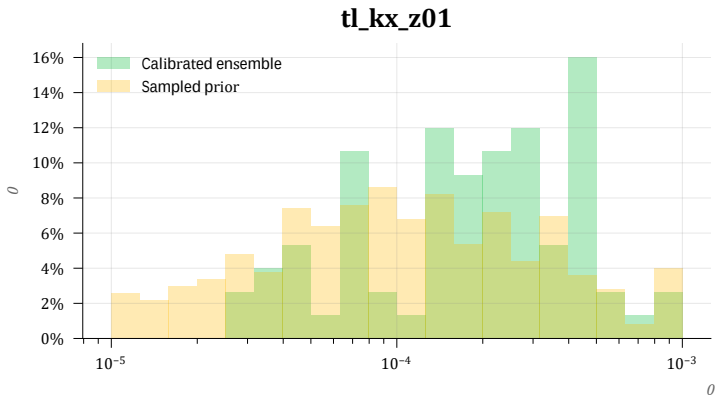

ss_z14
ss_z15
ss_z16
ss_z17
ss_z18
ss_z19
sy_z01
sy_z02
sy_z03
sy_z04
Calibrated ensemble
Sampled prior
Parameters

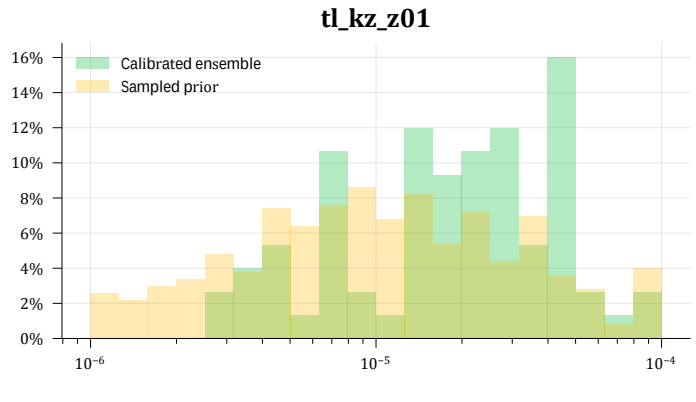

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sy_z12
sy_z13
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Calibrated ensemble
Sampled prior
Parameters

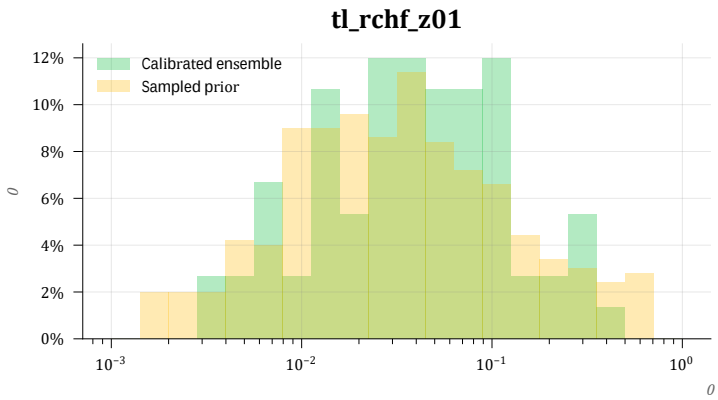

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sy_z19
tl_dep_k_z01
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tl_dep_k_z08
Calibrated ensemble
Sampled prior
0
Parameters

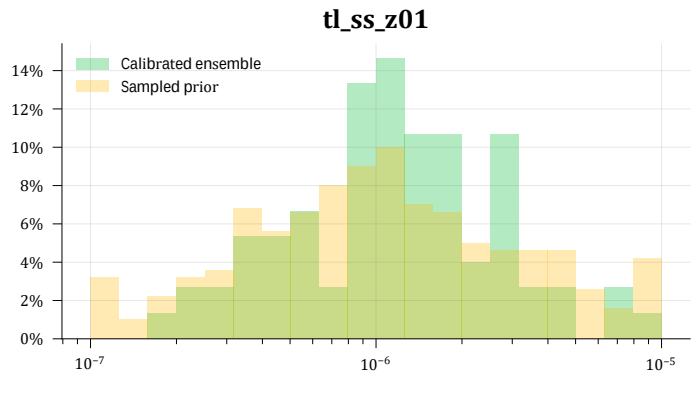

tl_evtf_z01
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Sampled prior
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25%
20%
15%
10%
5%
0%
0
10^{-1}
10^{0}
0

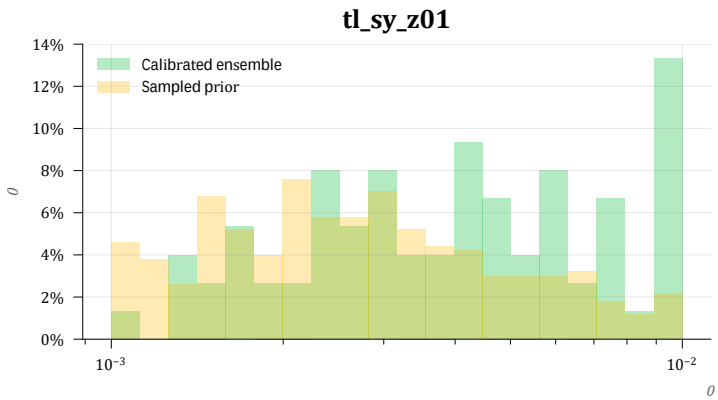

tl_exdp_z01
Calibrated ensemble
Sampled prior
25%
20%
15%
10%
5%
0%
10^{-1}
10^{0}
10^{1}


tl_kx_z01
Calibrated ensemble
Sampled prior
16%
14%
12%
10%
8%
6%
4%
2%
0%
0
10^{-5}
10^{-4}
10^{-3}
0


tl_kz_z01
Calibrated ensemble
Sampled prior
16%
14%
12%
10%
8%
6%
4%
2%
0%
10^{-6}
10^{-5}
10^{-4}


tl_rchf_z01
Calibrated ensemble
Sampled prior
12%
10%
8%
6%
4%
2%
0%
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
0


tl_ss_z01
Calibrated ensemble
Sampled prior
14%
12%
10%
8%
6%
4%
2%
0%
10^{-7}
10^{-6}
10^{-5}


tl_sy_z01
Calibrated ensemble
Sampled prior
14%
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10%
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6%
4%
2%
0%
0
10^{-3}
10^{-2}
0

Appendix F Sensitivity Analysis Plots

Blackwater North Extension Project

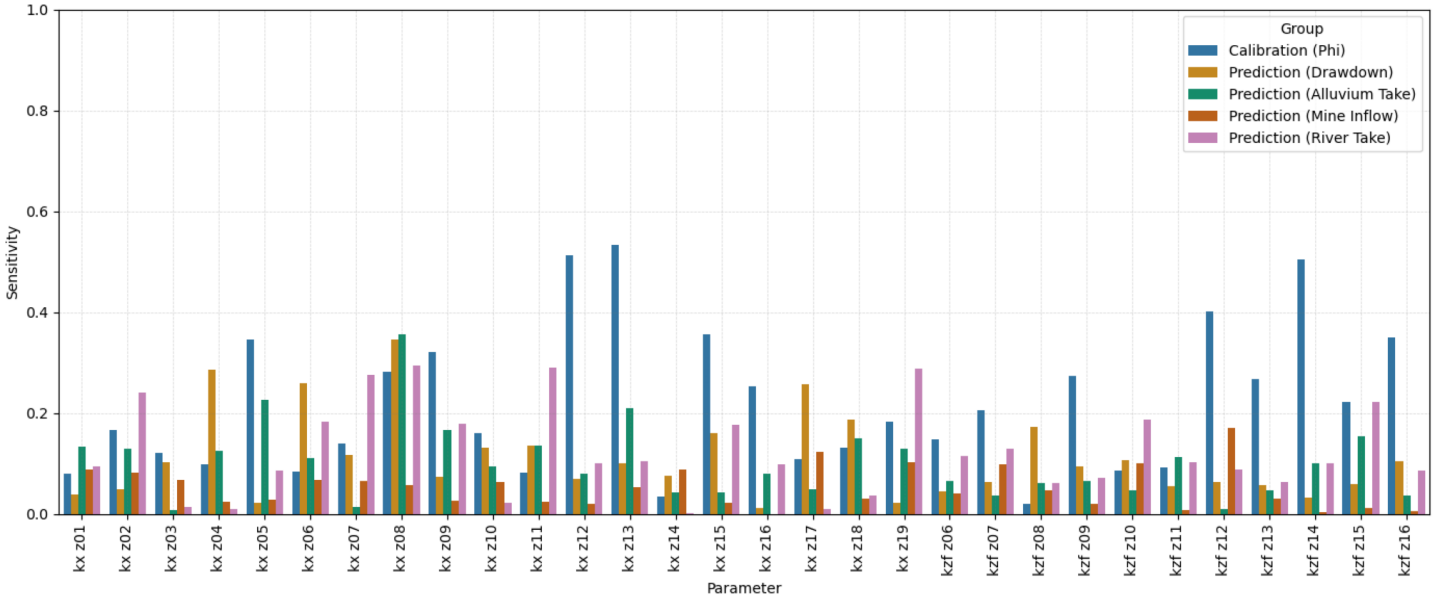
Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

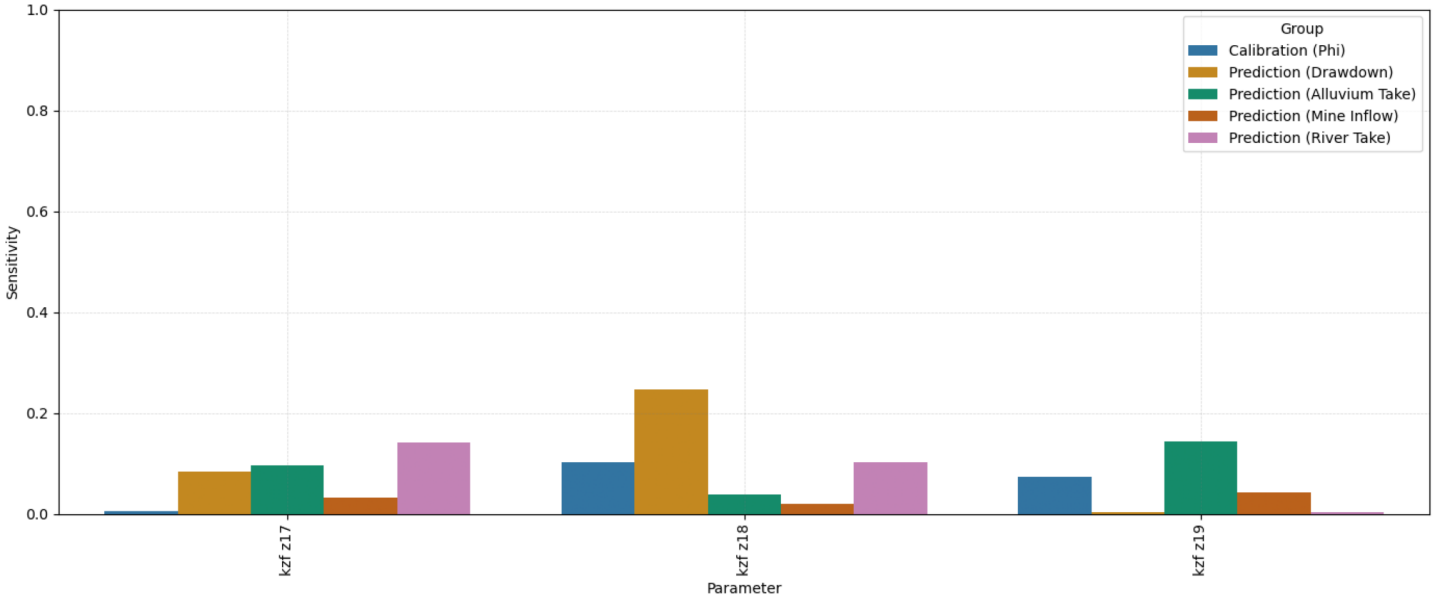
SLR Project No.: 640.031809.00001

7 October 2026

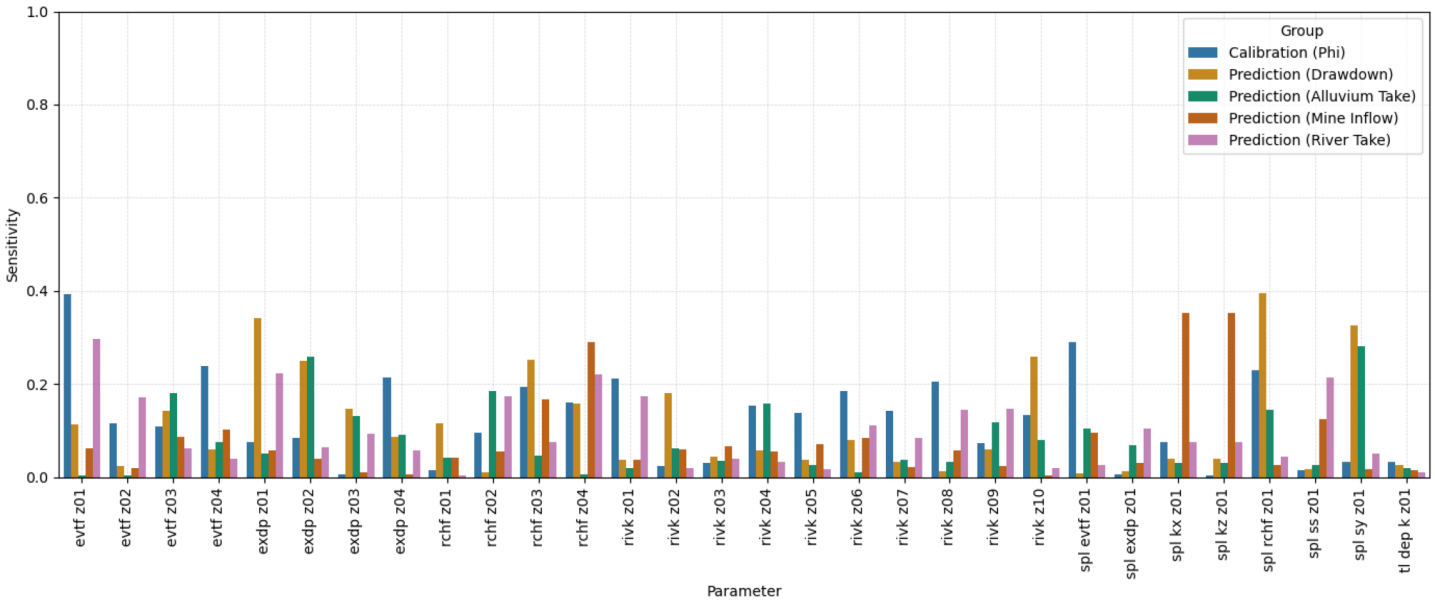
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure1



