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Calliope

Hydrogeological Assessment for Operations Progressive Rehabilitation and Closure Plan and Environmental Authority amendment

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Operations
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Rev	Date	Prepared By	Comments
3	June 2025	Ian Oppy	Hydrogeological Report for PRC Plan
2	February 2024	Stephen Feiss	Hydrogeological Report for PRC Plan
1	March 2023	Stephen Feiss	Hydrogeological Report for PRC Plan

FORWARD

This Hydrogeological Assessment report has been prepared to support a Progressive Rehabilitation and Closure (PRC) Plan application in consideration of a planned EA (EA) amendment.

The previous Hydrogeological Report version 2 (v2) was prepared by Steve Feiss who was site hydrogeologist for Sibelco from 2013-18 and for Graymont from 2022-24. This version (v3) has been prepared by Ian Oppy who was Sibelco's hydrogeologist from 2010-13, 2018-19 and for Graymont since 2010. The report versions have many common threads but there is a technical difference between v2 and v3 with change of authorship.

Elevated water levels in Pit 3 following large rainfall events were attributed in v2 to be from leakage through the western bund wall, in conjunction with large groundwater volumes entering the pit void by groundwater discharge. A final pit void (Pit 3-4) Water Balance based on this technical understanding predicted extreme groundwater inflows and a high storage volume of pit water which could potentially overflow into Awoonga Dam.

Historical and further investigations in 2025 are outlined in this report, which demonstrate that elevated water levels in Pit 3 following large rainfall events are from surface water capture and that there is little groundwater flow at the Calliope mine. Multiple lines of evidence include water investigative drilling; surface water and groundwater sampling and characterisation of Pit 3 water flow using data logger water level results. A final void Pit 3-4 Water Balance Model has been constructed based on the technical understanding outlined in this report and a prediction made of water fill in Pit 3-4 final void. The future climate is predicted to be hotter and drier and with increased evaporation pit water level will equilibrate within the final pit void with no overflow to Awoonga Dam.

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1 INTRODUCTION

A Hydrogeological Assessment report has been prepared to support a Progressive Rehabilitation and Closure (PRC) Plan and a planned Environmental Authority (EA) amendment for the Calliope Limestone mine.

1.1 Project Location

The Calliope Limestone mine (Calliope) is located 12 kilometres south of the township of Calliope and 36km south of the major centre of Gladstone, Queensland Australia. The Calliope is covered by nineteen Mining Leases as shown in Figure 1 and is bordered to the east, west and south by Awoonga Dam, which is the fresh water source for the Gladstone and Calliope region.

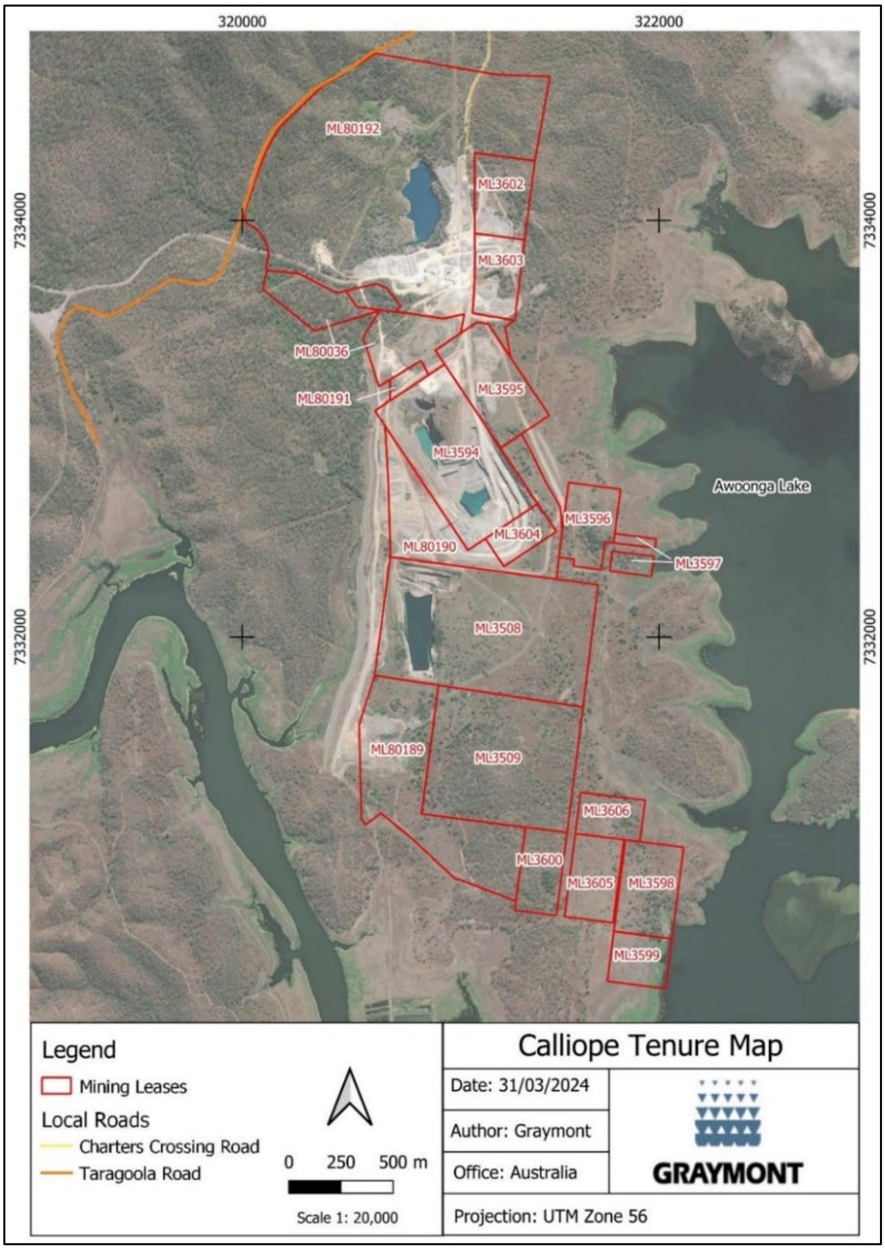

Figure 1 Calliope Tenure Map

The Calliope operational areas are predominately located on Graymont freehold land with the exception of Lot 90 on SP275218 (Figure 2) which is freehold owned by the Gladstone Area Water Board (GAWB), who manage the Awoonga Dam water storage. Graymont has a land access agreement with GAWB.

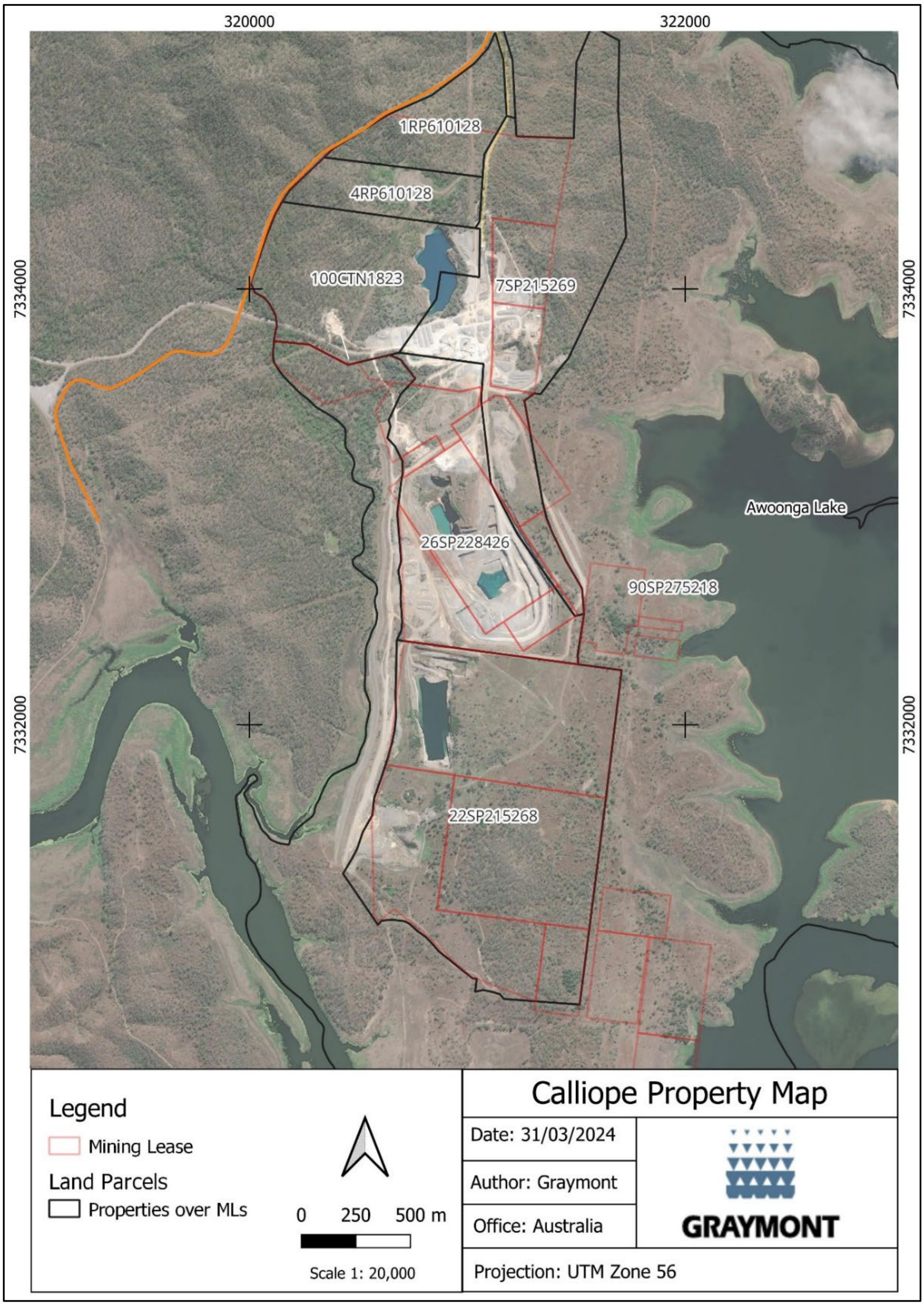

Figure 2 Calliope Property Map

A site map is provided below in Figure 3 which shows site elements which relevant to this report, including mining voids, flood protection bund walls, Waste Dump, Farm Dam and Awoonga Dam.

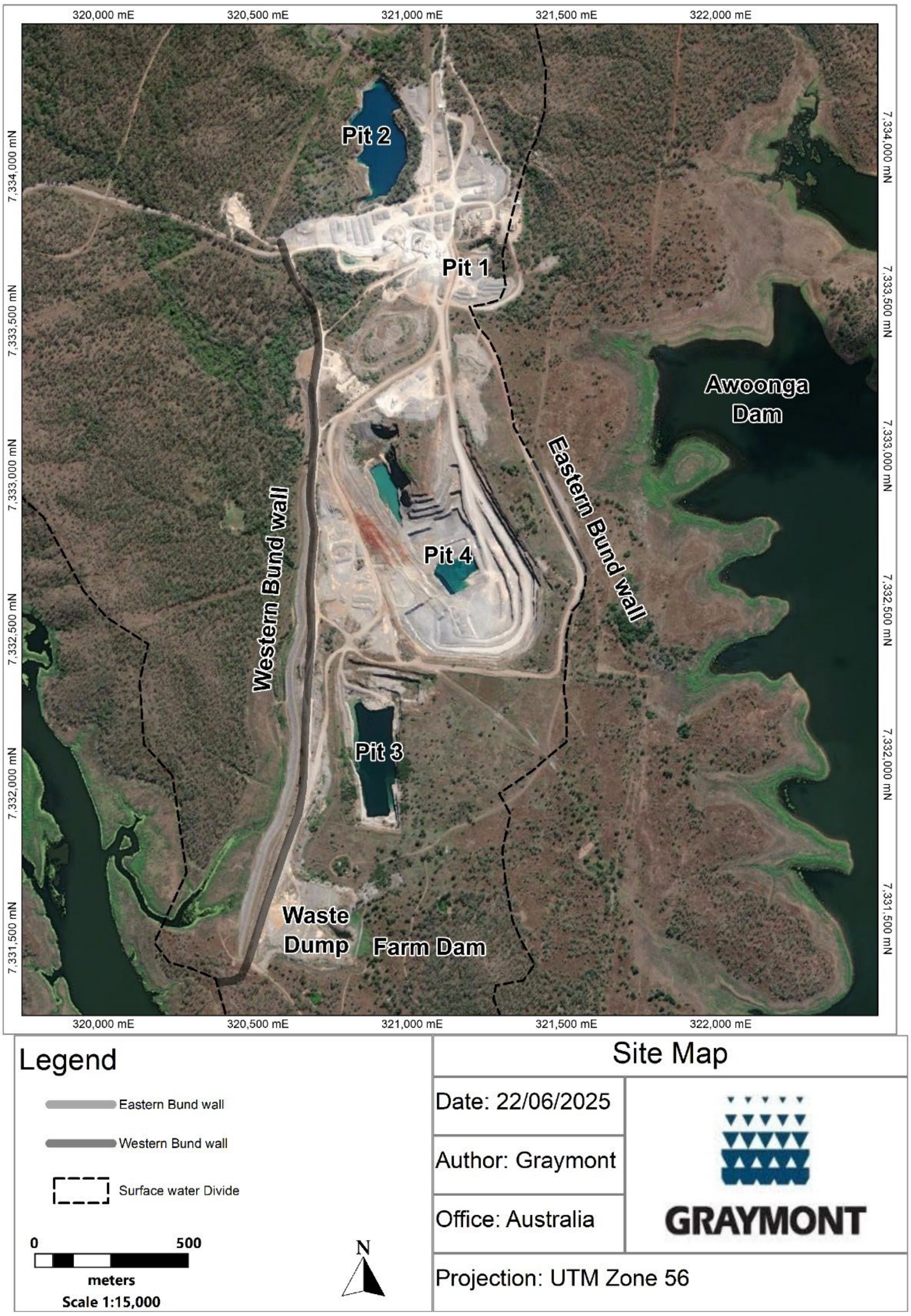

Figure 3 Site Map

At the time of this report only one of the four pits, Pit 4, was active in the mining of limestone. It is planned in future decades to extend the active mine to include Pit 3 immediately south of Pit 4. The combined future mine pit will be herein referred to as Pit 3-4. The main high water bunds protecting the site from rising surface water levels in Lake are the Western Bund and Eastern Bund Report.

1.2 Report Structure

The report has been structured to address the requirements of the following as they relate to groundwater impacts, including:

- Sections 2, 3, and 4 of the *Guideline for Application requirements for activities with impacts to water* (ESR/2015/1837)
- Sections 3.1 and 3.6.1 of the *Statutory guideline Progressive rehabilitation and closure plans (PRC plans)* (ESR2019/4964)
- Items 6 and 7 of the *Information Request Notice* for the amendment application for the EA (reference: C-EA-100720590)
- Items 16, 17 and 18 of the *Information Request Notice* for the application of a PRCP schedule (reference: C-EATPRCP-100177101)

A cross-reference table detailing the relevant requirements and how these have been addressed throughout the report is provided below.

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
Guideline for Application requirements for activities with impacts to water			
2	The activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment.	Storm water runoff is managed in accordance with the Calliope Water Management Plan (WMP). Details of how the WMP ensures no contamination of water values has been provided in this Rreport.	9.1
2	Any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland.	Pit water discharge is in accordance with the WMP which provides control measures for managing water discharge to achieve the EA surface water contaminant release limits.	9.1
2	The activity will be managed so that adverse effects on environmental values are prevented or minimised.	The WMP describes the risks and control measures required to manage water flow and quality on site.	9.1
2	There will be no direct or indirect release of contaminants to groundwater from the operation of the activity.	There is little groundwater at Calliope. Groundwater outside the pit voids slowly drains into the pit voids where it is mixed with surface water to become pit water. Pit water is released in accordance with EA conditions.	7.3.5 7.3.6
2	There will be no actual or potential adverse effect on groundwater from the operation of the activity. Or, the activity will be managed to prevent or minimise adverse effects on groundwater or any associated surface ecological systems.	Groundwater monitoring is undertaken in accordance with EA license requirements to assess potential adverse effects to groundwater and any non-compliances are investigated and any required control measures would be implemented.	2.1.2
3	Site plan Identify on a scaled site plan 1. Topographical contours 2. Identify the direction(s) of surface water runoff and drainage lines that pass through, or are near, the site and any surface waters 3. Any existing or proposed water bores or groundwater monitoring wells within or on land adjacent to the site.	A plan of the Groundwater Monitoring Network is provided with drainage lines and topographical contours	7.3.1
3	Provide a conceptual model showing the movement (including direction and rate of flow) of groundwater in the area. This requirement is essential for activities which have a high risk of contaminating groundwater to determine appropriate locations for compliance monitoring.	A conceptual model is provided showing the movement of groundwater.	6
3	If the environmental authority application is for a resource ERA (mining or petroleum), identify any environmentally	The environmentally sensitive places adjacent to the project are Upper norther creeks area, which includes	3.2

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Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	sensitive places within or adjacent to the proposed mining tenement.	the Ragotte Creek catchment – Calliope; Awoonga Dam and groundwater. Environmental values for these have been provided in the report.	
3	Provide a description of hydrogeological features of the site which include soil and rock types (including porosity, permeability) and stratigraphy (including faulting and fracture propensity).	Project Description includes soil, geology and aquifers.	4.3 4.4 4.6
3	Identify and describe any barriers which are overlying and underlying aquifers.	The aquifer is unconfined and there are no overlying or underlying barriers identified.	4.6
3	Identify the environmental values of potentially affected groundwater the location and depth to groundwater (including perched aquifers or water tables) and the depth to water level/potentiometric surface on the site.	Calliope environmental values are described and are in alignment with Boyne River Basin environmental values.	4.6
3	Details of any groundwater bores in the vicinity of the proposal and the uses of extracted water.	A map of registered bores within 9 km of the site is provided and discussed.	3.9.2
3	Details of the background quality of groundwater, specifically for common anions and cations to characterise the water and for other qualities that may be affected by the proposed ERA e.g. hydraulic conductivity, transmissivity and flow rate. This is only required for activities which pose a material or significant risk of impacting on the quality of groundwater through direct or indirect releases or alteration of hydrology.	Groundwater chemistry based on historical sampling and analysis is provided and discussed.	7.3.5
3	Results of any testing to confirm aquifer properties.	Slug test results from 2002 and 2025 provide an estimate of Hydraulic conductivity but there is insufficient groundwater for pump testing.	7.3.2
3	Where there are underground ecosystems or groundwater dependant ecosystems associated with the groundwater and the proposed activity presents a real risk to these ecosystems, details of those ecosystems and their interactions with the groundwater will be required.	A search of Queensland Globe revealed that there are no GDE's in the Ragotte Creek catchment	3.9.3
4	Identification of potential contaminants and expected concentrations and/or daily and annual loads (including range)	EA conditions stipulate potential contaminants with release limits for surface water and trigger values for groundwater. Daily and annual loads have not been calculated.	2.1.2
4	Identification of whether any contaminants are persistent, toxic, or bio-accumulative and Description of the source(s) of contaminants	Potential contaminants of concern are listed on EA licence and discussed in Project Hydrogeology and the WMP.	7.1.3 7.3.6 9.1.2 9.2.2
4	Identify activities that could lead to direct or indirect impacts and unplanned / uncontrolled release of contaminants to waters, such as, spills, seeps, leaks, or stream bed and/or bank disturbance and describe the magnitude of the disturbance.	Potential contaminant sources are discussed for surface water and groundwater..	7.1.7 7.3.7
4	Where groundwater interacts with surface waters, it is necessary to identify whether the impacts on groundwater quality or elevation, will compromise any identified environmental values and water quality objectives for those waters, or adversely affect a surface ecological system (i.e. through surface–groundwater interactions), or impact on other surface environmental values e.g. agriculture, terrestrial ecosystems. In order to obtain approval for a direct release of contaminants to groundwater, the department must be satisfied that there are no other viable alternatives, and the release is to a confined aquifer and will not deteriorate the environmental values of the receiving groundwater.	Pit water, which is predominantly surface water but has a small groundwater component. Any pit water released in accordance with the EA is in accordance with the water quality limits.	2.1.2 9
4	Where the groundwater hosts an underground aquatic ecosystem, the ANZECC water quality guidelines recommends that that the highest level of protection should be provided to these ecosystems.	Not applicable – The operation does not host an underground aquatic ecosystem	n/a
4	Where the applicant proposes an impact to groundwater, monitoring is likely to be required prior to the commencement of the proposed ERA in order to collect	Groundwater monitoring has been undertaken since 2012 and EA EPML00969013 conditions C17-24 stipulate groundwater monitoring requirements for the	2.1.2

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	sufficient baseline information, as well as at regular intervals during the life of the ERA, including during establishment and any rehabilitation and site closure, to determine if there are any adverse impacts to groundwater as a result of the operation.	Calliope groundwater monitoring network, which is currently for bores FM5 and FM6.	
4	Where there is an indirect release or potential release of contaminants to groundwater, applicants must provide the following information:	Potential sources of contaminants include primary sources from the weathering rocks and secondary sources introduced by mining. The water quality parameters of concern are hydrocarbons and metals Hydrocarbons and metals are not routinely monitored in Pit 2 but FM6 provides groundwater quality data for flow in Pit2 from six monthly annually monitoring. Bore FM5 provides groundwater quality data for flow into Pit 4. Metal concentrations in both the bores are low and are at or near detection limits	7.3.6
	The geological stability of the relevant site for the ERA.	Geological stability is discussed in the geotechnical report.	n/a
	The location, quality and use, or potential use, of the receiving groundwater.	The regional groundwater and its use are described.	3.9
	The permeability of the earth under the place where the ERA is carried out.	Permeability of Waste Dumps is discussed in the geotechnical report. Permeability of groundwater in rock is determined from the slug tests.	7.3.2
	The presence of containment devices at the relevant site for the ERA and their effectiveness in preventing or minimising the release of the waste.	Not applicable – The operation does not have contaminant devices.	n/a
	The distance separating the receiving groundwater from any containment device.	Not applicable – The operation does not have contaminant devices.	n/a
	The potential for fluctuations in the level of the receiving groundwater.	Not applicable – The operation does not have contaminant devices.	n/a
	The way in which materials, including contaminants, will be removed from the containment system	Not applicable – The operation does not have contaminant devices.	n/a
	The way in which materials, including contaminants, will be removed from the containment system	Not applicable – The operation does not have contaminant devices.	n/a
4	Risk assessments are undertaken to determine the significance of a risk and to assist applicants and the assessing officers to decide whether it is acceptable for an ERA, or action, to proceed given the mitigation measures proposed. A risk assessment helps determine the level of environmental risk by quantifying the probability of an event happening, as well as its severity and consequences. A risk assessment may be qualitative or quantitative and can consider environmental, economic, social and other impacts. Risk assessments should not adopt assumptions that conflict with protection of water quality and environmental values of waters or compliance with s. 440ZG of the Act e.g. concluding contaminating waters in a green zone is acceptable because persons are not allowed to take the seafood for consumption.	The WMP forms part of site's Environmental Management Plan. The WMP describes the risks and control measures required to manage water flow and quality on site, monitor water quality and regulate safe water discharge from site	9.1
4	Groundwater impact assessment For activities that pose a high risk of impacting groundwater, a full groundwater impact assessment must be conducted including appropriate modelling to demonstrate that the ERA will not cause adverse impacts on groundwater resources.	Groundwater Impact Assessment undertaken There is little groundwater at Calliope. Modelling undertaken commensurate with the risk profile to groundwater users.	3.7 8
4	A groundwater impact assessment must include:		
	Detailed assessment of current groundwater resources including geological and geochemical characteristics.	Groundwater investigations and monitoring from these investigations, and from bores, have been used to characterise groundwater behaviour.	4.6 5.3 7.3
	Hydrogeological assessment of groundwater resources including groundwater flow characteristics, storativity, hydraulic conductivity and permeability in zones to be impacted by the proposed activities.	Groundwater flow has been determined from investigative drilling and bore monitoring. Permeability has been determined from a slug test of a monitoring bore because there is insufficient groundwater for a pumping bore to accurately determine aquifer parameters including storativity.	7.3.2

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	Details on how seepage detection between deep and shallow groundwater will be considered and managed.	Not applicable – Groundwater is shallow and unconfined.	4.6
	Connectivity with surface water resources.	Groundwater slowly flows into mining voids so connectivity is restricted to mixing with surface water on the pit floor prior to the discharge of pit water.	6
	Impact on groundwater quality as a result of the proposed ERA.	Groundwater slowly flows into mining voids so connectivity is restricted to mixing with surface water on the pit floor prior to the discharge of pit water.	6
	Impact on groundwater flow regimes and drawdown.	There is insufficient groundwater for a pumping licence so there is no dewatering of the aquifer or drawdown of the aquifer.	7.3
	Impact on existing users and future potential uses.	Groundwater slowly flows into mining voids so connectivity is restricted to mixing with surface water on the pit floor prior to the discharge of pit water. Assessment undertaken of pit water potential impacts on environmental values .	6 4.8
	Numeric groundwater modelling of groundwater resources and expected impacts of the proposed ERA.	Not applicable – Groundwater modelling has been undertaken commensurate with low groundwater risk profile. There is little groundwater at site and groundwater flow is towards the mining voids.	n/a
	Groundwater lowering/reduction in hydraulic head (from new voids e.g. caves/karst systems).	A groundwater level map has been created from groundwater monitoring and investigation level measurements. Blasting creates fractures which can extend into the pit floor which capture surface water which is artificial groundwater. There is no creation of larger scale voids.	5.3.3
	Cones of depression and associated impacts.	There is no groundwater pumping and no cone of depression from pumping because there is insufficient groundwater. There are no receiving environments potentially exposed to groundwater level drawdown from the project.	4.8
	Potential contaminants generated and the impacts on the identified environmental values. Potential sources for ground water contaminants include: − Waste rock dumps and tailings disposed underground/in pit − Workshops − Seepage from tailings dam, waste rock dumps, heap leach, process ponds or the direction of pits toward any relevant catchment or town water supply	Potential contaminants identified and control measures implemented in the Water Management Plan and the Groundwater Management Plan. Assessment undertaken of pit water potential impacts on environmental values	9.1 & 9.2 4.8
4.2	**Proposed management practices** Once the magnitude and risk of each impact to the environmental values is known, applicants must identify avoidance, mitigation, monitoring, reporting and offset strategies, where appropriate, to address the risks. These strategies can include physical works, processes or treatments. Similarly, they could include management or monitoring practices. In many cases, adequate environmental management will require both physical works as well as management practices. When identifying avoidance, mitigation, monitoring, reporting and offset strategies the applicant should clearly detail how the works or practices will link back to and address the previously identified risk.	Potential impacts identified and control measures implemented in the Water Management Plan and the Groundwater Management Plan. Assessment undertaken of pit water potential impacts on environmental values	9.1 & 9.2 4.8
4.4	**Groundwater monitoring program** One of the performance outcomes for water is establishing contingency measures. For activities that pose a high risk of impacting groundwater, applicants are strongly encouraged to establish a groundwater monitoring program for the site. The monitoring program should be suitable to monitor the impacts to the environment and provide a detection system to identity if environmental harm has or has the potential to occur.	Groundwater Monitoring network was established in 2012 and monitoring results and network suitability is annually reported to the EPA. An additional three bores are being added to the groundwater monitoring network.	7.3.1
4.4	**Water management plans**	The Water Management Plan (WMP) forms part of site's Environmental Management Plan	10.1

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	Applicants for mining ERAs are encouraged to develop a water management plan. The primary purpose of a mining project water management plan is to examine and address all issues relevant to the importation, generation, use, and management of water on a mining project in order to minimise the quantity of water that is contaminated and released by and from the project.		
Statutory guideline Progressive rehabilitation and closure plans			
3.1	**Baseline information** In addition to the legislative requirements, the following information about the site, where relevant, is considered necessary by the administering authority (as per section 126C(1)(j) of the EP Act) to decide whether to approve the PRCP schedule: • geological setting • site hydrology and fluvial networks • groundwater levels and properties	Project Description includes soil, geology and aquifers. The site hydrology, fluvial network, groundwater levels and properties are explained throughout the document.	4 7 8 9
3.6.1	Assess the hydrogeology of the site and all connected strata and develop a conceptual model of the mine site's groundwater systems. This information must be integrated into the design of rehabilitation strategies and choice of PMLU or NUMA.	A conceptual model is provided from an assessment of site hydrogeology.	6
3.6.1	The hydrogeological assessment should include the following steps:		
	determining the groundwater occurrence including the existence of, and depth to, aquifers and aquitards	Limestone and the volcanics can form either a weak, unconfined, fracture rock aquifer or an aquitard depending upon the connectivity of fractures in these rocks. The depth to groundwater is variably but is typically 15-20 metres depth below natural surface.	4.8
	locating groundwater recharge and discharge locations locally and regionally	Regional recharge is in topographic elevated positions associated with thin soil cover and discharge is in topographic lows associated with deep soil and regolith. Groundwater flow at Calliope is from topographic high to topographic low.	3.9.2 7.3.1
	groundwater quality within each of the aquifers and from surface expressions (i.e. seeps and springs)	Groundwater quality of limestone is not chemically distinguishable on a Piper plot from groundwater in volcanic rock. The limestone and volcanic rock are considered to be a single aquitard and a single aquifer when fractures in the rocks are connected.	5.3
	current and potential future uses of groundwater including existing groundwater extraction bores	Not applicable – No groundwater licence or extraction at Calliope because of an absence of groundwater.	2.1.2
	groundwater flow direction and velocity, including field tests to determine hydraulic conductivity	Groundwater flow has been determined by investigative drilling. Hydraulic conductivity has been determined by slug tests. There is insufficient groundwater for pump testing.	5.3 7.3.2
	the development of potentiometric mapping and hydro stratigraphic cross sections	Groundwater is a watertable not a potentiometric surface. Hydro stratigraphic cross-sections have been created from groundwater intersections from drillholes.	4.6
	groundwater modelling to determine contaminant transport and potential changes to groundwater level from dewatering or waste storage.	Not applicable - No dewatering of pit voids or waste storage	4.6
3.6.1	**Water management** The management of surface and groundwater is a key consideration in achieving long-term rehabilitation success. The rehabilitation planning part must include a description of the following:		
	a description of the contaminants that pose a risk to environmental values of the receiving environment	Potential contaminants identified and mitigations measures outlined in Water management Plans. An Assessment was undertaken of pit water potential impacts on environmental values.	10.1 4.8

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Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	source, pathway and fate of contaminants that have the potential to impact environmental values	Pathway receptor linkages identified and assessed	4.7
	infiltration and seepage intervention and collection controls	The WMP outlines water control measures	10.1
	surface water diversions and long-term management requirements	The WMP outlines water control measures. In the long-term surface water diversion modifications will be required when Pit 3 combines with Pit 4 and works required will be addressed at that time.	9.1
	dewatering requirements	There is no groundwater dewatering.	2.1.2
	on-going water management and reduction requirements (i.e. treatment).	There is no groundwater dewatering.	2.1.2
3.6.3	**Voids** For mine sites with voids, the rehabilitation planning part must include a void closure plan that includes, but is not limited to, the following:		
	void hydrology, addressing the long-term water balance and water level in the voids, stratification connections to groundwater resources and potential for overflow	Water balance modelling shows that the Pit 3-4 void will remain a sink, despite increasing the groundwater inflow from the measured 1 l/s to 25l/s.	8.3
	groundwater modelling to determine whether the void is acting as a sink or a source for groundwater	Water balance modelling shows that the Pit 3-4 void will remain a sink, despite increasing the groundwater inflow from the measured 1 l/s to 25l/s. Current groundwater inflow is <1 l/s and a predicted, conservative, final void inflow of 5 l/s has been used for water balance modelling.	8
	a water balance study including an assessment of void surface and groundwater interactions such as: • groundwater lowering/reduction in hydraulic head (from new voids) (e.g. caves/karst systems) o cones of depression and associated impacts • the drainage and flooding behaviours of surface waters in the vicinity of the void • the potential extent of flooding and implications of interactions with the void • a conceptual model that incorporates all projected inflows, outflows, and recharge rates • water storage and long-term water balance • each of the major water fluxes into and out of the void • the sources of surface water within the mine catchment that are likely to influence the water quality in the void • predicted water quality in the long-term including potential stratification • a 3D void design plan • rehabilitation strategies	A water balance model has been derived from water investigations. Pit water stratification was investigated in Pit 3 which displays some stratification which is common for deeper water columns.	8 7.1.3
Information Request Notice for the amendment application for the EA			
6	The application provided a hydrogeological assessment for the site however the analytical modelling is based on the limited available groundwater data and did not consider the complexity of the geology associated with the site.	A total of 34 holes were drilled in 2025 around the perimeter of Pit 4, Pit 1 and east of Pit 3 which defined geology and groundwater behaviour. The majority of holes were drilled dry and slowly made water. All drillholes were capped and collars surveyed to ensure groundwater data integrity. Limestone in pit void is bedded sub-vertically and is flanked outside the pit void by volcanic rock. Geology is simple and there is sufficient groundwater data, in addition to drilling, to demonstrate that there is little groundwater and that analytical modelling is appropriate.	5.3
6	Provide a numerical hydrogeological model which considers the complexity of the mining site including but not limited to:	A numerical model was constructed in 2002 but this construction was hampered by an absence of hydraulic aquifer parameters, because of insufficient groundwater to undertake a pump test and modelled results have been proven to be unreliable. An example	8

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
		is that the model predicted a possible 10 fold increase in groundwater at 40mAHD. Pit 4 is currently at -20mAHD, being 78% the depth of modelled pit depth, and groundwater inflows remain very low. The analytical water balance model and predictions as outlined in the previous Hydrogeological Assessment is not in alignment with the 2011 conceptual and analytical mode. The 2011 model was derived from field sampling and showed that there is little groundwater entering Pit 3 void. The 2011 model was verified by investigative drilling in 2018, being 14 holes west of Pit 3, and recent investigation has showed that there is also little groundwater entering Pit 4 void. A numerical model has not been derived because sensitivity analysis of the updated analytical water balance model, based on all available water data, demonstrates that there is little groundwater at final void and numerical modelling of groundwater is not justifiable based on the negligible risk of groundwater interaction with any other water bodies outside the pit void.	
	Inclusion of cross section for all voids that identifies the limestone resource in comparison to the final projected void levels.	Cross-sections included for Pit 3 and Pit 4.	4.6
	Consideration of adjacent geological formations and faulting Further Clarification Note: Section 3.4 states, 'specific lithological boundaries are not necessarily constraining the flow of groundwater and hence a lithostratigraphic boundary for the aquifer is not appropriate' however, there is no discussion on the likely groundwater connectivity between Calliope beds and the other nearby geological formations and as such this statement appears unsupported by data. The interaction between the geological formations is critical for understanding potential impacts of mining and how modelling of the mining impacts should be undertaken	Groundwater -lithological relationship further investigated by drilling. The majority of drilled were dry with the most groundwater intersected at and near the volcanic -limestone contact. Site blast hole drilling driller logs of water intersection confirm that groundwater intersections are uncommon. There is no known faulting in Pit 3-4. Drilling confirm that groundwater occurrence is variable between lithologies. Groundwater chemistry of drillholes and bores from both lithologies are similarly variable and there is no clear distinction between groundwater from limestone and volcanic. A lithostratigraphic boundary can be defined but it is not a groundwater boundary condition.	4.6
	Consideration of recharge to the groundwater system through north-south groundwater gradient and rainfall Further Clarification Note: The application identifies that the groundwater flows eastward from the Boyne Range State Forest towards Lake Awoonga, however any recharge from this area may have limited impacts on the mining area given the faulting between the Rockhampton Beds and the Calliope Beds. The only certain groundwater gradient currently proven is from north to south from FM6 to FM5 and recharge in the area may be attributed to the elevated areas in the north (in the Calliope Beds) and draining south	Investigative drilling confirmed that groundwater divide aligns with surface water divide. Groundwater flow is north to south from Pit 2 to SE of Pit 4 while also flowing easterly and westerly from the groundwater divide. Groundwater at FM6 flows to Pit 1, and at FM5 to Pit 4. Rainfall response of groundwater is similar in both FM5 and FM6 which indicates similar recharge. Rockhampton Beds lie to the west of current and life of mine Pit 3-4 void and do not influence the conceptual and analytical water balance modelling presented in this report. Additional investigative drilling of 34 holes has proven that groundwater flow is easterly and westerly from the groundwater divide.	5.3
	Consideration of hydraulic connectivity that considers changing ground elevation Further Clarification Note: The model assumes constant hydraulic conductivity in all directions in what appears to be a single layer model which potentially does also not account for changing ground level elevations	Limestone and volcanic are primarily an aquitard but both can host groundwater in fractures but water level flow and chemistry is indistinguishable and there is only a single weak unconfined aquifer at Calliope. Pit 3 and 4 voids combined measured groundwater seepage is <1 l/sec and since Pit 4 floor is at -20mAHD, being 67% of final void depth, and is 95% of final void width.	5.3 7.3.3