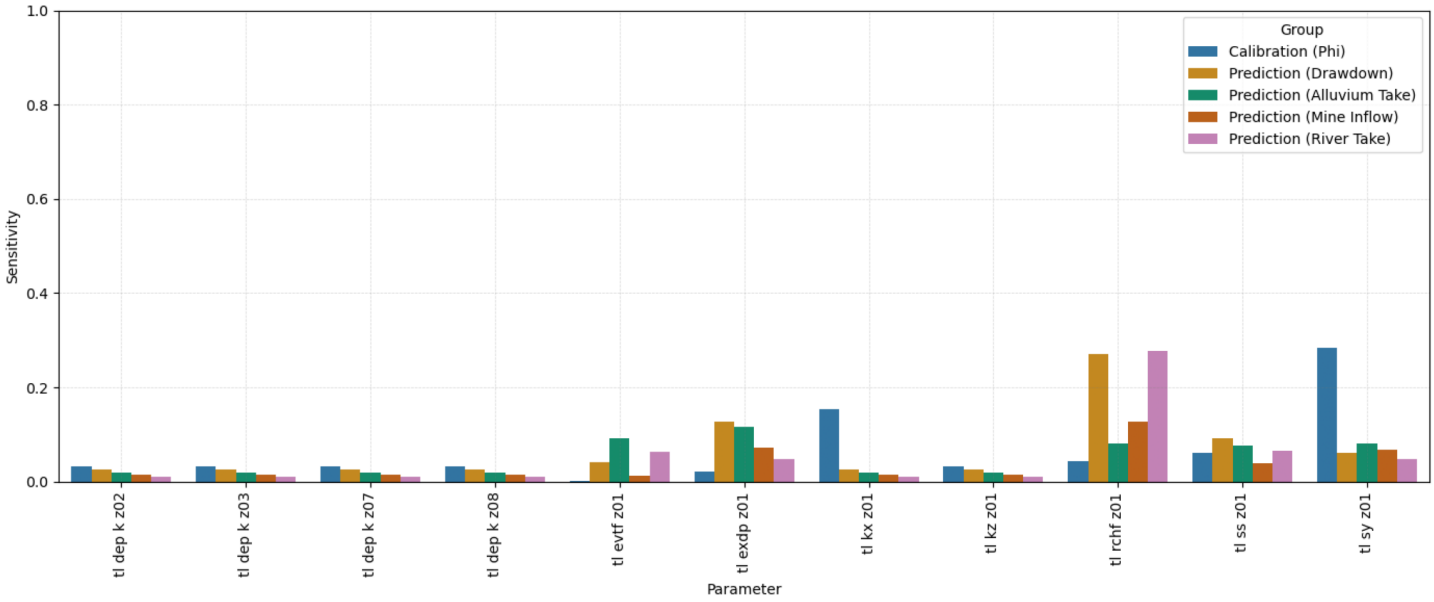
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure2



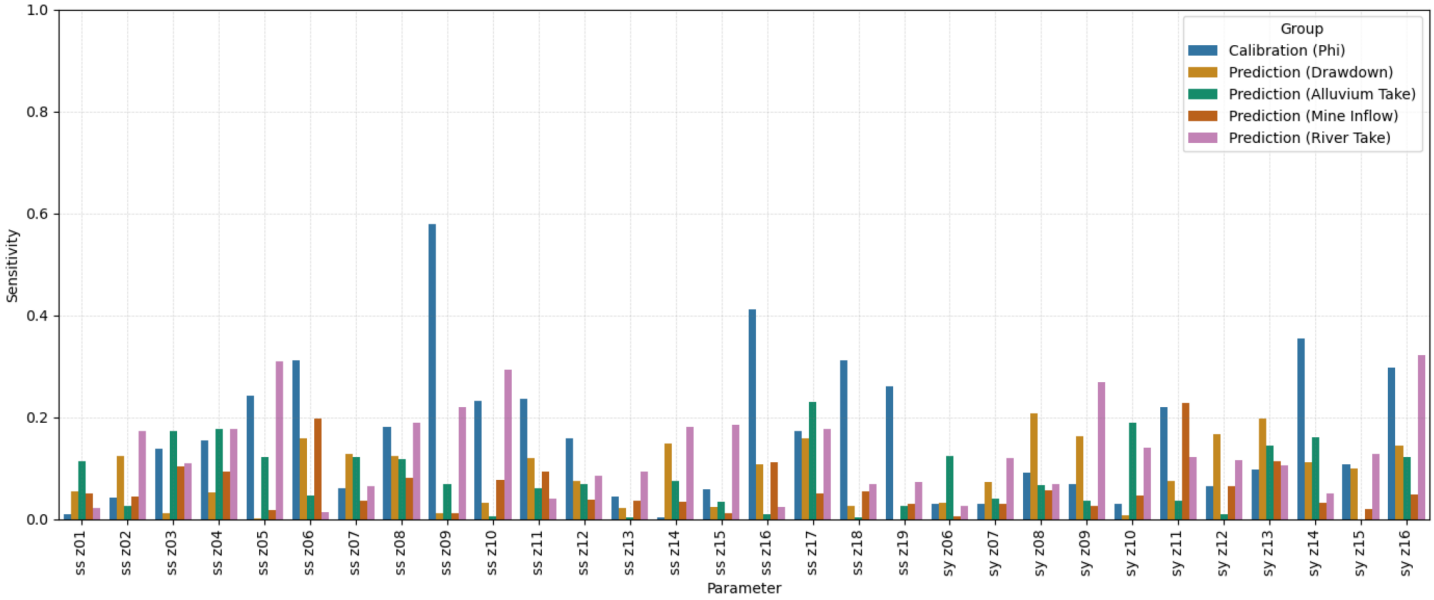
Linear Regression Sensitivity Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure1



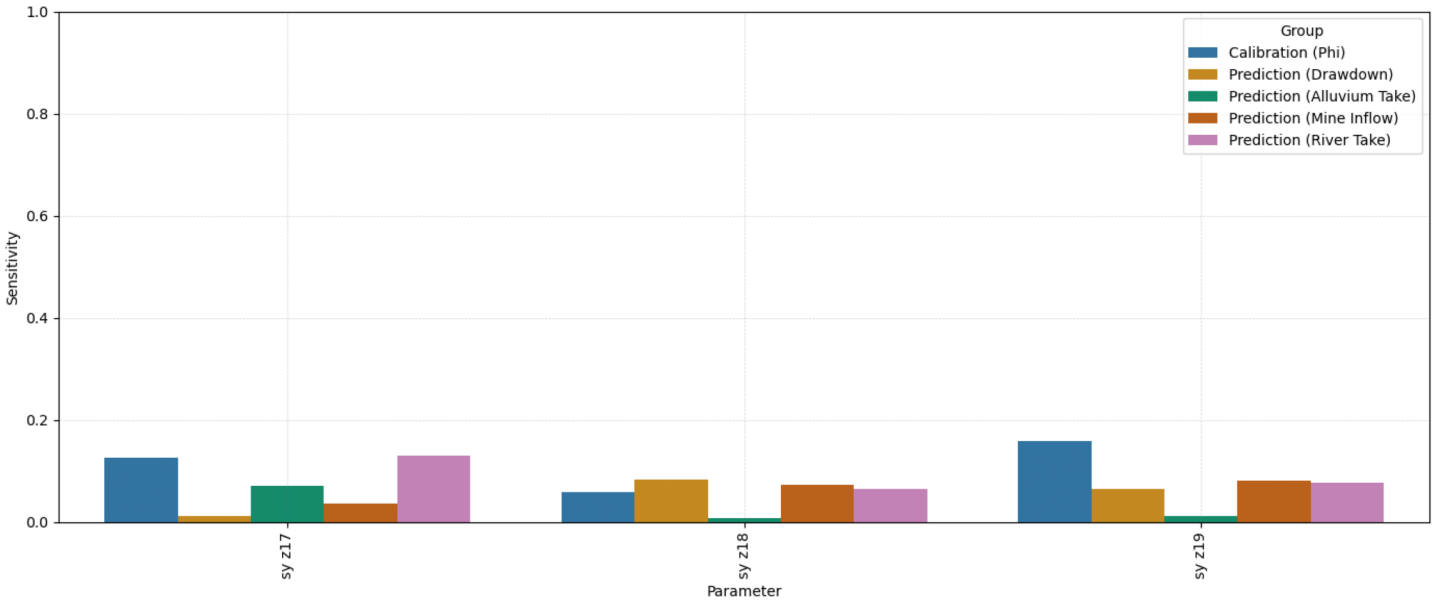
Linear Regression Sensitivity Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure2



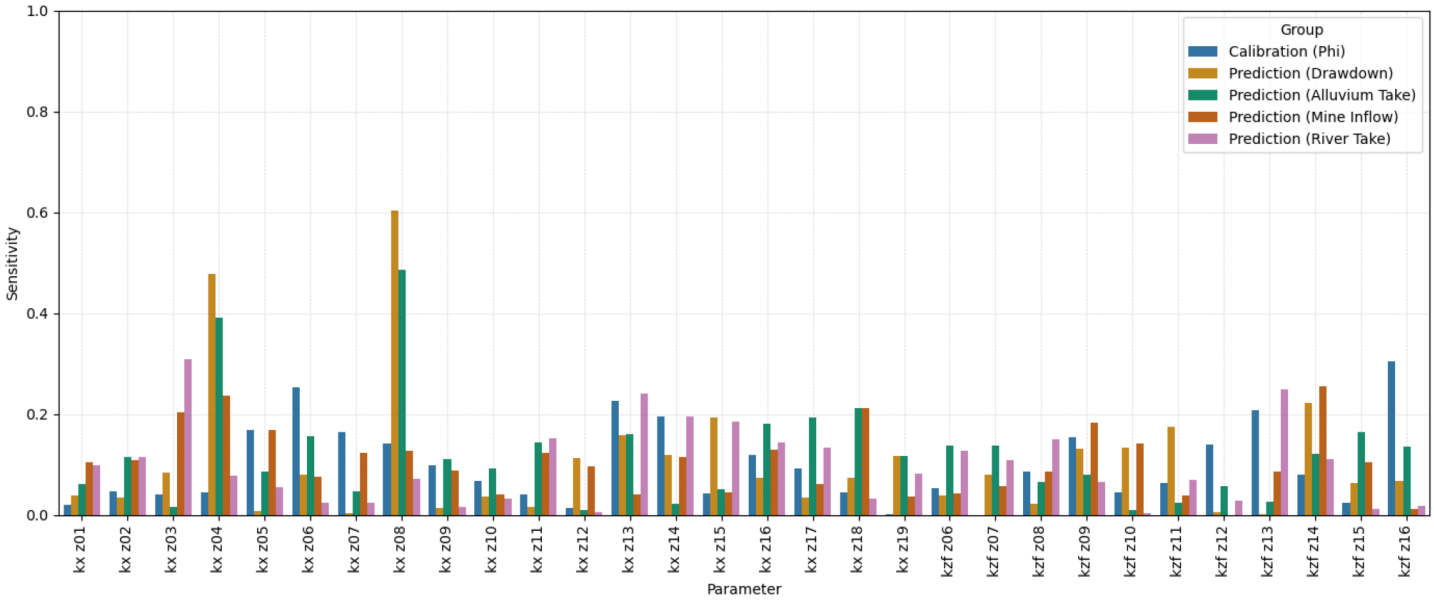
Linear Regression Sensitivity Coefficient (Absolute Value)_Storage Parameters_Figure1



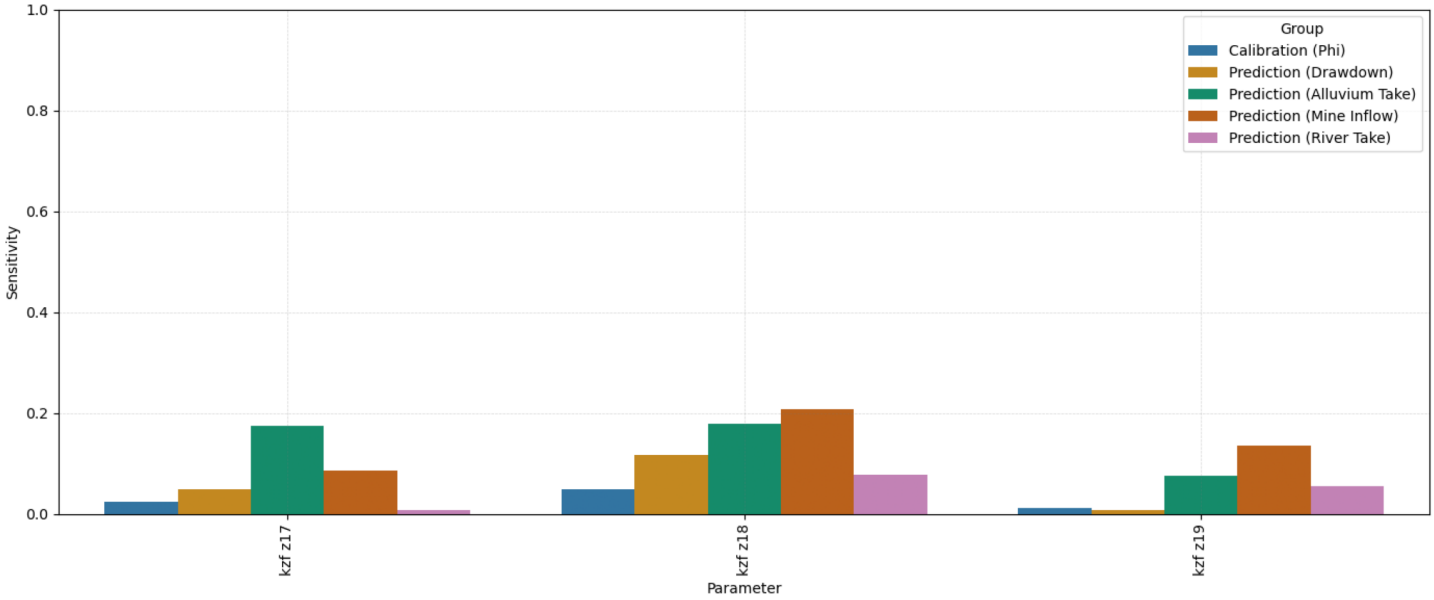
Linear Regression Sensitivity Coefficient (Absolute Value)_Storage Parameters_Figure2



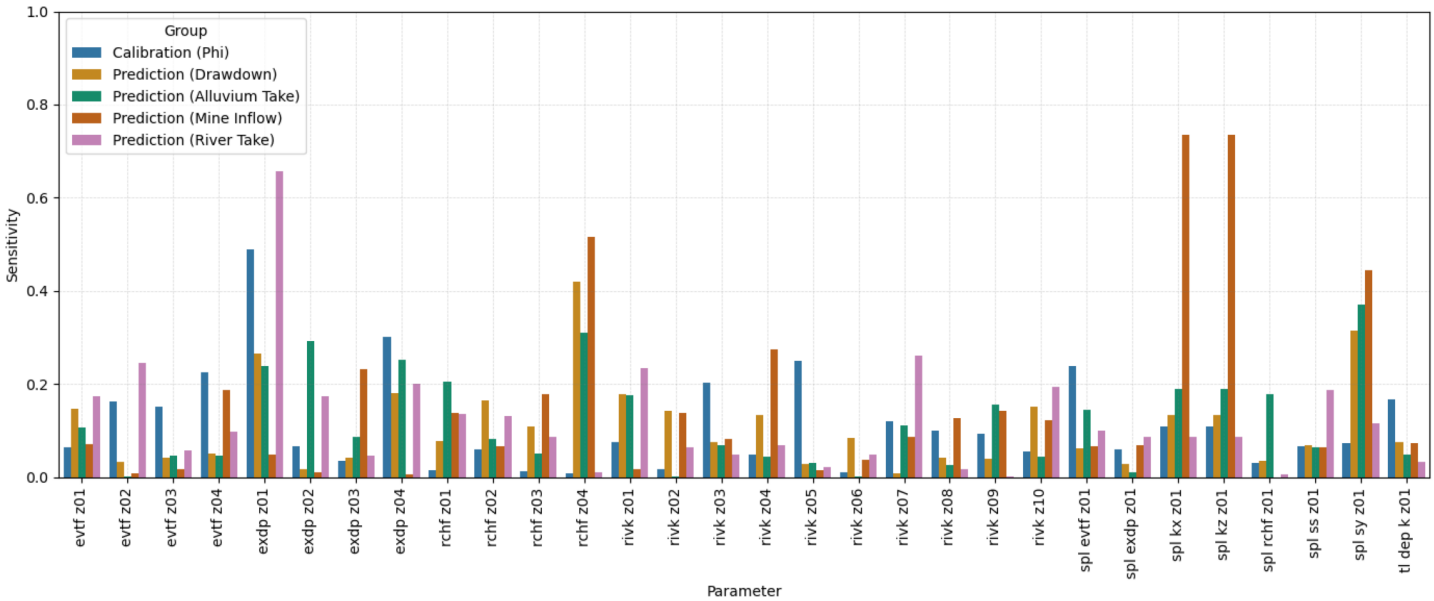
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure1



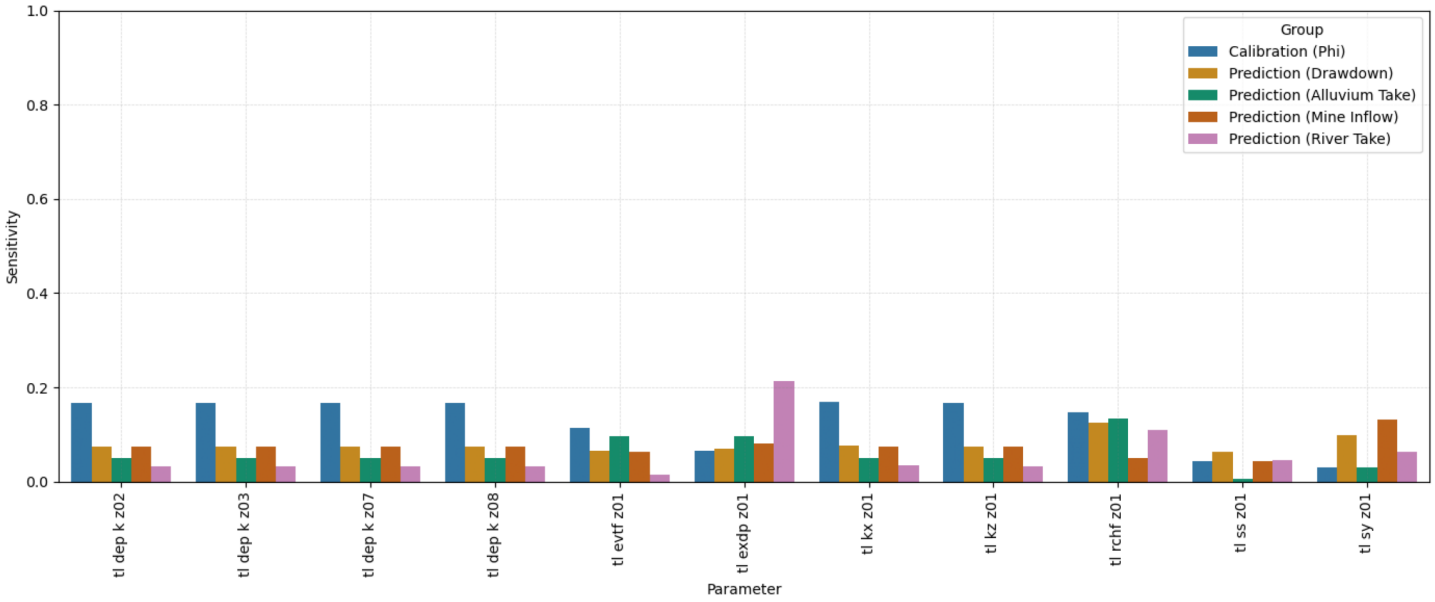
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure2



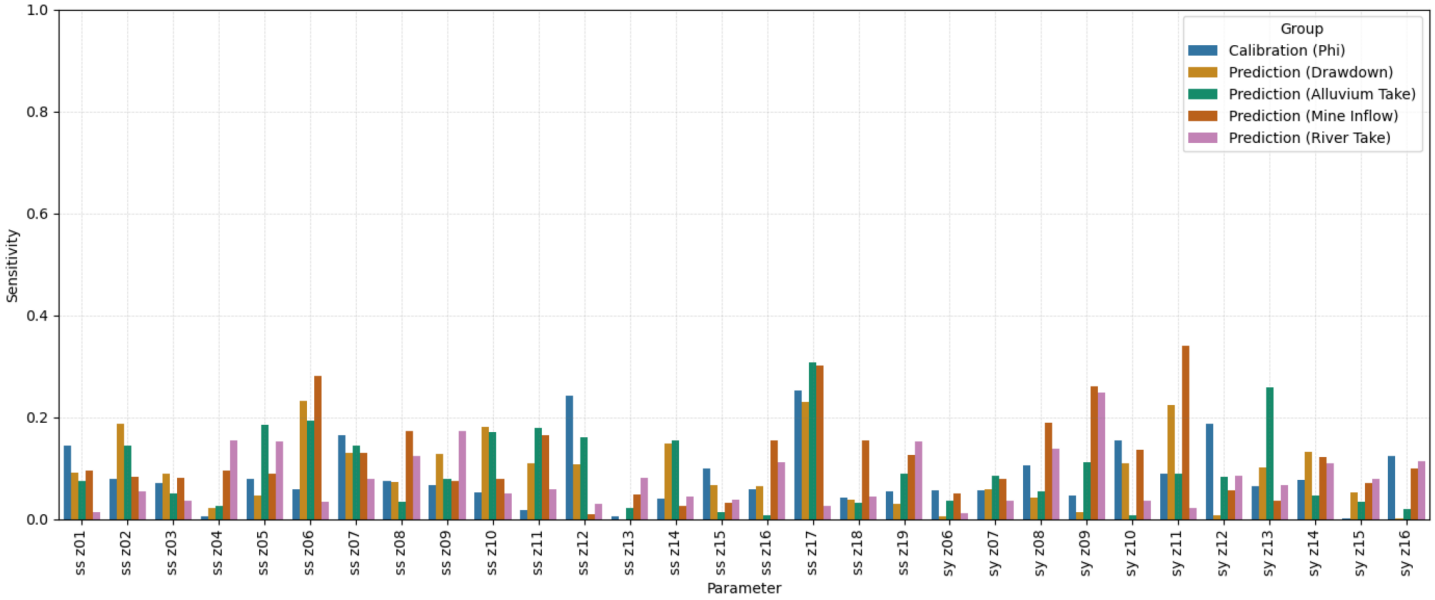
Spearman Rank Correlation Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure1



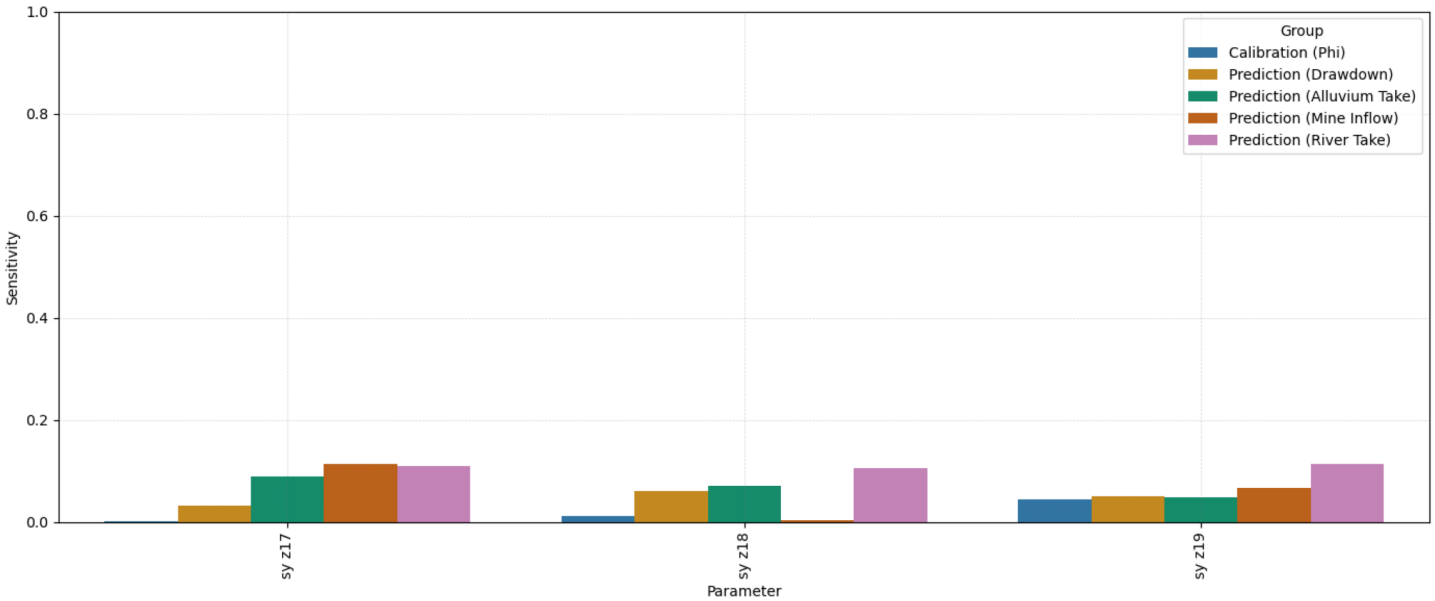
Spearman Rank Correlation Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure2



Spearman Rank Correlation Coefficient (Absolute Value)_Storage Parameters_Figure1



Spearman Rank Correlation Coefficient (Absolute Value)_Storage Parameters_Figure2



Appendix G Uncertainty in 1 m Drawdown Contours

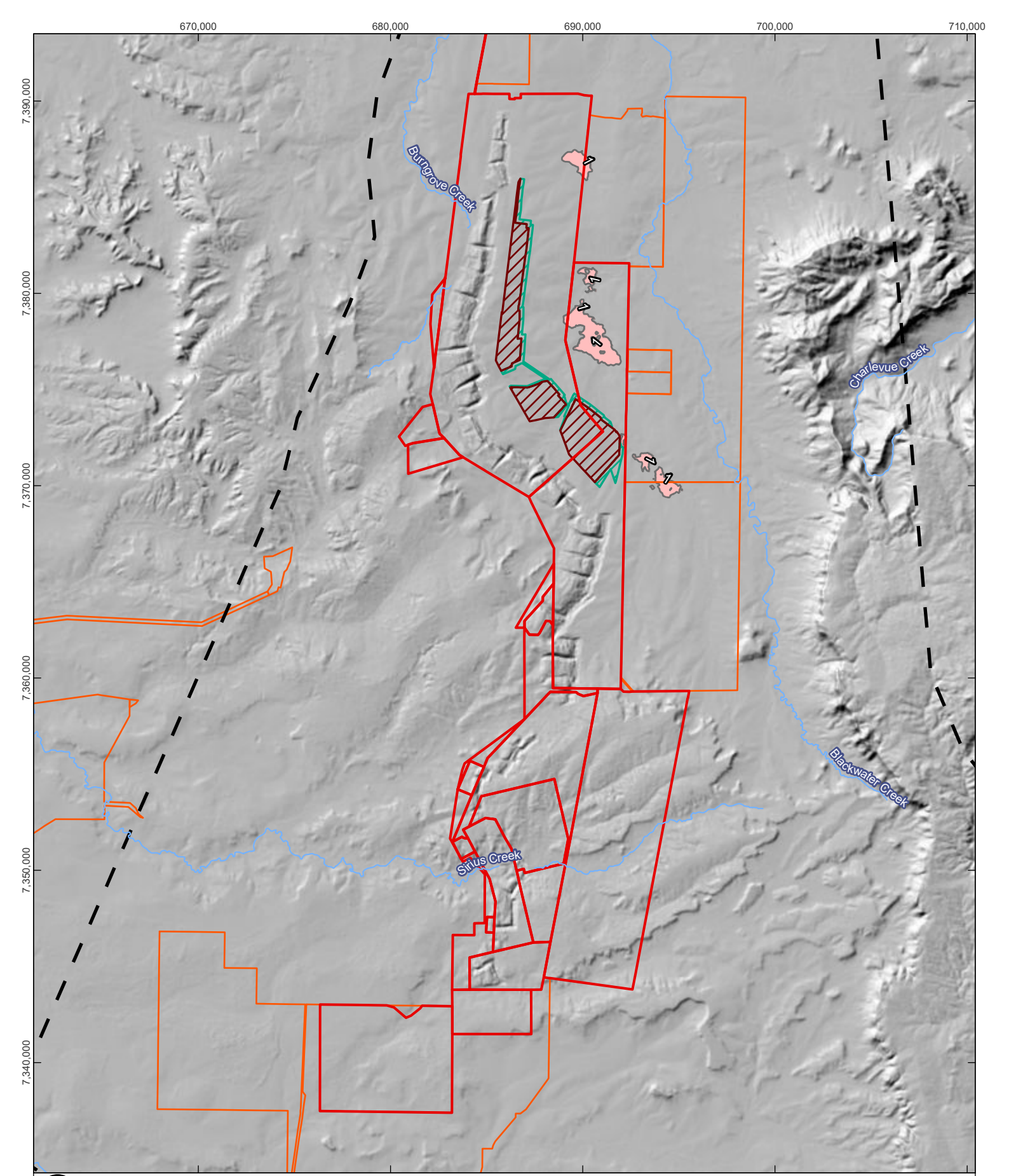
Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

7 October 2026



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

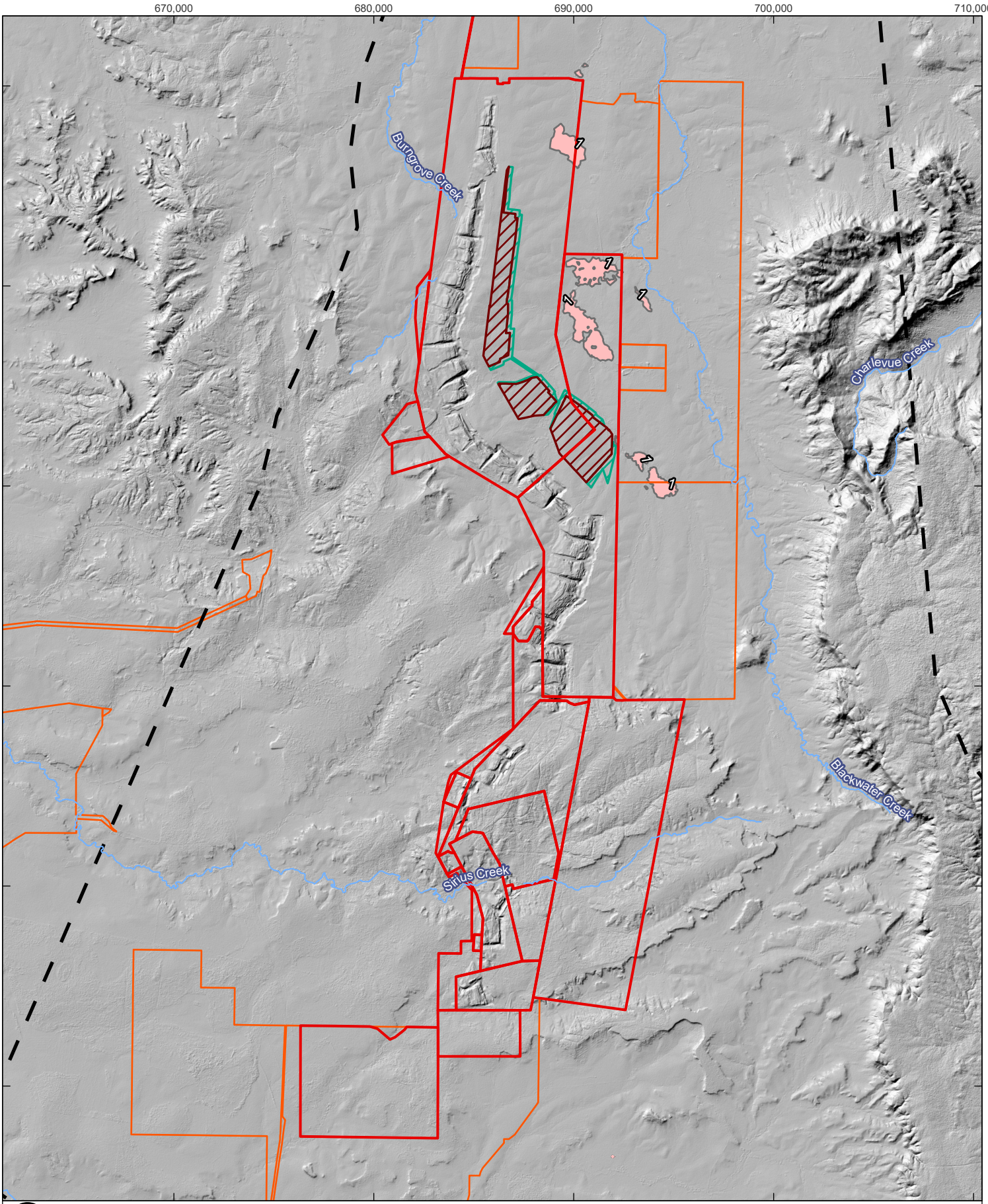
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ALLUVIUM/TERTIARY (END OF MINING) (LAYER 1)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E01_Uncertainty in Predicted 1m Incremental DD in Alluvium and Tertiary (EoM) L1