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
		Groundwater has not been intersected from drilling below 5mAHD or in the pit floor. It is very unlikely that significant groundwater will be intersected in Pit 3-4 final void based on Resource drilling to a maximum depth of -105.1mAHD. An analytical water balance model has been derived based on a field measurements and metered data. Hydraulic conductivity estimates do not change modelled outcomes but slug test results from bores FM1-4 in 2002, with a hydraulic conductivity of 0.003 m/day, support findings that there is little groundwater seepage. Slug test results from bore FM6 in 2025, with a hydraulic conductivity of 0.042m/day further support findings there is little groundwater seepage.	
	Consideration of connectivity to Awoonga Dam and changes to water levels over time Further Clarification Note: It does not appear to consider the connection with Awoonga dam including the significant seepage that can occur at times from Awoonga dam to the pit/s or the changing water levels over time in Awoonga dam and how that is impacting groundwater.	Awoonga Dam leakage to Pit 3 was proposed by GHD in 2011, however no physical evidence has been found of piping from all Western Bund wall inspections. Water chemistry confirms that water flowing into Pit 3 is not related to Awoonga Dam water because it is 2.5 times the salinity of Awoonga Dam and Piper Plots confirm that it is of a different chemistry. Water chemistry shows that the Pit 3 water is from surface water flowing from the Farm Dam. Investigative drilling in 2018 delineated groundwater at 32mAHD being approx. 5m below water inflow which provides dampness on bench but no groundwater inflow into Pit 3. The 2018 drilling was undertaken when Awoonga Dam water level was 38.8mAHD and demonstrates that only very minor seepage occurs beneath the western bund wall when Awoonga Dam water level is elevated. The water inflow into Pit 3 is not from Awoonga Dam leakage or groundwater seepage. There is no relationship between water flow into Pit 3, aka "significant seepage" and groundwater seepage.	5.2
	Consideration of clarification of the limestone resource and final water bodies Further Clarification Note: The assessment lacks consistency and clarity on the limestone resource in relation to the site hydrogeology. Section 1.2 of the report gives the appearance that the limestone extends to 8 m below the surface by identifying that grey limestone with clay filled cavities is present to a depth of between 5 to 8 meters however, section 2.3.2 assumes that the void will be approximately 100 m below the natural surface.	Drilling confirms that the limestone Resource extends to -105.1mAHD being m below the natural surface but limestone is weathered with some voids, that are generally clayed, at shallow depths beneath the natural surface.	4.3 4.5
	Consideration of the influence of all voids when determining the impacts to groundwater and the inclusion of a map identifying the location of each pit. Further Clarification Note: Appendix 6 Figure 2 appears to indicate that the proposed future combined pit 3 and pit 4 has been represented by two extraction points. This does not appear to be representative of the full pit area or any impacts that pit 2 may be continuing to have.	End of mine life Pit 3-4 will remain a void, Pit 1 has been filled and Pit 2 will also remain a void. Groundwater is mounded at Pit 1 between Pit 2 and Pit 3-4. Pit 2 is currently used for water storage of pumped Pit 4 water to be used on site. Groundwater will slowly flow and seep into Pit 2 void but is unlikely to measurably change water quality given the large volumetric difference between pit water and groundwater seepage. A map of all pits is included.	5, 8
	Consideration of limitations associated with this monitoring network and potential limitations that this places on the groundwater modelling Further Clarification Note: The inadequate groundwater monitoring network provides a significant limitation to modelling in its inability to provide an initial understanding of the groundwater levels and flow direction.	The current groundwater monitoring network is appropriate based on groundwater behaviour and groundwater risk profile but an additional 3 bores will be installed to at the site.	7.3.1
Information Request Notice for the application of a PRCP schedule			

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
16	Appendix E *(F)* and section 7.2 of the PRC plan discusses drilling records for various bores but no information on these records is provided. There may also be some uncertainty in some hydraulic parameters used in groundwater modelling (section 2.2 of Appendix F). Provide: • Omitted information on monitoring bore construction details. • Update hydraulic parameters to reflect site geology and water flow dynamics.	Bore construction details are appended. Hydraulic parameters are updated to reflect site geology and water flow dynamics.	 7.3.2
17	Section 2.3 of Appendix E *(F)* includes a water balance model to predict water levels in the final void, but no information is provided on which model was used or the input parameter values used. The model must be referenced and described in the PRC plan document Include a detailed description of the water balance model used to predict final pit water levels.	The Water Balance Model in the previous report version used an average groundwater seepage of 43 l/s for the final Pit 3-4 void , based on interpreting water inflow to Pit 3 to be groundwater. The Water Balance Model in this report version used an average groundwater seepage of 5 l/s. for the final Pit 3-4 void, based on observed and measured groundwater inflows <1 l/s for both pits. Sensitivity analysis of the Water Balance Model in this report shows that if average groundwater seepage is <45 l/s with seasonally varying rainfall pit water will remain contained within the pit void. A detailed description is provided of methodology, assumptions, parameters and predicted pit water fill under different climatic scenarios.	8.3
18	Appendix E *(F)* shows predicted groundwater contours and flow directions, with flow near the site to be west to east. The predicted future water table (Figure 10a) suggests the final void will be a flow through system. Figure 7 shows the bores on site but there appears to be few bores along the eastern boundary, across which is the predicted direction of groundwater flow. Additional groundwater monitoring bores are required to be installed, along this eastern boundary to confirm groundwater levels and flow directions, to better describe and model the hydrogeological character of the site (Section 2.10.3 of Appendix E *(F)*). This is important in terms of quantifying groundwater flow direction particularly as the final void will be a flow through landform in direct contact with the regional groundwater. Include a hydrogeological assessment that accurately describes the groundwater flow and velocity and provide modelling to determine contaminant transport.	Investigative drilling confirmed that groundwater divide aligns with surface water divide with groundwater flowing east and west from the divide. The predicted future water table will remain a closed system. Investigative drilling and subsequent water monitoring has confirmed groundwater levels and flow direction. Three monitoring bores are planned to be installed at investigation drilling locations. Currently there is <1 l/s of groundwater seepage into combined Pit 3 and Pit 4 voids and in accordance with the Water Balance Model if there is <35l/s of groundwater at final landform then the final landform Pit 3-4 void will remain a sink. This hydrogeological assessment accurately describes groundwater flow because it is based on recent intensive fieldwork and extensive historical fieldwork, some of which was not previously reported.	5.3

Table 1 Cross-Reference Report Table

1.3 Assessment Method

The Calliope is an established operation with an Environmental Authority license and an Environmental Management Plan (EMP). The EMP defines environmental protection measures for the management of impacts associated with the project and addresses Environmental Authority license conditions. The EMP outlines Water Management Objectives, Environmental Values, potential impacts, target and key performance indicators, control measures, monitoring and reporting. Further details on Water Management are provided in the Water Management Plan (WMP) and in the Groundwater Management and Monitoring Plan (GMMP). Surface water management structures at Calliope effectively controls the flow of rainfall run-off and store excess run-off to prevent uncontrolled releases and allow continued mining operations.

Pit water is composed of groundwater and surface water. Groundwater flow entering the active Pit 4 is monitored in accordance with EA conditions and groundwater unaffected by mining is also monitored in accordance with EA conditions. A suite of water quality parameters are analysed for the groundwater samples and groundwater triggers levels are applied to the monitoring bores. Pit water is either used, stored and/or discharged. Pit water that is used or stored onsite is not routinely sampled. Surface water that is discharged has regulatory controls being surface water release limits and licensed surface water discharge points. Pit Water to limits set for Electrical Conductivity (µS/cm), pH and Total Suspended Solids (mg/L).

The assessment method adopted in this study to address Regulatory requirements has been:

- Review and summarise existing Water Management
- Synthesis historical groundwater investigations, identify data gaps and to undertake a groundwater investigation in 2025 to bridge data-gaps relating to groundwater behaviour and risk profile
- Determine the Boyne River Basin Plan environmental values relevant to Calliope
    - Environmental values relevant to Calliope are: Upper northern creek catchment, Awoonga Dam and Groundwater (Bores…etc)
- Identify mechanisms of potential impact and risks to environmental values of the Boyne River Basin
    - Awoonga Dam and downstream environmental values
    - Bores
    - Mine voids groundwater interaction and water quality
    - Groundwater Dependent Ecosystems (GDE)

Assessment outcomes presented in this report demonstrate that groundwater at Calliope has a low risk profile because of a lack of groundwater and because mining voids act as sinks.

2 REGULATORY FRAMEWORK

2.1 Project Environmental Approvals

2.1.1 Water License

The Calliope is located in the Boyne River Basin, which has a water plan that :

- regulates the take and interference of surface water
- allows for the take of groundwater and overland flow water
- provides for water allocations, water licences and seasonal water assignment

Under the *Water Act 2000*, 'associated water' refers to underground water that is taken or interfered with as a result of an authorised activity (such as mining). This usually involves activities like dewatering mine pits. These activities are managed through the underground water management framework outlined in Chapter 3 of the *Water Act 2000*. As the Calliope only uses water stored in Pit 2 and does not access any additional surface water or groundwater, this is considered 'associated water' and therefore does require a water license under the *Water Act 2000.*

2.1.2 Environmental Authorities

Mining activities are undertaken in accordance with regulatory approved Mine Plans and Environmental Authority (EA) licence conditions. The current EAs for Calliope are listed in Table 1 and include a prescribed EA for the taking of quarry material and a Resource Activity EA for mining of limestone. The Resource Activity EA is the subject of this application and is discussed further below.

EA Reference	Permit Type	Approval Authority	Status	Date Granted
EPML00969013	Resource Activity	Dept of Environment and Science	Active	1st February 2021
EPPR00881913	Prescribed ERA	Dept of Environment and Science	Active	18th January 2019

Table 2 Calliope EAs

EA EPML00969013 outlines the requirement for Calliope Limestone Operation to ensure offsite impacts are minimised and any discharge waters are within acceptable limits. Release limits for licensed surface water discharge points and their monitoring frequency are shown below. Condition C2 of the EA states that the release of contaminants to waters must only occur from specified release points F1, F2, C1 and C2. See Table 1.

Release Point (RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
F1	321432	7332026	Pit 3 and Pit 4	End of pipe F1 (Discharge Monitoring Point)	Lake Awoonga Dam
F2	320399	7331469	Undisturbed natural flow and/or Pit 3	Raggote Ck at F2 (Downstream Monitoring Point)	Farmers Dam
C1	320757	7333601	Pit 1, Pit 2 and Pit 4	C1 dam spillway (Discharge Monitoring Point)	Pit 2 and/or Recycled Water Storage Dam
C2	320102	7333854	Undisturbed natural stormwater flow	C2 creek adjacent to rail siding road (Upstream Monitoring Point)	Ragotte Creek

Table 3 Surface water release points

A map of EA surface water release points and groundwater monitoring locations is shown in Figure 4.

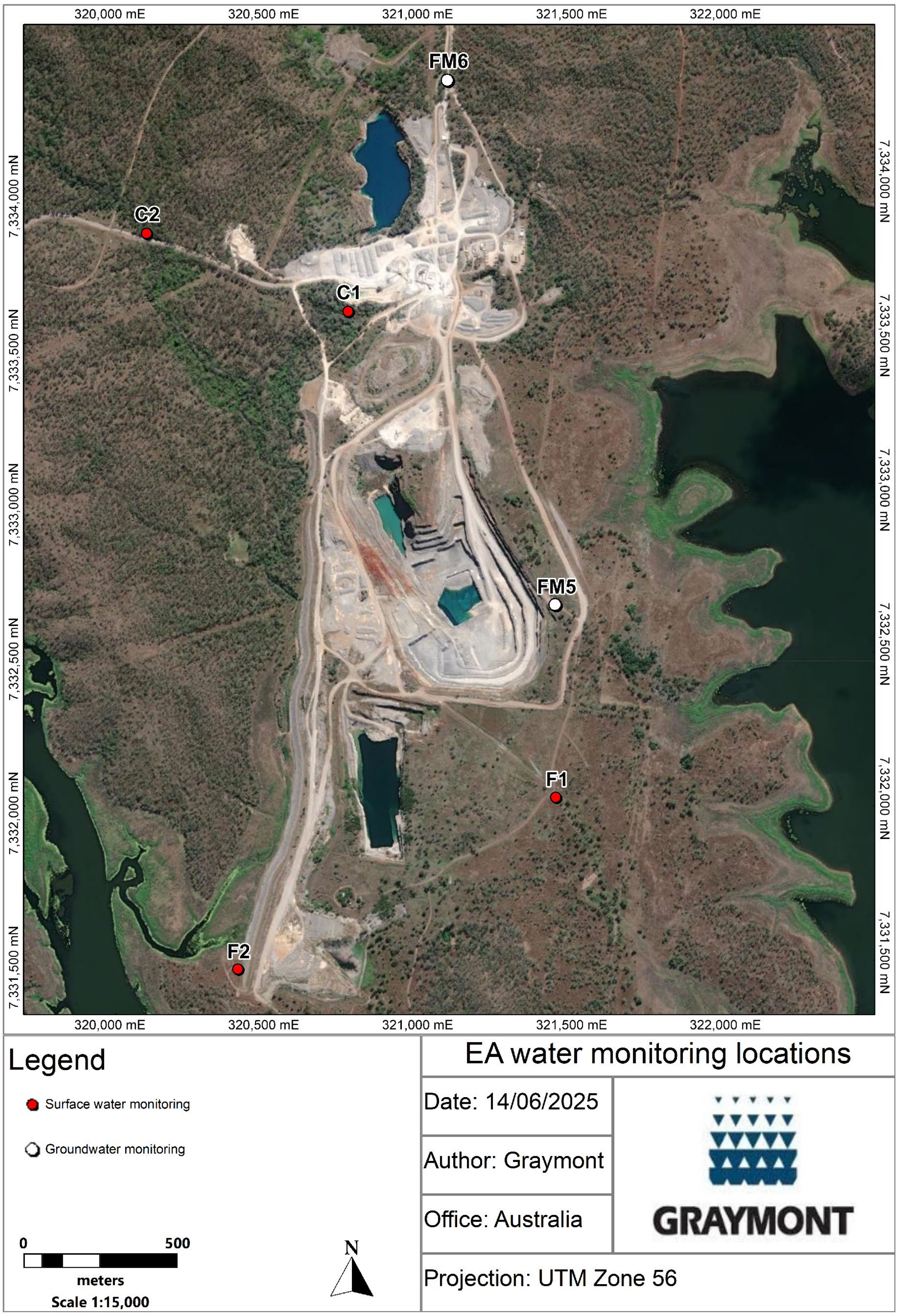


Figure 4 Surface water and groundwater monitoring locations

Surface water contaminant release limits are table below.

Quality Characteristic	Release Limits	Monitoring Frequency
Electrical Conductivity (µS/cm)	900	Weekly during discharge
pH (pH Unit)	6.5 (minimum), 8.5 (maximum)	Weekly during discharge
Total Suspended Solids (mg/L)	100 (maximum), or when measured at C1, F2 or F1 not more than 110% of the value at monitoring point C2.	Weekly during discharge

Table 4 Surface Water Contaminant release limits

The origins of the release limits is not known but they are similar to, but more stringent than, the ANZECC Guidelines for the default maximum values for Tropical Australia freshwater lakes & reservoirs which are 900 µS/cm, pH 6.0-8.0 and turbidity 200NTU. The risks and control measures required to manage water flow and quality on site, monitor water quality and regulate safe water discharge from site, are described in the Calliope Water Management Plan (WMP) forms part of Calliope Environmental Management Plan. See Section 9.

Groundwater

There is insufficient groundwater for pumping and aquifer dewatering and Calliope does not have a groundwater take and use licence. Groundwater outside the pit voids slowly drains into the pit voids where it is mixed with surface water to become pit water. Pit water is released in accordance with EA conditions. In July 2012 Sibelco developed and implemented a Background Groundwater Monitoring Program in accordance with MINB100942509 groundwater conditions C17-25. The aim of the Background Groundwater Monitoring Program (BGMP) was to provide sufficient data for developing a Groundwater Management and Monitoring Plan (GMMP). Groundwater monitoring bores FM5 and FM6 were installed in July 2012. Bore FM5 benchmarks groundwater at the active Pit 4 whereas Bore FM6 benchmarks groundwater at the inactive Pit 2. Comparative Analysis of the water quality from bores is undertaken to assess FM5 water quality changes against FM6 water quality changes. Groundwater monitoring results taken from FM5 and FM6 in the period July 2012 to October 2013 were used to benchmark groundwater water quality parameters results, from which EPML00969013 groundwater trigger values were derived. Sinclair Knight Merz Pty Ltd was engaged by Sibelco to develop the GMMP for the Calliope Quarry which, in accordance with EA conditions the GMMP, must:

i. Be able to detect a significant change to groundwater quality values due to activities that are part of this mining project
ii. Include measures to minimise the impact of the mining activities on groundwater resources

EA (EA) EPML00969013 conditions C17-24 stipulate groundwater monitoring requirements for the Calliope groundwater monitoring network, which is currently for bores FM5 and FM6. Groundwater monitoring locations were shown in Figure 4. EPML00969013 groundwater trigger values are shown in Table 3.

Water Quality Indicator	Unit	Trigger Value
Calcium (Ca)	mg/L	250
Chloride (Cl)	mg/L	200
CO3	mg/L	500
Electrical Conductivity (EC)	µS/cm	1500
HCO3	mg/L	500
Magnesium (Mg)	mg/L	35
Petroleum Hydrocarbons (Total)	mg/L	1.0
pH	pH units	6.5 – 8.5
Potassium (K)	mg/L	5.0
SO4	mg/L	20
Sodium (Na)	mg/L	100
Total Suspended Solids (TSS)	mg/L	1500

Table 5 Groundwater trigger values

Groundwater level monitoring of the bores is undertaken quarterly. Groundwater quality sampling of EC, TSS, pH and major anions (and cations) is six monthly, whereas metal screen and hydrocarbons are monitored annually. See Table 6.

Monitoring point	Easting (GDA 94)	Northing (GDA94)	Monitoringfrequency			
			Groundwater level	EC, TSS, pH and Major Anions	Metal Screen	Hydrocarbon
FM5	321430	7332650	Quarterly (Jan, Mar, Jul, Sep)	Six monthly (Jan, Jul)	Annual (Jul)	Annual (Jul)
FM6	321080	7334350				

Table 6 Groundwater monitoring frequency

Analysis of FM5 and FM6 monitoring data is provided in Section 7.3

Groundwater sampling which exceeds trigger levels is investigated and investigation results reported with 28 days to DETSI in accordance with EA conditions.

Calliope Water Management is discussed in Section 9.

2.2 PRC Plan

A PRC Plan is required for all mines with a site-specific EA for a resource activity. In accordance with the *Environmental Protection Act 1994,* all site-specific EAs for resource activities must also have an approved PRC Plan. The site is currently progressing a transitional approvals process for the Calliope Limestone PRC Plan.

Decision criteria used by the administering authority when assessing a PRC Plan is outlined in Section 2.5.1 of the PRC Plan guidelines and includes:

- Regulatory Requirements
- Site Specific EA application
- Proposed PRC Plan schedule
- Response to an information request
- Standard criteria
- PRC plan guideline

In 2023, Graymont developed a PRC Plan (PRC Plan-EPML00969013-v1) to meet the requirements of:

- The transition notice issued to Graymont on 31 March 2021 by the DETSI (formerly DES)
- The Mining *and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act)
- Sections 126B, 126C and 126D of the *Environmental Protection Act 1994* (EP Act)
- PRC Plans Guideline (ESR/2019/4964) (PRC Plan Guideline) (DESI 2024g)
- Schedule 8A of the *Environmental Protection Regulation 2019* (EP Regulation)

To ultimately align this PRC Plan with the EA, an EA amendment application (the EA amendment) was submitted to the Administrating Authority on 10 September 2024 and is in Information Request (IR) phase.

3 PROJECT SETTING -BOYNE RIVER BASIN

3.1 Boyne River Basin and Calliope

The Boyne River Basin (Basin) is located in Queensland's central coast region. The Calliope is located within the Basin adjacent to Awoonga Dam at the northern end of the Basin catchment (Figure 5).

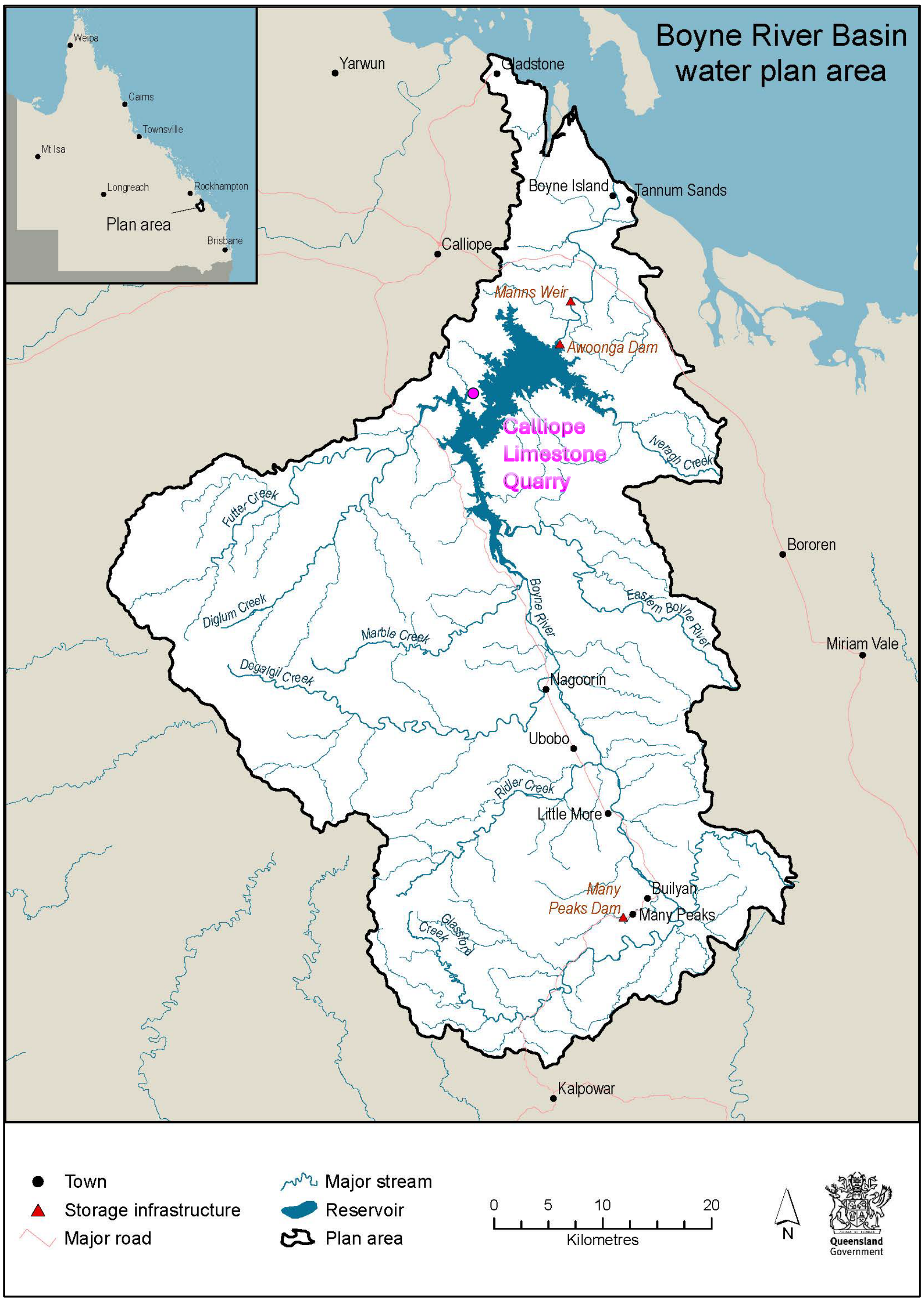


Figure 5 Boyne River Basin (from Boyne River Basin Plan)

The Calliope is located at the southern end of the Ragotte Creek catchment. Ragotte Creek flows into Awoonga Dam which is located approximately 20 km upstream of the mouth the Boyne River. Figure 6.

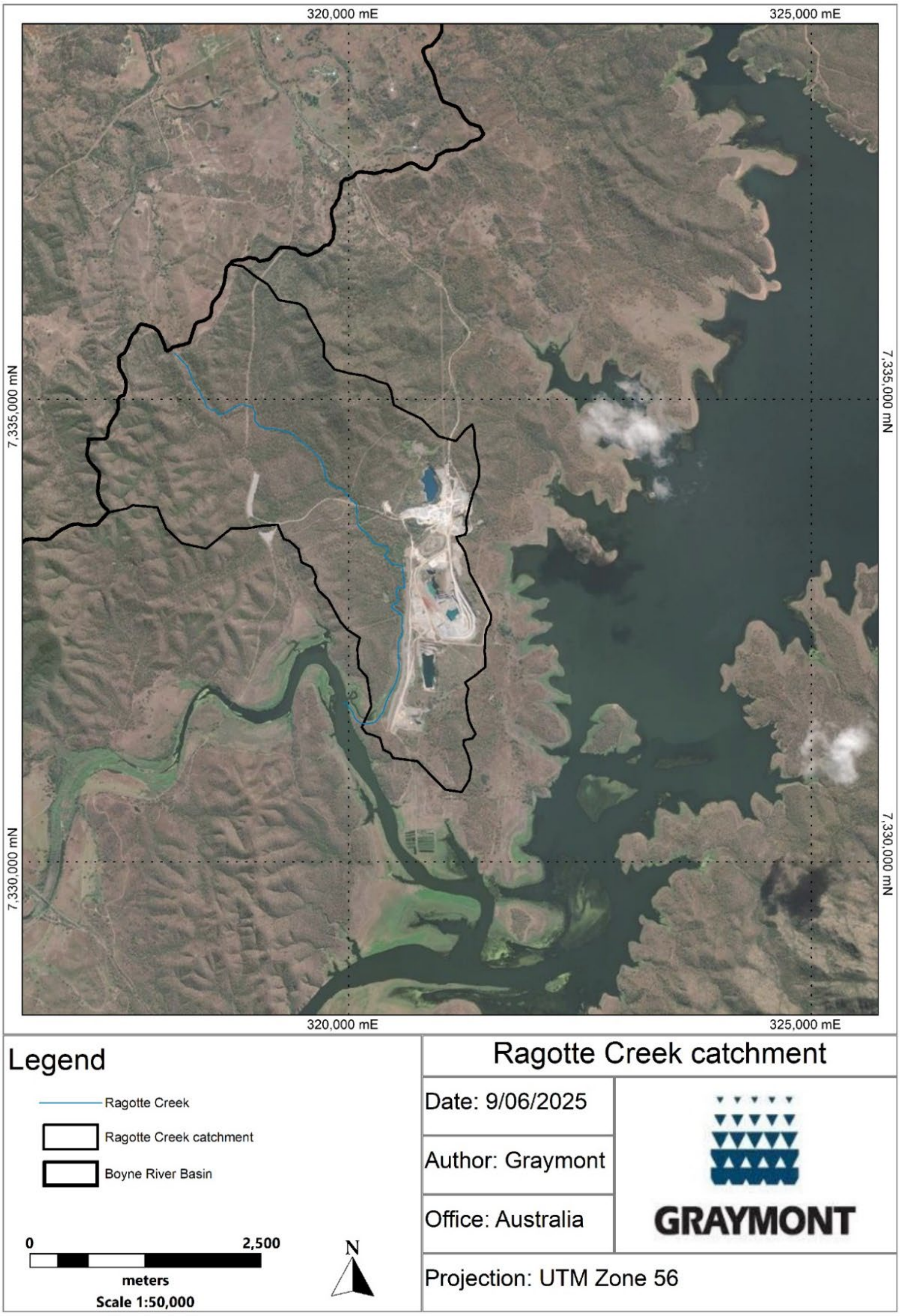


Figure 6 Ragotte Creek catchment

Mining creates sub-catchments at the southern end of the Ragotte Creek catchment. See Section 4.1.3.

3.2 Environmental values

The Boyne River Basin Environmental Protection (Water) Policy 2009 Central Queensland map outlines environmental values across the Boyne River Basin. The Boyne River Basin Plan Environmental values relevant to Calliope are shown below in Table 7.

Boyne River Basin Environmental values			
Environmental values	Upper northern creeks	Awoonga Dam	Groundwater (bores, etc)
Aquatic ecosystems	✓	✓	✓
Drinking water	✓	✓	✓
Primary recreation	✓	✓	
Secondary recreation	✓	✓	
Visual recreation	✓	✓	
Human consumer	✓	✓	
Cultural and spiritual values	✓	✓	✓
Aquaculture	✓	✓	
Farm supply/use	✓		✓
Irrigation	✓		✓
Stock water	✓	✓	✓
Industrial use		✓	✓

Table 7 Boyne River Basin Environmental values relevant to Calliope

3.2.1 Upper northern creeks

The upper northern creeks are unregulated and flow into Awoonga Dam. The Ragotte Creek catchment lies within the Upper norther creeks sub-zone, which has a moderately disturbed aquatic environmental value.

3.2.2 Awoonga Dam

Awoonga Dam was constructed in the Boyne River to supply water for industrial and urban use and is the main source of drinking water for the greater Gladstone region. The Awoonga Dam is owned and operated by the Gladstone Area Water Board. The Awoonga Dam water supply is the key environmental value in the local area and due to the downstream connection with the Boyne River valley, may indirectly impact downstream environmental values. The quality of water within Awoonga Dam is significantly influenced by the type and management of land use activities in the catchment, with nutrients and sediment levels attributed to the land clearing and cattle grazing that has occurred in the Boyne Valley over the past 100 years. (GAWB, 2025).

3.2.3 Groundwater

Regional groundwater beneficial use is discussed in Section 3.9 and Calliope water quality objectives are outlined in Section 4.7.

3.3 Climate

The climate of the Boyne River Basin is classified as sub-tropical with warm to hot summers and mild dry winters. The average daily temperature is 22°C/year; annual potential evapotranspiration ranges from 1750-2300 mm/year for an average of 1870mm and annual rainfall ranges from 500-1875 mm/year for an average of 1000 mm/year (Queensland Government, 2023).

Daily rainfall and evaporation from Long Paddock for a node located being approximately 1km west of Pit 2. Average annual rainfall is 880mm and average annual evaporation 1900mm. Monthly rainfall, evaporation and temperature is shown in Figure 7 from 1975-2025 and from 2002-2025, since the raising of Awoonga Dam wall.

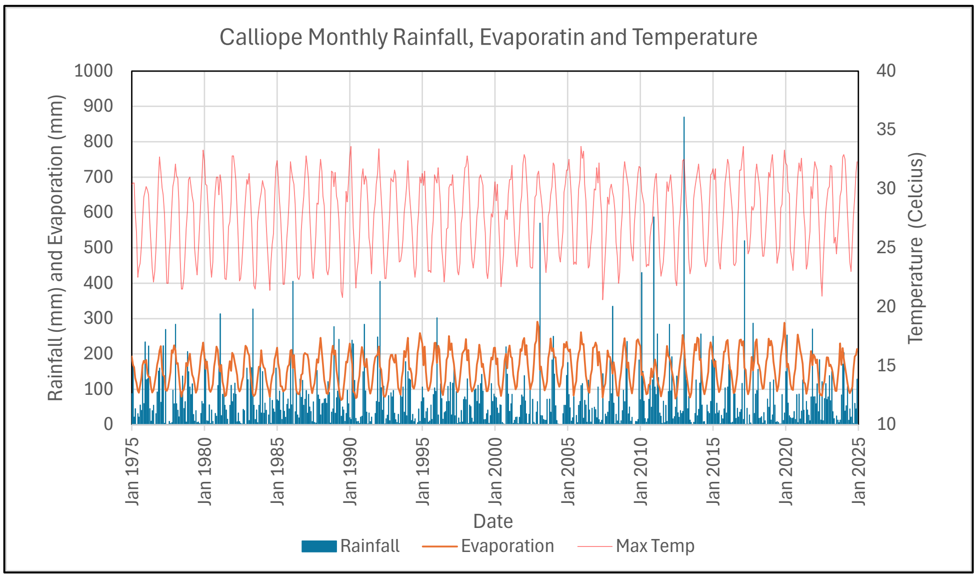
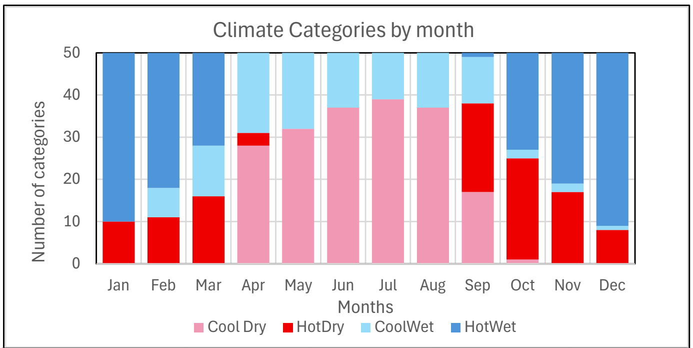


Figure 7 Monthly Rainfall, Evaporation and Temperature 1975-2025

From 2003-2017 there were six extreme rainfall events which elevated Awoonga dam water level and led to excess pit water capture but there have been none since 2017. The 50 year rainfall and evaporation record was analysed and it was determined that monthly median rainfall is 45mm and monthly median evaporation is 157mm. This data was used to categorise monthly climate into the four categories of Hot Dry, Hot Wet, Cool Dry and Cool Wet (Figure 8).



Category	Hot Dry	Hot Wet	Cool Dry	Cool Wet
Rainfall (mm)	<45	>45	<45	>45
Evaporation (mm)	>157	>157	<157	<157

Figure 8 Climate categories

The monthly categories had surface water runoff coefficients derived for each category which were used in the Water Balance model estimate of Pit 3-4 predicted pit water fill level (Section 8.1.2).

3.3.1 Rainfall and evaporation data used for final void Water Balance model

The 1975 to 2025 Monthly rainfall and evaporation records were used to predict the 2100-2200 rainfall and evaporation for the Water Balance model by replicating and repeating this 50 year cycle

Global Climate Models are provided by the Queensland Government which display projected impact of high (RCP8.5) and lower (RCP4.5) greenhouse gas emission (GHGE) scenarios on the Boyne River Basin. See Figure 9. Climate change trends are discussed in respect to projected change (no trend/increase/ decrease), magnitude of change (none/slight/small/ medium/large) and the level of confidence in the projection (weak/moderate/strong).