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

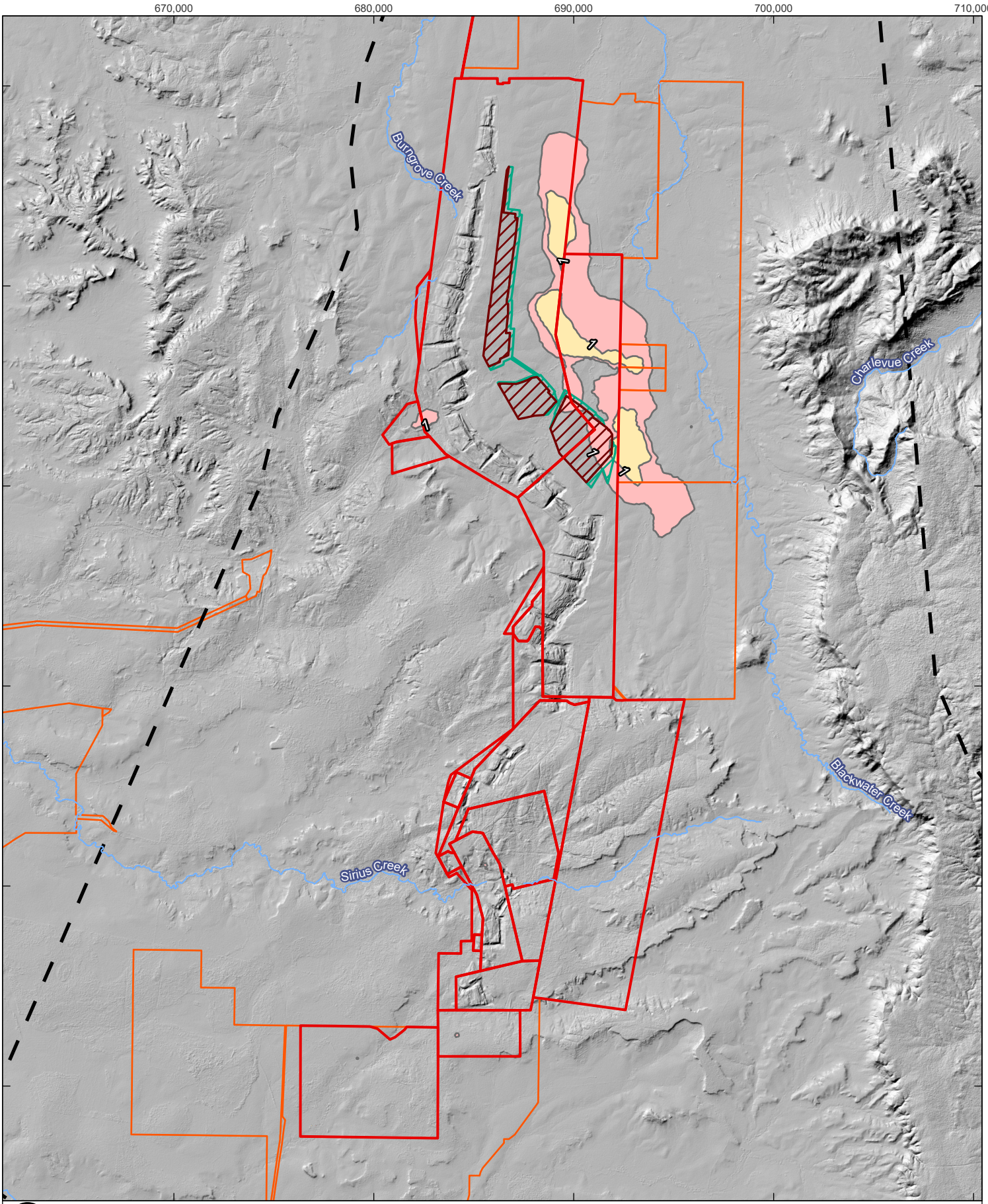
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ALLUVIUM/TERTIARY (END OF RECOVERY) (LAYER 1)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-2

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0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

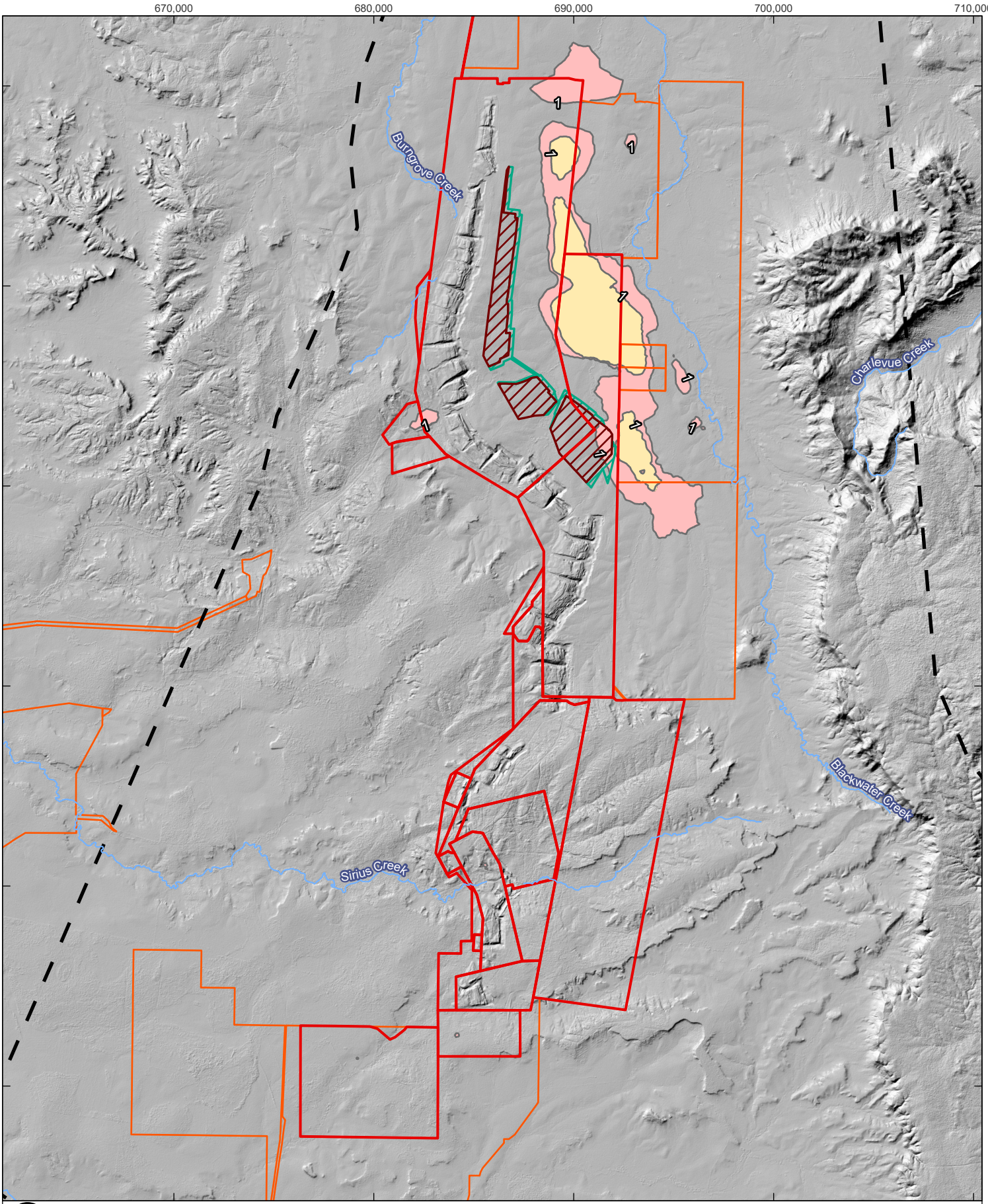
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ALLUVIUM/WEATHERED (END OF MINING) (LAYER 2)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E03_Uncertainty in Predicted 1m Incremental DD in Alluvium and Weathered (EoM) L2



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

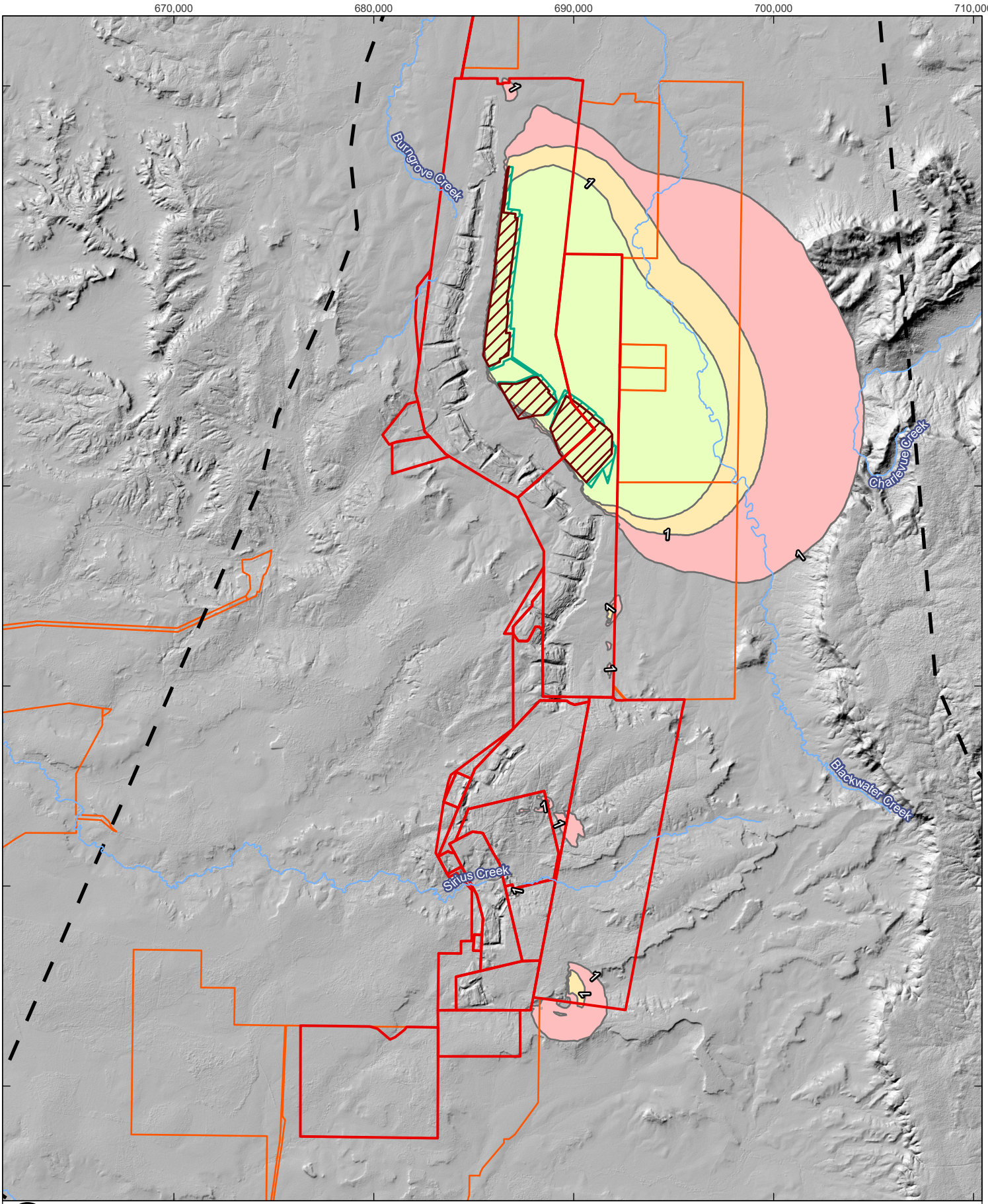
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ALLUVIUM/WEATHERED (END OF RECOVERY) (LAYER 2)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-4

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E04_Uncertainty in Predicted 1m Incremental DD in Alluvium and Weathered (EoR) L2



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

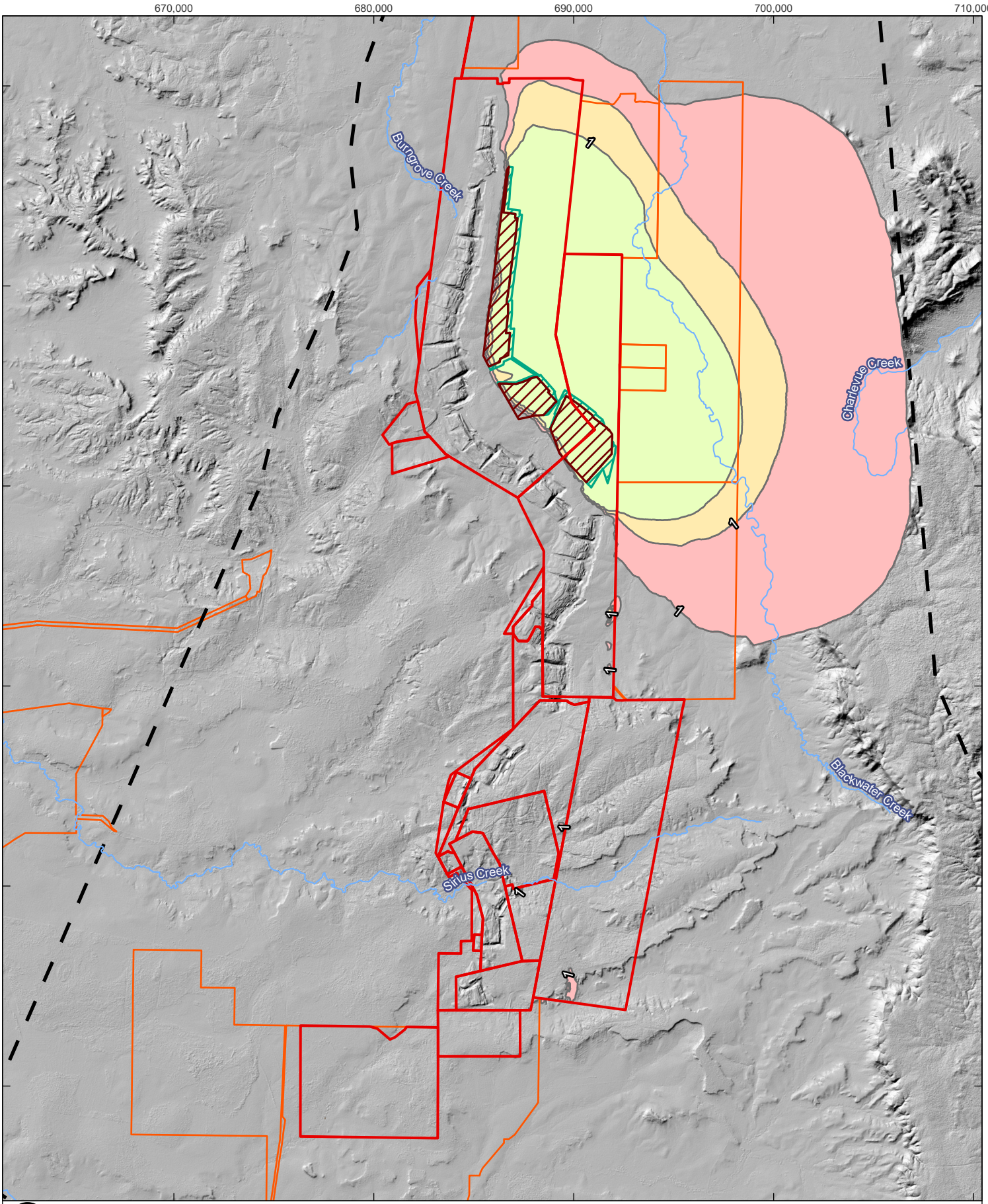
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ARIES SEAM (END OF MINING) (LAYER 8)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-5

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0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

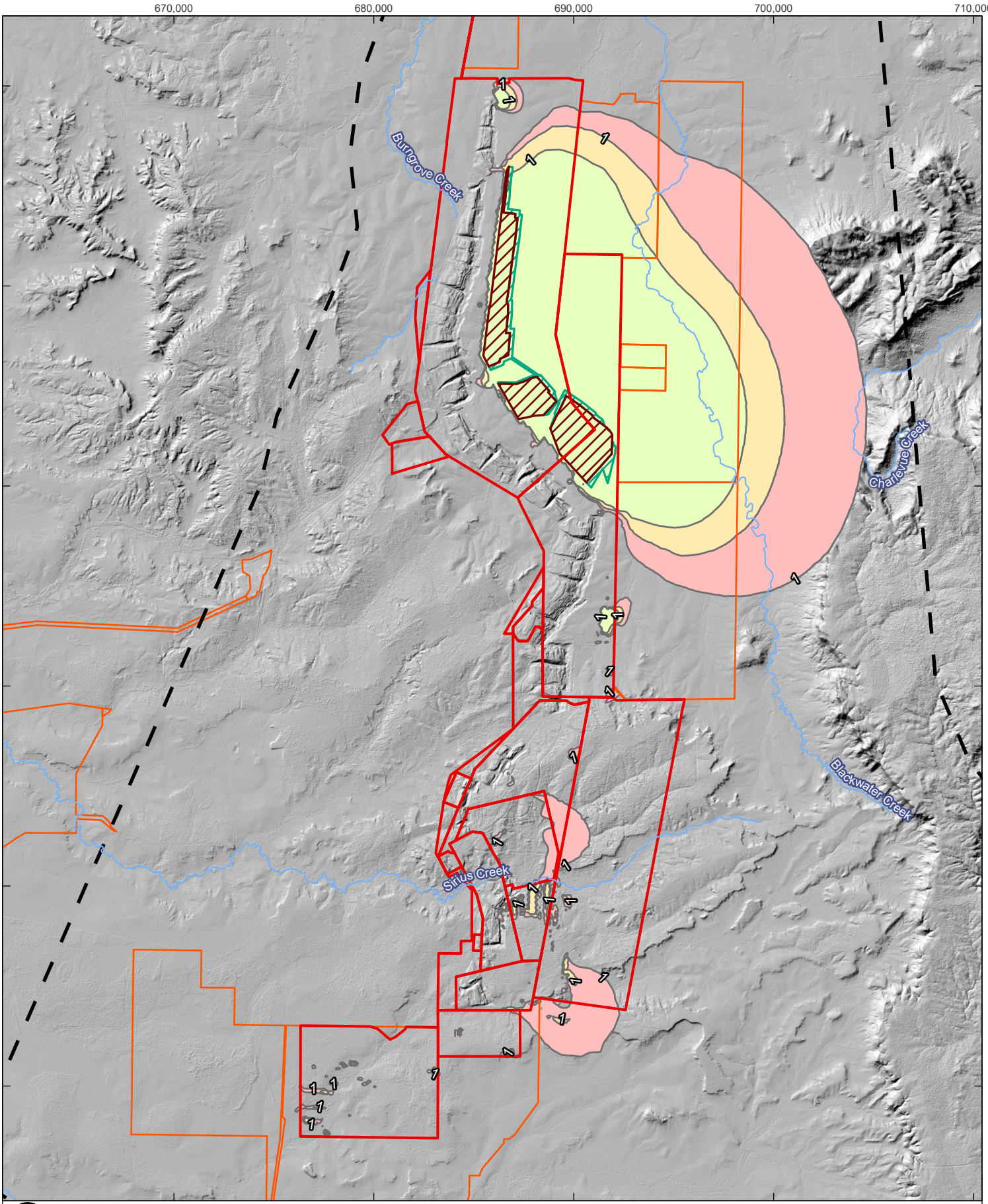
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ARIES SEAM (END OF RECOVERY) (LAYER 8)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E06_Uncertainty in Predicted 1m Incremental DD in Aries Seam (EoR) L8



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

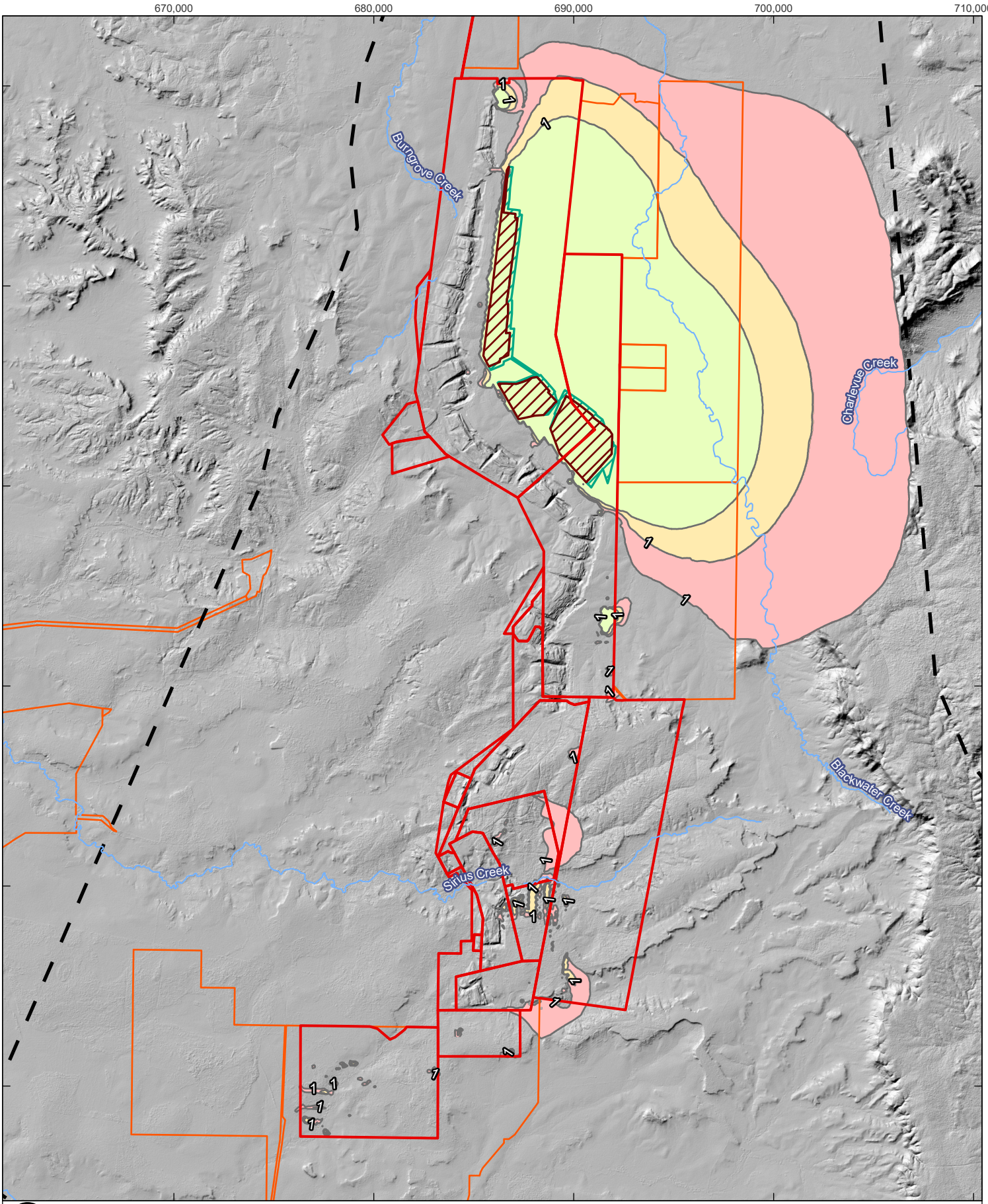
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN POLLUX SEAM (END OF MINING) (LAYER 12)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E07_Uncertainty in Predicted 1m Incremental DD in Pollux Seam (EoM) L12



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

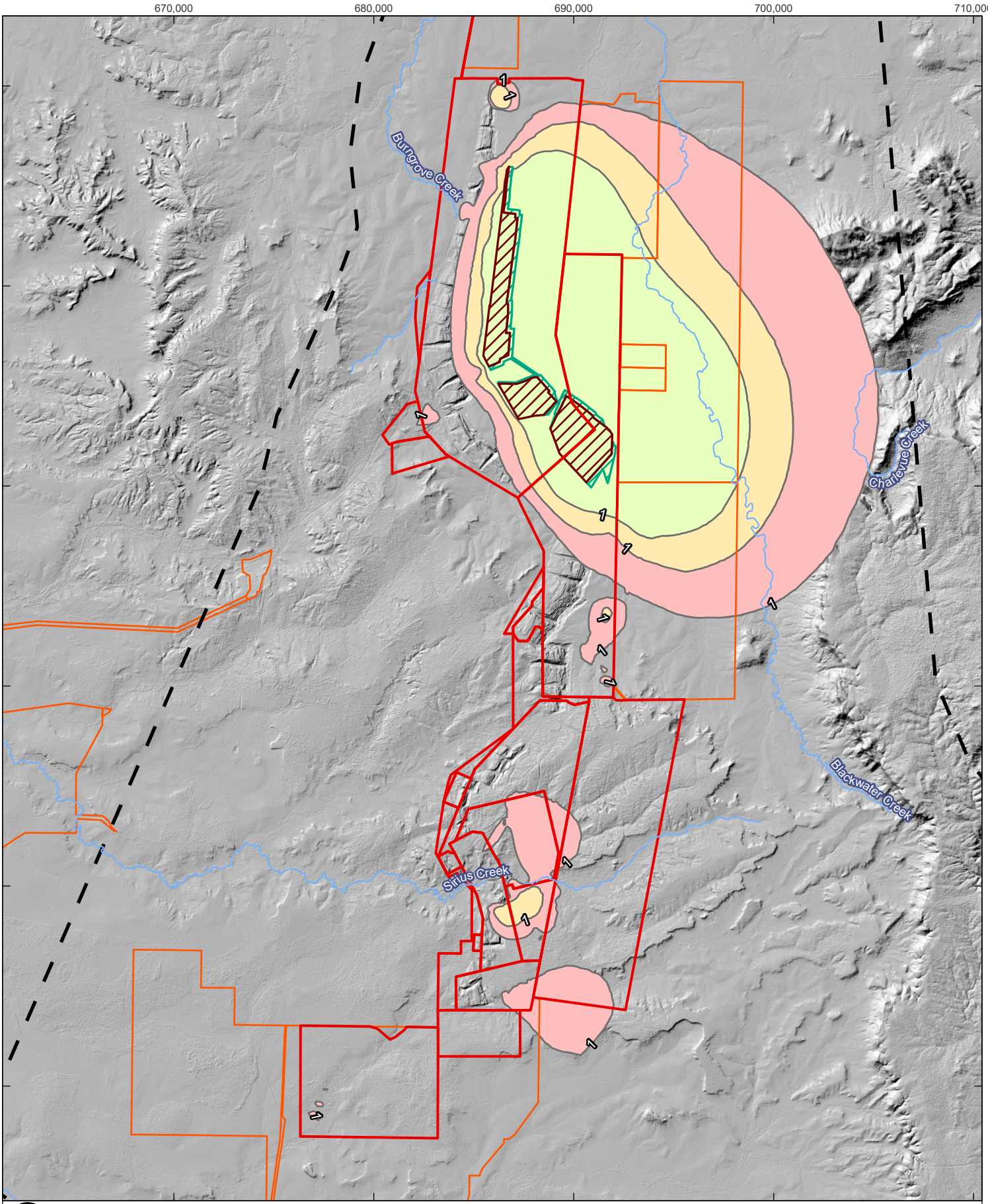
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN POLLUX SEAM (END OF RECOVERY) (LAYER 12)

SLR

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APPENDIX G-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E08_Uncertainty in Predicted 1m Incremental DD in Pollux Seam (EoR) L12



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

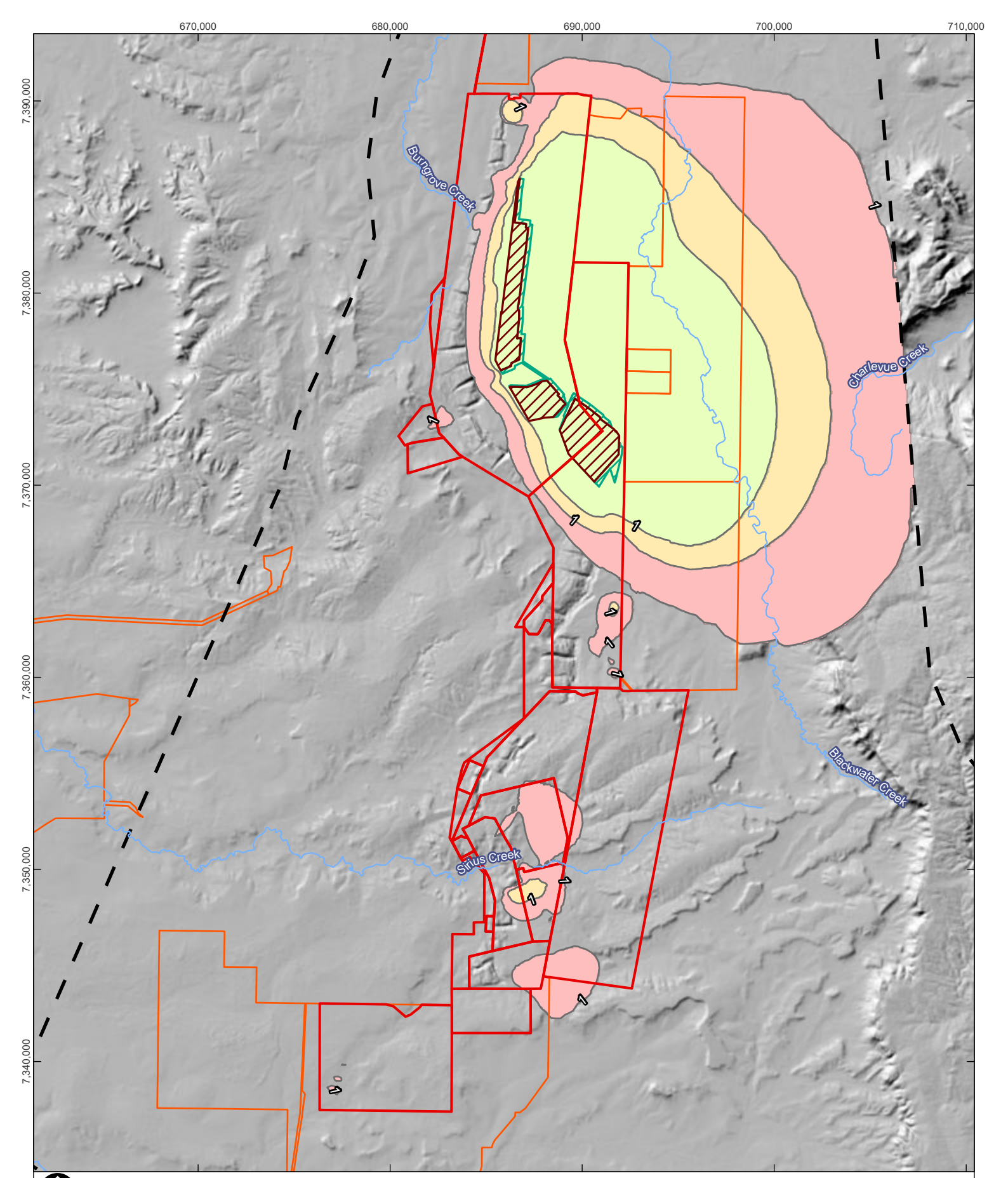
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN BURNGROVE FORMATION (END OF MINING) (LAYER 16)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E09_Uncertainty in Predicted 1m Incremental DD in Burngrove Formation (EoM) L16