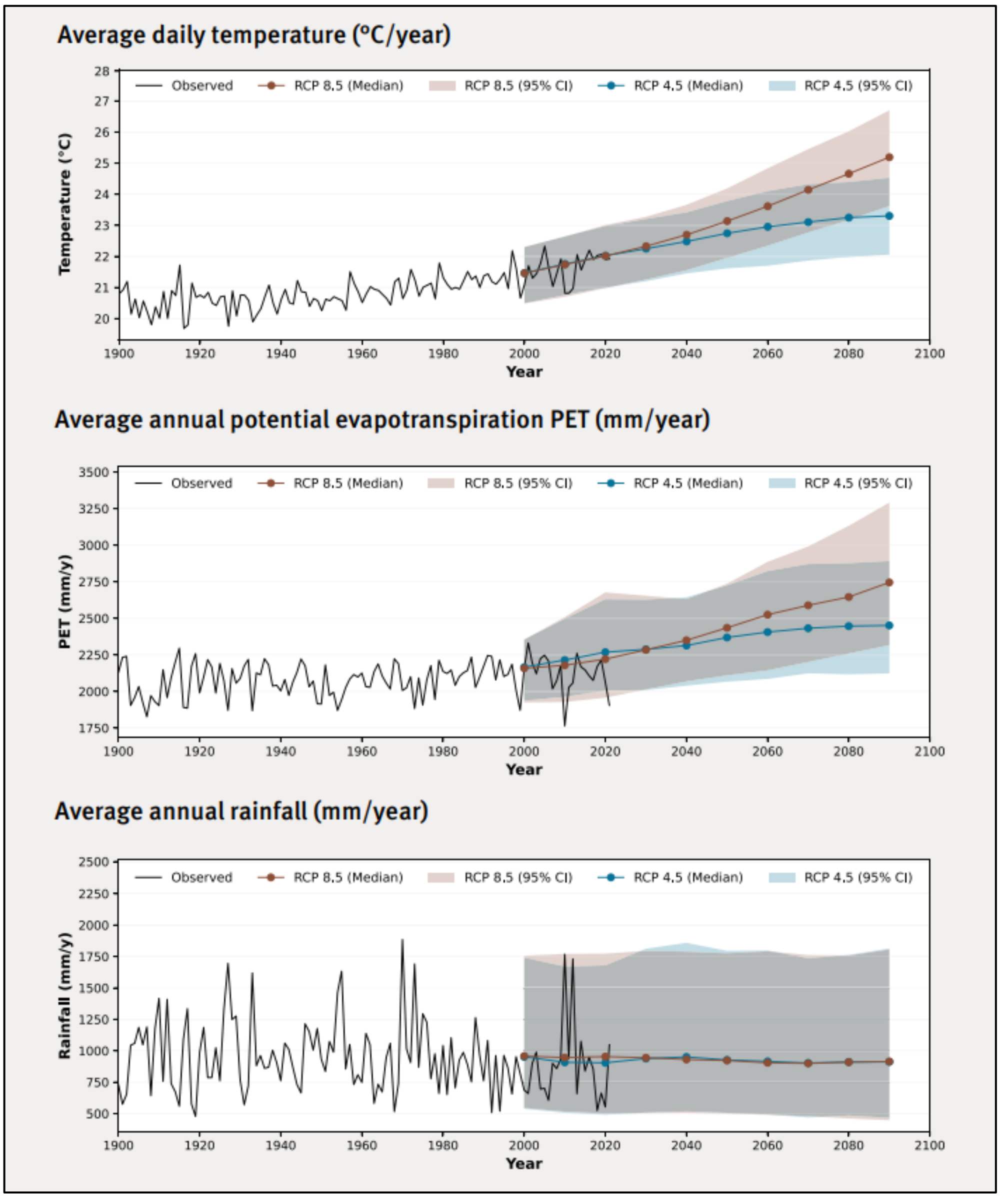


Figure 9 Boyne River Basin Global Climate Model scenarios

The climate at 2100 is projected to be hotter (large increase, strong confidence), drier (medium increase, strong confidence) with a slight decrease in rainfall (weak confidence). Projected seasonal climate trends are an average monthly temperature increase for all seasons; evaporation increase for all seasons, particularly in summer and spring and rainfall decrease in winter and spring but with an increase in summer.

Climate Models (GCM) show a general warming across the state and for the Boyne River Basin the higher GHGE scenarios indicate a 6.3% increase in evaporation and the lower GHGE a 3.8% in evaporation. A 2% Water Balance model

Monthly rainfall and evaporation records from 1975-2025 for the Calliope are provided in Section 4.2. The 1975-2025 rainfall and evaporation record was used to predict rainfall and evaporation from 2100 by applying GHGE estimate high and lower scenarios to this climate record. See Section 8.2.

3.4 Topography

The Calliope Limestone operation is located within the Boyne River catchment of the Fitzroy Region. Topography of the Boyne River catchment varies from steep ranges down to the river valleys and Awoonga Dam. (Figure 10).

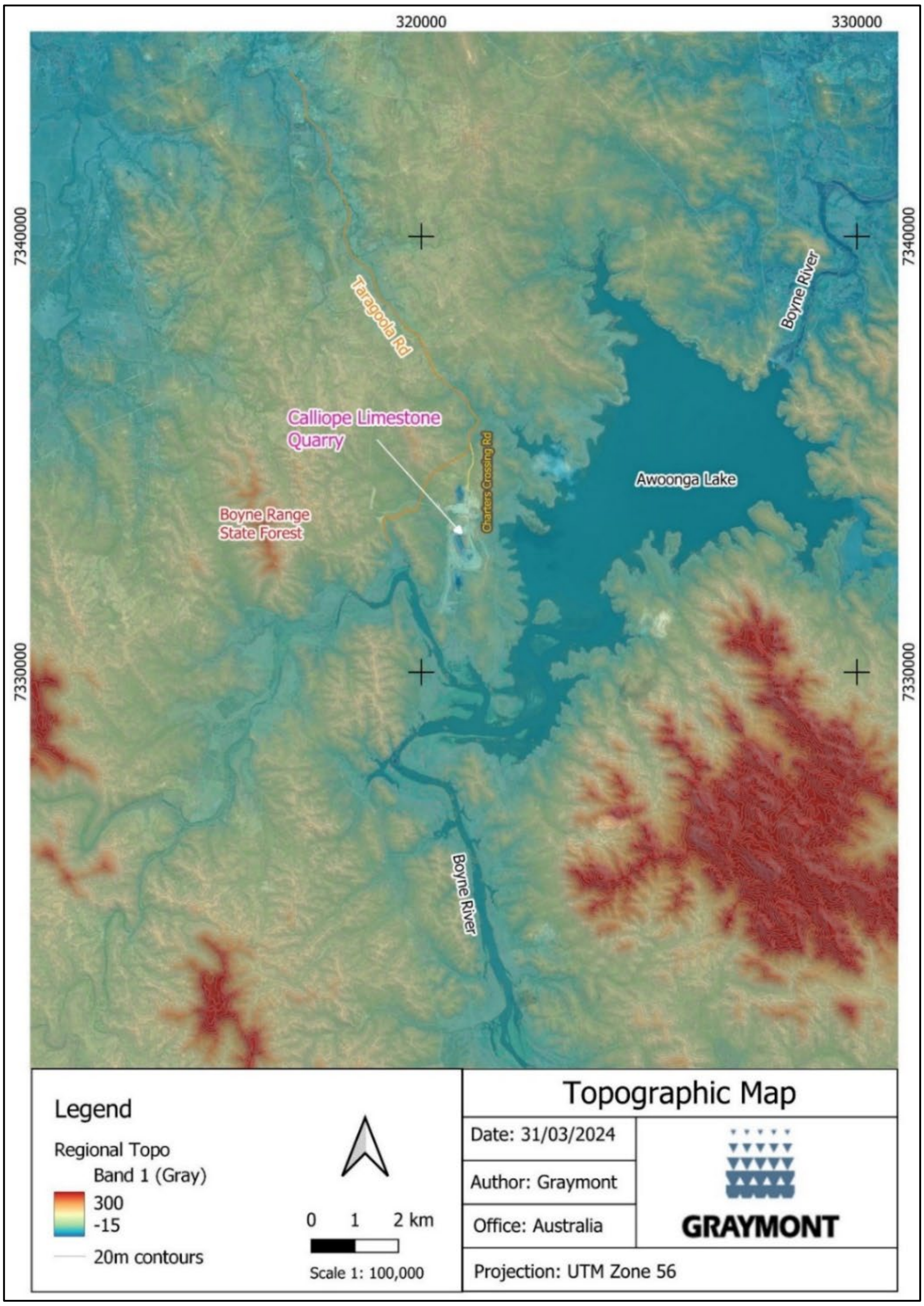


Figure 10 Regional topography

3.5 Regional Geology

The Calliope lies within the New England Orogen, part of Tasman Orogenic Belt, a Palaeozoic continental convergent plate margin. The belt is composed of Palaeozoic deep and shallow water marine sedimentary rocks, mafic volcanic rocks and is intruded by granitic plutons with extensive Quaternary cover. Around Calliope the area is divided into the Calliope, Coastal, and the Rockhampton Sub-provinces which are separated and bounded by regional faults. The Calliope is located in the Silurian-Devonian aged Calliope Beds. (Figure 11).

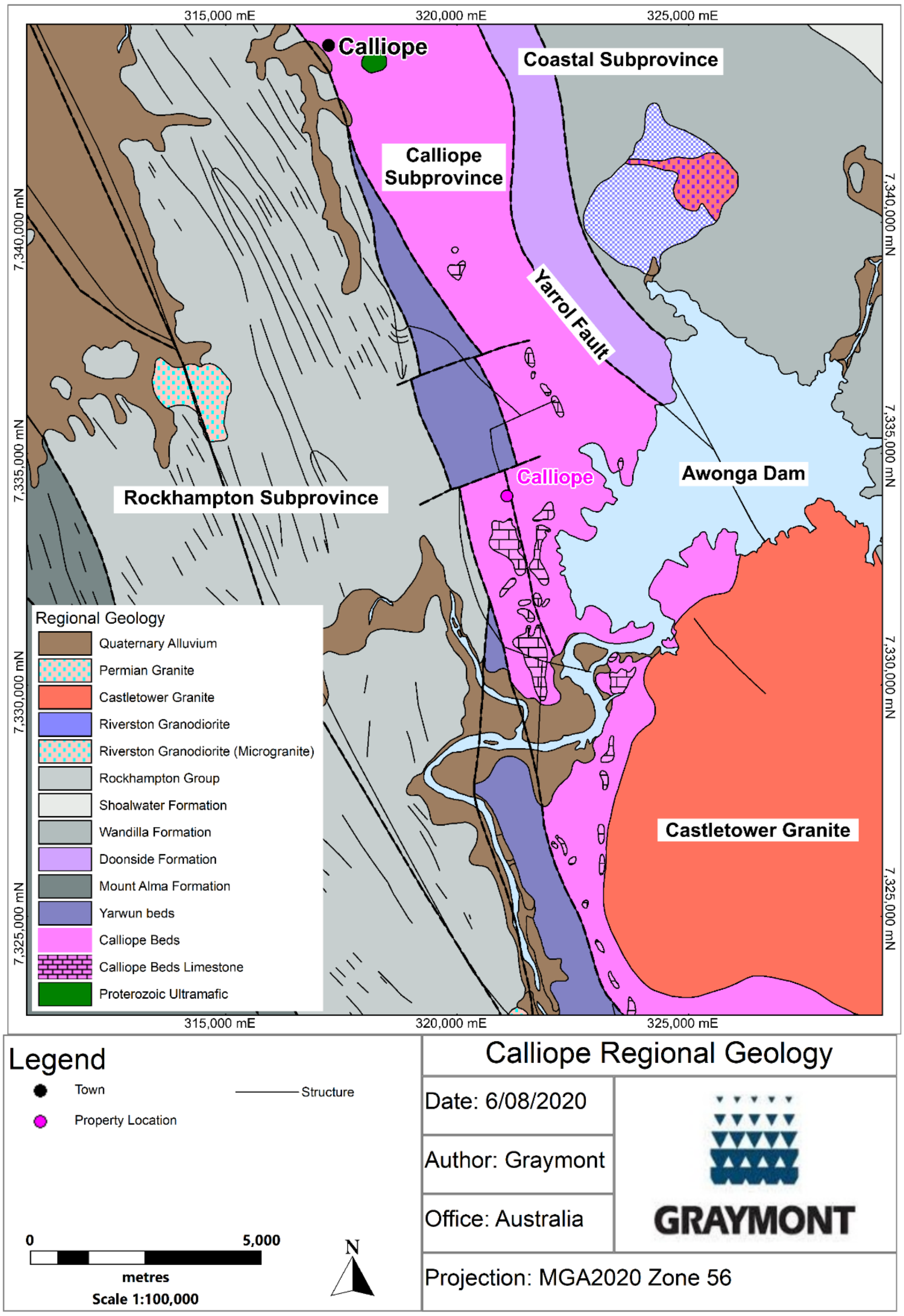


Figure 11: Regional Geology

3.6 Land use and local resources

Land uses of the Boyne catchment include grazing (74%), nature conservation (16%) and forestry (5%). Recreation including camping, fishing hiking and mountain biking in the region provides an economic boost to the region. Mining (limestone) is a small part of the catchment. The Awoonga Dam provides recreation facilities for picnicking and camping and is a popular spot for boating and fishing. Offshore from the Gladstone area lies several Great Barrier Marine Park zones that aim to manage the waterway use for the protection of the Reef. Curtis Island, hosts a large National Park and Conservation area just north of Gladstone offers recreational activities including rainforest walks and camping.

3.7 Vegetation

Catchment vegetation includes eucalypt woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*) with an understorey of native tussock grasses. The eucalyptus woodland is described as open woodland often with a shrubby layer and occurs on undulating rises and low hills, often with distinct strike pattern formed on moderately to strongly deformed and metamorphosed sediments and interbedded volcanics and Permian sediments.

3.8 Surface water

The Boyne River and its tributaries flow northerly into Awoonga Dam. The Awoonga Dam weir is located on the downstream side (northern end) of the dam. Awoonga Dam is operated by the Gladstone Area Water Board, is a regulated structure providing water supply to the region. Downstream of the Weir, the Boyne River continues northeast toward the coast between the towns of Boyne Island and Tannum Sands 12 kilometres south of Gladstone. The Boyne River is joined by several tributaries along its length. The Awoonga Dam at full supply level (FSL) of 40m AHD holds 778,900 ML and a surface area of 6,791 hectares. The maximum water level recorded at the spillway was 48.3m AHD on 27th January 2013, and the lowest levels on 4th February 2003 of 20.84m AHD. The Awoonga Dam receives surface water discharge from Calliope. Calliope water quality objectives are outlined in Section 4.7.

3.9 Regional Groundwater and its beneficial use

The *Boyne River Basin Water Plan 2013* allows for the take of groundwater and overland flow water but because groundwater take is not licensed, there is potential to extract water using bores from groundwater adjacent to the watercourse, which may impact on surface water availability. This is considered a low risk. (*Ministers Performance assessment Report - Boyne River Basin Plan, 2019*). Regional groundwater in the Boyne Basin is primarily used for pastoral, horticultural, and domestic purposes.

3.9.1 Regional groundwater recharge and discharge

Regional recharge is in topographic elevated positions associated with thin soil cover and discharge is in topographic lows associated with deep soil and regolith.

3.9.2 Regional groundwater bores

A search of bores on the Queensland State database within a 9 km radius of the project showed 39 bores. Of the 39 bores, 28 are classified as ‘Existing’, and the remaining 11 are classified as ‘Abandoned and Destroyed’. See Figure 12. Hydrogeological information from the data is limited. Water level data is sporadic, and no continuous data exists to derive trends for water levels or water quality. The closest bore to the site is Bore ID 111,148 which is located 2.8km up catchment from Calliope. This bore is in the Yarwun beds, which have been fault offset from the Calliope beds and which a different aquifer system from the Calliope Beds aquifer system. Bore ID 111,148 has a yield of 1.15l/s.

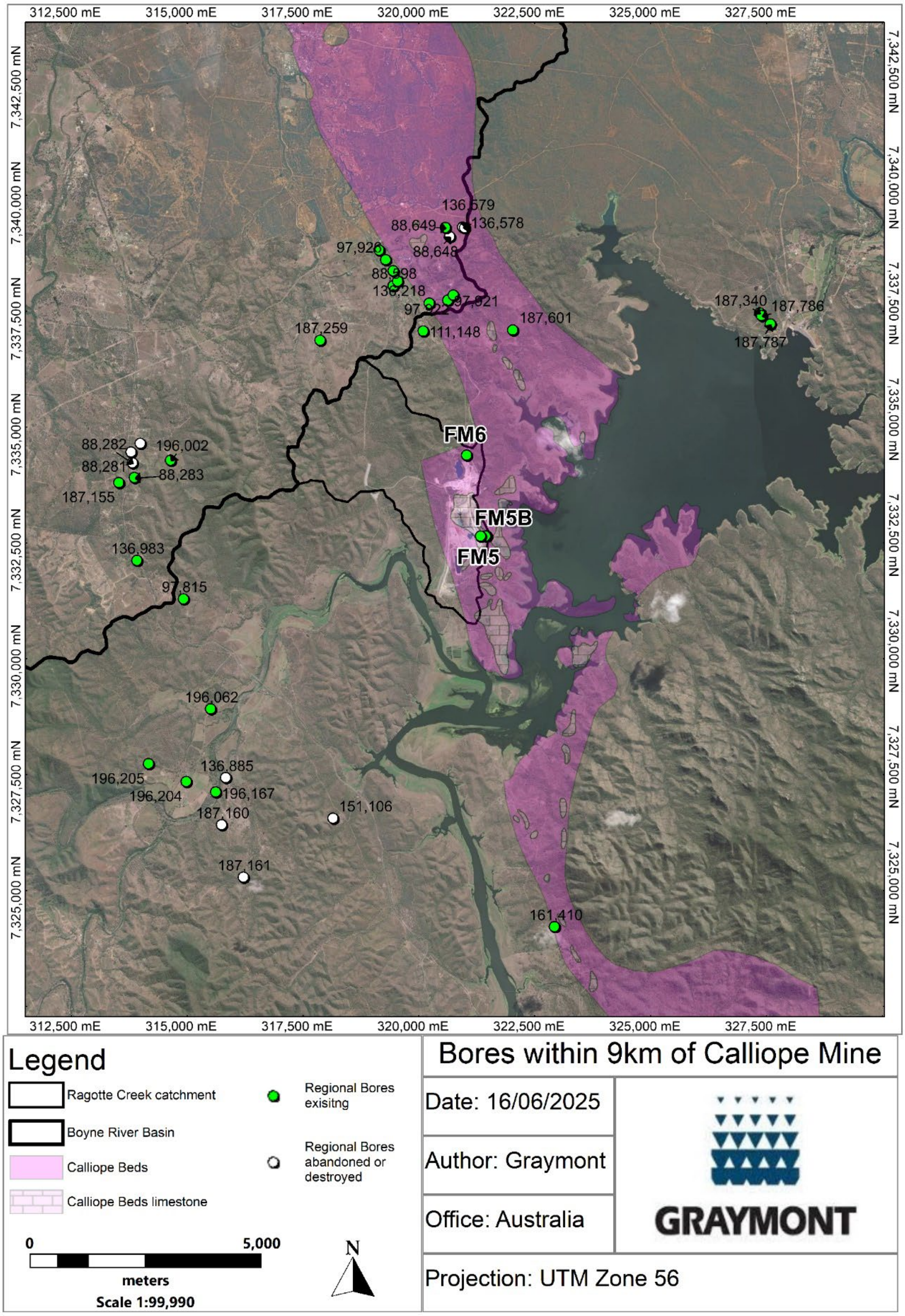


Figure 12 Bores within 9km of Calliope from QGlobe

A summary of registered bores constructed in the Calliope Beds within 9km of the Calliope is provided below in Table 8.

Registered number	Status	Bore depth	Yield l/s	Aquifer	Aquifer depth interval
88648	Abandoned and destroyed	75	None	Limestone	Dry
88649	Existing	47	1.5	Limestone	15 - 47m
97921	Existing	31	1.01	Andesite	27 - 31m
97922	Existing	14	0.74	Andesite	7.3 - 14m
136218	Existing	13.5	0.51	Limestone	
136578	Abandoned and destroyed	60.96	None	Limestone	Dry
136579	Abandoned and destroyed	18.29	None	Limestone	Dry
151688 (FM6)	Existing	60.5	n/a	Andesite	
151689	Existing	16		unknown	15 - 16m
161410	Existing	17.68	1.26	Limestone	6.71 - 17.68
187601	Existing	25	0.65	Andesite	8 -13.8m
187861	Abandoned and destroyed	51	None	Limestone	Dry
187863 (FM5)	Existing	30	n/a	Limestone	18 - 24m
187863 (FM5B)	Existing	30	n/a	Andesite	

Table 8 Registered bores constructed in Calliope Beds within 9km of the Calliope

The Calliope beds limestone and andesite is predominantly an aquitard but with connected fractures can form a yielding fracture rock aquifer. The maximum recorded bore yield from the Calliope Beds within 9km of the Calliope is 1.5l/s.

4 PROJECT DESCRIPTION – CALLIOPE

4.1 Mining voids and mining created sub-catchments

4.1.1 Site History

Limestone Exploration in the early 1960's led to the granting of mining leases to Frost Enterprises and Comalco with mining commencing in 1967 coinciding with the development of the Queensland Alumina Limited (QAL) alumina refinery at Gladstone. Limestone extraction began at Pit 1 (ML3603) and on the Comalco lease now called Pit 4 (ML3594). A 1969 aerial photograph of the Calliope is provided below as Figure 13.

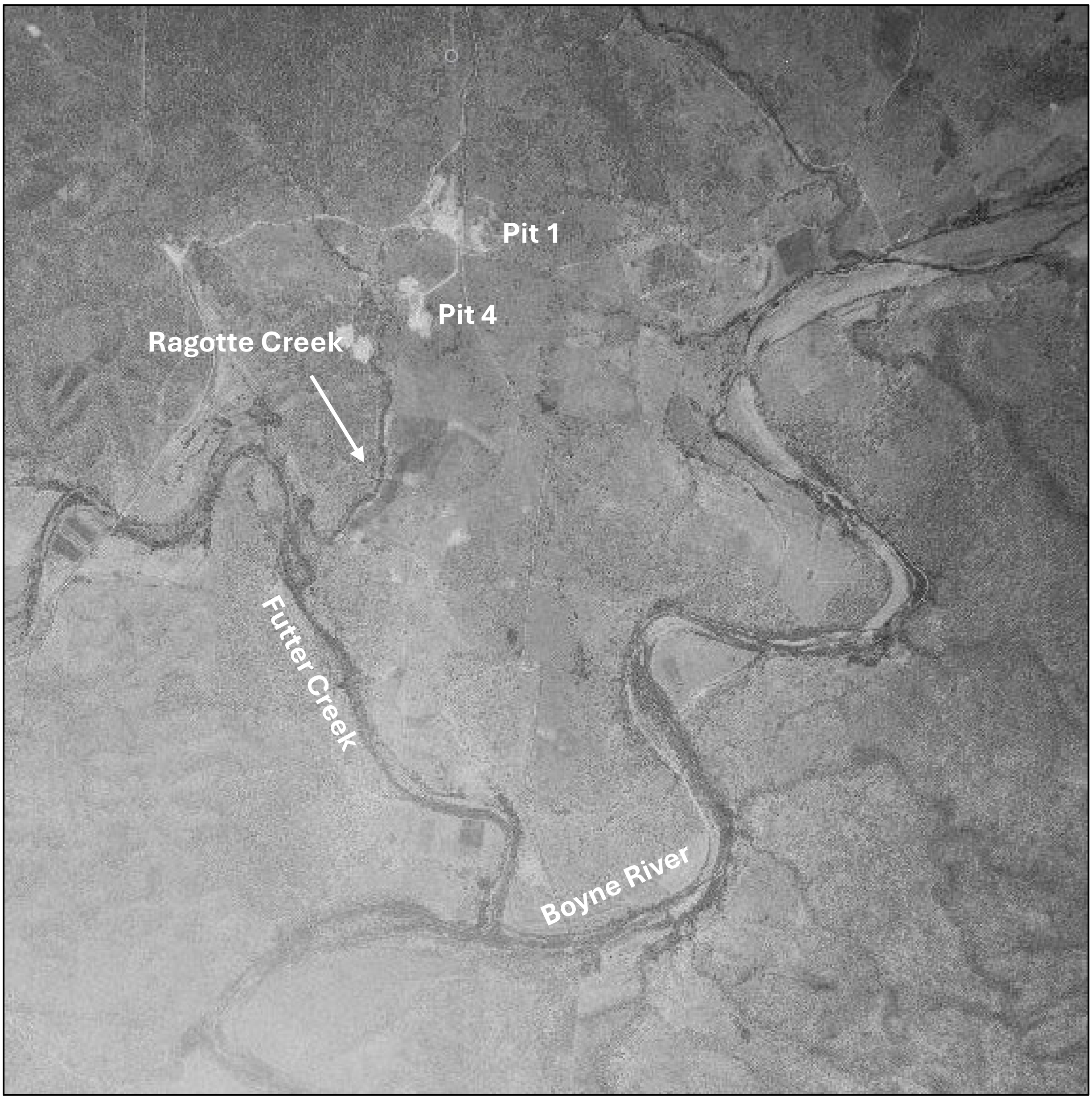


Figure 13: Calliope 29 November 1969

Limestone is extracted by conventional open cut benching methods. Four pits have been excavated at the Calliope, being Pits 1-4, although Pit 1 has now been backfilled.

In the 1980s the raising of Awoonga Dam wall by 24 metres did not impact the Calliope but the planned raising of the Awoonga Dam wall by a further 11 metres to 47mAHD in 2001 led GAWB to initiate earthworks for flood protection of the then named 'Frost Quarry. Frost Enterprises provided the construction services to widen and raise the spoil heaps, supply of crusher dust and haul trucks for material transport. The earthworks were completed in 2002.

Unimin acquired Frost Enterprises in September 2004. At this time, Unimin operated the two pits, the 'Frost Pit' now called Pit 3 and the 'Comalco Pit' now called Pit 4. Unimin merged with Sibelco Australia in 2011 assuming ownership of the site. Several additional mining leases were granted in 2013 to make the tenure more contiguous. In 2019 Graymont took ownership of the Calliope Limestone operation.

4.1.2 Mining Summary

Limestone is mined by conventional open cut benching methods. Mining begins with topsoil stripping and removal of clay rich overburden and waste rock. This material has been used for the construction of the western and eastern bund walls, which are large barriers to prevent surface water inundation of the quarry workings, as well as for safety bunding around pit voids and for surface water flow control. Excess overburden waster material is hauled to the Waste Dump, located south of Pit 3. The Waste Dump extends from the western bund wall as an increasingly widening barrier against potential flood inundation from Awoonga Dam.

Limestone is extracted by drilling and blasting to produce a high-quality limestone suitable for calcination and hydration and a medium quality limestone suitable for crushed rock and aggregates.

There are no geochemically reactive or acid forming wastes, tailings dams, or heap leach pads onsite, and the environmental risks from the inert waste rock is considered low/negligible.

The Calliope currently operates three pits with only Pit 4 currently used for extraction. Mining over the next 70 years will lead to the am amalgamation of Pit 4 with Pit 3 (Pit3-4) and end of mine life is currently scheduled for 2100, but this may change depending on reserves and yearly sales quantities. A PRC Plan amendment will be undertaken if there are any material changes to operations that will impact the rehabilitation staging of the Project. All future disturbance until EOML will be authorised by, and undertaken in accordance with, the amended EA.

4.1.3 Mining created sub-catchments

Prior to the commencement of mining surface water flow in Ragotte Creek catchment was inward and southerly to Futter Creek. A June 1997 aerial photograph of Pit 3 catchment is provided as Figure 14.

In 1997 waste material was being placed to the west of Pit 3, in as southerly direction, which provided a barrier between Ragotte Creek and mine workings. Surface water at this southern end of the Calliope Mine flowed southerly into Pit 3 and westerly into Ragotte Creek. Surface water and groundwater flowed into the Pit 3 from the western wall of Pit 3 as marked in Figure 14. Surface water flowed along an unnamed drainage line into Ragotte Creek through what is now the Farm Dam.

An organic rich black clay is shown on Figure 14 which indicates that this area is a natural topographical low. Prior to mining modifying surface water flow, surface water would have flowed southerly to the unmade drainage line and then into Ragotte Creek. This organic black clay layer provides the conduit for the current northerly flow of surface water from the Farm Dam to Pit 3.

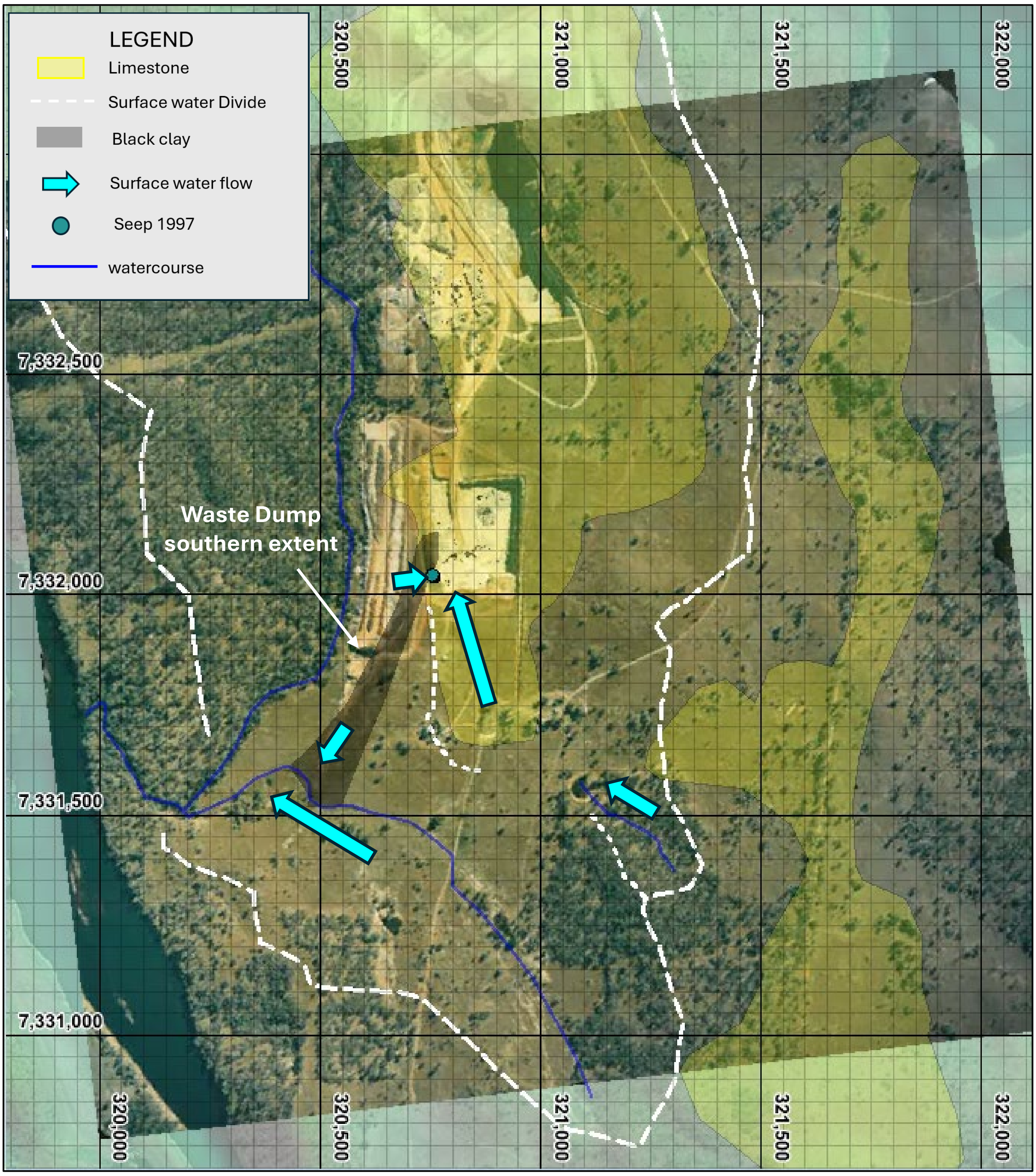


Figure 14 Pit 3 catchment in June 1997

A coinciding surface water and groundwater inflow point source into Pit 3 (Seep) is observable in the June 1997 as marked in Figure 14. The Seep was present in 1997, when the Waste Dump was adjacent to the Seep, prior to the completion of the construction of the western bund wall. The Waste Dump was a source of surface water run-off for the Seep.

The construction of the Western Bund Wall in 2002 impeded westerly surface water flow to Ragotte Creek and created the closed Pit 3 and Farm Dam sub-catchments. A 2002 Calliope map of spoil heaps used in the construction of the Western Bund Wall is shown as Figure 15.

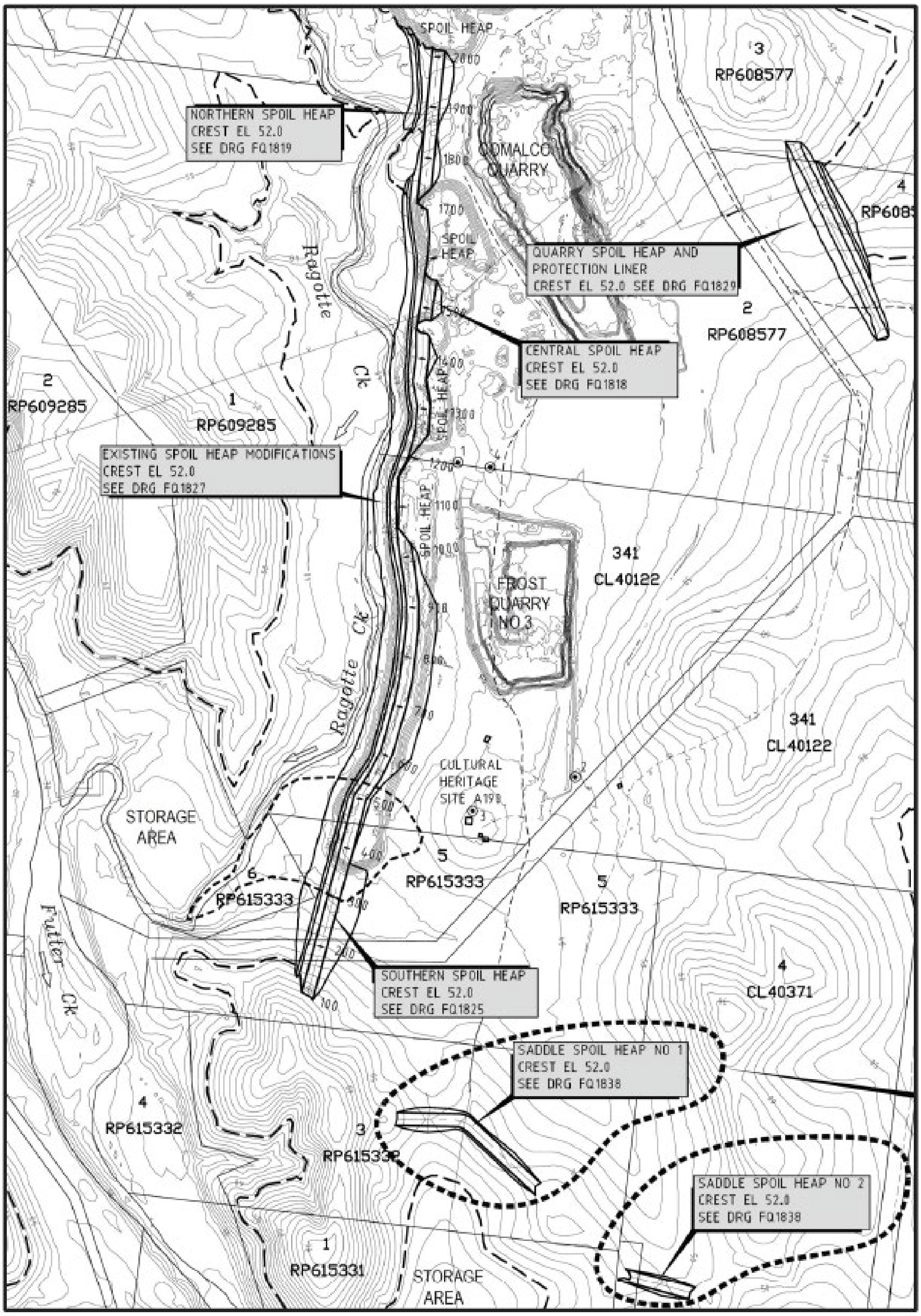


Figure 15 Spoil heaps used in the construction of the Western Bund wall (GAWB, 2002)

The construction map provides a chainage distance for the western bund wall, from south to north, which is referenced by later investigations of potential leakage of this wall. The Seep is located at chainage 860. A September 2004 aerial photograph of Pit 3 catchment is provided as Figure 16.