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

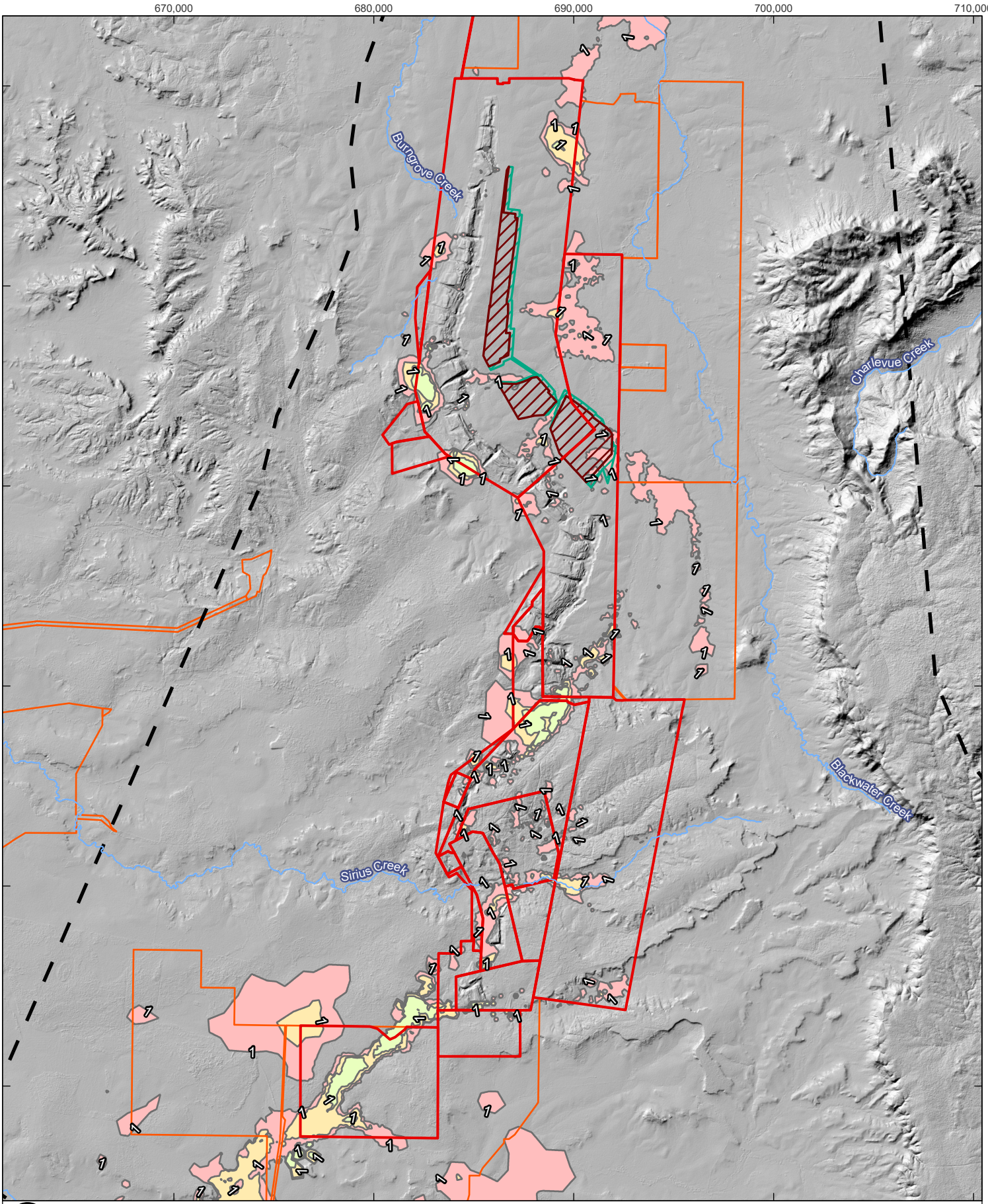
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN BURNGROVE FORMATION (END OF RECOVERY) (LAYER 16)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E10_Uncertainty in Predicted 1m Incremental DD in Burngrove Formation (EoR) L16



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

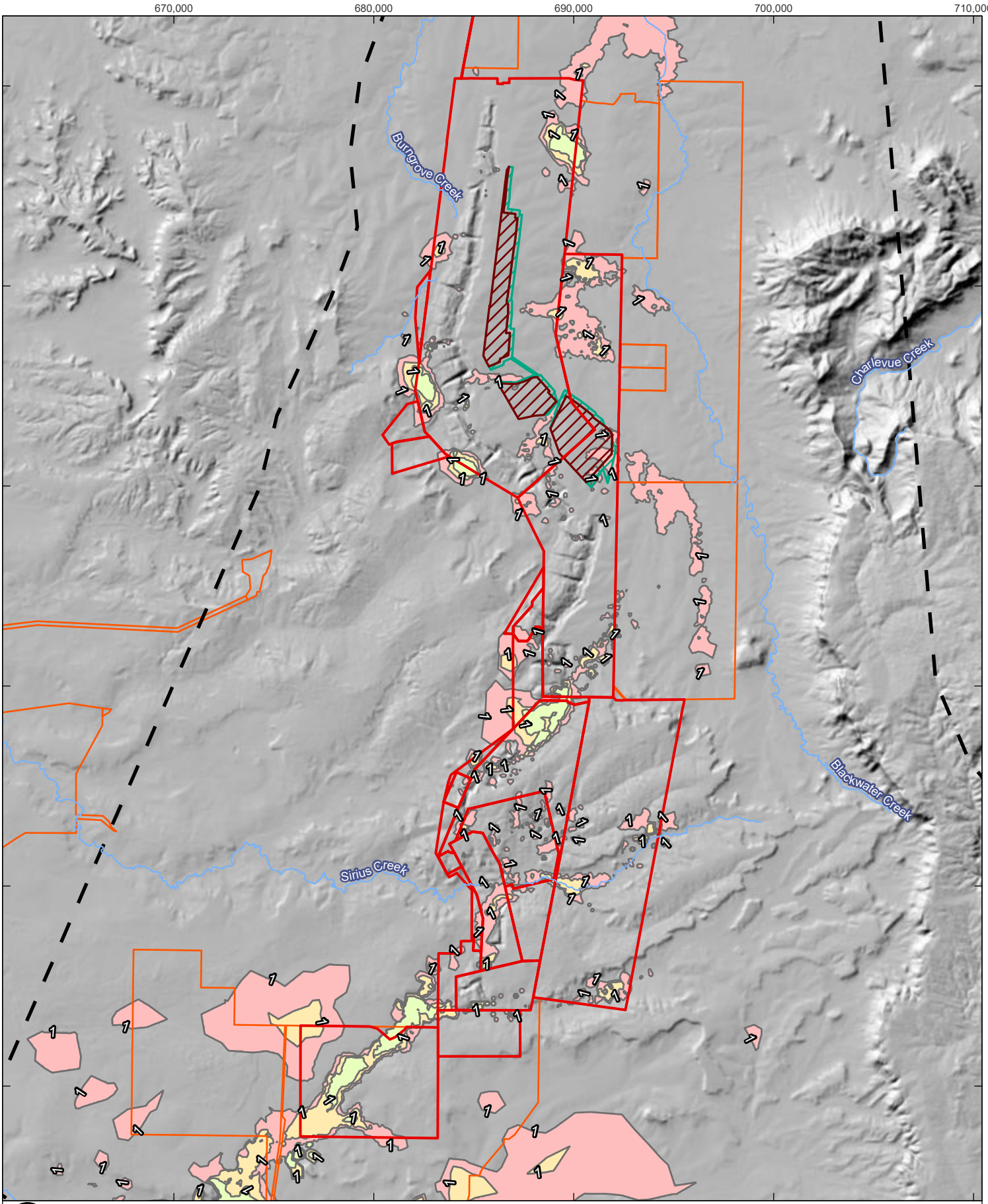
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ALLUVIUM/TERTIARY (END OF MINING) (LAYER 1)

SLR

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APPENDIX G-11

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E11_Uncertainty in Predicted 1m Cumulative DD in Alluvium and Tertiary (EoM) L1



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

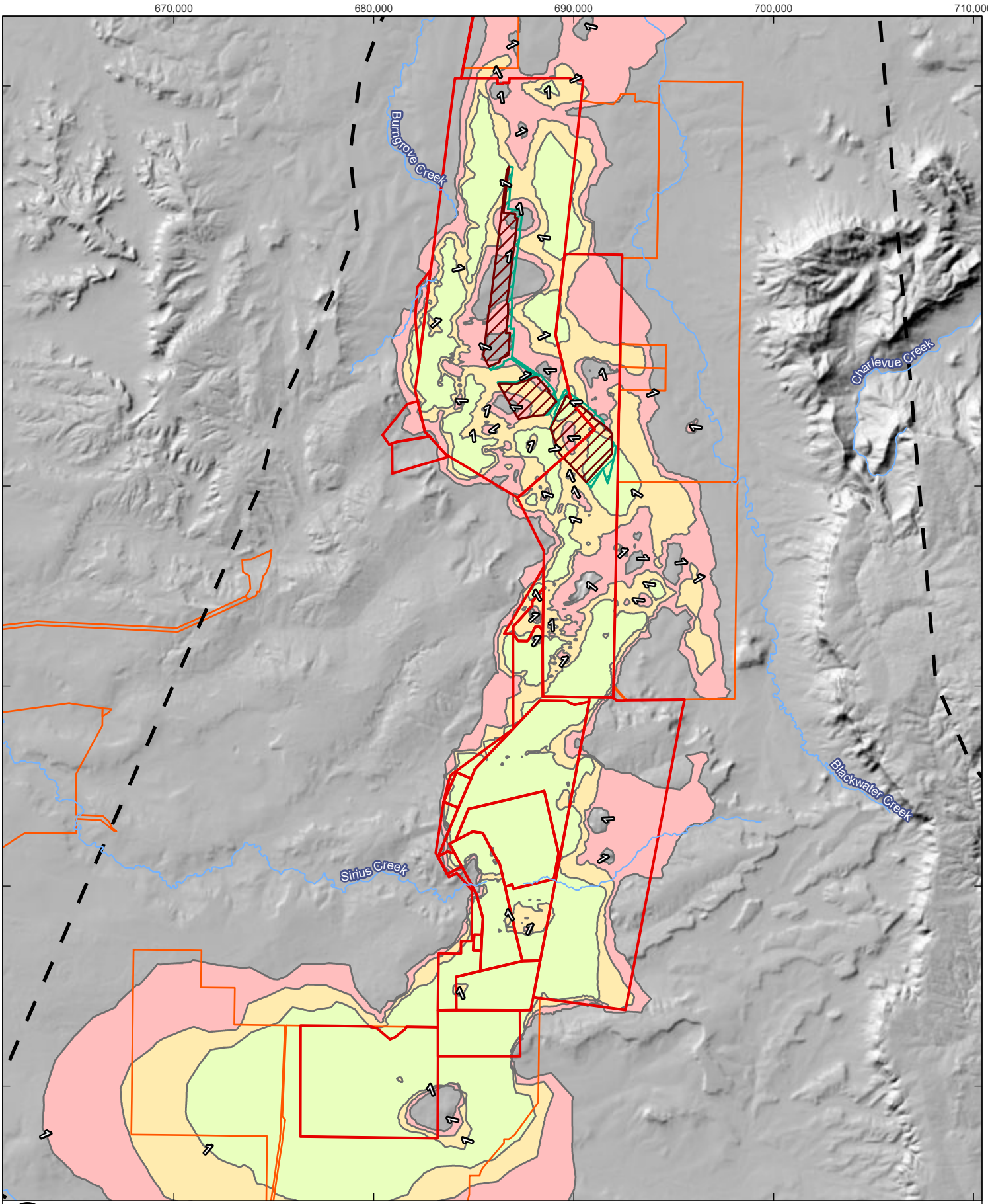
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ALLUVIUM/TERTIARY (END OF RECOVERY) (LAYER 1)

SLR

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APPENDIX G-12

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E12_Uncertainty in Predicted 1m Cumulative DD in Alluvium and Tertiary (EoR) L1



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

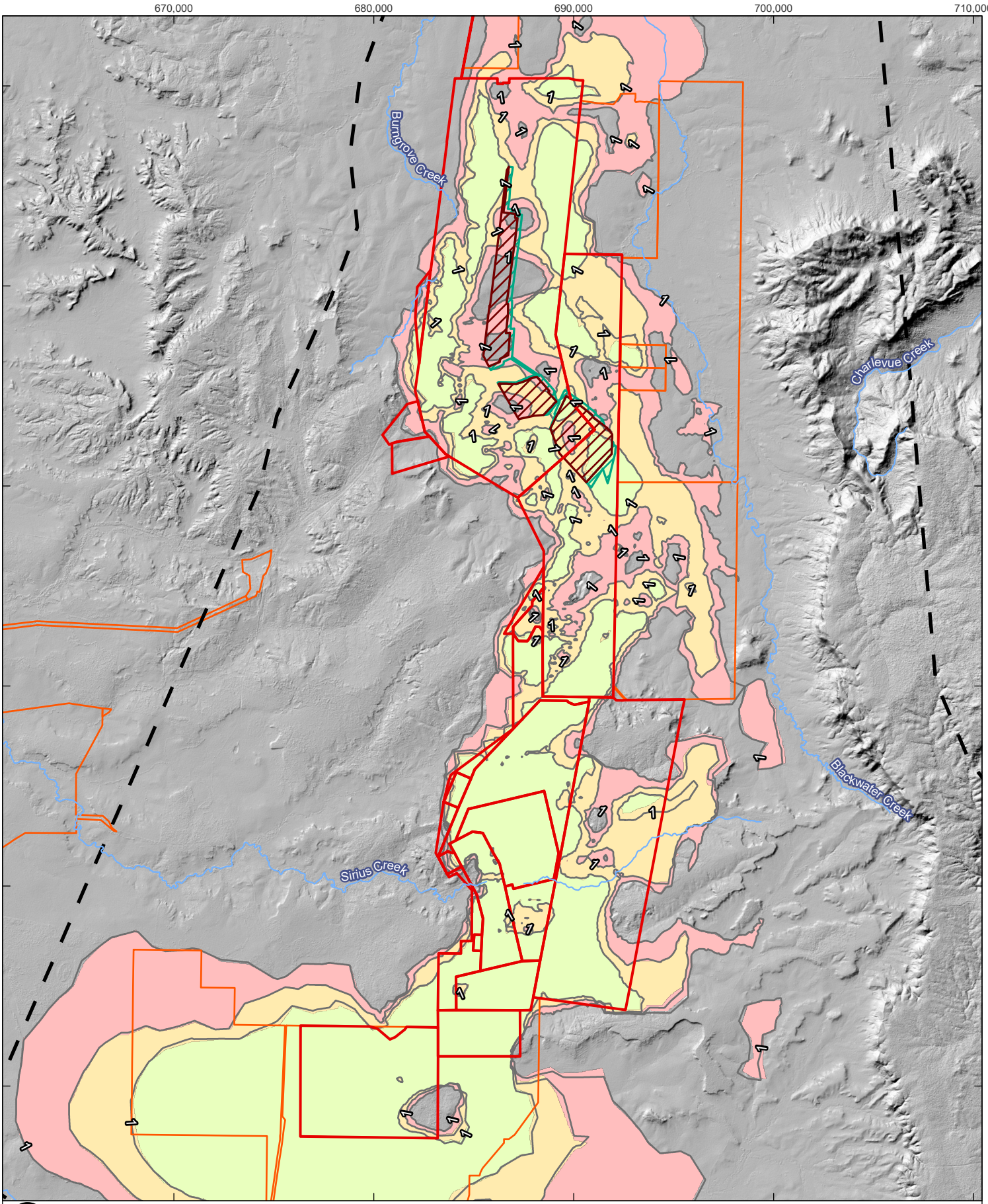
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ALLUVIUM/WEATHERED (END OF MINING) (LAYER 2)

SLR

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APPENDIX G-13

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E13_Uncertainty in Predicted 1m Cumulative DD in Alluvium and Weathered (EoM) L2



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

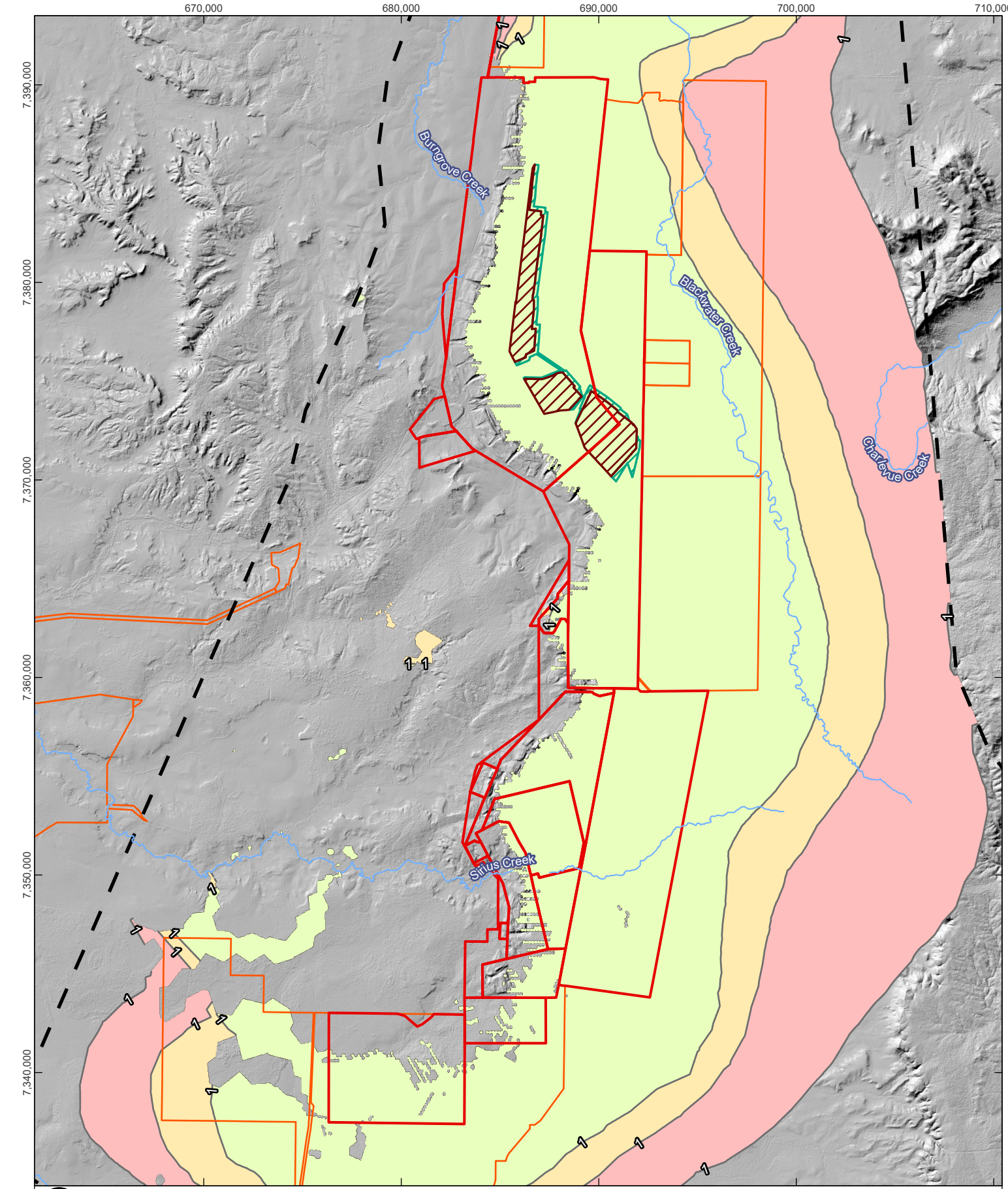
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ALLUVIUM/WEATHERED (END OF RECOVERY) (LAYER 2)

SLR

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APPENDIX G-14

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E14_Uncertainty in Predicted 1m Cumulative DD in Alluvium and Weathered (EoR) L2



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

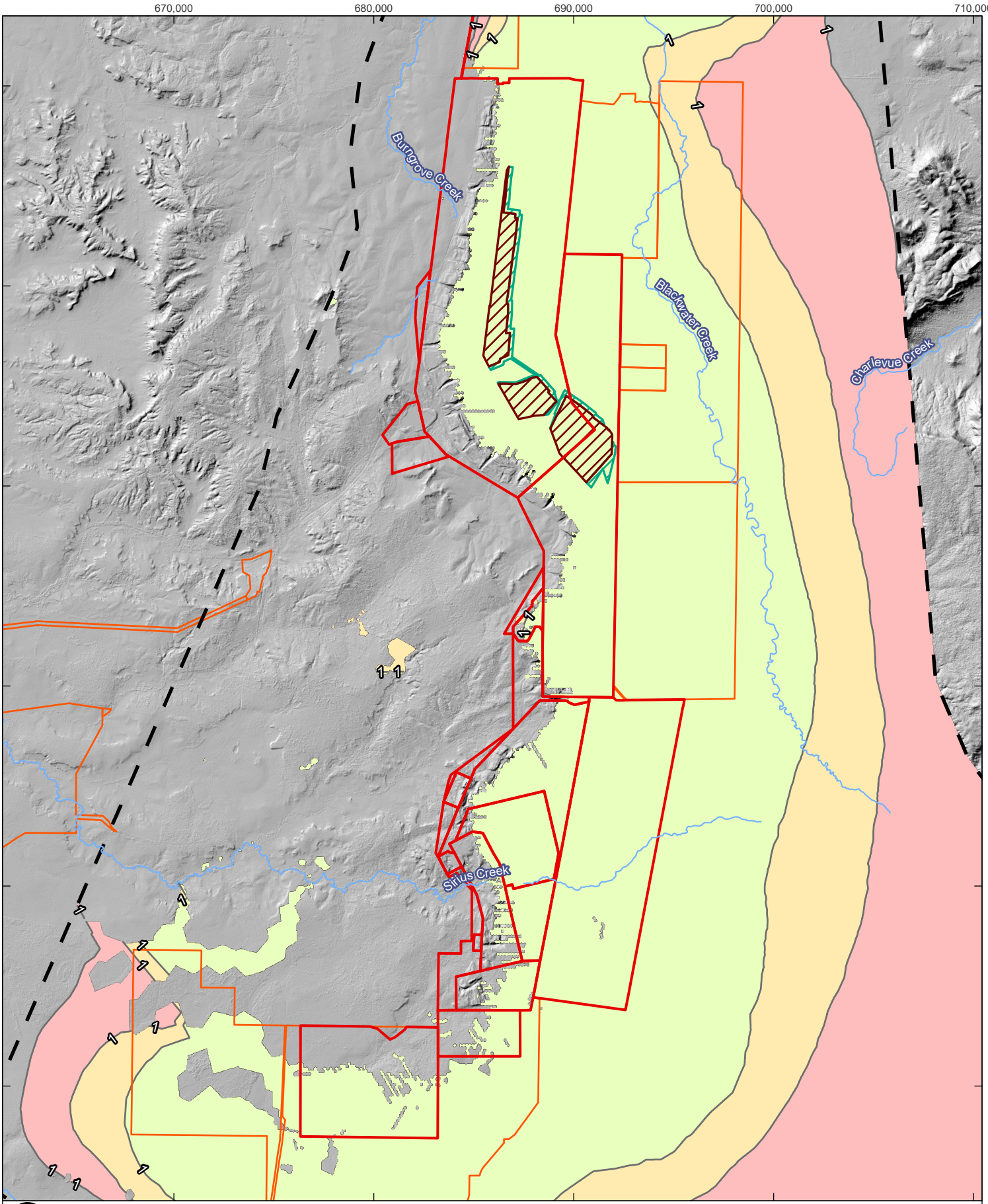
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ARIES SEAM (END OF MINING) (LAYER 8)

SLR

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APPENDIX G-15

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E15_Uncertainty in Predicted 1m Cumulative DD in Aries Seam (EoM) L8



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

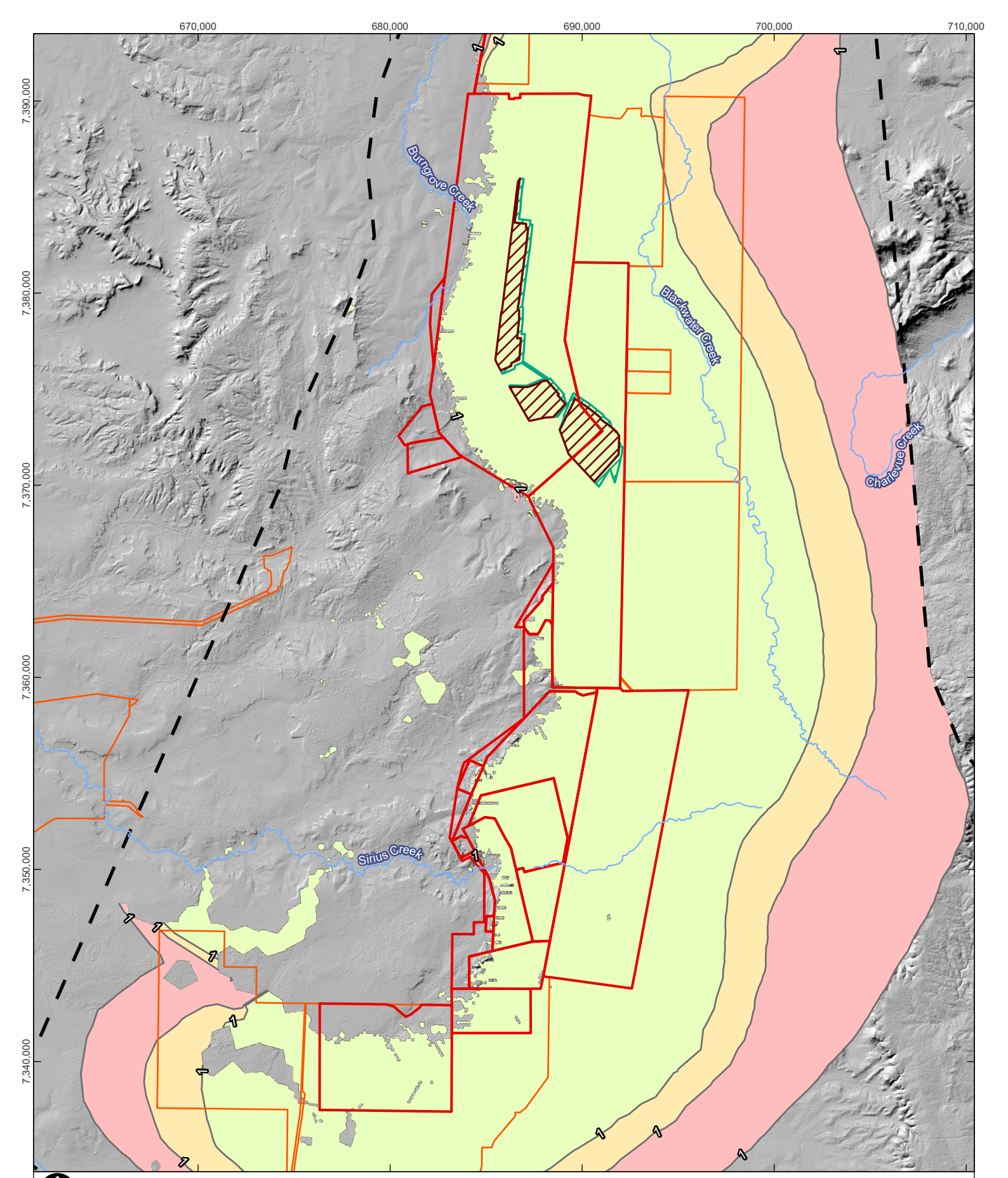
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ARIES SEAM (END OF RECOVERY) (LAYER 8)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-16

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E16_Uncertainty in Predicted 1m Cumulative DD in Aries Seam (EoR) L8



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

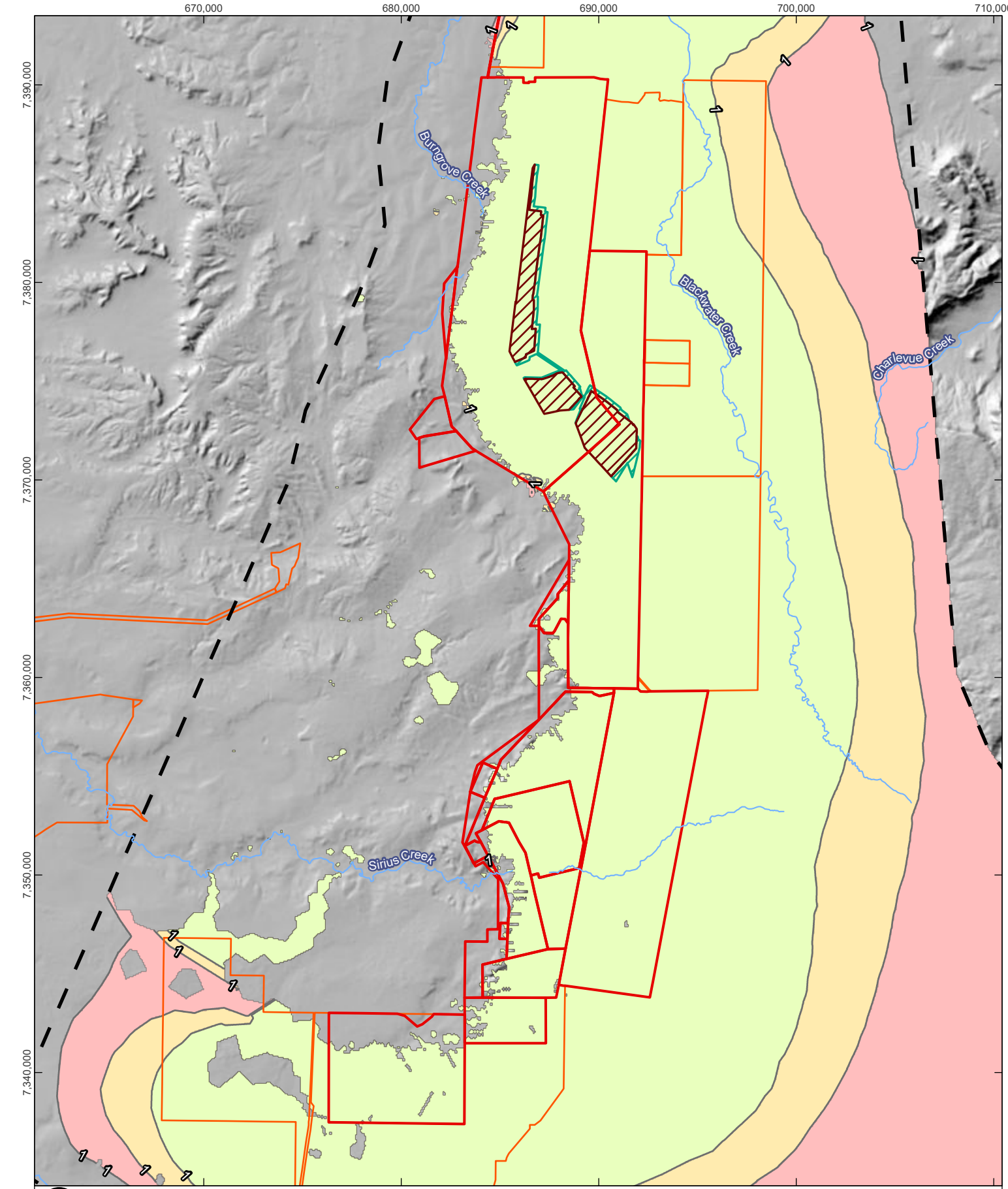
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN POLLUX SEAM (END OF MINING) (LAYER 12)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-17