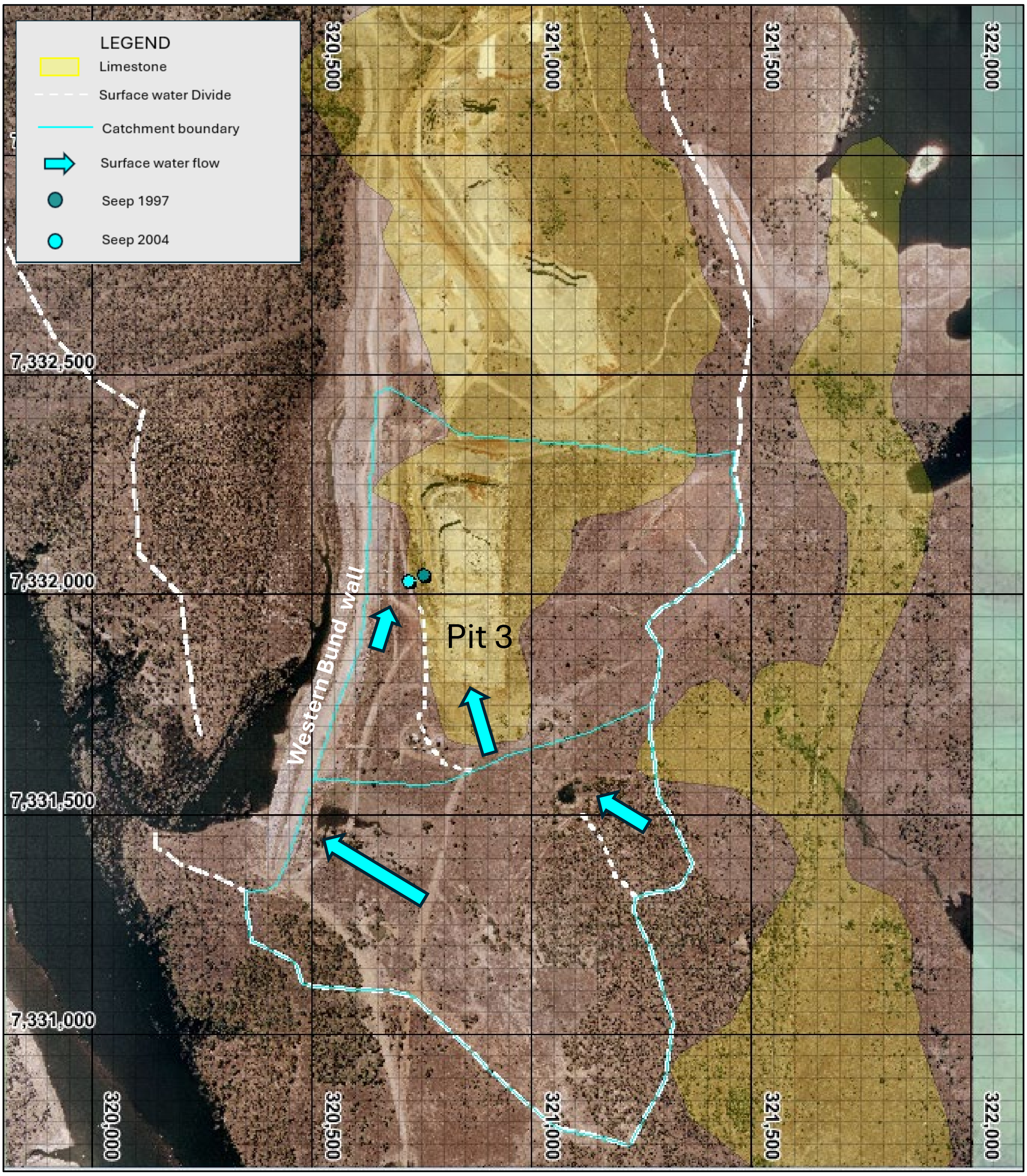


Figure 16 Pit 3 void and Farm Dam sub-catchments in September 2004

In September 2004 Pit 3 was dry but erosion had caused the Seep to migrate westerly as shown in Figure 16. Although Pit 3 was dry at this time there was water in Ragotte Creek and minor water in the Farm Dam. The relevance of observed water in the Farm Dam and Ragotte Creek is that GHD in 2011 proposed that excess water in Pit 3 following an extreme rainfall event was due to a possible piping failure mechanism from the ponding of water by the Farm Dam against the unlined eastern side of the Western Bund Wall. In 2004 water was ponding on the eastern side of the western bund wall because the Western Bund Wall impeded surface water flow that used to flow into Ragotte Creek.

In March 2011 a high rainfall event led to excess water in Pit 3. The point source of the excess water is the Seep (Figures 12 and 14) and the water dynamics of the Seep are discussed in detail in Section 5.2. The Pit 3 catchment in November 2012 is shown in Figure 17.

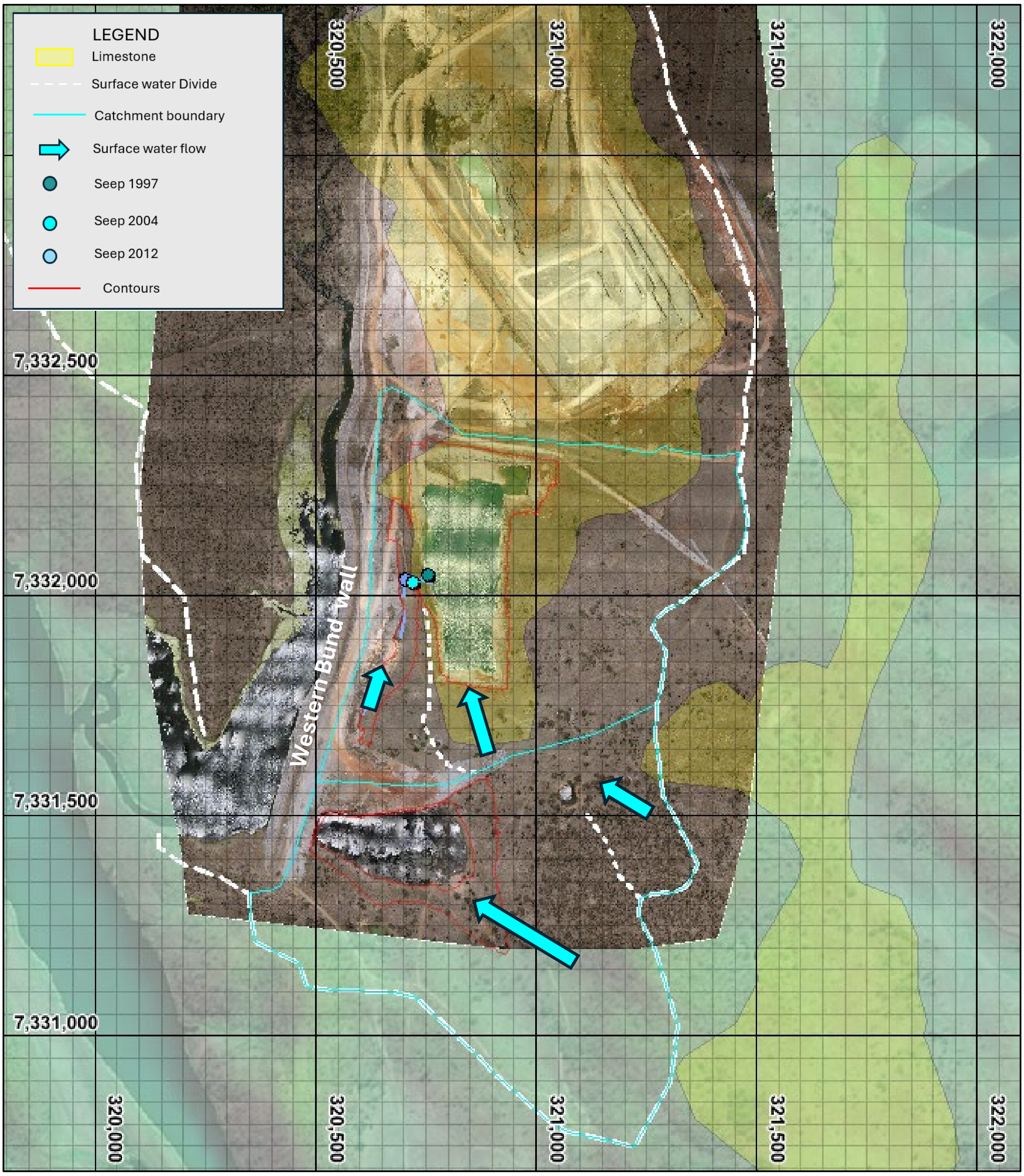


Figure 17 Pit 3 and Farm Dam sub-catchments November 2012

In November 2012 surface water flowed along the western bund wall from the Farm Dam and into Pit 3 at the Seep. The Seep had further migrated to the west with erosion and during a high rainfall event in 2013 slumping occurred creating the current scoured channel from the Western Bund Wall into Pit 3. Further discussion on surface water flow from the Farm Dam to Pit 3 is provide in Section 5.2.

The landform has been modified since 2012 by expansion of Pit 4 void, expansion of the Waste Dump in the 'Farm Dam' area and the infill of Pit 1. Current mine sub-catchment boundaries are shown below in Figure 18.

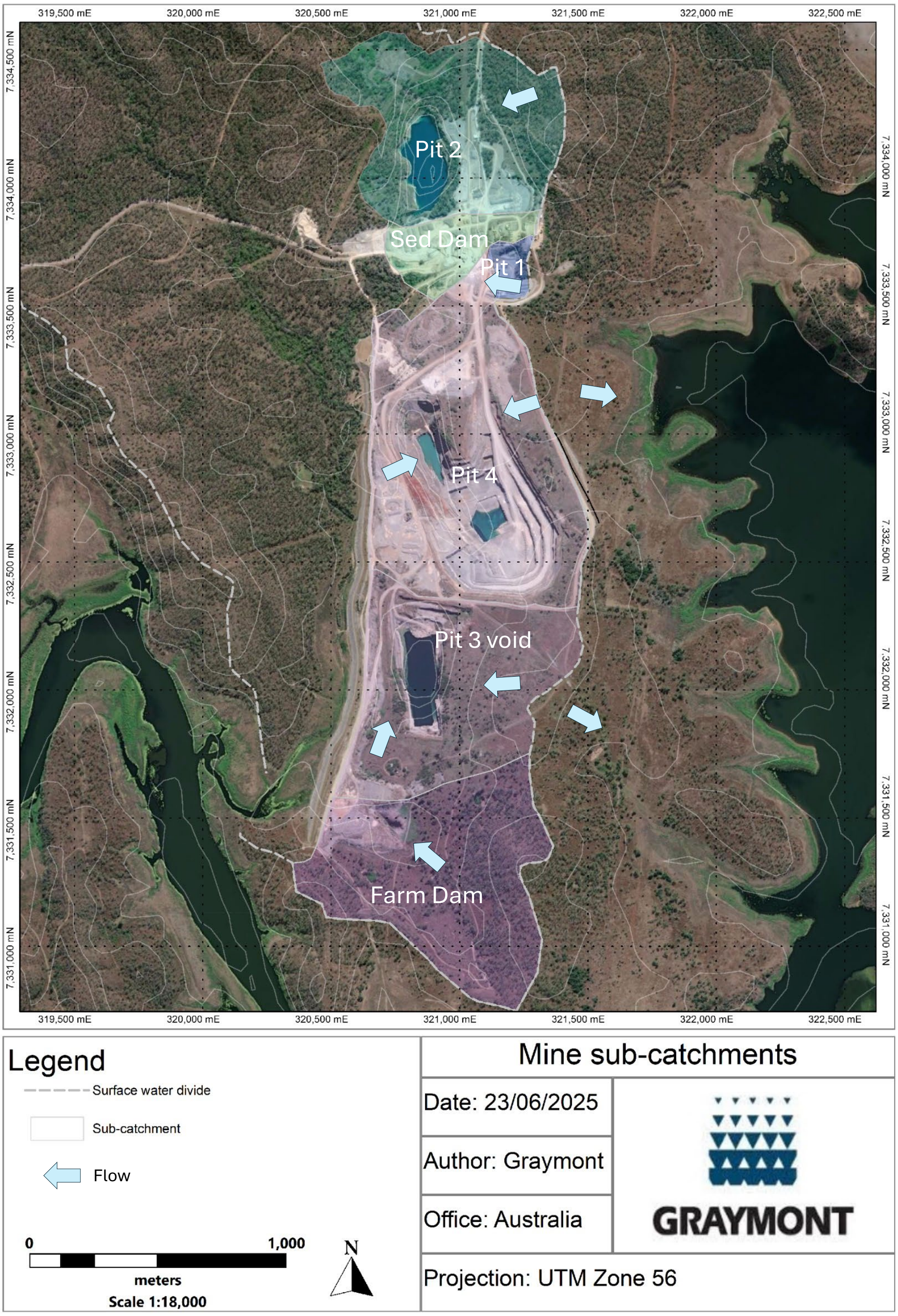


Figure 18 Mine sub-catchments

A description of the individual sub-catchments is provided below .

Pit 1

The Pit 1 catchment area has a roadside bund separating clean rainfall run-off water from the active mine area on the east side of the catchment. Pit 1 has been backfilled and drainage within the catchment is directed northwest and into the Sediment Dam catchment. Surface water run-off that has come in contact with stockpiled limestone material flows into the Sediment Dam catchment. The northern part of the catchment includes the employees crib room, workshop and access track.

Pit 2

Pit 2 catchment area includes the main entrance to the site, the contractor truck waiting area at the site entrance, main office and plant stockpile storage areas. Pit 2 is an inactive pit void for mining purposes and acts as a water storage facility for the site. Process water for the plant operation is obtained from Pit 2 storage. Water is also used for dust suppression purposes and washdowns. The Pit 2 void is the focus for drainage for this catchment. Overflow from the adjacent slurry dam catchment area will flow to the Pit 2 void under higher run-off conditions.

Sediment Dam and Slurry Pond

Run-off from the wash plant and screening area flows west toward the sediment dam which captures and settles sediment before discharge through release point C1. Release only occurs in wet climate conditions and after monitoring has confirmed water quality compliance. Run-off from Pit 1 area is also directed into the Sediment Dam catchment.

Run-off from the crushed limestone stockpiles which can include fine material, flows west into the slurry pond where settling occurs. During higher wash plant water use and wet climate periods, overflow is directed northward to Pit 2 void via subsurface pipeline.

Pit 4

Pit 4 currently has two void compartments. The main water supply and storage void is the northern compartment with a pontoon and pump system installed. The southern void compartment is the active mine area. Pit 4 water is primarily pumped from Pit 4 to Pit 2, and if required to C1 release point provided water quality parameters are met.

Pit 3

Pit 3 is currently inactive for mining but will become active in the future. The void receives surface water run-off, groundwater seepage and potentially leakage from Awoonga Dam. The relative contribution of these water sources has been subject to numerous investigations which is discussed in Section 5.2. In more extreme wet climate conditions if storage capacity is significantly reduced, water can be pumped to the F1 release point provided water quality parameters are met.

Farm Dam and Waster Rock Dump

The Farm Dam and its sub-catchment have been created by the construction of the western bund wall which impounded surface water which prior to the construction of the western bund wall flowed into Ragotte Creek. The western side of the Farm Dam catchment is progressively being developed as a waste dump. Water storage in the Farm Dam is continually modified by the ongoing placement of waste material against the eastern side of the Western Bund Wall. The Farm Dam has a theoretical run-off overflow at 43mAHD to Pit 3 but does not fill beyond 38mAHD because of sub-surface water flow beneath the western wall of the Waste Dump which becomes. surface water flow along the western bund wall from the Farm Dam to the Seep and then into Pit 3 void. See Section 5.2..

4.2 The Calliope Geology

A map of Calliope geology is provided below in Figure 19.

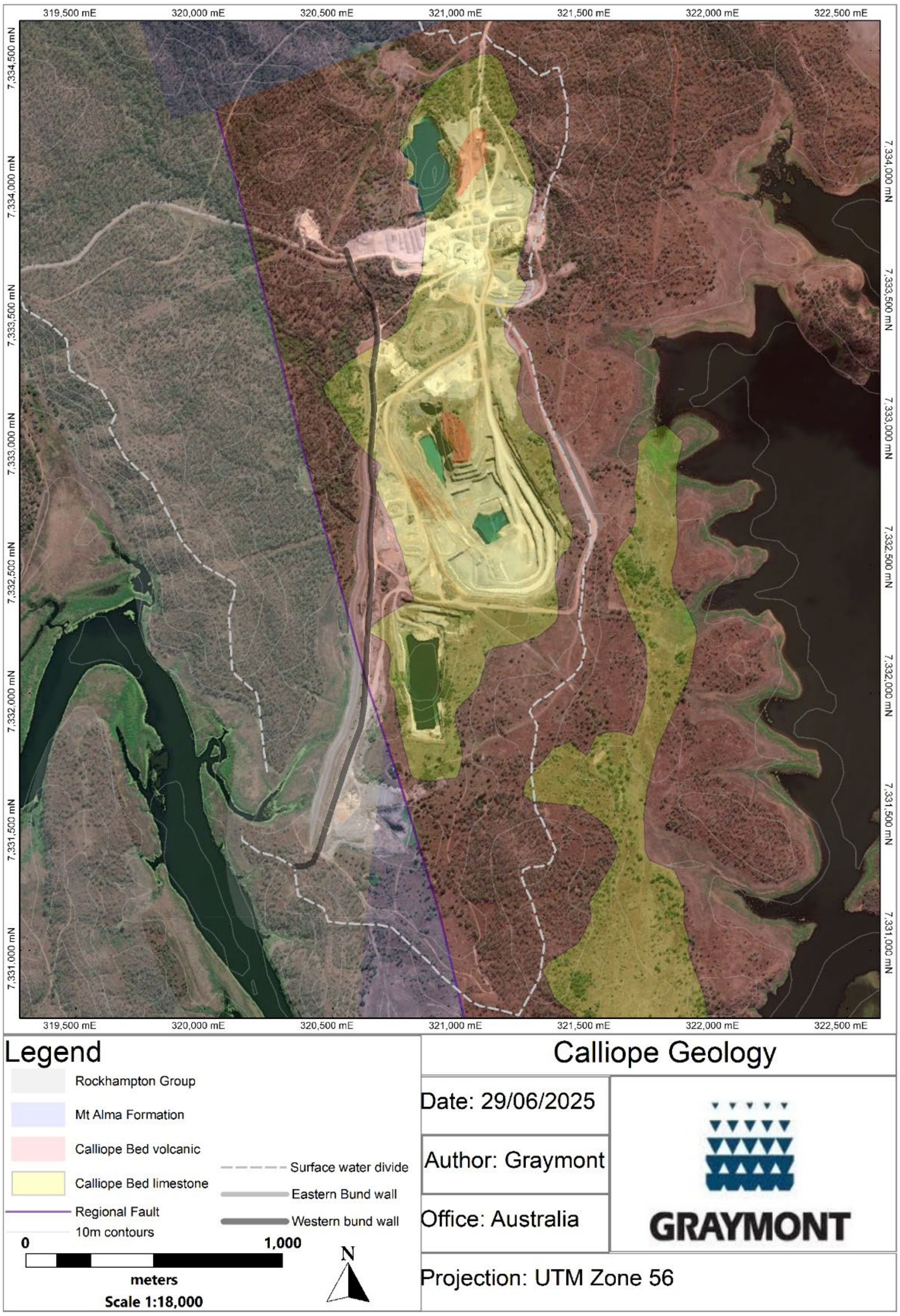


Figure 19 Calliope geology

The Calliope is located in the Silurian-Devonian aged Calliope Beds of limestone and volcanic rocks. Limestone outcrops as two well defined, elongated north-south lenses flanked by volcanic. The limestone-volcanic contacts are sub-vertical, with the exception of isolated remnant sub-horizontal volcanic caps. Bedding and cleavage are orientated north-south and joint direction generally vary between northeast-southwest and southeast-northwest. The younger Rockhampton Group sediments lie to the west of a north north-west trending fault, which lies outside Pit 3 and 4 voids. The fault is to the east of the Farm Dam abutment with the western bund wall and to the west of the Seep and has no apparent relationship to both these features. See Figure 19.

Volcanics rocks vary in colour from being blue grey to black and from green-grey to purple-red to red. Volcanic is present as a sub-vertical sills and sub-horizontal dykes. This is unusual because sills are mainly sub-horizontal and dykes sub-vertical and imply regional thrusting. The volcanic rocks are mainly basaltic and are typically 40-55% SiO_2, 4-10% CaO, 3-7% MgO, 2-4% Na_2O, 9-13% Fe_2O_3 and 0.3% SO_3. Fresh Limestone is typically 0.5% SiO_2, 54.5%CaO, 0.3%MgO, 0.01% Na_2O, 0.2% Fe_2O_3 and 0.05% SO_3.

The limestone has been subjected to regional metamorphism, folding and faulting with numerous joint sets. The limestone is massive, fine grained and even textured, light to dark grey but can vary to pink, red and pale brown in zones around faults and dykes. A photograph of a black mafic volcanic exposed by mining in the eastern wall of Pit 4 is shown as Figure 20.

Figure 20 Black mafic volcanic in the eastern wall of Pit 4 (from Rocktest, 2023)

The limestone has been weathered and clayed as shown in a photograph mosaic of the western wall of Pit 4 in Figure 21.

Figure 21 Weathering of limestone in the western wall of Pit 4

An E-W, north viewing, geological cross-section 7332650N of Pit 4 is shown below in Figure 22.

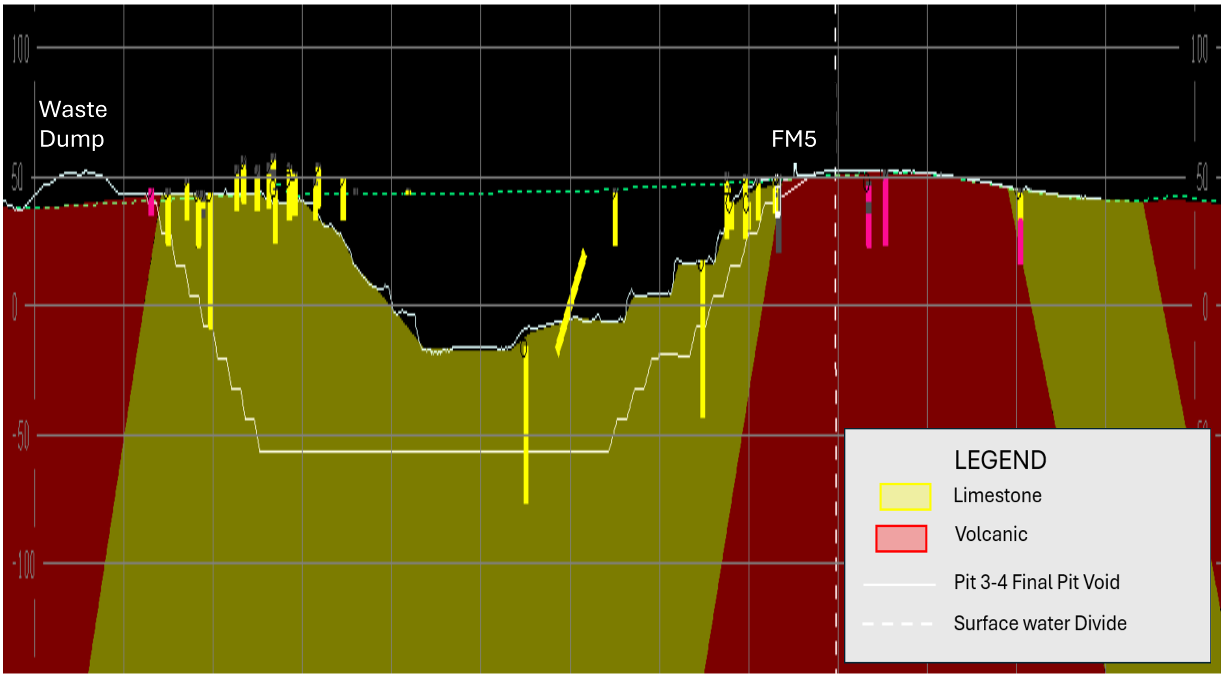


Figure 22 Cross-section 7332650N showing Pit 4 geology

Limestone in Pit 4 is bounded by volcanic which is exposed as fresh rock in Figure 20 in an upper bench. An E-W, north viewing, geological cross-section 7332175N of Pit 3 is shown below in Figure 23.

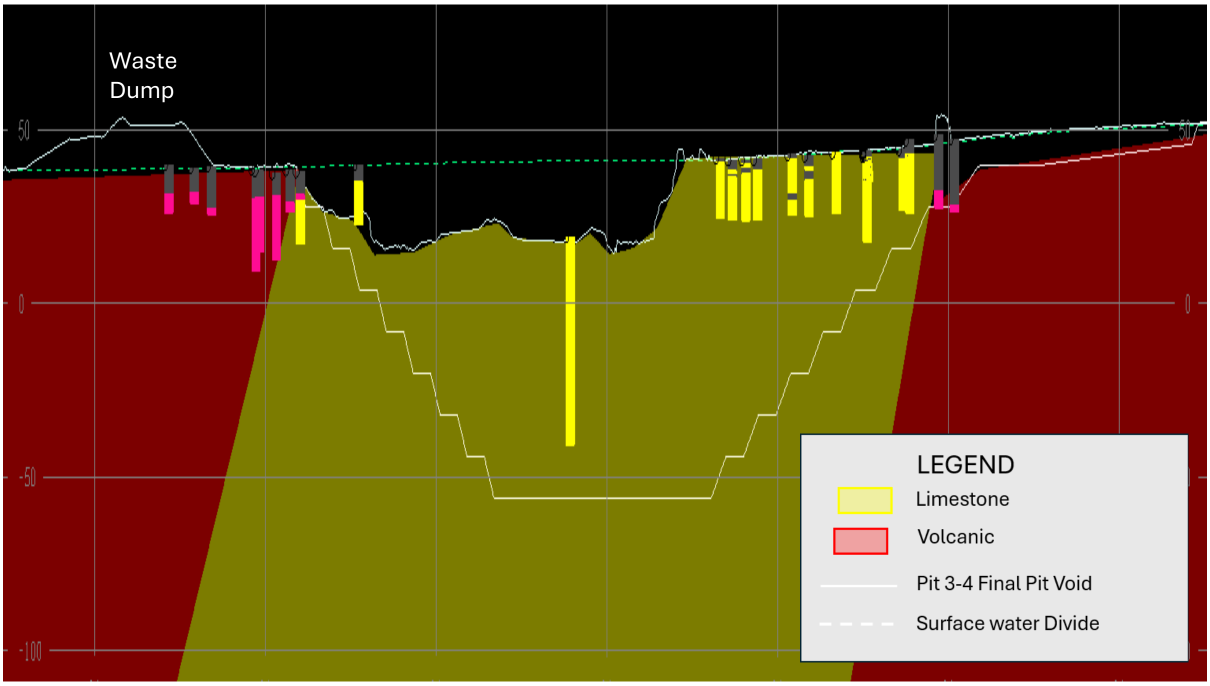


Figure 23 Cross-section 7332175N showing Pit 4 geology

The geological cross-section in Pit 3 is very similar to Pit 4.

GRAYMONT

4.3 Soils

Limestone occurs as either low outcrops or beneath a shallow cover of dominantly red-brown earths, topsoil and clay. Limestone is flanked by volcanic rocks which to the east are overlain by red-brown earths and red hematite iron-oxides associated with this topographic high. Overburden depth ranges from 10-15 metres. Volcanic rocks to the east are overlain by yellow brown earths and yellow brown goethite, which is a hydrated iron-oxide, in the topographic low. Black organic rich clay is present along the eastern flank of the western bund wall being on the western high wall of Pit 3, which includes the Seep into Pit 3.

4.4 Voids, mineral dissolution salt stores

Mining of limestone in places exposes volcanic contacts. The contacts are sub-vertical with the exception of isolated remnant sub-horizontal volcanic caps. Limestone is weathered and clayed near the surface with voids created by dissolution of infiltrating slightly acidic rainfall. Voids are filled by red to orange clay. Clayed and cavitied limestone is currently exposed on the western side of Pit 4 to an average depth of 10 metres. Limestone becomes fresher with depth to form a massive crystalline layer, Volcanic rocks are also weathered, clayed and cavitied and fresher with depth to form a massive crystalline layer.

The voids have formed by water dissolving minerals in the rock and releasing cations and anions to the regolith. Weathering of volcanic rocks releases the cations Ca, Mg, Na, Fe and some S to the regolith, and limestone weathering releases Ca. XRF results reveal that the SO_3% of volcanic is a low 0.28% and for limestone a very low 0.05%. Carbon is added to groundwater via CO_2 in soil water at roots of plants and by $CaCO_3$ dissolution and anions and cations are leached to groundwater.

The primary source of salinity in Central Queensland is the deposition of cyclic salts by precipitation and aeolian dust. (Oppy, 1999). There is an additional contribution from mineral weathering of cations and CO_3 anion from the dissolution of CO_2 in soil water. Stream salinity is attributed to salting in dryland and irrigation areas, discharges of saline groundwater, cyclic salt and the dissolution of surface salts in run-off water. The salinisation of groundwater is generally attributed to a changing water balance associated with salt affected regolith. Rainfall typically causes an initial increase in surface water salinity from flushing of salts out of the regolith (first flush) but extended rainfall causes a decrease in salinity by dilution. Rainfall typically causes an increase in groundwater salinity by leaching of salts from the regolith. The regolith salt store decreases in wet periods. Evaporation, in extended dry periods typically causes an increase in salinity by concentration. Groundwater salinity decreases in extended dry periods as groundwater lowers and salt is precipitated out of groundwater into the regolith. The regolith salt store increases in dry periods. Rainfall adds major ions to the regolith, groundwater and surface water which leads to the formation of the salts halite NaCl and gypsum $CaSO_4$. Kalf and Associates (2002) calculated dissolved minerals in water samples from bores FM1 and FM4, located west of Pit 4 and of the seepage into the western edge of Pit 3. See Table 9.

Location	FM1			FM4			Pit3 seep top			Pit3 seep bottom		
	mg/L	mmol/L	%	mg/L	mmol/L	%	mg/L	mmol/L	%	mg/L	mmol/L	%
Halite NaCl	2.14	0.037	1%	33.08	0.566	12%	89.06	1.522	23%	86.52	1.479	22%
Carbonate CaCO3	184.04	1.840	53%	164.18	1.642	58%	203.41	2.034	54%	214.44	2.144	55%
Dolomite (Ca,Mg)CO3	151.46	0.823	43%	68.46	0.370	24%	53.01	0.288	14%	53.01	0.288	14%
Anhydrite CaSO4	11.34	0.083	3%	18.43	0.135	6%	34.03	0.250	9%	32.61	0.239	8%

Table 9 Calculation of dissolved minerals

Groundwater in bores FM1 and FM4 have lower carbonates than the Pit 3 seep but higher dolomite whereas the Pit 3 seep has higher halite and anhydrite than groundwater in the bores. Mining operations can sometimes lead to Acid Mine Drainage however, this is not considered to be likely given the nature of the geology, carbonate based, which leads to near neutral groundwater. Groundwater chemistry is discussed in Section 7.3.5. The source of the Pit 3 seep is discussed in Section 5.2.

4.5 Quarry aquifers and aquitards

Limestone and volcanic rock are both weathered near the surface but with depth form a massive crystalline layer. Massive crystalline limestone and volcanic rock have negligible primary porosity, but are variably finely fractured which can form a weak secondary porosity from connected fractures. The Calliope beds limestone and volcanics are predominantly an aquitard but with connected fractures can form a low yielding fractured rock aquifer. The depth to groundwater is variable at the Calliope, but is typically 15-20 metres depth below natural surface. Groundwater is primarily hosted in volcanic rock and not limestone. Limestone aquifers are unconfined and low yielding. Groundwater occurs at or near volcanic-limestone contacts. Drilling records indicate that most holes are drilled dry but slowly make water through fractures. Fractures are sufficiently open to allow some groundwater flow but are too closed for appreciable groundwater flow. Previous testing indicated a low bulk hydraulic conductivity in the order of 0.003 m/day (Kalf, 2003). Groundwater levels indicate that the surface water divide which lies to east of Pit 4, coincides with a groundwater divide, and that groundwater flows westerly towards Pit 4 and easterly to Awoonga Dam. Groundwater flow is most pronounced north-south indicating a north-south stratigraphic and structural control on groundwater flow. Groundwater levels rapidly respond to rainfall recharge an indicate hydraulic conductivity anisotropy.

The groundwater divide provides a natural buffer against Awoonga Dam water level rises. Groundwater flow from this divide remaining easterly even when the Awoonga Dam water was elevated above 40 mAHD. Groundwater has been intersected by drilling at and near the eastern wall and also outside the western wall of Pit 4 near the volcanic-limestone contact. Groundwater has apparently been observed in the eastern wall but this is not substantiated by photographic evidence as no seepage is observed in wall photographs. See Figure 20. Groundwater is connected by fracturing and forms a watertable, but groundwater flow into Pit 4 is so minor that evaporation exceeds seepage and the pit remains dry. Seepage has been observed in Pit 4 at the volcanic cap contact with limestone contact, but dries up during extended dry periods. An E-W, north viewing, hydrogeological cross-section 7332650N of Pit 4 is shown in Figure 24.

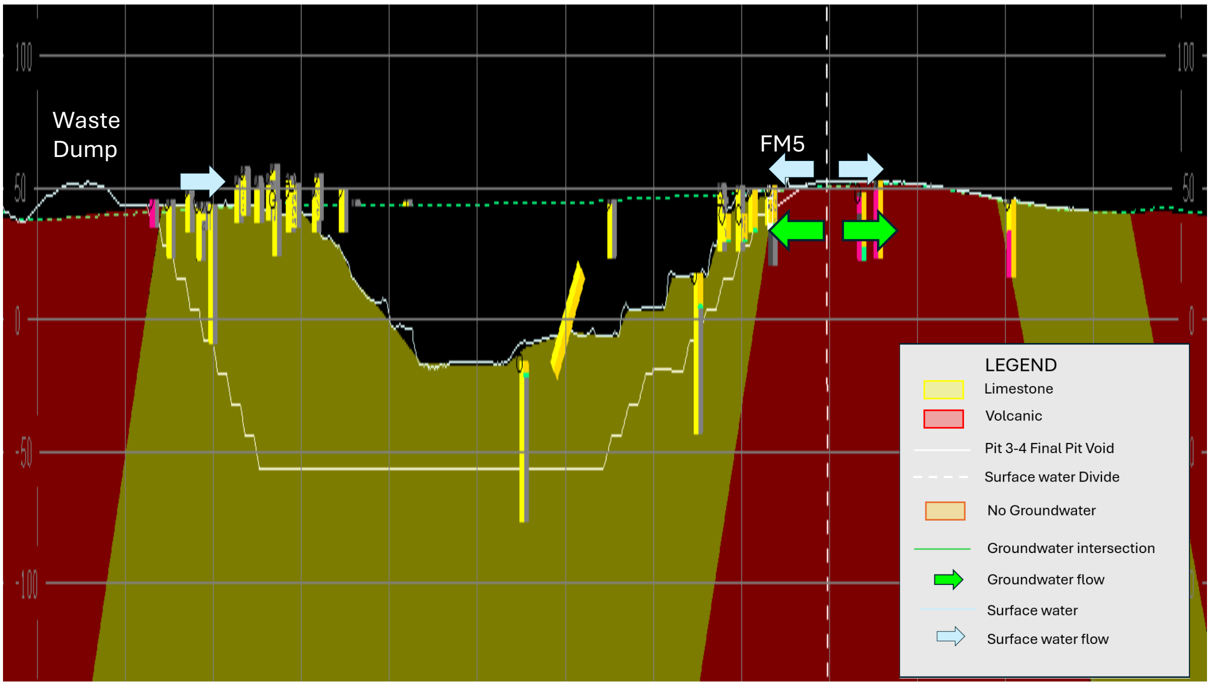


Figure 24 Cross-section 7332650N showing Pit 4 geology and groundwater intersections

Groundwater was observed by Kalf (2003) in the eastern most limestone but was considered not to be connected with the quarry limestone. An E-W, north viewing, hydrogeological cross-section 7332175N of Pit 3 is shown in Figure 25.

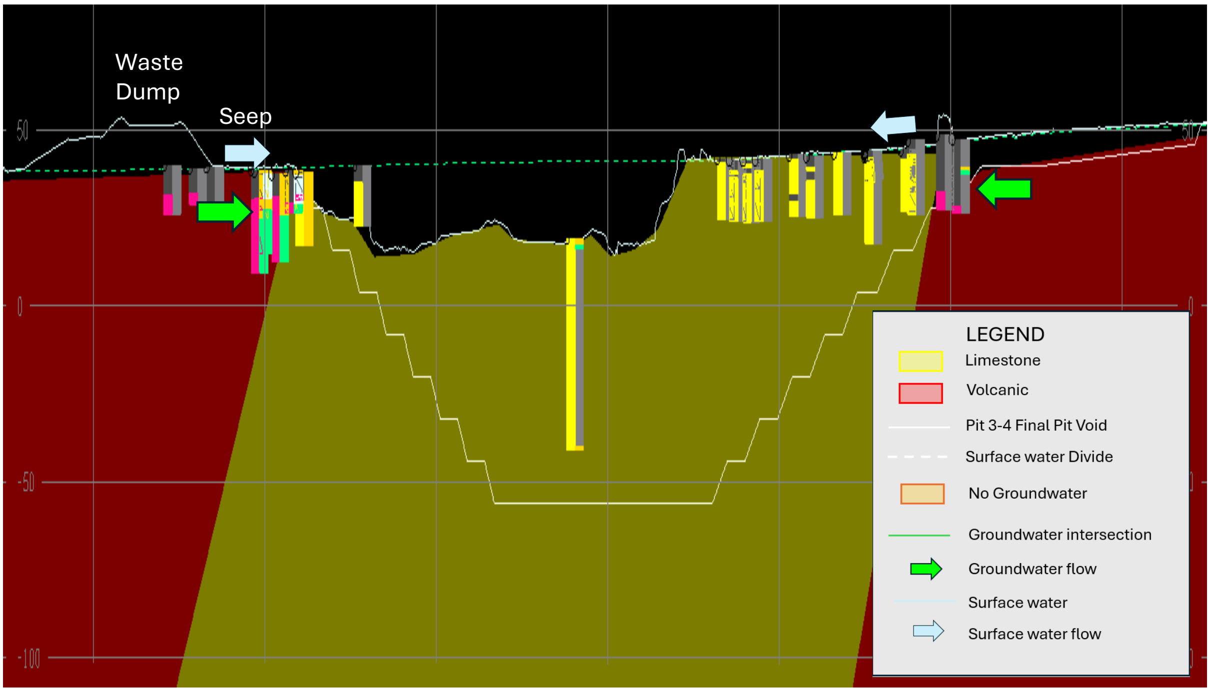


Figure 25 Cross-section 7332175N showing Pit 4 geology and groundwater intersections

Groundwater was intersected by drilling in 2018 near the Western Bund wall as discussed in Section 4.2 but water inflow to Pit 3 is mainly surface water with little groundwater.

Limestone is karstic near the surface but voids are clay filled and both the limestone and volcanic rock have low permeability (Section 6.3.5) and there is no evidence for hydraulic head being impacted by mining. Groundwater is discussed in detail in Sections 5.3 and 7.3.

4.6 Environmental values

Boyne River Basin Plan Environmental values relevant to Calliope were discussed in Section 3.2 and are:

- Upper northern creeks
- Awooonga Dam
- Groundwater (bores…etc)

The Awoonga Dam lies within the Boyne River catchment which has water quality targets under the Reef 2050 Water Quality Improvement Plan for sediment, nutrients (nitrogen and phosphorus) and pesticides flowing to the reef. GAWB manage the Awoonga Dam water supply which may indirectly impact downstream environmental values but do not manage control impacts from land use activities in the catchment such as land clearing and cattle grazing. Released dam water is assessed against Water Quality Guidelines and specifically Australian Drinking Water Guidelines as water supply is the primary function of Awoonga Dam. GAWB cannot control downstream impacts of released water as the Boyne River flows through rural and urban environments to the coast.

The Calliope lies within the Ragotte Creek catchment (Section 3.1) and surface water and groundwater is contained within this catchment. Surface water is discharged from Calliope to Ragotte Creek (upper northern creek) and Awoonga Dam in accordance with EA release criteria. Groundwater at Calliope is low flow and insufficient for bore extraction and use. Groundwater flow is towards mining voids and there is no uncontrolled seepage outside the mining envelope.

4.6.1 Potential impacts to Calliope Environmental values

The Boyne River Basin Plan Environmental values relevant to Calliope were identified in Table 7. The potential impact to Calliope Environmental values and pathway receptor linkage are provided below in Table 10.

Calliope Environmental values			
Environmental values	Description		Pathway Receptor Linkage
Aquatic ecosystems	✓	Calliope Mine is located in Ragotte Creek adjacent to Awoonga Dam, a tributary to Boyne River. Areas downstream may support aquatic ecosystems. Water discharges from the site are in accordance with EA licence conditions.	Unlikely
Drinking water	✓	Raw water from Lake Awoonga is processed at water treatment plants for drinking. Graymont annual. Water discharges from the site are in accordance with EA licence conditions.	Unlikely
Primary recreation	✓	Areas adjacent to the site support recreational activities including swimming and diving. Water discharges from the site are in accordance with EA licence conditions.	Unlikely
Secondary recreation	✓	Lake Awoonga supports recreational fishing and boating activities. Water discharges from the site are in accordance with EA licence conditions.	Unlikely
Visual recreation	✓	The site is located approximately 7km south west of the Lake Awoonga lookout, boat ramp, and camping area, and is not clearly visible from this location. Potential contamination at the site is unlikely to be contributing to deterioration of the aesthetics of Lake Awoonga.	Unlikely
Human consumer	✓	Areas downstream from the site may be utilised for the consumption of aquatic foods, including fish.	Unlikely
Cultural and spiritual values	✓	Mining is in accordance with Regulatory approved cultural heritage requirements and it seems unlikley that the cultural and spiritual values of Lake Awoonga are impacted, but it is acknowledged that they may possibly be impacted.	Possible
Aquaculture	✓	The site is not located in proximity to any aquaculture facilities.	Unlikely
Farm supply/use	✓	The site is bounded by woodland is not located in proximity to any farms and groundwater flow is toward voids and surface water flow to Awoonga Dam.	Unlikely
Irrigation	✓	There are no groundwater bores in the Ragotte catchment. Pit water is mainly surface wtare and any groundwater in pit voids is naturally mixed on the pit floor and pit water is then released in accordance with EA licence conditions.	Unlikely
Stock water	✓	Water discharges from the site are in accordance with EA licence conditions, which is suitable for livestock.	Unlikely
Industrial use	✓	Not applicable	Unlikely
Groundwater	✓	Mining voids are groundwtaer sinks.	Unlikely

Table 10 Potential impacts to Calliope Environmental values

4.6.2 Potential contaminants

Potential contaminants in pit water are salinity, pH, suspended solids, sulphate, nitrate, metals and hydrocarbons (Section 7.1.7) and similarly for groundwater (Section 7.3.7).

4.6.3 Mechanisms of potential impacts and risks to environmental values

The mechanisms of potential impacts and risks to environmental values are:

- Mixing of potentially contaminates pit water and Awoonga Dam water
- Seepage of potentially contaminated pit water into Awoonga Dam
- Mine void interaction with potentially contaminated groundwater
- Reduced groundwater supply to regional bores
- Reduced groundwater supply to Groundwater Dependent Ecosystems

Mixing of pit water and Awoonga Dam water

The potential impacts arising from the formation of the pit void may occur via several mechanisms.

A connection between the final void pit water and Awoonga Dam water may occur via overland flow in a scenario where Lake Awoonga floods to the extent that floodwater enter the void and pt lake water is released into the flood waters. The highest Awoonga Dam water levels recorded was in January 2013 which peaked at 48.3m AHD without breaching the levees surrounding the mine. The rainfall event that caused the maximum water level observed at Awoonga Dam was 870mm in 24 hours (SILO data, Queensland Government "Long Paddock database) and is equivalent to greater than 1 in 2000-year event (BoM rainfall designs database). According to the 'Awoonga Dam Emergency Action Plan', the top of the flood control bunds (at 52.0 mAHD) would not be breached until an event less likely than a 1 in 10,000 AEP flood event (that would result in a dam height of 50.12 m). Modelling outputs presented in the 'Flood Mapping for the Boyne River Basin' suggest that flooding of Awoonga Dam may result in floodwaters entering the Calliope voids. However, given the unlikely nature of the event, the benign nature of the pit lake water and the vast dilution of pit water that would result from a PMF, the risk to downstream environmental values from this mechanism is negligible.

Flooding of the final void due to inflows from on-site catchments could resulting in water overtopping the void and perimeter bunds and reaching Awoonga Dam. The flood modelling prepared by Engen showed that even during a PMF, the water level in the final voids was below the crest of the voids and do not indicate a risk of voids overtopping. This consistent with Water Balance modelling predicted water fill of Pit 3-4 void post mining which is -10mAHD. See Section 8.3.

Seepage of pit water into Awoonga Dam

Seepage of pit water through the bedrock to Awoonga Dam is extremely low to negligeable because the long-term void water levels will be lower than the Awoonga Dam water levels, hence the groundwater gradient will be towards the mining void.

Mine voids interaction with groundwater

The main mining void (combined Pit 3 and Pit 4) will be dewatered progressively as required to access the limestone resource and will remain a water storage post-mining. Pit 2 void is planned to remain a water storage facility for the current life of mine and post-mine. The Pit 2 water level is assumed to continue at current water levels 40 m RL. Pit 1 void has been filled, and post-mine will be used for light grazing. The pit will continue to be dewatered while mining and following cessation of mining, the mine voids will be recharged by direct rainfall, surface run-off and minor groundwater seepage until an equilibrium is reached with evaporation. The predicted final equilibrium void water level will be -10mAHD (Section 8.2) which is 23.6m lower than the Awoonga Dam dead storage water level. The hydraulic gradient toward the final void means there is not likely to be seepage through the bedrock toward the Awoonga Dam. Therefore, the void is demonstrated to act as a groundwater sink.

Reduction in groundwater supply to regional bores

Two monitoring bores, FM5 (State water database RN187863) and FM6 (Queensland State water database RN151688), are the current registered groundwater monitoring bores for the site as required under the current Environmental Authority (EA). Groundwater levels and groundwater quality data are obtained 6-monthly to analyse and report trends. An additional monitoring bore (RN187863, also known as FM5B) located close to the original FM5 was drilled in January 2021 due to low groundwater levels in FM5 during mid-2019 to late-2020. FM6 (State water database RN151688) is located at the northern end of the Calliope.

There are no pumping bores in the Ragotte Creek catchment or the Calliope because only minor groundwater has been intersected which is insufficient for the construction of a groundwater pumping bore (Kalf and

Associates, 2002). The Calliope beds limestone and andesite is predominantly an aquitard but with connected fractures can form a low yielding fractured rock aquifer. The maximum recorded bore yield from the Calliope Beds is 1.5l/s. Regional drilling of the Calliope Beds is in alignment with the Calliope drilling results which are discussed in Section 5.3. Groundwater seepage at the Calliope is <1 l/s which is in alignment with a maximum yield from the Calliope Beds of 1.5l/s from regional drilling. Investigative groundwater drilling is discussed in Section 5.3. There are two bores within the Boyne catchment, excluding the Calliope monitoring bores, that are located in the Calliope Beds. One bore is located south of Awoonga Dam and the other in another catchment east of the Calliope. Groundwater behaviour in both bores is not related to groundwater observed at the Calliope, because of geographical position and groundwater flow is under gravity towards the Awoonga Dam. Mining activities at the Calliope are a negligible risk to human groundwater beneficial users in the Boyne River Basin.

Reduction on groundwater supply to Groundwater Dependent Ecosystems

A search of Queensland Globe was undertaken to assess whether mining activities could impact other biological organisms in groundwater. The results from this search was that there are no Groundwater Dependent Ecosystems (GDE) in the Ragotte Creek and adjacent catchment. GDE's categories investigated were surface expression, terrestrial, subterranean and potential GDE's. Since there are no GDEs in Ragotte Creek catchment and groundwater flows under gravity towards the Awoonga Dam, mining activities at the Calliope are a negligible risk to GDE's in the Boyne River Basin.

4.6.4 Monitoring – asssessing against Water Quality Guidelines

The Australian Drinking Water Guidelines (ADWG) (NHMRC 2011) provide a basis for determining the quality of water to be supplied to consumers in all parts of Australia. The Guidelines are not mandatory legally enforceable standards, and the implementation of the guidelines is at the discretion of each state and territory. With a few exceptions (e.g. nitrate, copper, sulphate, fluoride), all health-based guideline values relate to lifetime exposure, such that a single result above the guideline value is unlikely to present an immediate health risk (Australian Drinking Water Guidelines, 2025). Water quality data presented in Table 11 indicates that physical and chemical characteristics of pit water and groundwater within the mining lease currently meets the drinking water and stock water quality guidelines except for the aesthetic drinking water salinity guideline value and would be expected to meet the guidelines post-mining.

Parameter	Water Guidelines			EA Compliance		FM5 groundwater		FM6 groundwater		Pit 4 active pit		Pit 3 inactive pit		Pit 2 water storage		Discharge F1 (2023-25)		Discharge C1 (2023-25)		Discharge C2 (2023-25)	
	Drinking		Stock	Surface water discharge	Ground water trigger																
	Health	Aesthetic				Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count
Salinity (µS/cm)	NA	938	5,970	**900**	**1500**	1212	24	1184	32	489	3	750	2	570	1	738	19	574	36	197	2
pH	NA	6.5 – 8.5	NA	**6.5-8.5**	**6.5-8.5**	6.7	24	6.8	32	7.97	3	8.4	2	8.7	1	8.1	19	8.1	36	7.6	2
TSS (mg/L)	-	-	-	**100**	**1500**	181	24	19	32						1	6	19	7	36	10	2
Ca (mg/L)	-	-	-		250	180	24	159	32	57	3	62	9	42	1						
Mg (mg/L)	-	-	-		35	14	24	25	32	11	3	7	9	12	1						
Na (mg/L)	-	-	-		100	59	24	66	32	24	3	60	9	53	1						
K (mg/L)	-	-	-		5	1	24	2	32	0.5	3	0.5	9	0.5	1						
HCO_3 (mg/L)	-	-	-		500	455	24	468	32	116	3	121	9	137	1						
CO_3 (mg/L)	-	-	-		500	<1	24	<1	32	0.5	3	0.5	9	0.5	1						
Cl (mg/L)	NA	250	NA		200	91	24	114	32	18	3	119	9	43	1						
SO_4 (mg/L)	NA	250	1,000		20	15	24	10	32	88	3	33	9	50	1						
TPH (mg/L)	-	-	-		1	<0.05	24	<0.05	32	<0.05	3	<0.05	2	<0.05	1						
As (mg/L)	0.01	-	5			<0.001	5	0.002	8	<0.001	3	<0.001	2	0.001	1						
Cd (mg/L)	0.02	-	0.01			<0.0001	5	<0.0001	8	<0.0001	3	<0.0001	2	<0.0001	1						
Cr (mg/L)	-	-	-			0.001	5	<0.001	8	<0.001	3	<0.001	2	<0.001	1						
Cu (mg/L)	2	1	1			0.005	5	0.005	8	<0.001	3	<0.001	2	<0.001	1						
Pb (mg/L)	-	-	-			0.031	5	0.009	8	<0.001	3	<0.001	2	<0.001	1						
Ni (mg/L)	0.02	-	1			0.005	5	0.002	8	<0.001	3	<0.001	2	<0.001	1						
Zn (mg/L)	NA	3	20			0.038	5	0.014	8	<0.005	3	<0.05	2	0.020	1						
nitrate (mg/L)	50	-	-			5.1	1	0.04	1	3.27	2	0.36	1	0.23	1						
TN (mg/L)	-	-	-			5.7	1	0.1	1	3.88	2	0.57	1	0.34	1						

Table 11 Monitoring bores compared to Water Quality Guidelines

5 CALLIOPE WATER INVESTIGATIONS

Calliope water investigations can be broadly categorised as follows:

1. Predicted water impacts in Pit 3 prior to western bund wall construction
2. Source of excess water in Pit 3 after western bund wall construction
3. Groundwater behaviour based on water investigative drilling

A summary timeline of categorised investigations is provided in Table 12 below.

Year	Author - Report	Investigation	Outcomes	Discussion
1. Predicted water impacts in Pit 3 prior to western bund wall construction				
2002	Awoonga Alliance - Frost Quarry Protection Works Design and Investigation	Identified that the 10 m raising of Awoonga Dam would inundate the quarry site unless protected. The solution was based on the use of the existing spoil heaps	Permeability tests of existing spoil heap and found them to be permeable and so a clay liner was proposed on western side of the bund wall	A liner consisting of crusher dust, clay, and rock was placed on the reservoir side of the bank to a height 47mAHD.
2003	Kalf and Associates - Hydrogeological Model assessment of sub-surface inflow due to increase in Awoonga Dam storage level - Taragoola Mining Lease Area	Investigated whether increased dam water level would induce increased groundwater flow into existing and future deeper pits. Fieldwork was undertaken by GEMS. MODFLOW numerical groundwater modelling was undertaken by Kalf and Associates	Mine staff estimated that 1.2-3.5 litres/sec continuously flowed into Pit 3 from rock at 32mAHD prior to dam construction. The contribution of direct rainfall/run-off of this flow was unknown. Modelled outcomes indicated that seepage into Pit 3 would increase by about a factor of 2 at 47RL. Groundwater inrushes unlikely as a result of Awoonga Dam storage levels being increased to 47mAHD.	Investigative drilling in October 2018 demonstrated that groundwater intersected at 32mAHD is approx. 5m below water inflow at 37mHD, which is surface water flowing from the Farm Dam. Seepage observed at 32mAHD on the bench was insufficient for flow and there is little groundwater at Calliope.
2. Source of excess water in Pit 3 after western bund wall construction				
2011	GHD - Investigation of inflows to Pit 3	Possible failure mechanism from a March 2011 rainfall event involves the ponding of water within the rocky fill of the bund between the clay liner and the natural material at seepage site, Chain 800-850m, when the lake level is in excess of RL 38m	Created a Water Balance model based on the assumption that Pit 3 was empty prior to March 2011 rainfall. GHD estimated 600ML of water inflow entering Pit 3 via the seepage site is a mixture of water derived from the reservoir and the Farm Dam. The water balance carried out by GHD suggests an average leakage rate through the Bund Wall of between 45 L/s and 62 L/s between September 2010 and March 2011, when the Awoonga Dam level was between 38.8 m and 42.5 mAHD.	No field evidence for proposed failure in bund wall. Hypothesis disproved as water inflow continued when the lake level fell below 38mAHD. The Seep was sampled in March 2025 when Awoonga Dam water level was at 32mAHD.
2011	GHD - Investigation of inflows to Pit 3	A possible failure mechanism was proposed being ponding of water by the Farm Dam, Chain 300m, against the unlined eastern side of the Western Bund Wall caused piping failure.	Pit 3 is derived predominantly from a combination of direct rainfall; runoff from the surrounding catchment area; and direct or indirect seepage from the reservoir and Farm Dam.	No field evidence for proposed failure in bund wall. From 2011-25 water has been observed flowing along western bund wall from Farm Dam to Pit 3.

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Year	Author - Report	Investigation	Outcomes	Discussion
2013	GHD - Repair to Flood Damage on Western Bund Wall	Possible erosion or pipe on Western Bund in spoil heap material, north of "seep", at Chain 1300m.	Proposed approaches to repair the dam being localised repair and raising of clay liner	No earthworks undertaken
2011	Sibelco - Investigation of inflows to Pit 3	Investigate possible Awoonga Dam leakage by undertaking water sampling and reviewing GHD Water Balance model	Water sampling of seep was twice the salinity of Awoonga Dam and water chemistry was different from Awoonga Dam water. Turbidity of seep was less than turbidity of Awoonga Dam. GHD model incorrectly assumed that Pit 3 was empty as evidence by site photographs. Surface water inflow was calculated to be around 600ML based on catchment area which aligned with GHD estimated seep.	Water salinity, chemistry and estimated inflow volumes did not support the hypothesis that Awoonga Dam was leaking. Further work was proposed, which included salinity profiling of Awoonga Dam so to discount stratification as an explanation for why Awoonga Dam is much fresher than the water inflow and Pit 3 water. Geophysical work was not recommended. Salinity profiling of Awoonga Dam in 2018 showed that water quality remained unchanged at depth and also remained at the similar salinity. Further water chemistry confirmed that water inflow and Pit 3 water is distinct from Awoonga Dam which supports the conclusion that Awoonga Dam leakage is not the water source of the water inflow to Pit 3.
2016	Sibelco and GAWB Meeting to discuss seepage between lake Awoonga Dam and Pit 3.	Further investigation proposed to address uncertainty as to the exact sources and pathways of increased water seepage	GAWB proposed to undertake geophysical investigations during future flood events.	No geophysical investigations undertaken
2017-2018	Sibelco - data loggers in Pit 3	Data loggers were installed in Pit 3 to measure water level variation over time and to use this data to quantify water inflows into Pit 3	Sibelco (Feiss) created a Water Balance model using the pit water level data and proposed that pit water level variations were due to groundwater seepage rates of 36l/s in a wet cycle from 15th March 2017 to 31st March 2017, 20 l/s in a draining cycle from 15th April 2017 to 30th June 2017, and 5.4 l/s during a dry cycle from 8th March 2018 to 7th April 2018 and that there is currently significant groundwater seepage at the Calliope.	Sibelco (Feiss) has not differentiated between Farm Dam surface water flow and groundwater flow into Pit 3. The Water Balance model has no flow from Farm Dam during the investigative period which is not in accordance with site observations that water continues to flow into Pit 3 from the Farm Dam when there is water in the Farm Dam.
3. Groundwater behaviour based on water investigative drilling				
2002	GEMS	A total of 8 holes were drilled east of Pit 4 to further investigated groundwater behaviour following the installation of monitoring bores FM1-4	A total of 5 holes were drilled dry, 2 holes had some moisture at the base and groundwater was intersected in only one drillhole. This drilling supported the conclusion that there is little groundwater.	There is little groundwater east o Pit 4
2012	Sibelco - Background Groundwater Monitoring Program	Installation of monitoring bores and derivation of water quality parameter trigger values from benchmark readings.	Monitoring bores FM5 and FM6 were installed to create a Groundwater Monitoring Network at the Calliope. FM5 was installed adjacent to active Pit 4 and FM6 was installed adjacent to inactive Pit 2. Trigger values were derived based on benchmark results.	Monitoring results have informed groundwater behaviour at the site. Groundwater in FM5 and FM6 behave similarly. An additional monitoring bore FM5B was installed in 2021 when FM5 ran dry.

Year	Author - Report	Investigation	Outcomes	Discussion
2018	Sibelco - Investigative drilling and water sampling	A total of 14 holes were drilled west of Pit 3 to investigate the nature of water inflow into Pit 3. Groundwater intersection and later water level measurements, with sampling, was undertaken of drillholes. Surface water bodies including water seep to Pit 3, Pit 3, Farm Dam and Awoonga Dam were sampled.	Investigative drilling in October 2018 demonstrated that groundwater intersected at 32mAHD is approx. 6m below water inflow at 38mHD, which is surface water flowing from the Farm Dam. Salinity and surface water chemistry demonstrated that Awoonga Dam is distinct from Farm Dam and Pit 3. The water quality of the Farm Dam and Pit 3 is chemically similar.	Groundwater is a negligible source of water to Pit 3. Water chemistry does not support Awoonga Dam leakage. Pit 3 water has mixed sources of water from (1) rainfall runoff, (2) surface water flow from the Farm Dam with (3) minor groundwater seepage from floor of Ragotte Creek through bedrock fractures being ~32RL beneath Bund Wall to Pit 3 and (4) very minor groundwater seepage from country rock surrounding Pit 3.
2025	Graymont - investigative drilling and water sampling	A total of 34 holes were drilled across the site including around Pit 4, Pit 1 and south-west of Pit 3.	Drilling was undertaken primarily targeting the limestone volcanic contact where it is most likely to intersect groundwater. A total of 21 holes were drilled dry and groundwater was intersected in 13 holes. Some dry holes slowly made water. Water level measurement and sampling were undertaken and results used to derive a groundwater level map and characterise groundwater across Calliope.	Groundwater chemistry in limestone is similar to groundwater in the volcanics and there is no clear distinction between groundwater from limestone and volcanics

Table 12 Water Investigation summary timeline

5.1 Predicted water impacts in Pit 3 prior to raising the western bund wall

The proposed 10 m raising of Awoonga Dam wall from a full supply water level of 30 to 40mAHD was identified as potentially causing inundation and flooding of Pit 3 and that the increased dam water level could induce increased groundwater flow into existing and future deeper pits. Groundwater Environmental Management Services Pty Ltd (GEMS) in 2002 undertook a hydrogeological assessment to investigate and predict possible future water impact. Field work in November 2002 involved investigative water drilling, sampling and bore installation and water sampling. Investigation drilling results are discussed in Section 5.3.

A planned pumping bore was mot installed because of insufficient groundwater but monitoring bores FM1-4 were installed to the east of Pit 4. Recovery tests were undertaken on these bores and a hydraulic conductivity of 0.003m/day was derived using the Hvorslev Analytical solution. Ragotte Creek was dry at the time of the investigation.

Two dominant spring zones were identified in the map. Groundwater flow in the spring in the north west corner of Pit 4 is rainfall driven and is dry during drier weather irrespective of water level in Ragotte Creek, and will be incorporated by final void Pit 3-4, so no further discussion of this spring is provided. The dominant Pit 3 spring,is referred to in this report as the Seep.

A map of Pits 3 and 4 by Kalf and Associates is provided below as Figure 26

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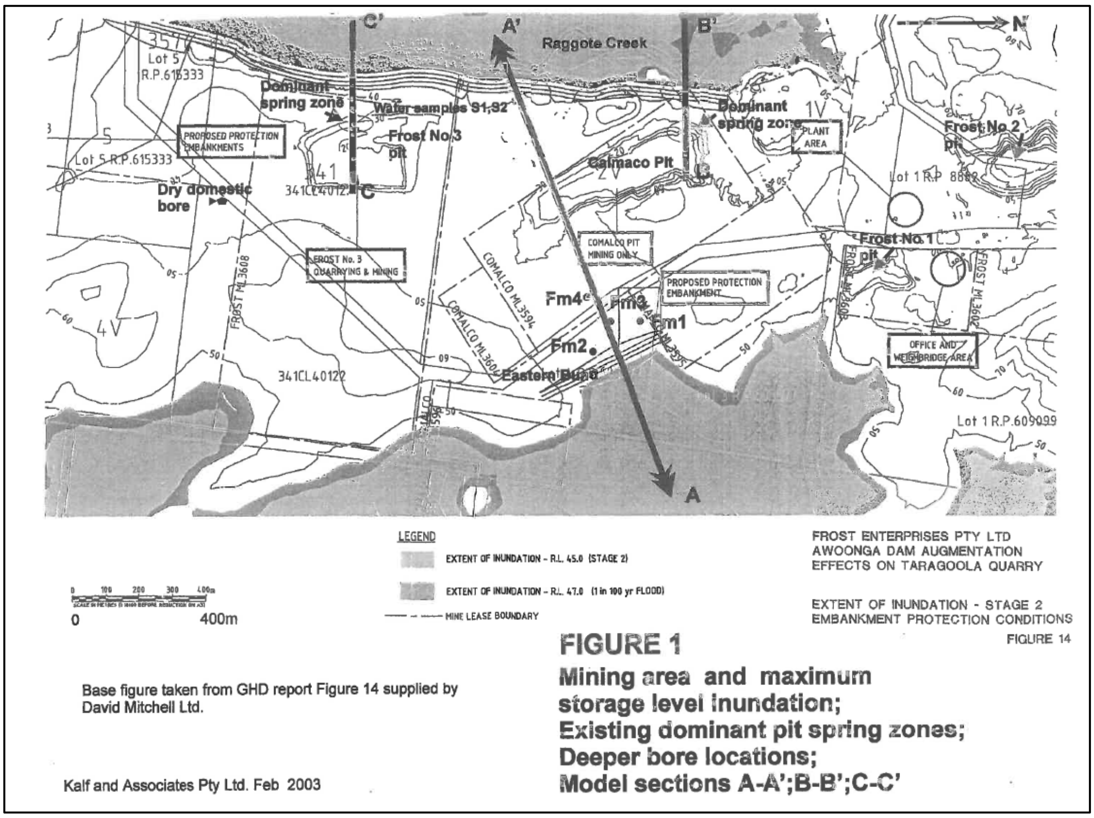

Figure 26 Mining area map (Kalf and Associates, 2003)

A cross-section of Pit 3 (C’-C) is provided as Figures 27.

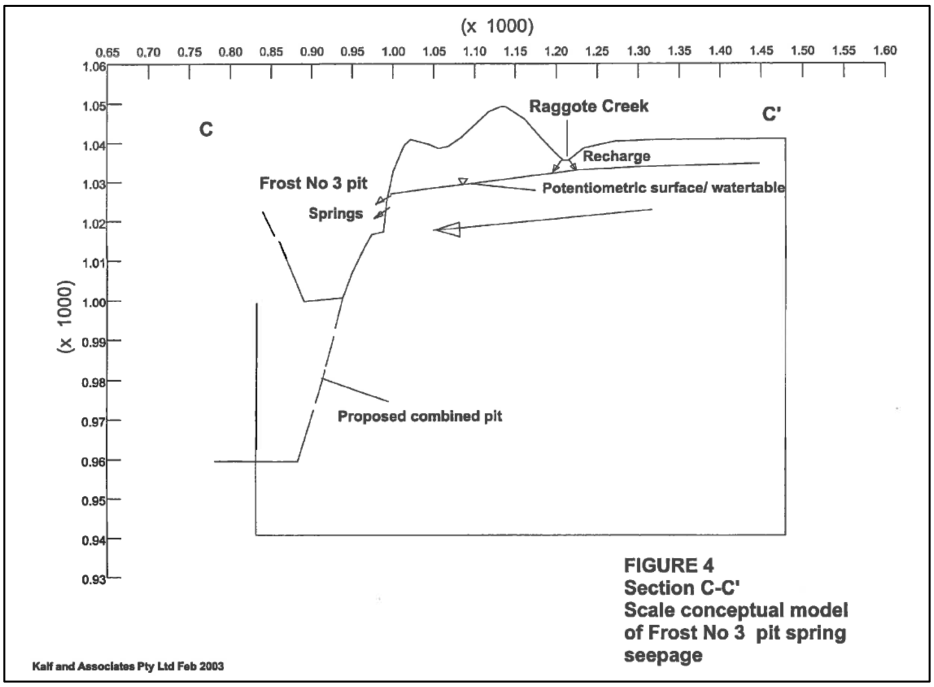

Figure 27 Pit 3 sectional conceptual model (Kalf and Associates, 2003)

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MODFLOW numerical models were constructed for Pit 4 Eastern bund wall, Pit 4 north west seepage zone and the Pit 3 pit western seepage zone (Seep).The models created were a variably saturated finite element model based on the scale conceptual models. See Figure 27. The permeability of the fracture zone and inflow rate is not known precisely and therefore absolute inflow rate cannot be simulated easily or precisely (Kalf and Associates, 2002). A simulation was made using a higher permeability in section, with k=0.5m/day arbitrarily chosen ((Kalf and Associates, 2002). No permeability testing was undertaken near Pit 3 but hydraulic conductivity testing results from near Pit 4 indicated a very low value of 0.003m/day, being 2 orders of magnitude lower than values used in the model. Modelled outcomes are shown in Figure 28.

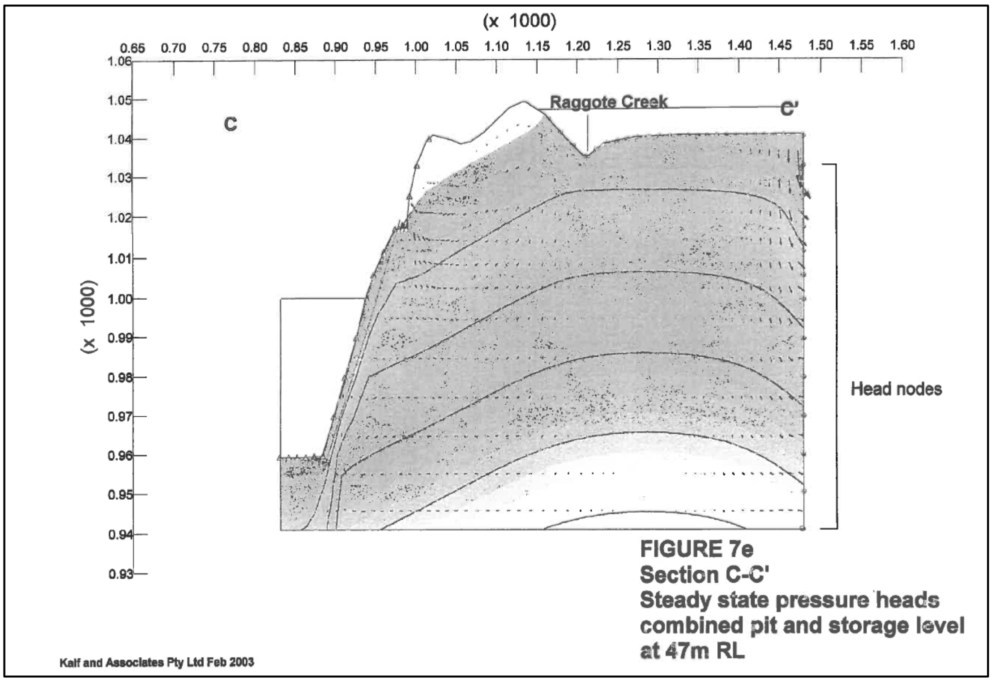

Figure 28 Pit 3 sectional numerical model (Kalf and Associates, 2003)

The Pit 3 modelled outcomes do not align with the conceptual model which shows a watertable in an unconfined aquifer seeping into the pit whereas the numerical shows groundwater, as a potentiometric surface, being drawn down below the pit which requires a bore to be installed in the pit floor.