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E17_Uncertainty in Predicted 1m Cumulative DD in Pollux Seam (EoM) L12



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

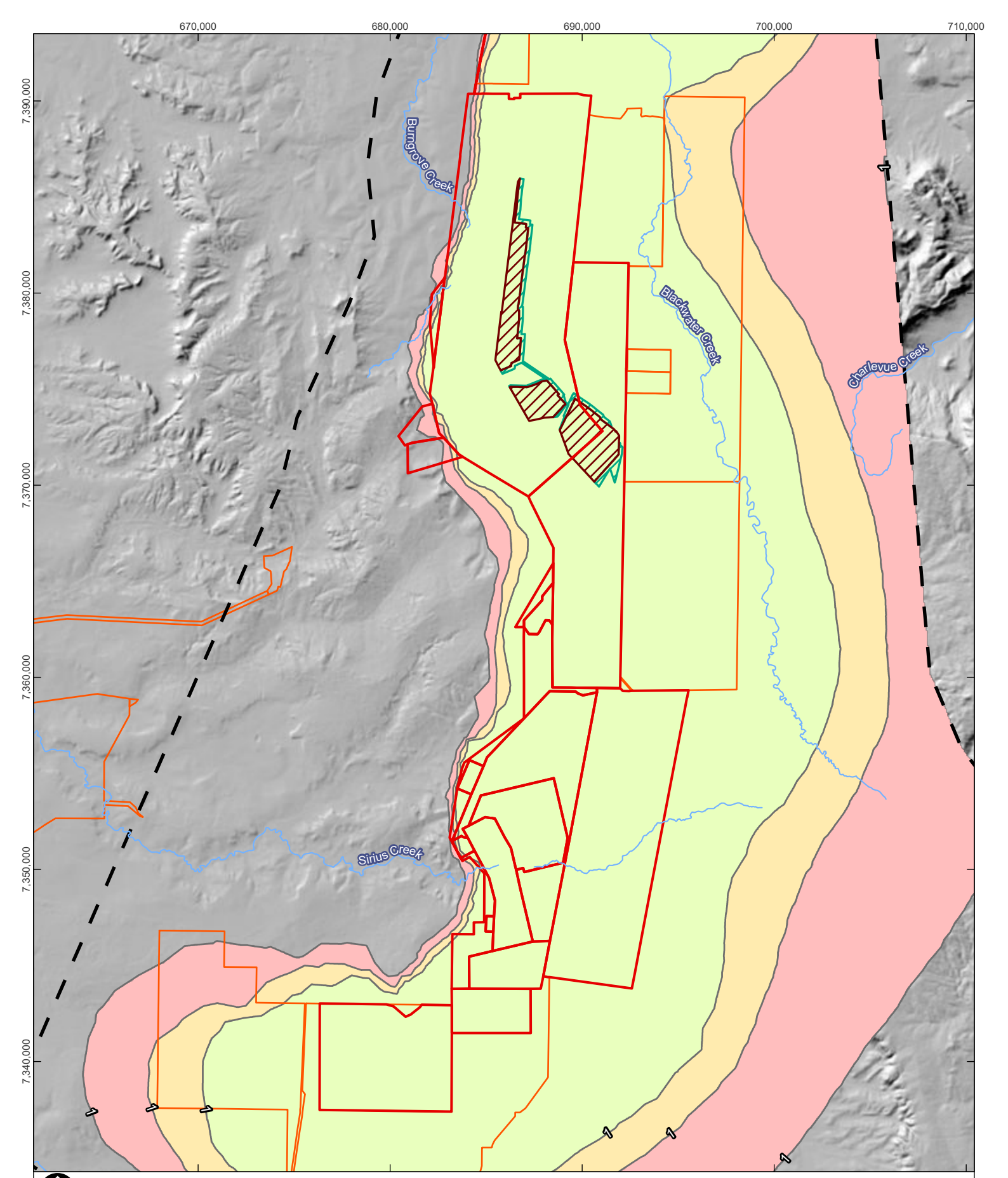
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN POLLUX SEAM (END OF RECOVERY) (LAYER 12)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-18

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E18_Uncertainty in Predicted 1m Cumulative DD in Pollux Seam (EoR) L12



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

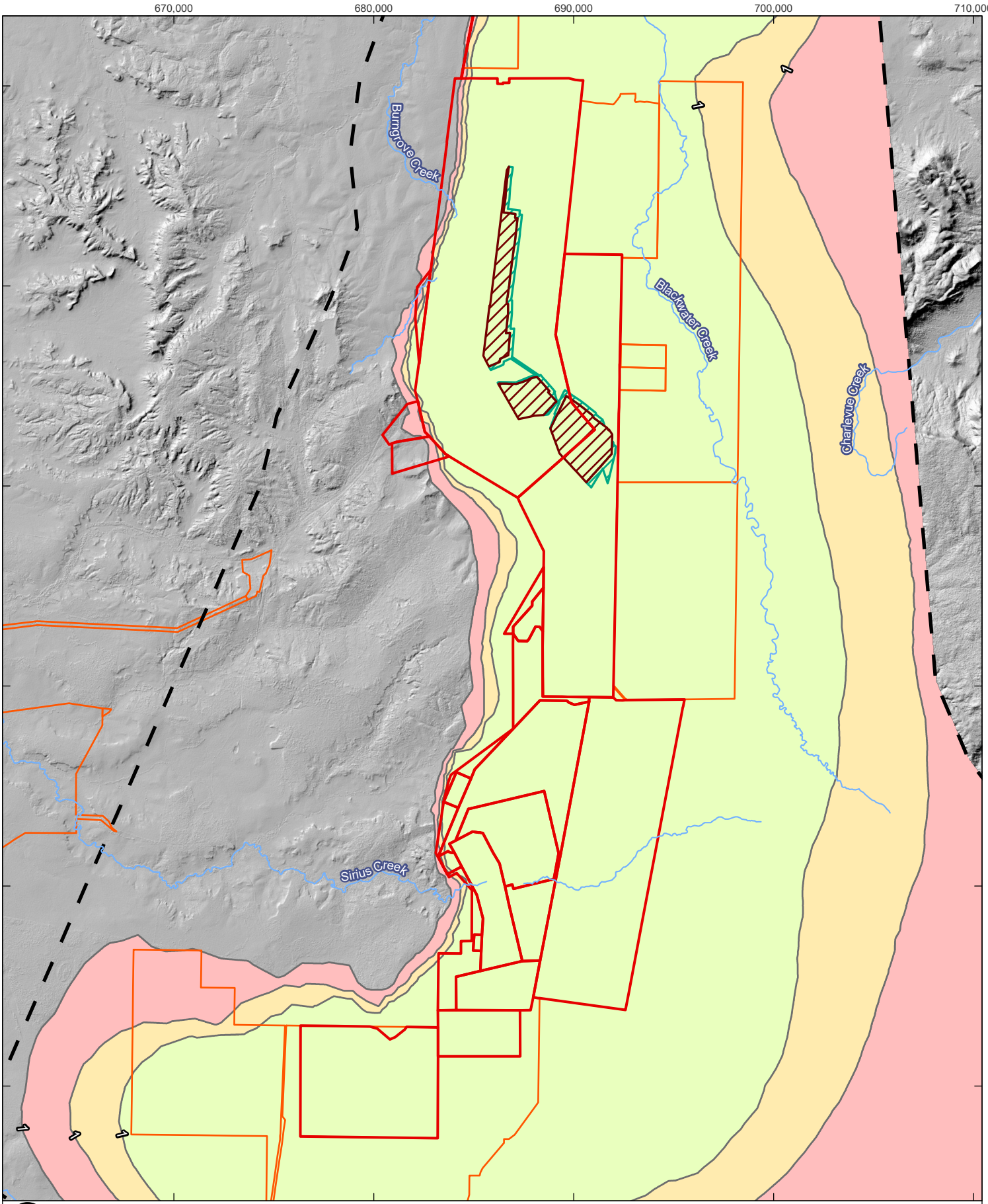
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN BURNGROVE FORMATION (END OF MINING) (LAYER 16)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-19

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E19_Uncertainty in Predicted 1m Cumulative DD in Burngrove Formation (EoM) L16



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

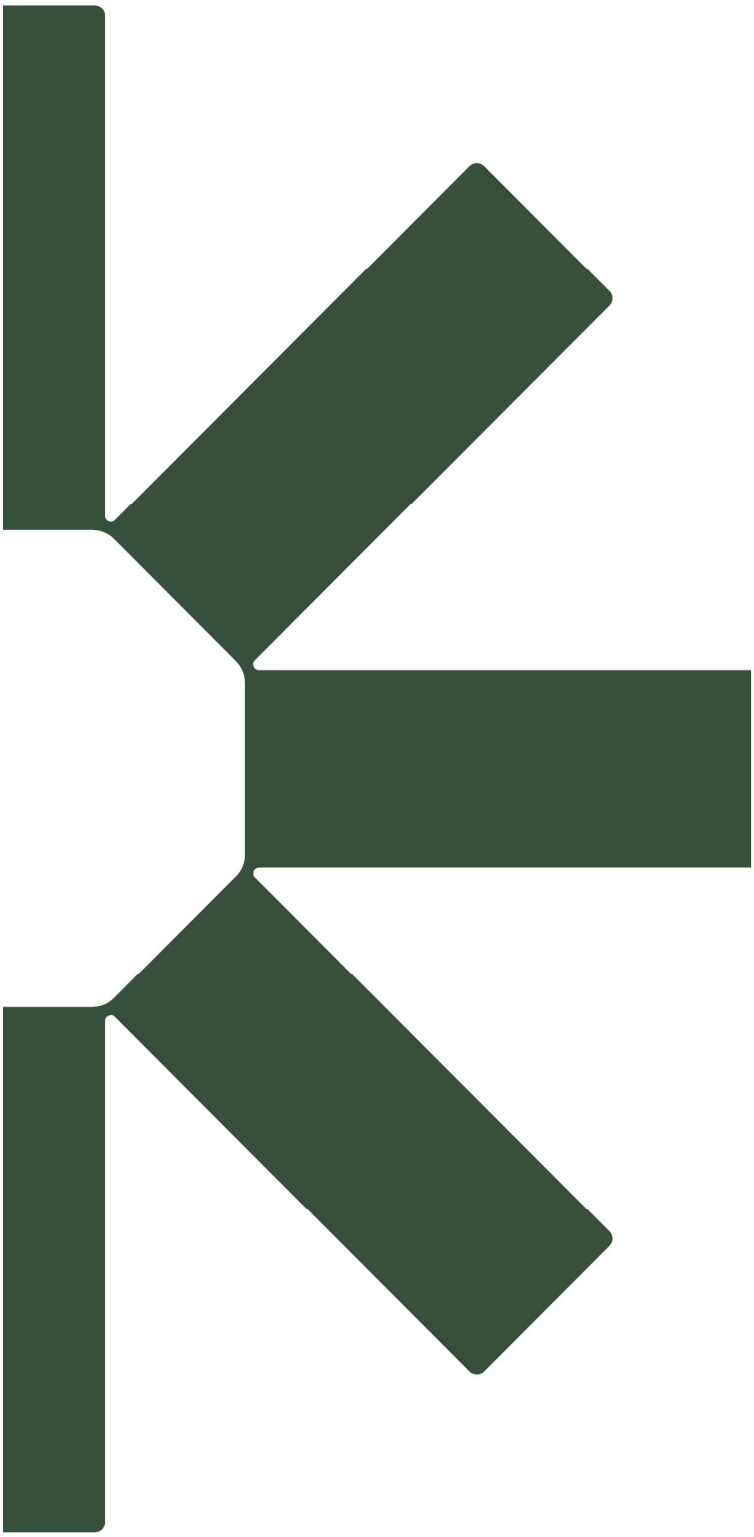
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN BURNGROVE FORMATION (END OF RECOVERY) (LAYER 16)

SLR

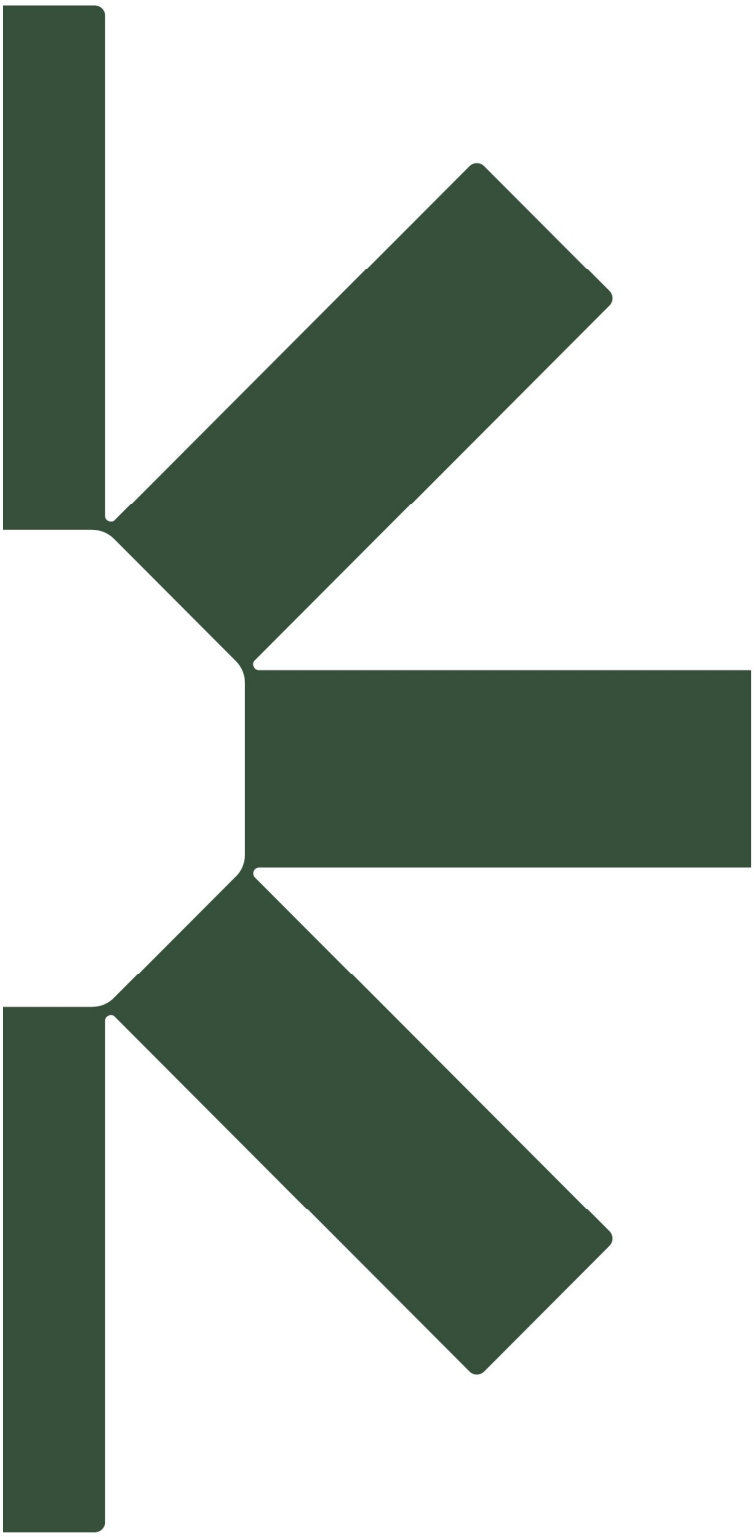
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX G-20

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E20_Uncertainty in Predicted 1m Cumulative DD in Burngrove Formation (EoR) L16



Making Sustainability Happen



Making Sustainability Happen