Model simulation results indicate that current inflows for both Pit 3 and Pit 4 could increase by a factor of 2 when Awoonga Dam reaches 47RL. It was also proposed that excavation to -40mAHD could increase inflow by a factor of 10 but the probability of a fracture extending uniformly to the base of such a pit is considered to be very low based on the data available (Kalf and Associates, 2002). The current Pit 4 floor is at -20mAHD being 78% of modelled depth and groundwater inflows remain unchanged which suggests that the modelled outcomes are unreliable.

5.2 Source of excess water in Pit 3

Calliope is bounded by Awoonga Dam. In December 2010 a high rainfall event elevated Awoonga Dam water levels and large water inflows were observed to enter Pit3. From 2010-2019 the primary cause of excess water in Pit 3 has been investigated by site hydrogeologists, consultants engaged by both Sibelco/Graymont and the Gladstone Area Water Board (GAWB).

Potential sources of excess water in Pit 3 include :

- A possible piping failure mechanism by ponding of water against the unlined eastern side of the Western Bund Wall (GHD, 2011b), where the Farm Dam was created by the construction of the Western Bund Wall at Chain 300 as per Figure 13. Other locations for proposed locations of piping failure are west of Pit 3 at Chain 850 (GHD, 2011a) as per Figure 13. Piping failure was also proposed north of the Western Bund in spoil heap material at Chain 1300 by GHD (2013) from the 2013 flood reservoir peak of 48.3 mAHD
- Groundwater seepage (Sibelco- Feiss, 2017)
- Surface water run-off from the Farm Dam area (Sibelco, 2011)

Multiple lines of evidence have been used to determine the sources of excess water in Pit 3 including geological mapping and drilling; water investigative drilling; surface water and groundwater sampling; water chemistry which includes salinity, pH and major ion; photographic records, accurate volumetric estimate of Pit 3 water using data loggers and catchment analysis.

5.2.1 Awoonga Dam possible leakage to Pit 3

The GHD hypothesis that excess water in Pit 3 was possibly leakage through the Western Bund Wall was investigated by Sibelco (2011). At the time of this investigation water freely flowed along the western bund from the Farm Dam along the bund wall to the Seep and then flowed into Pit 3 as described in Section 4.1.3. Awoonga Dam water level at this time was at 40.3 mAHD.

Water sampling in March 2011 was undertaken which included Awoonga Dam, the Farm Dam, the water flowing along the western bund wall and the Seep into Pit 3. Water salinity and chemistry results from this sampling event are shown in Table 13.

Water Quality parameters		Awoonga Dam	Farm Dam	Water flow along Western Bund Wall	Seep into Pit 3
Electrical Conductivity @ 25°C	µS/cm	282	601	632	618
Total Dissolved Solids @180°C	mg/L	161	341	345	325
Redox Potential	mV	144	167	158	164
pH	pH Unit	7.8	7.3	7.4	7.2
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	mg/L	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	mg/L	93	106	134	141
Total Alkalinity as CaCO3	mg/L	93	106	134	141
Sulfate as SO4 2-	mg/L	8	4	27	13
Chloride	mg/L	22	115	85	92
Calcium	mg/L	23	38	62	57
Magnesium	mg/L	8	12	7	8
Sodium	mg/L	19	58	48	51
Potassium	mg/L	2	3	2	2
Total Anions	meq/L	2.64	5.45	5.64	5.69
Total Cations	meq/L	2.68	5.49	5.85	5.82

Table 13 Water sampling results from March 2011

Water salinity and chemistry of Awoonga Dam is distinct from the Farm Dam, water flow along the western bund wall and the Seep and it was concluded that Awoonga Dam was not the water source of the Seep because water leaking through the dam wall could not double in salinity while passing quickly through the dam wall and that the water was primarily surface run-off from the Farm Dam.

To further test this conclusion salinity profiling was undertaken in 2018 of Awoonga Dam to investigate whether there was salinity stratification of the water column; specifically whether water on the floor of the Dam was twice as saline as at the surface. Salinity profiling was undertaken from a boat on Awoonga Dam at eight locations and no change in salinity with depth was observed.

Water sampling undertaken in 2018 in addition to Awoonga Dam included a catchment dam, the Farm Dam, water flow along the western bund wall, the Seep and Pit 3. Further follow-up water sampling was undertaken in2025 which included Awoonga Dam, catchment dams, the Farm Dam, the Seep and Pit 3.

The 2011,2018 and 2025 monitoring demonstrated that Awoonga Dam salinity of 250+/50µS/cm was much fresher than Pit 3 salinity which is typically 630+/-100µS/cm. A map showing the location of the 2011, 2018 and 2025 monitoring points with salinity sampling results is presented as Figure 29.

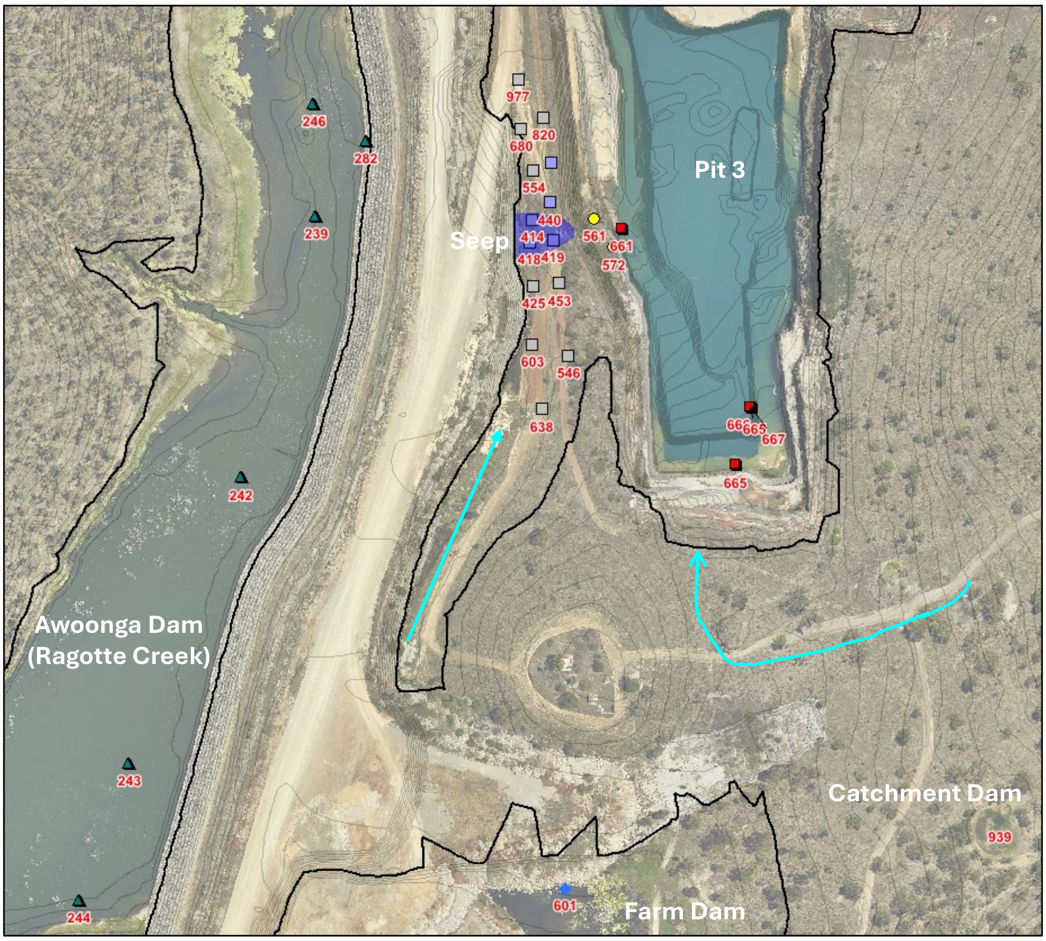

Figure 29 Surface water salinity sampling results 2011 and 2018

Major Ion water chemistry of surface water results are presented as a Piper plot in Figure 30. Awoonga Dam water is chemically distinct from Pit 3 sub catchment and Farm Dam sub-catchment water. Awoonga Dam water is Ca-Mg-HCO3 type water whereas the Farm Dam and water flowing along the bund wall and Pit 3 water are mixed type water with similar chemistry and the catchment dam is a Na-K-Cl-SO4 type water. Water chemistry also does not support leakage and it is concluded that Awoonga Dam does not leak through the western bund wall.

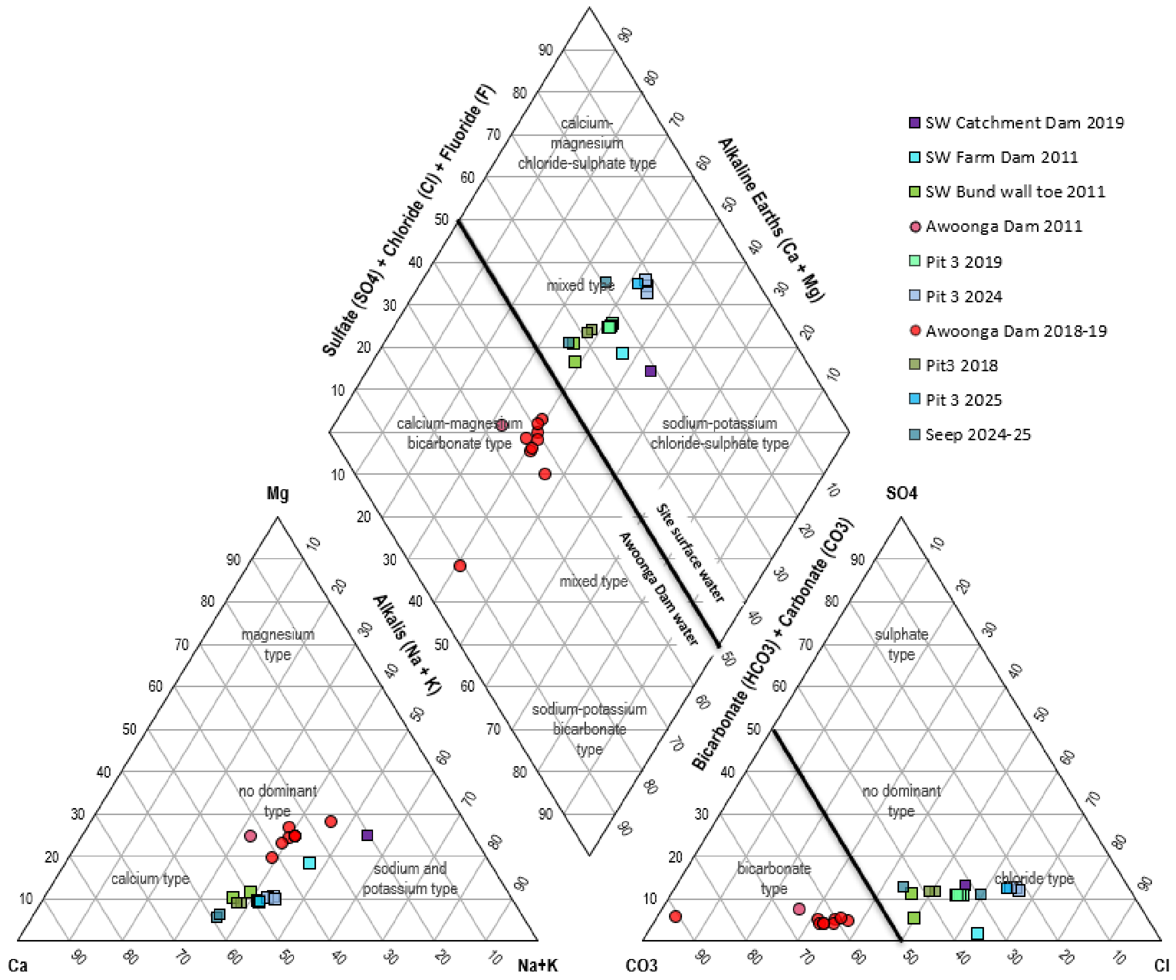

Figure 30 Awoonga Dam with Pit 3 and Farm Dam sub-catchment major ion chemistry

5.2.2 Groundwater seepage contribution to Pit 3 water

Seepage is considered to be the normal flow of water through an embankment or natural material, while leakage is considered to be flows resulting from a failure or deficiency in the embankment or foundation. Mine staff estimated that 1.2-3.5 litres/sec continuously flowed into Pit 3 from rock at 32mAHD prior to dam construction. This inflow is thought to be primarily from spring seepages but the contribution of direct rainfall/run-off of flow is unknown (Kalf and Associates, 2002). The Seep was present in 1997, when the Waste Dump was adjacent to the Seep, as a source of surface water run-off for the Seep, prior to the completion of the construction of the western bund wall.

The Seep was considered by Sibelco (Feiss) in 2017 to be exclusively groundwater and there was no differentiation between Farm Dam surface water flow and groundwater seepage into Pit 3. Investigative drilling was undertaken from the 2-3 October 2018 to further assess the relationship between the Seep and groundwater and to better define groundwater behaviour between the Western Bund wall and Pit 3. At the time of drilling surface water was flowing along the western bund wall to the Seep then entering Pit 3. A total of 14 holes were drilled with location and groundwater intersection details shown in Table 14 with an accompanying drillhole location map in Figure 31.

Location Details				Drilling Details					
Drill site	Easting	Northing	Natural surface mAHD	Dril Date	Hole Depth	Clay Depth	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD
C01	320712	7332119	38	2/10/2018	12	9.5	Volcanic	9.5	28.5
C02	320694	7332110	38.3	2/10/2018	23.5	7.6	Volcanic	11	27.3
C03	320718	7332083	38.3	2/10/2018	21	6.7	Volcanic	dry	
C04	320704	7332077	37.5	2/10/2018	25	6.3	Volcanic	12	25.5
C05	320717	7332051	38	2/10/2018	25	10	Limestone	12	26
C06	320703	7332037	37.7	2/10/2018	25	8	Volcanic	dry	
C07	320701	7332019	37.4	2/10/2018	25	10.5	Volcanic	dry	
C08	320720	7332021	38	2/10/2018	26	11	Volcanic	dry	
C10	320704	7331984	37.9	3/10/2018	16.5	6	Volcanic	7	30.9
C11	320732	7331928	39.2	3/10/2018	25	7	Volcanic	7	32.2
C12	320703	7331937	38.2	3/10/2018	22	8	Volcanic	7	31.2
C13	320711	7331885	38.6	3/10/2018	25	8.5	Volcanic	10	28.6
C14	320692	7332150	38.6	3/10/2018	29	8.4	Volcanic	dry	

Table 14 Pit 3 Groundwater investigative drilling in 2018

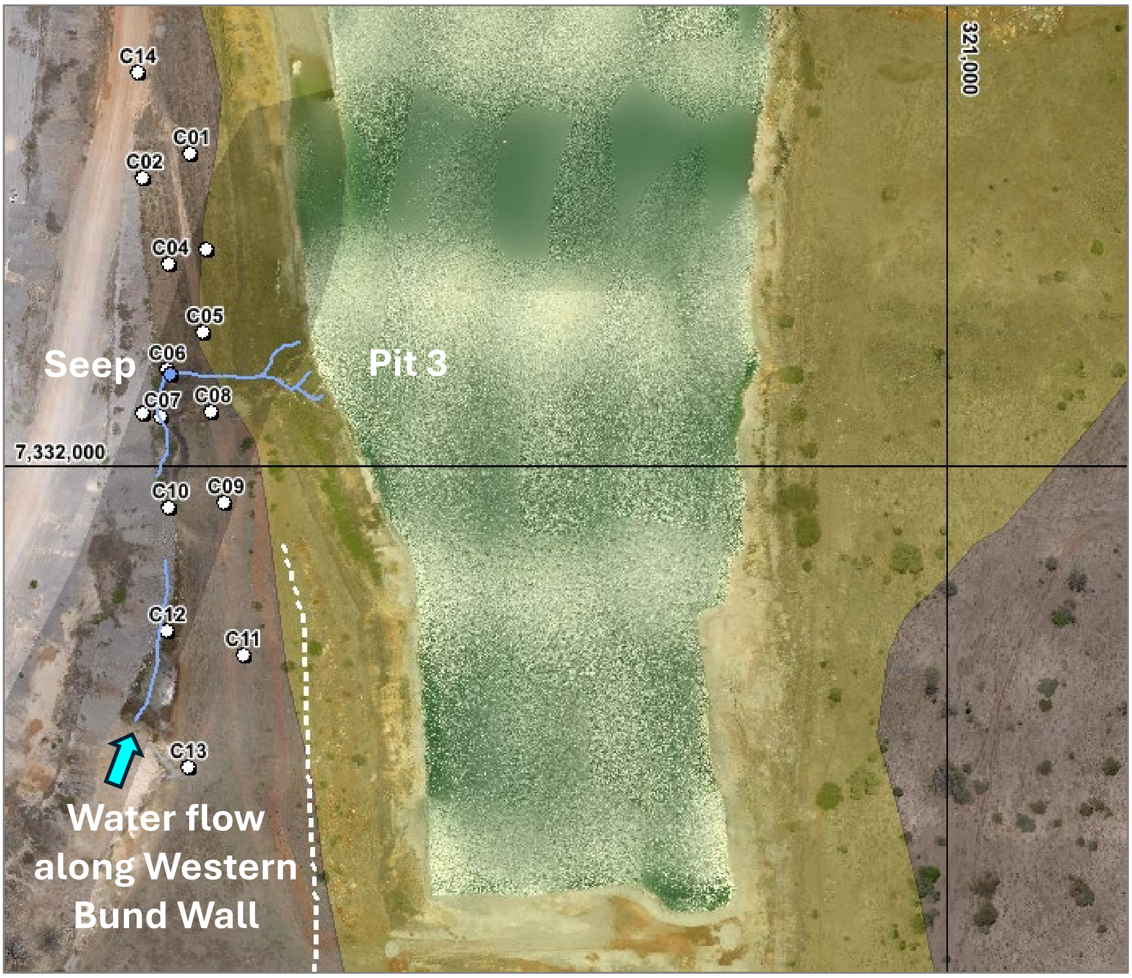

Figure 31 Map of groundwater investigative drilling in 2018

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Groundwater level and flow

The drilling was undertaken with a 3 metre pre-collar which provided stability around the hole collar to help prevent hole collapse. All of the holes were drilled in volcanic rock except for C05 which was drilled in limestone. Five of the fourteen holes were drilled dry. Groundwater was intersected at 26-32mAHD. All drillholes were capped and collars surveyed to ensure groundwater data integrity. Most of the holes slowly made water and were water level tested either the next day or late in the same day. C06 was drilled into Seep and groundwater was 5.15m below the surface at this location. Water samples were obtained from the drillholes. A year later on the 8 October 2019 eight of the 14 drillholes had partially collapsed while five of the drillholes were intact and water level measurements were undertaken from these holes. Following this sampling all holes were backfilled. A summary of monitoring results is provided in Table 15.

Groundwater Monitoring									
Drill site	Monitor Date	GW DBNS	Hydraulic head mAHD	Field EC	Water Sample	Monitor Date	GW DBNS	Hydraulic head mAHD	Field EC
C01	3/10/2018	6.79	31.21	820	✓	×			
C02	3/10/2018	6.45	31.85	680	✓	×			
C03	3/10/2018	dry			×	×			
C04	3/10/2018	6.47	31.03	554	✓	8/10/2019	6.91	30.59	391
C05	3/10/2018	6.50	31.50	440	✓	×			
C06	3/10/2018	3.50	34.20	414	✓	8/10/2019	5.15	32.55	303
C07	3/10/2018	3.24	34.16	418	✓	8/10/2019	3.74	33.67	306
C08	3/10/2018	6.84	31.16	419	✓	8/10/2019	7.34	30.66	319
C10	3/10/2018	5.67	32.23	425	✓	×			
C11	3/10/2018	5.36	33.84	546	✓	×			
C12	3/10/2018	7.24	30.96	603	✓	×			
C13	3/10/2018	5.52	33.08	638	✓	×			
C14	3/10/2018	8.37	30.23	977	✓	8/10/2019	7.63	30.97	781

Table 15 Groundwater monitoring of the 2018 drillholes

Groundwater is elevated at 34mAHD in holes C06 and C07 at the Seep which is 38mAHD. Groundwater level varies from 31-34mAHD with an average of 32mAHD being approximately 5 metres below the Seep entry site at 37mAHD and therefore seep inflow is not groundwater. A March 2015 photograph of the Seep into Pit 3 (Figure 32) shows the Seep surface water inflow at 37mAHD and groundwater seepage at 32mAHD.

Figure 32 The Seep and groundwater seepage into Pit 3 – 4 March 2015

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Groundwater and surface water chemistry

Sampling of the drillholes and surface water bodies was undertaken to characterise groundwater and its relationship with surface water. Groundwater and surface water major ion chemistry from the 2018-19 water investigation is shown in Table 16 below.

Site	Type	Date	Ca	Mg	Na	K	HCO3	CO3	Cl	SO4
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C01	Groundwater	3/10/2018	106	8	88	0.5	334	0.5	100	24
C02	Groundwater	3/10/2018	94	9	88	0.5	343	0.5	68	16
C04	Groundwater	3/10/2018	71	8	63	0.5	295	0.5	40	10
C05	Groundwater	3/10/2018	70	3	37	0.5	230	0.5	35	5
C06	Groundwater	3/10/2018	68	3	39	0.5	192	0.5	52	6
C07	Groundwater	3/10/2018	70	3	32	0.5	208	0.5	35	4
C08	Groundwater	3/10/2018	69	3	28	0.5	201	0.5	35	6
C10	Groundwater	3/10/2018	74	3	28	0.5	220	0.5	36	4
C11	Groundwater	3/10/2018	95	4	36	0.5	256	0.5	41	32
C12	Groundwater	3/10/2018	102	6	41	0.5	270	0.5	57	27
C13	Groundwater	3/10/2018	105	6	48	0.5	262	0.5	62	40
C14	Groundwater	3/10/2018	150	14	70	0.5	300	0.5	167	32
Awoonga Dam	Surface water	3/10/2018	21	6	22	2	87	0.5	31	6
Awoonga Dam	Surface water	3/10/2018	19	7	22	2	79	9	30	5
Pit 3	Surface water	3/10/2018	67	7	56	0.5	135	0.5	106	33
Pit 3	Surface water	3/10/2018	69	7	56	0.5	140	0.5	104	33
Seep	Surface water	3/10/2018	65	4	56	0.5	233	0.5	42	10
Seep2	Surface water	3/10/2018	80	3	36	0.5	205	0.5	48	19
Awoonga Dam	Surface water	15/01/2019	12	8	24	2	83	0.5	24	5
Awoonga Dam	Surface water	15/01/2019	17	7	21	2	77	0.5	26	5
Awoonga Dam	Surface water	15/01/2019	16	7	21	2	81	0.5	24	4
Awoonga Dam	Surface water	15/01/2019	17	8	21	2	81	0.5	25	4
Awoonga Dam	Surface water	15/01/2019	16	7	21	2	81	0.5	25	4
Awoonga Dam	Surface water	15/01/2019	16	7	21	2	80	0.5	27	4
Awoonga Dam	Surface water	15/01/2019	16	7	21	2	84	0.5	26	4
Catchment Dam1	Surface water	15/01/2019	39	29	119	3	117	0.5	124	141
Pit 3	Surface water	15/01/2019	62	7	61	0.5	120	0.5	121	31
Pit 3	Surface water	15/01/2019	62	7	61	0.5	121	0.5	119	31
Pit 3	Surface water	15/01/2019	62	7	60	0.5	123	0.5	116	30
Pit 3	Surface water	15/01/2019	61	7	60	0.5	121	0.5	116	30

Table 16 Groundwater and surface water major ion chemistry from 2018-19 investigation

Groundwater chemistry is variable with concentration of the anions HCO_3, Cl and SO_4 being higher in drillholes north of the Seep such as C14 and C01 which were the northern most drilled holes (Figure 13) and the lowest concentrations were C05-C10 which are located at the Seep. The lower concentrations in the Seep indicate leaching of groundwater from the Seep, which is surface water flow from the Farm Dam, into Pit 3. Groundwater has a sulphate concentration of 4-6mg/L which is the same as Awoonga Dam water which indicates that there is minor groundwater seepage beneath the Western Bund wall through bedrock fractures at approximately 32mAHD. Groundwater has a bicarbonate concentrations over double Awoonga Dam which indicates a residence and geochemical processes that are different from Awoonga Dam. Groundwater cannot leak or flow rapidly, in seconds, from Awoonga Dam through the Western Bund wall and over double the concentration of HCO_3.

A Piper plot of groundwater chemistry west of Pit 3 and surface water shows that they are chemically different with groundwater being Ca-MG-HCO3 type and the Seep mixed type (Figure 33).

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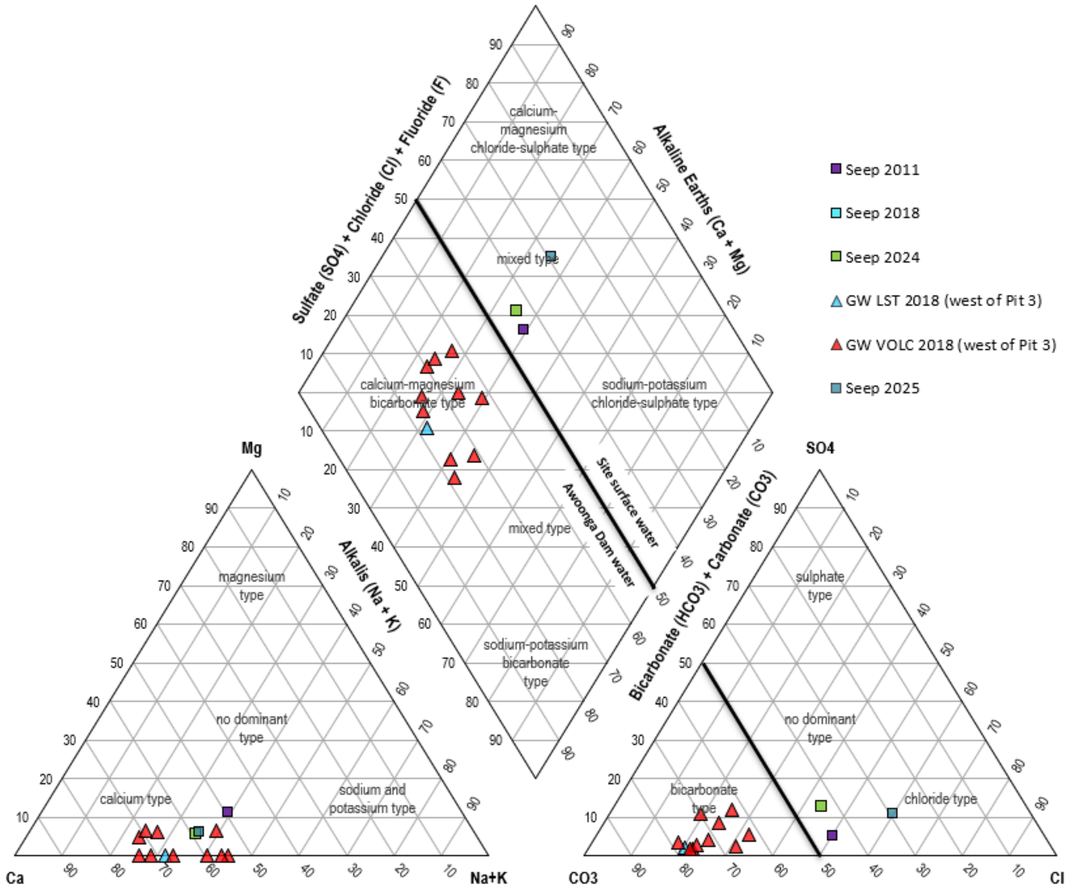

Figure 33 Groundwater chemistry and seepage into Pit 3

The water chemistry of groundwater is distinct from the chemistry of the seep (Figure 33) but is similar to Awoonga Dam as shown in Table 15 and in Figure 30.

The Seep is not groundwater and there is insufficient groundwater on the bench to be sampled and it is concluded that there is a groundwater contribution to Pit 3 form seepage below the Western Bund wall, but this is <1 l/s and cannot be sampled where observed on the bench surface.

5.2.3 Surface water source of excess water in Pit 3

Surface water collected in the Farm Dam seeps beneath and exits the uncompacted northern edge of the Waste Dump and then flows along the western bund wall to the Seep and into Pit 3. The Farm Dam theoretical overflow is at 43mAHD, being the elevation of material extending north-easterly from the Waste Dump, but water is regulated such that the water level in the Farm Dam does not exceed 38mAHD.

A February 2015 photograph (Figure 34) shows surface water pooled in the Farm Dam, water flowing between pools along the edge of the Western Bund wall to the Seep and then into Pit 3. The water quality of Awoonga Dam, Farm Dam and Pit 3 is visually very different with Awoonga Dam water having a brown discolouration and high turbidity from the agitation of clay by the previous 3 days of high rainfall. The Farm Dam water is black and indicates a contribution of organic matter and tannins, with no evidence of clayed material entering the Farm Dam; and Pit 3 water is the typical green-blue tinged colour of pit water in limestone.

Figure 34 Western bund wall surface water flow into Pit 3 on 22 February 2015

Data loggers were installed in Pit 3 in 2017/18 to further investigate the source of excess pit water and this data has been used to set-up and calibrate the final pit void Water Balance Model. A hydrograph of Pit 3 water levels for the period January 2017 to April 2018 is presented below in Figure 35.

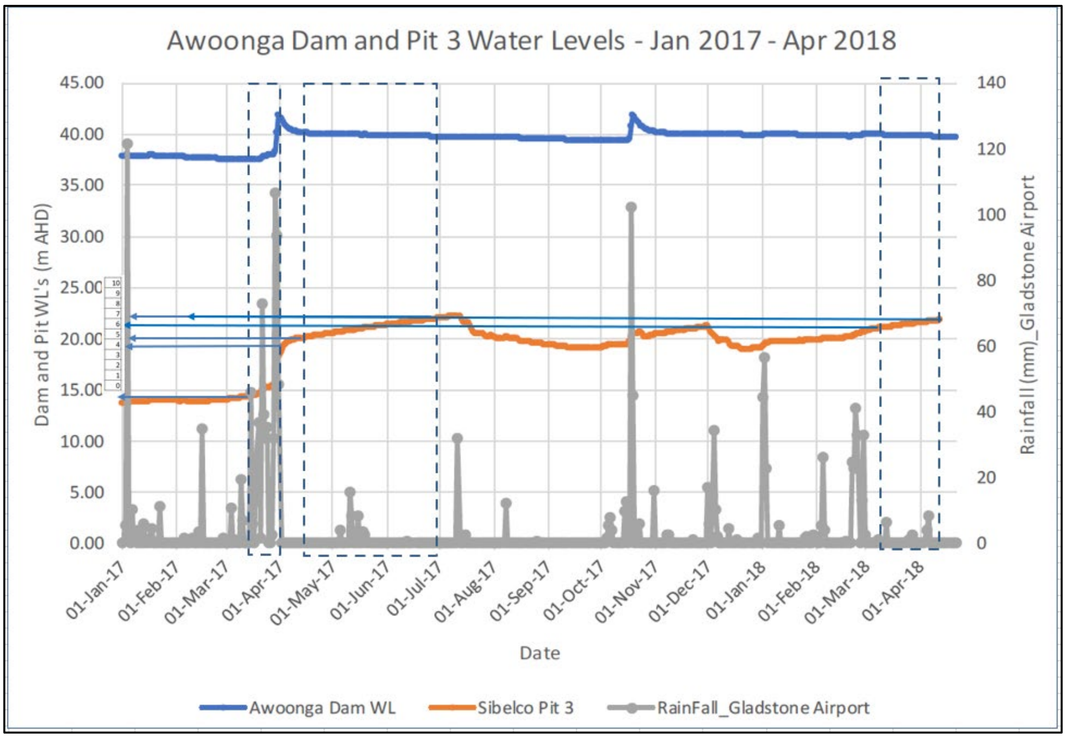

Figure 35 Calibration events obtained in Pit 3 from January 2017 to April 2018

Three calibration periods were identified by a Sibelco hydrogeologist (Feiss) and the Pit 3 water fluctuations for these calibration events were calculated to yield “seepage” rates of 36l/s (3.1ML/day) in a wet cycle from 15th March 2017 to 31st March 2017, 20 l/s (1.7ML/day) in a draining cycle from 15th April 2017 to 30th June 2017, and 5.4 l/s (0.5ML/day) during a dry cycle from 8th March 2018 to 7th April 2018. The dam water level was proposed to create a potentiometric surface in a semi-confined aquifer driven and equivalent to Awoonga Dam water level and at final pit void groundwater seepage would increase by a factor of 10.

This assessment of the Pit 3 data logger water levels did not differentiate between surface water flow from the Farm Dam and groundwater or the observed absence of groundwater at the Calliope. If the Awoonga Dam was leaking 3.1ML/day into the Farm Dam then at least 10ML of turbid clayed Awoonga Dam water should have leaked into the Farm Dam on the 22 February 2015 as per Figure 34. There is no clayed water in the Farm Dam and photographic evidence supports the hypothesis that excess Pit water following high rainfall events is not from Awoonga Dam leakage (Figure 34) and is not from groundwater (Figure 32). A Piper plot of Awoonga Dam, Farm Dam, water flow along the Western Bund Wall, the Seep and Pit 3 is shown as Figure 36.

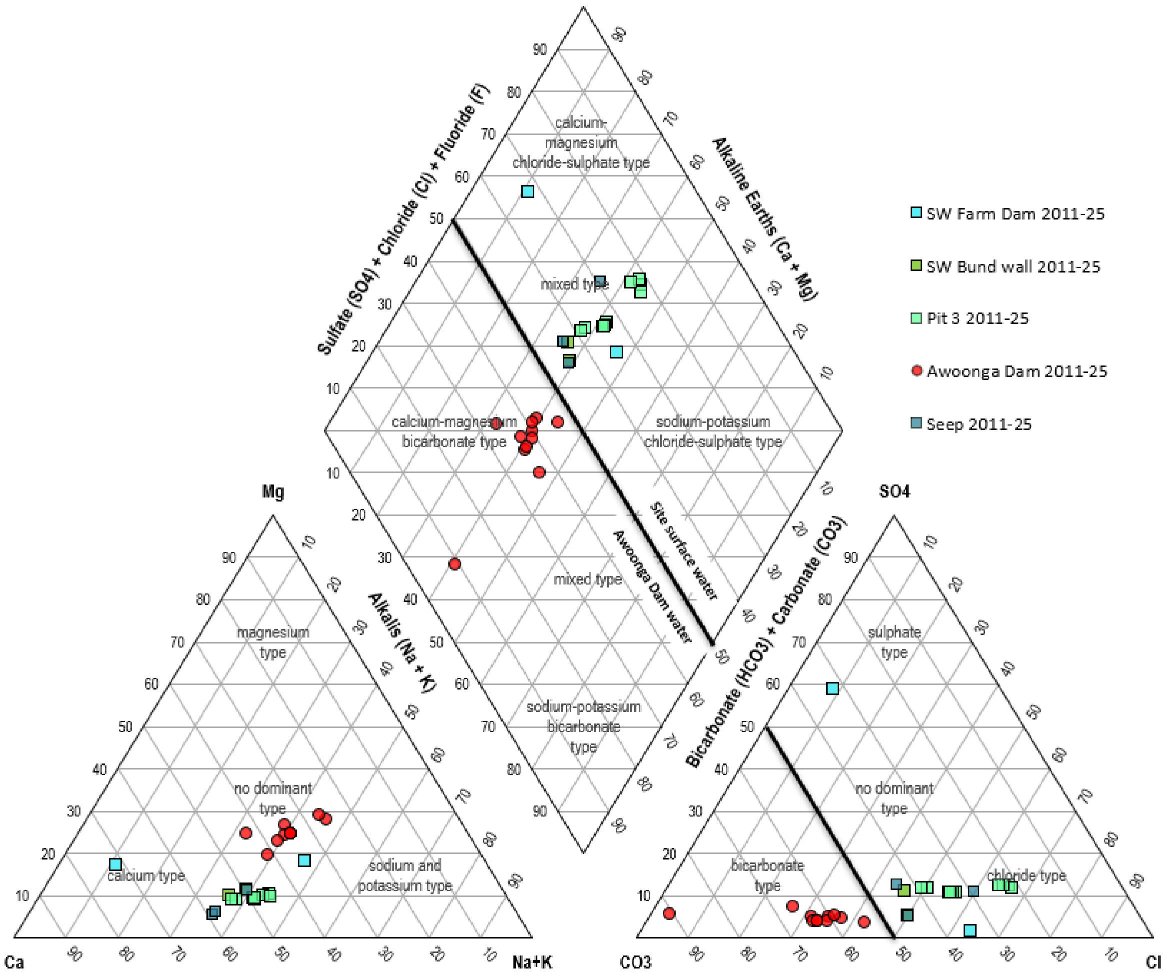

Figure 36 Awoonga Dam with Pit 3 and Farm Dam major ion chemistry

Awoonga Dam water is chemically distinct from Pit 3 and Farm Dam sub-catchment surface water. Awoonga Dam water is Ca-Mg-HCO3 type. Farm Dam and water flowing from the Farm Dam to Pit 3 and Pits 3 water are chemically similar being mixed type. Surface water flows from the Farm Dam to Pit when there is water in the Farm Dam.

Excess Pit 3 water following heavy rainfall is attributed to surface water run-off in the Pit 3 catchment with prolonged inflow following rainfall due to seepage and flow of water from the Farm Dam.

5.3 Groundwater behaviour from investigative water drilling

5.3.1 Interpreting drilled water intersections

Rotary Air Blast (RAB) drilling is routinely undertaken for drill and blast production at the quarry as well as geological resource definition drilling and investigative water drilling. Groundwater intersected by geological and investigative drilling is recorded. During an investigative groundwater drilling program groundwater measurements were made of the drilled hole void to determine whether the groundwater elevation of intersected groundwater has changed post-drilling or if a dry hole has slowly made water.

Drilled water intersections and post drilling groundwater measurements assist with interpretating groundwater behaviour and the host aquifer. See Figure 37.

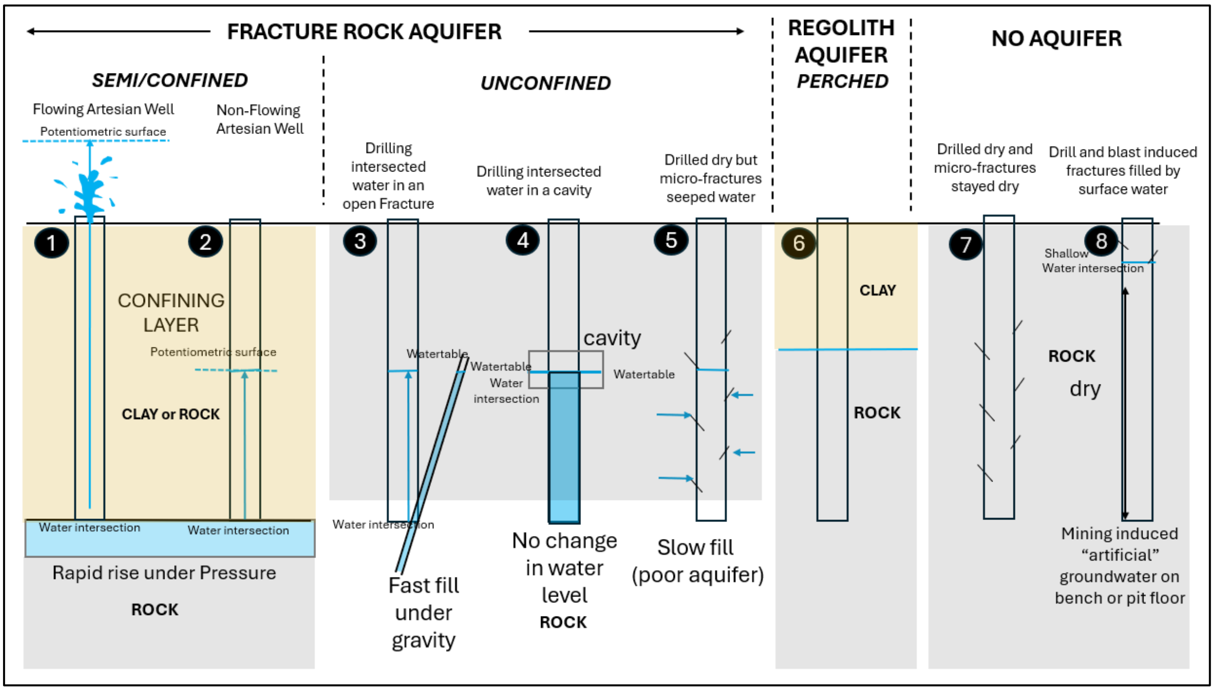

Figure 37 Drilled groundwater intersection types

At Calliope there has been no artesian flow observed in any drilled holes (1) whereas groundwater level has been observed to rise in an open drillhole post-drilling. The rise of groundwater post-drilling could possibly be interpreted as (2) but because of the delayed slow response are generally interpreted as (3) to (5) although (6) has been observed outside the pit envelope. Some holes were drilled dry and remained dry (7). Blasting on benches and the pit floor has created fractures that have led to the sub-surface capture of water in the fractures, being an artificial groundwater (8). Artificial groundwater is usually within 5 metres from the surface and can be distinguished from natural groundwater based on water chemistry.

5.3.2 Pit 3 investigative drilling in 2018

The 2018 investigation drilling west of Pit 3 and outcomes from this drilling was discussed in Section 5.2.2.

5.3.3 Site-wide investigative drilling in 2025

A total of 34 holes were drilled in 2025 around the perimeter of Pit 4, Pit 1 and east of Pit 3 define groundwater behaviour and further investigate groundwater -lithological relationships. Drillhole location and groundwater intersection details are shown in Table 17

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Location Details				Drilling Details					
Hole ID	East	North	Natural surface mAHD	Drill Date	Hole Depth (m)	Clay Depth (m)	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD
D01	320722	7332520	46	4/03/2025	25	13	Volc	13	33
D02	320806	7332367	46.4	4/03/2025	29	14	Volc	14	32.4
D03	320916	7332338	42.2	4/03/2025	25	20	LST	dry	
D04	321127	7332322	45.7	4/03/2025	25	8	LST	dry	
D05	321334	7332305	52.8	4/03/2025	29	4	LST	dry	
D06	321510	7332466	58.2	4/03/2025	29	10	Volc	dry	
D07	321551	7332638	52.8	4/03/2025	29	4	Volc	dry	
D08	321532	7332742	48.1	4/03/2025	25	12.5	Volc	21	27.1
D09	321702	7332679	45.2	4/03/2025	29	2	Volc	dry	
D10	321374	7333021	52.4	4/03/2025	25	3	Volc	24.5	27.9
D11	321318	7333156	61.8	4/03/2025	29	3	Volc	dry	
D12	321270	7333333	58.5	5/03/2025	29	9	Volc	dry	
D13	321195	7333480	56.5	5/03/2025	29	2	Volc	23.5	33
D14	321239	7333633	60.1	5/03/2025	29	2	Volc	dry	
D15	321135	7333732	61.5	5/03/2025	8	6.5	LST	dry	
D16	321133	7333734	61.4	5/03/2025	29	6.5	LST	14.5	46.9
D17	320986	7333320	50.6	5/03/2025	29	4	LST	dry	
D18	320740	7333178	44.6	5/03/2025	29	4	LST	dry	
D19	320700	7332964	45.7	5/03/2025	29	4	LST	dry	
D20	320704	7332752	44.4	5/03/2025	29	9	Volc	dry	
D21	321323	7332317	51.5	31/03/2025	29	3 (fill)	LST	24	27.5
D22	321212	7332216	49.7	1/04/2025	29	2	LST	dry	
D23	321433	7332040	61	1/04/2025	29	2	Volc	dry	
D24	321184	7331834	58.7	1/04/2025	29	2	Volc	dry	
D25	320819	7331696	42.3	1/04/2025	14.5	3	Volc	dry	
D26	320963	7331713	43.5	1/04/2025	13.5	2	LST	12	31.5
D27	320970	7331477	42.4	1/04/2025	14	1	Volc	14	28.4
D28	321029	7331167	43.6	1/04/2025	18	1	Volc	17.5	26.1
D29	321085	7330868	54	1/04/2025	23	3	Volc	dry	
D30	320743	7331231	45.1	1/04/2025	18	3	MetaSED	17.5	27.6
D31	320815	7331556	40.1	1/04/2025	18	3 (fill)	Volc	17.5	22.6
D32	320662	7333082	51.4	31/03/2025	18	4.5	LST	18	33.4
D33	321139	7333273	54	31/03/2025	29	3 (fill)	LST	dry	
D34	321409	7332693	47.3	31/03/2025	29	3 (fill)	Volc	dry	

Table 17 Groundwater investigative drilling in 2025

The drilling intersected volcanics in 20 holes, limestone in 13 holes, with these 33 holes being in Calliope Beds. One drillhole, D30, intersected metasediment, being metamorphosed and Rockhampton Group sedimentary rock. The holes were capped at the completion of drilling. A drillhole map is shown as Figure 38.

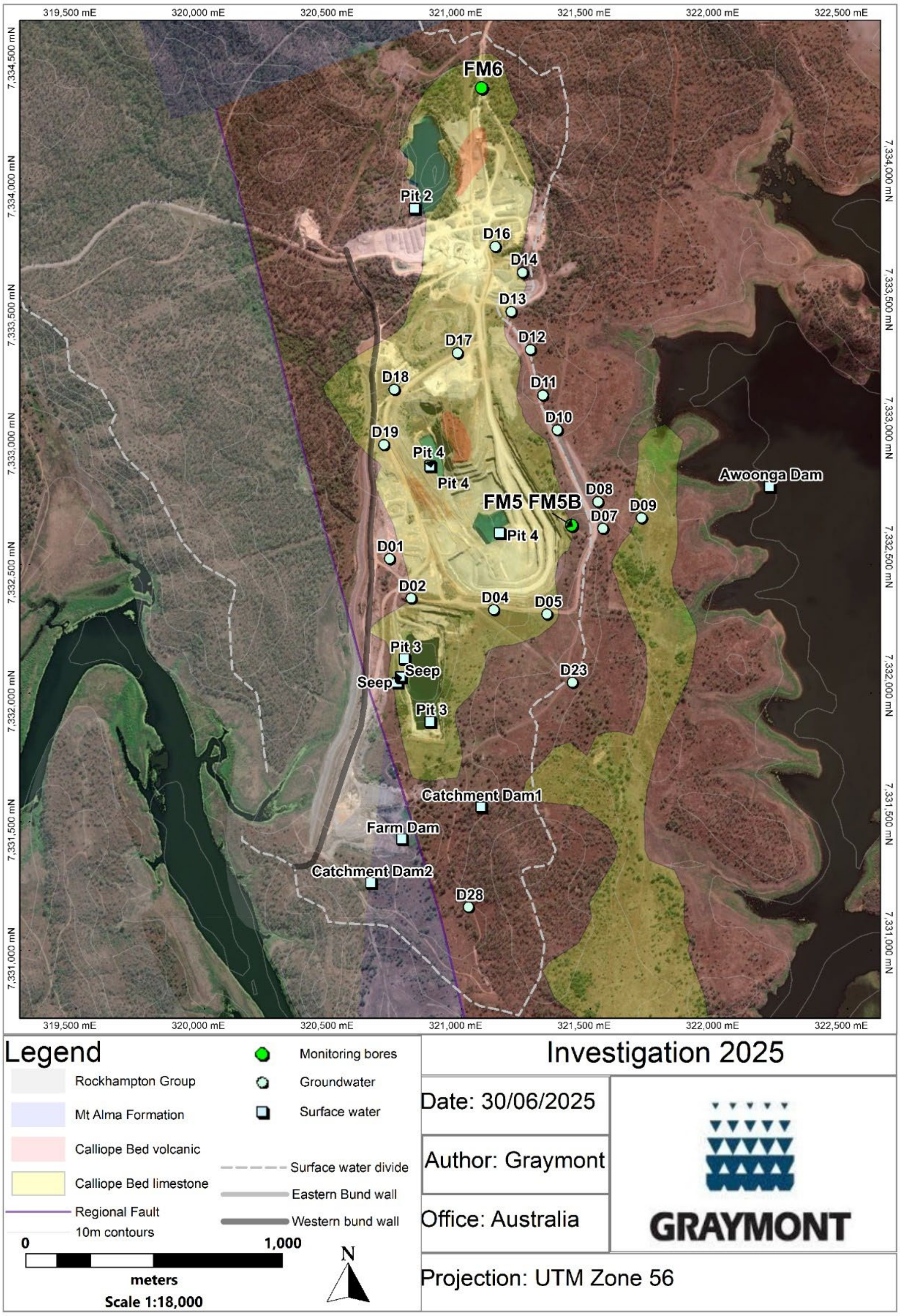

Figure 38 Groundwater Investigative drilling with surface water sites 2025

Groundwater level and flow

The majority of drilled were dry with the most groundwater intersected at and near the volcanic -limestone contact. Site blast hole drilling driller logs of water intersection confirm that groundwater intersections are uncommon. Most of the holes slowly made water and were water level tested either the next day or late in the same day. Water samples were obtained from the drillholes. All the 2025 drillholes were capped and collars surveyed to ensure groundwater data integrity. Monitoring results are provided in Table 18.

Groundwater Monitoring														
Hole ID	Monitor Date	DBNS (m)	Hydraulic head mAHD	Field EC	Monitor Date	DBNS (m)	Hydraulic head mAHD	EC	Water Sample	Monitor Date	DBNS (m)	Hydraulic head mAHD	EC	Water Sample
D01	4/03/2025	10.53	35.47	813	10/03/2025	10.6	35.4	331	✓	29/05/2025				×
D02	4/03/2025	12.96	33.44	1002	10/03/2025	12.8	33.6	419	✓	29/05/2025				×
D03	4/03/2025	dry			10/03/2025	dry			×	29/05/2025				×
D04	4/03/2025	dry			10/03/2025	19.8	25.9	4310	✓	29/05/2025				×
D05	4/03/2025	dry			10/03/2025	27.3	25.5	975	✓	29/05/2025				×
D06	4/03/2025	dry			10/03/2025	dry			×	29/05/2025				×
D07	4/03/2025	28.18	24.62	1689	10/03/2025	23	29.8	221	✓	29/05/2025	14.76	38.04		×
D08	4/03/2025	12.14	35.96	1928	10/03/2025	12.2	35.9	741	✓	29/05/2025				×
D09	4/03/2025	28.5	16.7	503	10/03/2025	27.6	17.6	875	✓	29/05/2025	12.2	33		×
D10	4/03/2025	16.33	36.07	2107	10/03/2025	15.8	36.6	382	✓	29/05/2025				×
D11	4/03/2025	27.91	33.89	2640	10/03/2025	23.5	38.3	3250	✓	29/05/2025				×
D12	5/03/2025	28.56	29.94	796	10/03/2025	16.4	42.1	377	✓	29/05/2025	15.1	43.4		×
D13	5/03/2025	16.65	39.85	1277	10/03/2025	10.7	45.8	120	✓	29/05/2025	14.7	41.8		×
D14	5/03/2025	19.63	40.47	864	10/03/2025	13.2	46.9	780	✓	29/05/2025	13.1	47		×
D15	5/03/2025	dry			10/03/2025	dry			×	29/05/2025	14	47.5		×
D16	5/03/2025	14.72	46.68	1328	10/03/2025	12.8	48.6	1022	✓	29/05/2025	10.65	50.75		×
D17	5/03/2025	28.58	22.02	930	10/03/2025	12.8	37.8	1022	✓	29/05/2025	12	38.6		×
D18	5/03/2025	27.57	17.03	823	10/03/2025	6.5	38.1	646	✓	29/05/2025	6.5	38.1		×
D19	5/03/2025	dry			10/03/2025	25.4	20.3	447	✓	29/05/2025				×
D20	5/03/2025	dry			10/03/2025	dry			×	29/05/2025	24.6	19.8		×
D21										29/05/2025				×
D22										29/05/2025				×
D23										29/05/2025	25	36	3700	✓
D24										29/05/2025	12.4	46.3		×
D25										29/05/2025	14.65	27.65		×
D26										29/05/2025				×
D27										29/05/2025				×
D28										29/05/2025	14.4	29.2	5240	✓
D29										29/05/2025				×
D30										29/05/2025				×
D31										29/05/2025	7.8	32.3		×
D32										29/05/2025				×
D33										29/05/2025				×
D34										29/05/2025				×

Table 18 Groundwater level monitoring of the 2025 drillholes

An interpreted groundwater level map was constructed from investigative drilling monitoring (Table 17) and current bores FM5, FM5B and FM6 in consideration of destroyed bores FM1-4. See Figure 3.

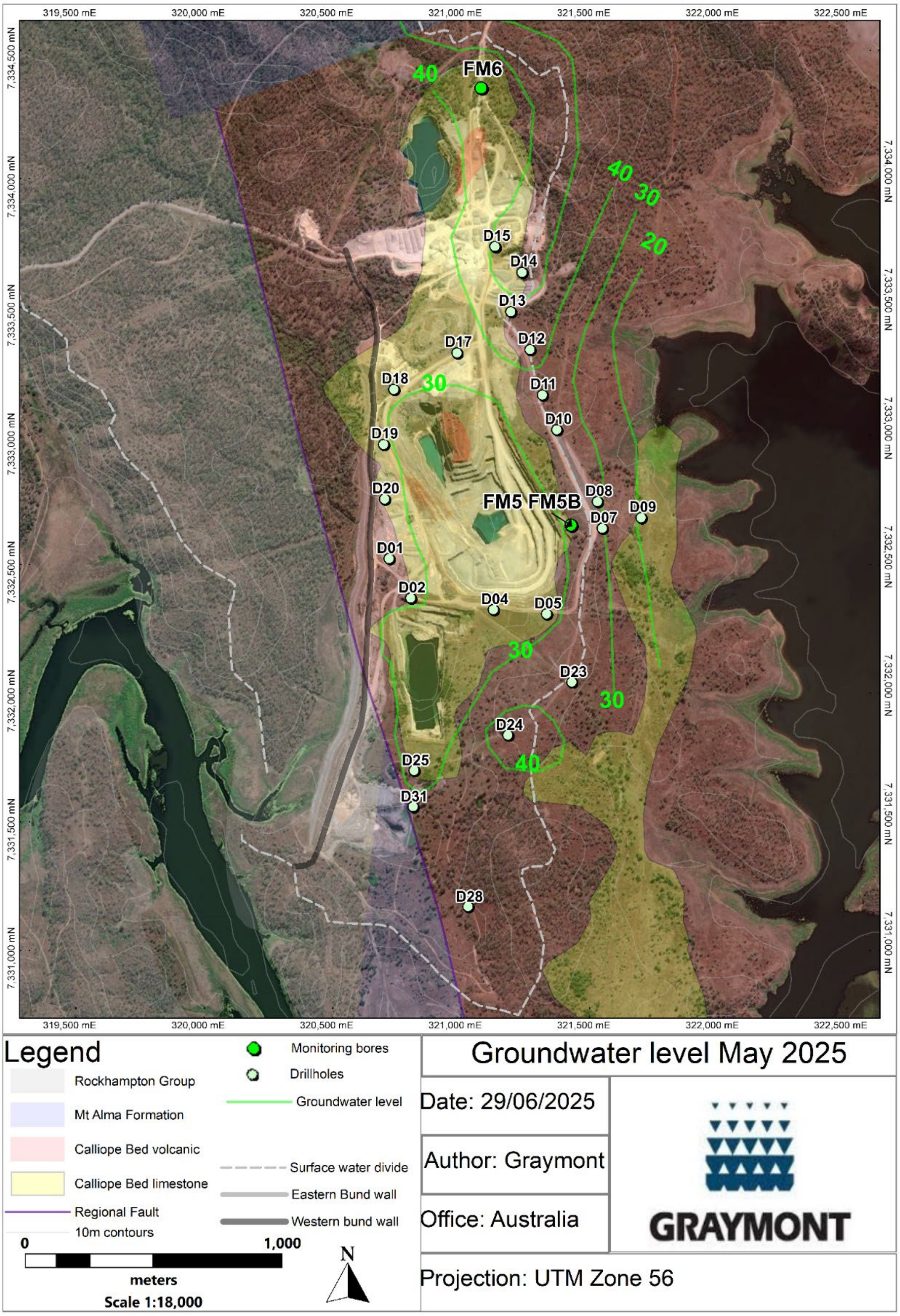

Figure 39 Groundwater level May 2025

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The 2025 Investigative drilling confirmed that a groundwater divide aligns with the surface water divide. Groundwater flow is north to south from Pit 2 to SE of Pit 4 while also flowing easterly and westerly from the groundwater divide. Groundwater at FM6 flows westerly and does not flow toFM5, and groundwater at FM5 flows to Pit 4. Investigative drilling and subsequent water monitoring has confirmed groundwater levels and flow direction and that Pit 3 and Pit 4 voids are groundwater sinks. The predicted future water table will remain a closed system. Three monitoring bores are planned to be installed at investigation drilling locations. See Section 7.3.1.

Groundwater and surface water chemistry

Sampling of the drillholes and surface water bodies was undertaken to characterise groundwater and its relationship with surface water. Groundwater and surface water major ion chemistry from the 2025 water investigation is tabled below with May 2025 monitoring bore results.

Site	Aquifer	Date	Ca	Mg	Na	K	HCO3	CO3	Cl	SO4
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
D01	Volc	10/03/2025	47	5	5	0.5	125	0.5	9	18
D02	Volc	10/03/2025	39	10	17	0.5	123	0.5	23	12
D04	LST	10/03/2025	376	10	464	0.5	323	0.5	1180	27
D05	LST	10/03/2025	156	18	23	2	23300	0.5	28	31
D07	Volc	10/03/2025	21	8	9	1	101	0.5	4	3
D08	Volc	10/03/2025	66	62	130	2	712	0.5	65	13
D09	Volc	10/03/2025	120	28	14	3	408	0.5	29	138
D10	Volc	10/03/2025	32	9	23	1	156	0.5	2	3
D11	Volc	10/03/2025	59	105	291	4	886	0.5	221	20
D12	Volc	10/03/2025	27	11	31	0.5	154	0.5	4	4
D13	Volc	10/03/2025	15	3	9	1	98	0.5	5	4
D14	Volc	10/03/2025	95	19	17	0.5	237	0.5	8	95
D16	LST	10/03/2025	122	12	66	2	383	0.5	40	48
D17	LST	10/03/2025	114	19	57	0.5	278	0.5	31	122
D18	LST	10/03/2025	104	4	18	0.5	1970	0.5	20	38
D19	LST	10/03/2025	70	2	9	0.5	157	0.5	16	13
D23	Volc	29/05/2025	78	182	522	3	788	0.5	910	47
D28	Volc	29/05/2025	369	206	468	4	703	0.5	1510	52
FM5	LST	29/05/2025	185	14	63	0.5	370	0.5	59	151
FM5B	Volc	29/05/2025	198	15	67	0.5	374	0.5	61	148
FM6	Volc	29/05/2025	144	9	34	1	409	0.5	18	10
Pit 3	n/a	19/03/2025	60	7	59	0.5	89	0.5	142	37
Pit 4	n/a	19/03/2025	50	7	24	0.5	116	0.5	18	47
Seep	n/a	19/03/2025	126	7	87	0.5	242	0.5	143	55
Awoonga Dam	n/a	29/05/2025	18	12	33	3	95	0.5	44	5
Catchment Dam1	n/a	29/05/2025	9	4	11	9	52	0.5	16	0.5
Catchment Dam2	n/a	29/05/2025	15	5	18	5	67	0.5	22	0.5
Farm Dam	n/a	29/05/2025	96	14	14	6	86	0.5	14	124
Pit 2	n/a	29/05/2025	42	12	53	0.5	137	0.5	43	50
Pit 3	n/a	29/05/2025	71	8	63	0.5	117	0.5	147	41
Pit 4	n/a	29/05/2025	58	11	18	0.5	90	0.5	17	89
Pit 4	n/a	29/05/2025	57	12	47	0.5	128	0.5	37	88
Seep	n/a	29/05/2025	130	8	93	0.5	242	0.5	178	57

Table 19 Groundwater and surface water major ion from 2025 investigation

Groundwater level maps with bicarbonate, chloride and sulphate from Table 19 are provided in Figures 40-42 respectively.

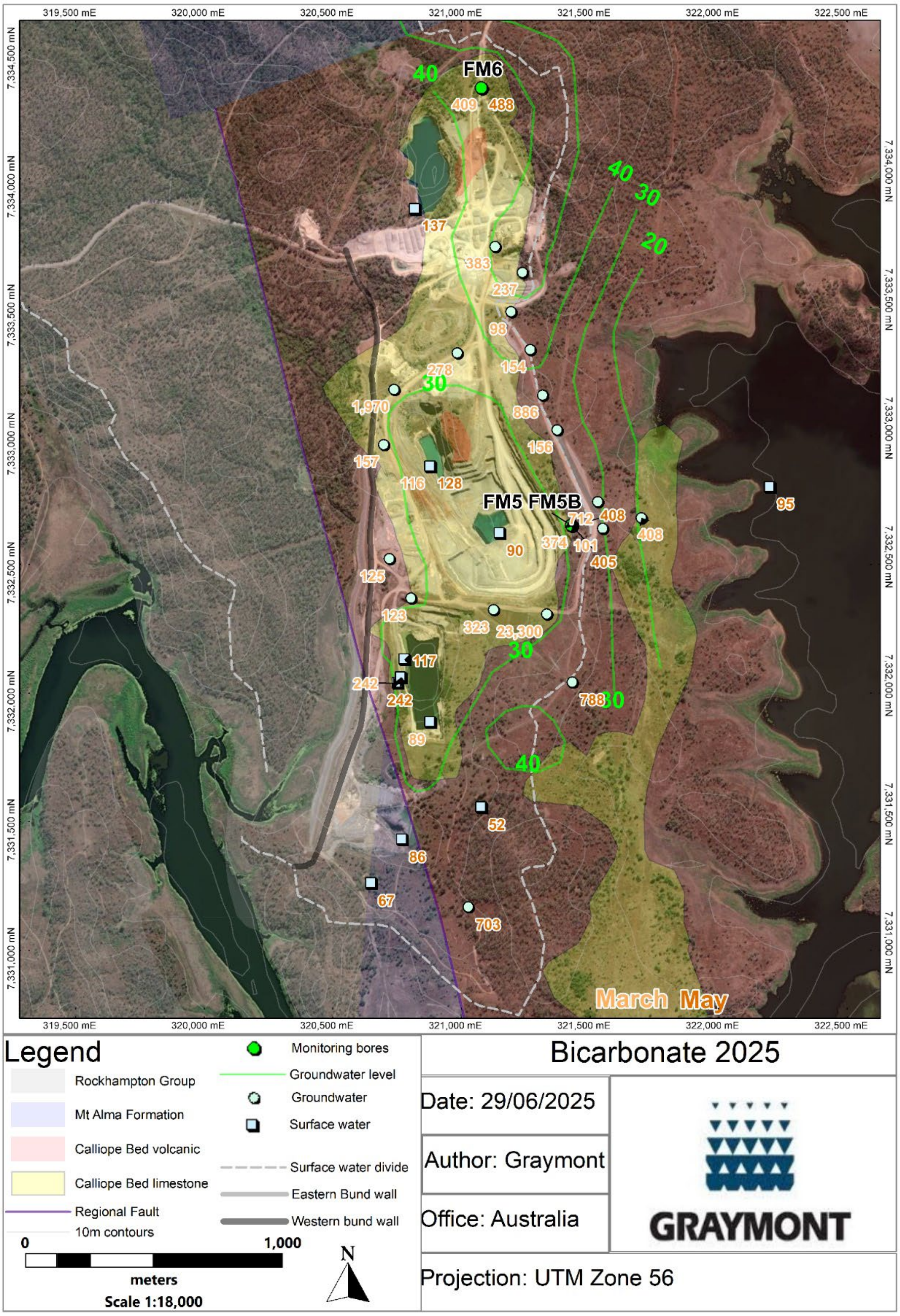

Figure 40 Water sampling results for bicarbonate 2025

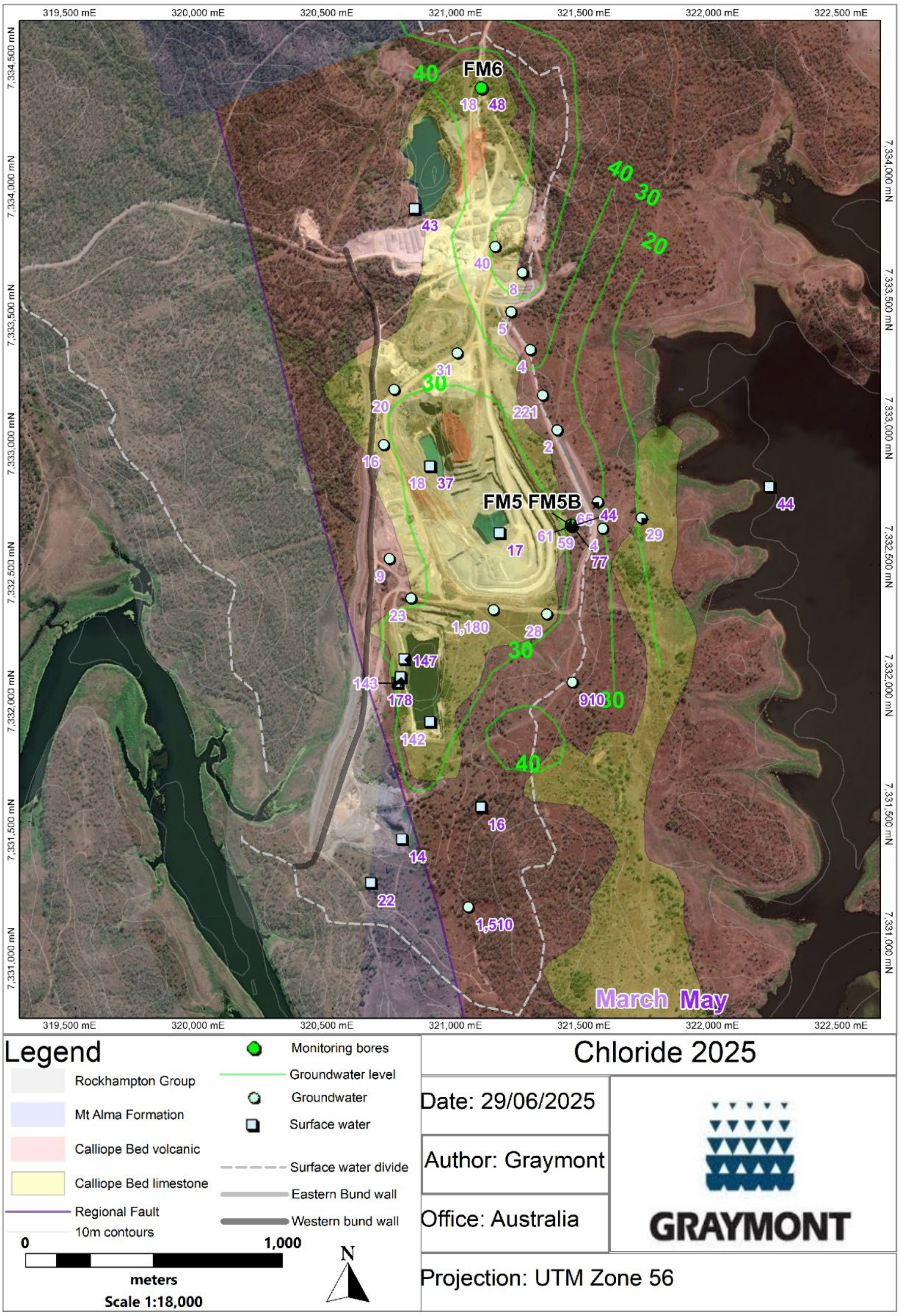

Figure 41 Water sampling results for chloride 2025

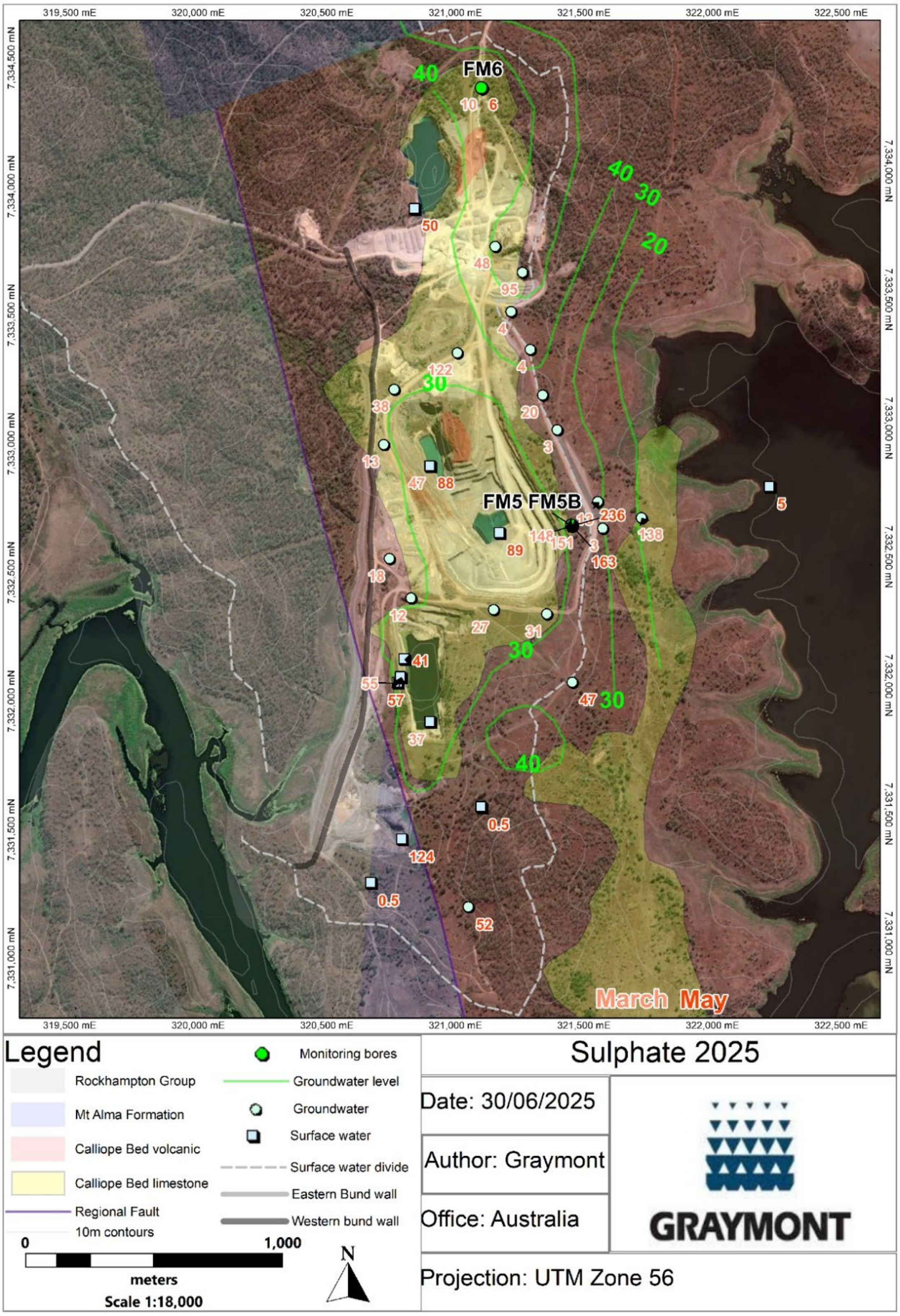

Figure 42 Water sampling results for sulphate 2025

Chloride and Sulphate are both low in groundwater at the ground divide east of Pit 4 which is a recharge zone. Sulphate increases with flow both westerly and easterly from the groundwater divide. The concentration of anions naturally vary and sulphate in pit water is discussed in Section 7.1.4. Sulphate in pit water is a potential contaminant of concern as discussed in Section 7.1.5. A Piper plot of 2025 drillhole is presented with 2018 drillhole data as Figure 43.

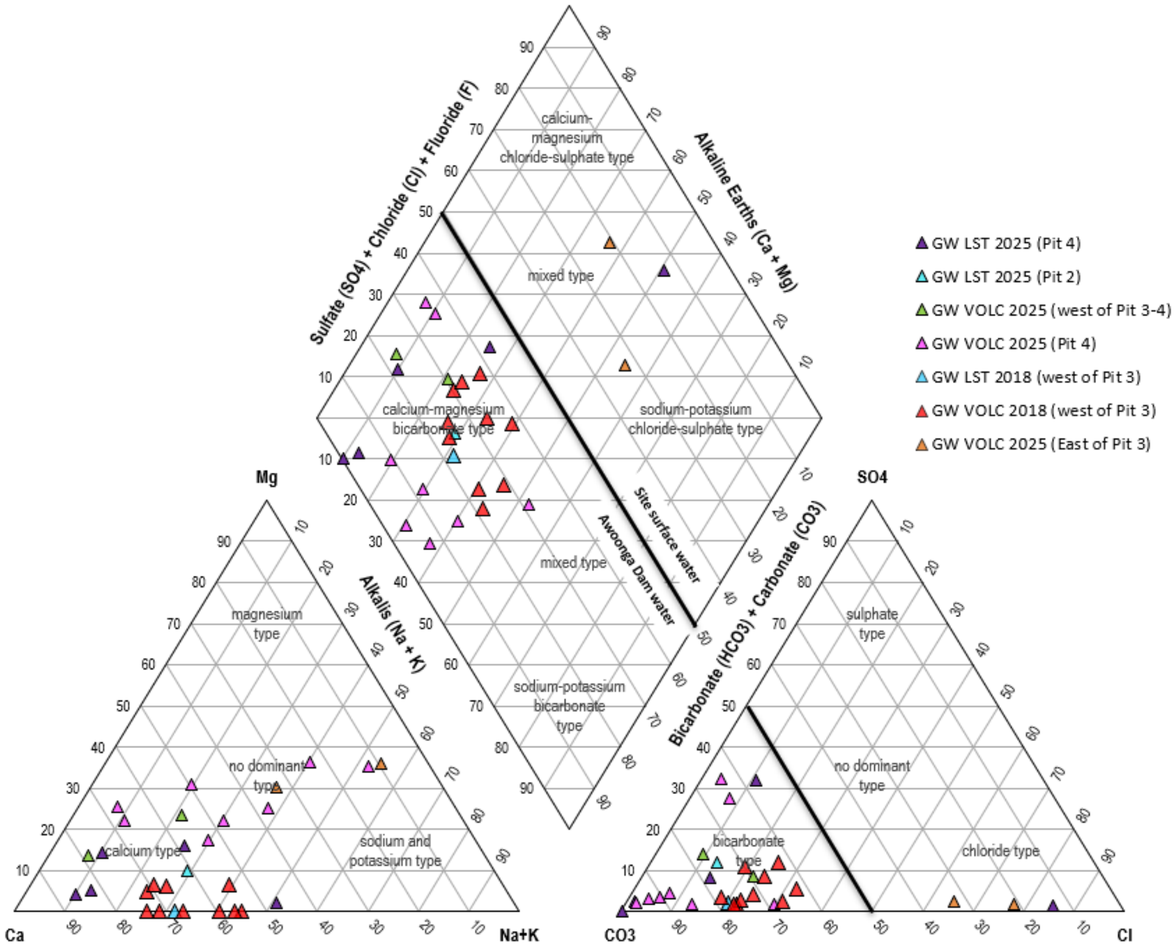

Figure 43 Investigative drilling 2025 with 2018 drillhole data

Groundwater is Ca-Mg-HCO3 with the exception of a limestone drillhole (D04) which is south of Pit 4 and has elevated NaCl and the two volcanic drillholes east of Pit which have elevated NaCl. Elevated NaCl in groundwater south and east of the pit voids is attributed to halite stored in the regolith.

Investigative drilling has confirmed that groundwater for limestone and volcanic are similarly variable and there is no clear distinction between groundwater from limestone and volcanic (Figure 39). A lithostratigraphic boundary can be defined but it is not a groundwater boundary condition.

The geology at Calliope is simple with sub-vertical lithological contacts. There is sufficient groundwater data to demonstrate that there is little groundwater and that the Water Balance analytical modelling approach outlined in Section 8 is appropriate.

<u>Nitrogen</u>

Nitrogen sampling was under taken in 2025 and the results are presented in Table 20.

Site	Aquifer	Date	Ca	Mg	Na	K	HCO3	CO3	Cl	SO4	Ammonia	Nitrite as N	Nitrate as N	TKN as N	TN as N
			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
D23	Volc	29/05/2025	78	182	522	3	788	0.5	910	47	0.90	0.67	0.64	2.90	4.21
D28	Volc	29/05/2025	369	206	468	4	703	0.5	1510	52	2.46	0.01	0.01	3.40	3.41
FM5	LST	29/05/2025	185	14	63	0.5	370	0.5	59	151	0.005	0.01	5.10	0.60	5.71
FM5B	Volc	29/05/2025	198	15	67	0.5	374	0.5	61	148	0.005	0.01	5.69	0.80	6.50
FM6	Volc	29/05/2025	144	9	34	1	409	0.5	18	10	0.005	0.01	0.04	0.05	0.10
Awoonga Dam	n/a	29/05/2025	18	12	33	3	95	0.5	44	5	0.01	0.01	0.07	0.40	0.48
Catchment Dam1	n/a	29/05/2025	9	4	11	9	52	0.5	16	0.5	0.19	0.01	0.02	3.30	3.33
Catchment Dam2	n/a	29/05/2025	15	5	18	5	67	0.5	22	0.5	0.16	0.01	0.03	0.90	0.94
Farm Dam	n/a	29/05/2025	96	14	14	6	86	0.5	14	124	0.01	0.01	0.19	0.90	1.10
Pit 2	n/a	29/05/2025	42	12	53	0.5	137	0.5	43	50	0.01	0.01	0.23	0.10	0.34
Pit 3	n/a	29/05/2025	71	8	63	0.5	117	0.5	147	41	0.04	0.01	0.36	0.20	0.57
Pit 4	n/a	29/05/2025	58	11	18	0.5	90	0.5	17	89	0.01	0.01	4.27	0.60	4.88
Pit 4	n/a	29/05/2025	57	12	47	0.5	128	0.5	37	88	0.01	0.01	2.27	0.50	2.78
Seep	n/a	29/05/2025	130	8	93	0.5	242	0.5	178	57	0.01	0.01	0.11	0.10	0.22

Table 20 Groundwater and surface water nitrogen results from 2025 investigation

Total Nitrogen (TN) in groundwater in the Farm dam sub-catchment, represented by drillholes D23 and D28, is similar to TN of groundwater in FM5 and FM5B but the composition of TN is very different. D23 has proportionally elevated organic nitrogen, D28 has proportionally elevated ammonia and FM5 and FM5B have proportionally higher nitrate. Catchment Dam 1 has proportionally elevated organic nitrogen.

The concentration of nitrogen forms vary with changing conditions N_2 in the atmosphere can be fixed (converted to ammonia and nitrate) by rainfall and by bacteria and archaea in soil and water. . Plants decompose to organic nitrogen and in warm moist conditions bacteria in soil convert organic nitrogen to ammonia and in oxidising conditions ammonia is converted to nitrite then nitrate. Nitrate concentrations can be reduced by plant uptake or in reducing conditions denitrified to ammonium. Nitrate not taken up by plants can be leached into groundwater. Table 20 shows that the water samples have been taken at different stages of nitrogen conversion and that similar TN in samples near and away from mining voids indicate natural processes.

6 CONCEPTUAL MODEL OF PIT WATER

The Calliope Limestone mine is located in the Silurian-Devonian aged Calliope Beds as limestone and volcanic rocks. Limestone outcrops as two well defined, elongated north-south sub-vertical lenses which abut the volcanics and in places is capped by volcanic rock. Limestone and volcanic rock are both weathered near the surface. Massive crystalline limestone and volcanic rock below the weathered rock have negligible primary porosity, but are variably finely fractured, which can form weak secondary porosity from connected fractures. The Calliope beds limestone and volcanics are predominantly an aquitard but with connected fractures can form a low-yielding fractured rock aquifer.

The groundwater quality of a fractured rock aquifer affected by rainfall weathering is dependent upon the nature of rainfall, such as timing, intensity and duration; and on salt storage in the regolith, which determines whether infiltration provides a diluting effect and/or a leaching effect on ions and/or metals. The fractured rock aquifers at Calliope are low yielding and are generally unsuitable for groundwater pumping. The maximum yield from bores in the Calliope Beds within 9km of the Calliope is 1.5l/s.

A natural topographic high and surface water divide lies to the east of Pit 3-4 within volcanic rock, which is a local recharge area for infiltration to groundwater. To the west of Pit 3-4 is a natural topographic low and is an area for potential groundwater discharge. Mining of limestone in Pit 3 has exposed the volcanic-limestone contact and the only known permanent groundwater seepage into Pits 3-4 which is west of Pit 3. Seepage has also been observed in the north-east corner of Pit 4 at the volcanic cap and limestone contact, but this seep dries during extended drier conditions and will be swallowed up by the future Pit 3-4 and so is not considered a future seepage source.

6.1 Pit 3-4 void Conceptual Model

A diagram of the Pit 3-4 final void pit water conceptual model has been created from the outcomes of Pit 3 and Pit water investigations and is shown below (Figure 44).

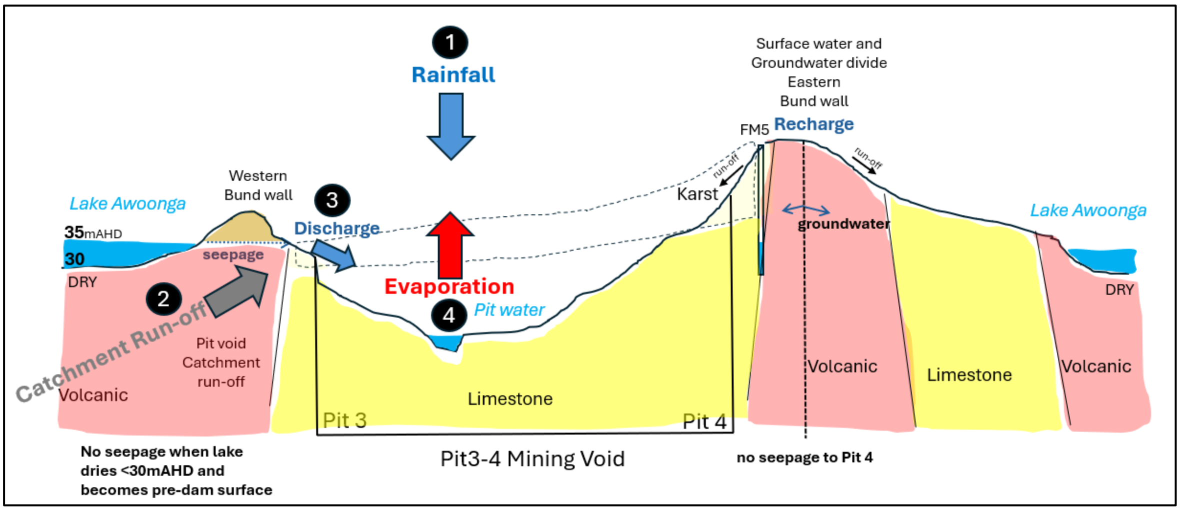

Figure 44 Pit Water Conceptual Model of future combined Pits 3-4

Pit water is created by:

1. Direct Rainfall onto pit floor
2. Surface water runoff into the pit void from the Pit 3 void and Farm Dam sub-catchments
3. Groundwater inflow into the pit void
4. Evaporation of pit water

Some features of the Conceptual Model are:

- Pit water is created in a mining void from direct rainfall, surface water run-off and limited groundwater seepage. Pit water levels are naturally lowered by evaporation or by pumping from the pit floor
- The Pit envelope is bunded for edge protection and this also redirects rainfall and surface water run-off away from the pit edge
- Pit water is driven by rainfall directly in the void and by surface water run-off from the Pit 3 void and Farm Dam sub-catchments
- During, and post- high rainfall events, surface water runoff occurs from the Farm Dam/Waste Dump area along the western bund wall to the topographic low west of Pit 3, referred to in this report as the Seep, from which this surface water flows in to Pit 3
- Pit water collected on the pit floor evaporates
- Pit floor pumping is intermittent and seasonal. In 5 months from January-July 2025 only 1.4ML of pit water was pumped from Pit 4. has been pumped from Pit 4 Pit water is pumped and released to Awoonga Dam through authorised release point in accordance with EA water release conditions.
- Lithological boundaries appear to constrain groundwater flow with nearly all groundwater in volcanic rock or at the limestone-volcanic contact
- Groundwater levels are considered to represent the watertable in an unconfined aquifer.
- Currently the only permanent groundwater inflow into a mining void is into Pit at a rate <1l/s
- There are no effective confining layers. There is no observed discharge under pressure either laterally or upward into the pit void and no evidence of a potentiometric surface or artesian conditions have been observed. .
- Groundwater discharge into the pit is limited. If there was significant groundwater discharge into the pit, then large volumes of water would need to be dewatered from the pit to prevent the pit from filling to a potentiometric surface at the elevation of the dam water level. This is not the case. Pit floor pumping is intermittent and seasonal , as the pit dries in the dry season there is little evidence of groundwater seepage.
    - Historical and current metering data is being compiled to quantify water inflows
- Groundwater levels and chemistry respond to recharge and therefore groundwater is driven by infiltration (rather than seepage from Awoonga Dam)
- Groundwater in Volcanic rock west of Pit 3 is approximately twice the salinity of Awoonga Dam water and groundwater east of Pit 4 is approximately four times the salinity of Awoonga Dam water. Awoonga Dam chemistry is different from groundwater at and near the pit void.
- The lines of evidence indicate that Awoonga dam does not leak into Pit 3
- Awoonga Dam cannot pressure pit water at depth because when Awoonga Dam recedes the land dries and Awoonga Dam eventually becomes dead storage at 13mAHD
- There is no groundwater extraction outside the pit void so the aquifer is not being depressurized as groundwater approaches the pit void
- There is little groundwater present in the limestone and therefore there is no cone of depression extending beyond the mined area or associated impacts to potential receptors.
- The planned life of mine Pit 3-4 created by combining Pit 3 and Pit 4 is also expected to have minimal groundwater inflow
- In the absence of groundwater pumping pit water levels are equilibrated when water inflows are balanced by evaporation. In the final pot void this is predicted to be at -10mAHD.

A Water Balance Model to assess future water levels within the pits has been created based on the Conceptual Model (Section 8).

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7 PROJECT HYDROGEOLOGY

7.1 Pit water

7.1.1 Pit water level and void capacities

Pit water level and void capacities are estimated below in Table 21.

Catchment Pit Void	Maximum water level (mAHD)	Void empty capacity (ML)
Pit 2		655
Pit 4	42.4	10,580
Pit 3	42.4	861
Pit3-4	50 (crest 52)	58,171

Table 21 Pit water level and void capacities

7.1.2 Surface water inflow to pit voids

Pit 1 has been backfilled. Pit 2 is an inactive pit void and acts as a water storage facility for the site which is filled by direct rainfall capture, surface water run-off and pumped Pit 4 water. Pit 3 is an inactive pit void. Pit 3 water is mainly surface water run-off and modified by rainfall and evaporation (Section 4.2). There is <1l/s of groundwater entering Pit 3 void which slowly seeps at approximately 32mAHD onto the bench (Section 5.2.2). Pit 4 is an active pit. This pit has little surface water inflow because of mounding at the top of the access ramp redirects surface water but rainfall is captured directly on the pit benches and floor. There is negligible groundwater entering the pit void and groundwater has not been sampled (Section 4.5).

7.1.3 Final landform abandonment bund

Abandonment bunds will reduce particulate matter and nutrients entering the pit voids, which is anticipated to provide a control measure for minimising the risk of algae growth.

7.1.4 Stratification of pit water bodies

Salinity profiling of Pit 3 was undertaken from a boat on the 4 October 2018. See Figure 45.

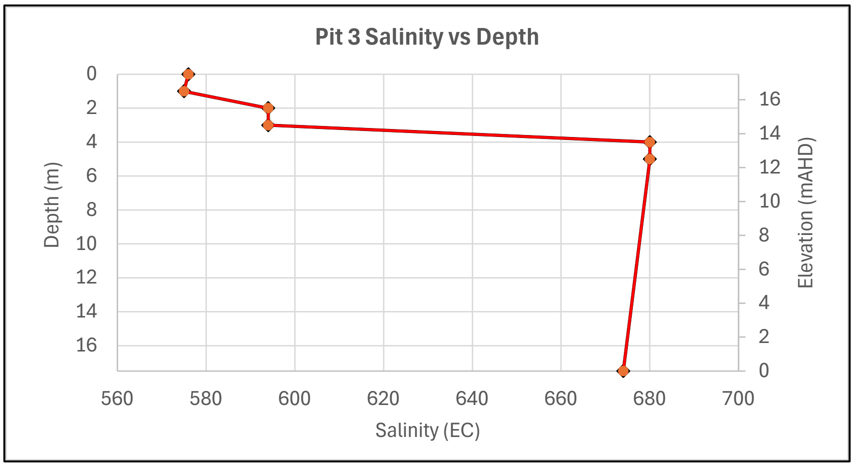

Figure 45 Pit 3 and Pit 4 major ions water chemistry

Stratification of the Pit 3 water profile was observed at 4 metres depth which equated to 17.5mAHD, where pit water salinity increased by 86 µS/cm from 594 to 680 µS/cm. This is common for deeper water columns. The salinity of the water column beneath this depth was uniform. Salinity profiling of Awoonga Dam next to Ragotte Creek whose depth is typically less than 2.5 metres, shows that there is no stratification of Awoonga Dam water in Ragotte Creek.

7.1.5 Pit water pumping

Pit 2 water is pumped to surface water release point C1. Pit 4 water is also pumped to this release point. Pit 3 water is pumped to surface water release point F1. Pit 4 water is pumped to surface water release point F1 and C1. Additional meters were installed to January 2025 to quantify groundwater component of pt water. Pit water pumping from 1 January to 30 June 2025 was 19ML from Pit 2; 35ML from Pit 3 and 18.3ML from Pit 4. The pumping volumes are low which indicates that there has to be little to no groundwater entering the pit voids and that pit water levels, which fluctuate with rainfall and surface water run-off, are naturally regulated by evaporation.

7.1.6 Pit water chemistry

Pit 3 and Pit water major ion chemistry A Piper plot of Pit 3 and Pit 4 major ion chemistry is provided below. See Figure 46.

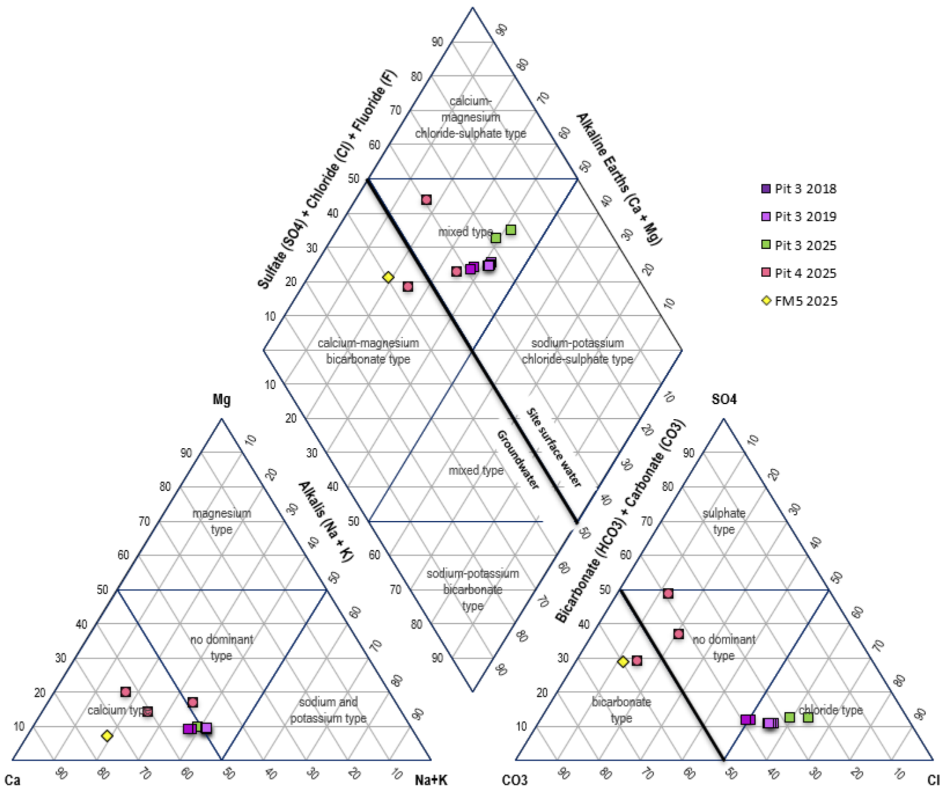

Figure 46 Pit 3 and Pit 4 major ions water chemistry

Pit 3 water has been extensively studied as discussed in Section 5.2 and has a surface water origin from surface water run-off and seepage from the Farm Dam. Large volumes of surface water have been observed to enter Pit 3 during and following heavy rainfall events. Direct rainfall capture causes dilution and pit water concentration and these effects modify Pit 3 salinity which is typically 630+/-100 µS/cm. The salinity of Pit 3 on 19 March 2025 was 733 µS/cm.

Pit 4 water chemistry indicates a predominantly surface water origin whereby salinity changes by dilution and evaporation effects with rainfall and evaporation. Pit 4 water has little surface water entering the pit following heavy rainfall but weathered material within the pit void may be washed onto the pit floor modifying pit water salinity and chemistry. The salinity of Pit 4 on 19 March 2025 was 472 µS/cm. The salinity of Bore FM5 replacement FM5B was 1384 µS/cm on the 29 January 2025.

7.1.7 Potential contaminants in pit water

Pit water can be the source of potential contaminants and can also be the sink of potential contaminants from surface water runoff from mining areas and from undisturbed areas.

Potential sources of contaminants in pit water include primary sources from natural processes and secondary sources introduced by mining. Primary sourced potential contaminants include salinity, pH, suspended solids, sulphate, nutrients (nitrate) and metals which all form by natural processes but mining activities can potentially disrupt, change and redistribute these water quality parameters. Secondary sourced potential contaminants include hydrocarbons and pesticides.

Hydrocarbons are managed through bunding and refuelling procedures and pesticides are not used on site. Hydrocarbons have not been detected in pit water samples. Metal concentrations are low.

Oxidisation of limestone and volcanic rocks is a natural process which is accelerated on the waste dump but limestone purity and low volumes of volcanic material ensures that pH remains near neutral and there are no acid forming waters at site.

Pit water within the Calliope Limestone Operation is considered a low risk source of contaminants. The generation of salts within the mining operations and accumulated within the pits is low, and on-going monitoring has shown the pit water is within the EA limits. Other potential contaminants such as pH and suspended solids within in the pits also achieve the required EA criteria.

The site essentially operates as a closed system with flood protection bunds and natural topographic highs preventing overland flow off-site to Awoonga Dam and conversely, protection from inundation from high water levels from Awoonga Dam. The pits are also closed systems and are sinks for surface water run-off and groundwater flow.

Nitrates

Nitrates are naturally occurring in surface water and groundwater from nitrogen transforming processes. See Section 5.3.3. Nitrate concentrations seasonally and water sampling on the 29 May 2025 gave results of 4.37mg/L and 2.27mg/L from Pit 4 and 0.36mg/L from Pit 3. Drinking water quality recommended limit is 50mg/L.

Sulphates

Sulphate is a major ion and a component of salinity and is regularised analysed for in groundwater samples but not pit water. Although sulphate is not regularly analysed for in pit water it was historically analysed for in discharge water until 2013 after which changed EA conditions no longer routinely required this analysis. A graph of sulphate concentrations at surface water release points is provided below with pit water, other surface water and groundwater results. See Figure 47.

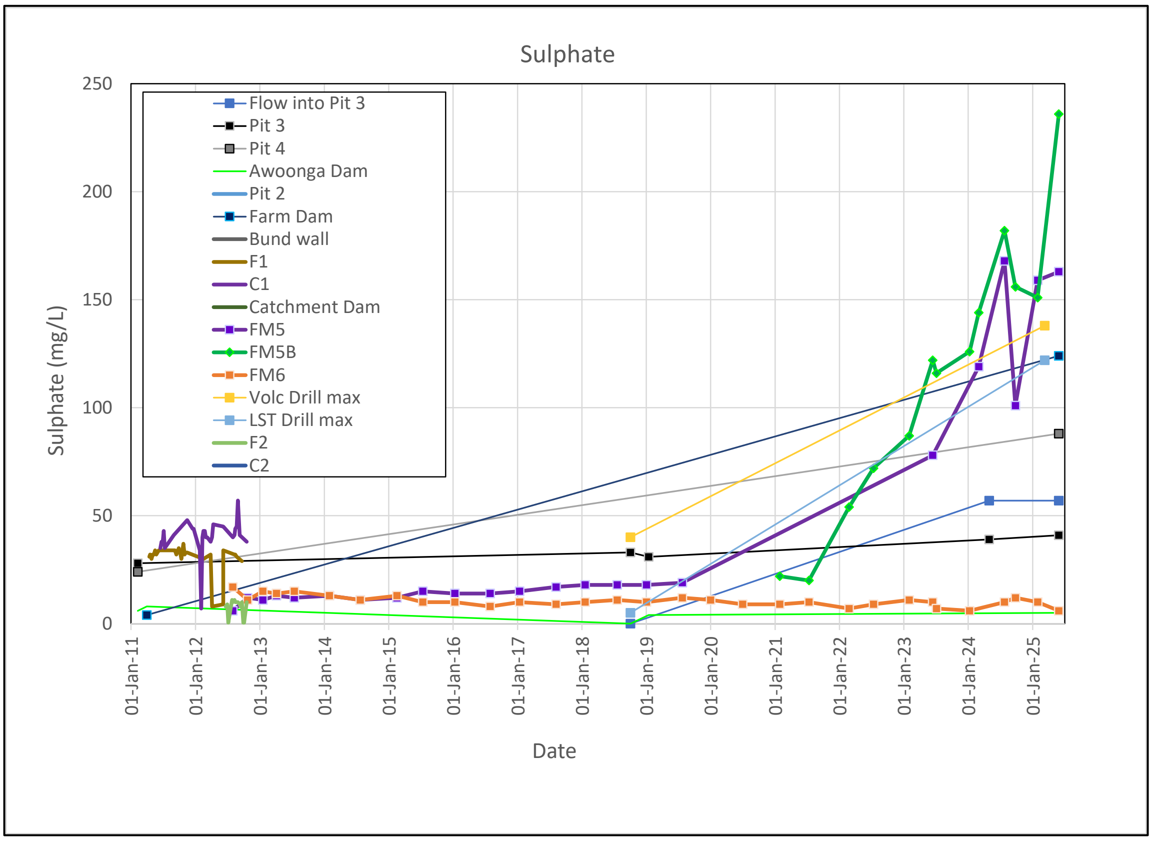

Figure 47 Sulphate in discharge water, pit water, other surface water and groundwater

Surface water at F1 is from Pits 3 and 4, F2 from natural flow and/or Pit 3 and C1 from Pits 1,2 and 4. Sulphate concentrations in surface water discharged in 2011-12 at F1 and C1 was in the 35-45 mg/L range. Sulphate concentrations in May 2025 for Pit 3 was 41mg/L and for Pit 4 was 88mg/L. Sulphate concentrations have increased across the mine sub-catchments and the Farm Dam has increased from 4mg/L in March 2011 to 124mg/L in May 2025. See Figure 43.

Sulphate concentrations in October 2012 for FM5 was 12 mg/L and FM6 was 11 mg/L. Following a period during which FM5 was dry, an adjacent deeper nested bore FM5B was installed in 2021. Sulphate concentrations for FM5B have increased since this time. In May 2025 FM5 sulphate concentrations were 163mg/L, whereas the FM6 concentration remained low at 6mg/L. The bores benchmark groundwater flow with FM5 benchmarking groundwater into the active Pit 4 and FM6 benchmarking groundwater into the inactive Pit 2. In 2012-13 sulphate in groundwater was lower than sulphate in surface water that was pumped from the Pit 3 and Pit 4 voids and therefore the source of elevated sulphate in these pit voids is not considered to be groundwater. Elevated sulphate in the pit voids is understood to result from rainfall and surface water inflow and the primary source is the dissolution of gypsum ($CaSO_4$). See Section 7.3.5. Elevated sulphate in pit water is from cyclic salts and the dissolution of surface salts in run-off water to the pit voids, with sulphate concentrations modified by evaporation. In the absence of mining and the construction of the Western Bund wall, surface salts in run-off water at Calliope were discharged to the Boyne River via Ragotte Creek. This natural salt discharge path has now been modified to collection in a mine void and salt collected in the mining voids is pumped to Awoonga Dam. The concentration of sulphate in Awoonga Dam in May 2025 was 5mg/L.

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7.2 Surface water release

When surface water is planned to be released surface water sampling is undertaken weekly from the specified release points F1, F2, C1 and C2 to test suitability for release. The water quality parameters tested are Electrical Conductivity (µS/cm), pH (pH Unit) and Total Suspended Solids (mg/L). Surface water release sampling results in a wetter climate is represented by 2012 sampling results. See Table 22.

Parameter	*EC (µS/cm)*				*pH*				*SS (mg/L)*				*Sulphate (mg/L)*			
EA Limit	*< 900 µS/cm*				*6.5 (min) 8.5 (max)*				*< 100 mg/L*				*< 500 mg/L*			
Date	F1	F2	C1	C2	F1	F2	C1	C2	F1	F2	C1	C2	F1	F2	C1	C2
25/01/2012			434				8.0				100				34	
2/02/2012				194				7.8				8				7
9/02/2012			437				7.9				<5				40	
15/02/2012			457				8.0				<5				43	
20/02/2012	556				8.1				<5				30			
23/02/2012			487				8.3				<5				43	
29/02/2012			448				8.0				9				40	
7/03/2012			525				8.0				<5				40	
14/03/2012																
21/03/2012																
22/03/2012	555		322	91	8.2		8.1	7.8	5		38	20	32		30	2
27/03/2012	559		406		8.1		8.1		<5		<5		32		38	
4/04/2012		242	445			7.9	8.0			6	10			8	40	
11/04/2012			498				8.1				<5				46	
18/04/2012																
19/04/2012			568				7.6				9				44	
26/04/2012	592	256	478		8.1	8.1	8.0		<5	8	20		29	8	33	
3/05/2012		272				8.0				8				12		
14/05/2012	269				8.0				<5				9			
30/05/2012		268				8.2				<5				10		
6/06/2012		260				8.6				<5				9		
7/06/2012	563		533		8.2		8.1		83		24		33		45	
13/06/2012																
20/06/2012		262				8.1				<5				8		
29/06/2012		252				7.8				6				9		
5/07/2012		264				8.3				<5				<1		
27/07/2012		275				8.5				5				11		
31/07/2012		293	560			8.4	8.1			5	15			10	40	
9/08/2012	591	274	546		8.0	8.0	8.1		<5	<5	24		32	11	41	
14/08/2012	589	269	578		7.7	8.0	7.9		<5	<5	<5		32	10	44	
22/08/2012	598	273	609		8.0	8.2	8.1		<5	11	20		31	10	45	
29/08/2012		281	662			7.8	8.1			8	6			10	57	
5/09/2012		267	511			8.0	8.1			7	5			9	41	
12/09/2012		276				8.2				14				8		
20/09/2012	652	298	709		8.2	8.6	8.1		<5	8	8		29	10	50	
28/09/2012		1650				8.2				<5				<1		
3/10/2012		286				8.3				7				<1		
10/10/2012																
17/10/2012		296	630			8.3	8.1			7	6			10	38	
24/10/2012		285				8.1				8				11		
31/10/2012		291				8.2				7				8		
7/11/2012		267				8.3				9				11		
12/11/2012		294				8.0				8				9		
14/11/2012																
22/11/2012	618	301			8.0	8.7			19	8			36	10		
28/11/2012	602	290	622		8.0	8.7	7.9		8	6	24		28	8	45	
12/12/2012	617				8.1				<5				31			
19/12/2012	585				8.1				12				30			
Maximum	652	1650	709	194	8.2	8.7	8.3	7.8	83	14	100	20	36	12	57	7
Median	590	275	518	143	8.1	8.2	8.1	7.8	12	8	15	14	31	10	41	5
Minimum	269	242	322	91	7.7	7.8	7.6	7.8	5	5	5	8	9	8	30	2

Table 22 Surface water release samples from 2012 in a wetter climate

In 2012, which was a wetter year, most surface water sample results met surface water release criteria. Sulphate was routinely sampled and the median sulphate concentration from F1 was 31mg/L. Surface water release sampling testing in a drier climate is represented by 2020 sampling results. See Table 23.

Parameter	EC (µS/cm)			pH			TSS (mg/L)		
EA Limit	< 900 µS/cm			6.5 (min) 8.5 (max)			< 100 mg/L		
Date	F1	F2	C1	F1	F2	C1	F1	F2	C1
6/01/2020	706	273		7.9	9.0		5	13	
3/02/2020	703	267		8.2	9.1		<5	<5	
26/02/2020	716	277	760	7.9	8.6	8.0	<5	<5	<5
11/03/2020	704	302	712	8.2	8.1	7.4	<5	<5	<5
18/03/2020	695	279		8.1	9.6		<5	<5	
25/03/2020	710	273		8.0	9.3		<5	<5	
1/04/2020	704	280		8.0	8.8		<5	8	
9/04/2020	699	258		7.6	9.5		<5	<5	
15/04/2020	711	274		8.1	8.8		<5	<5	
28/04/2020	700	268		7.9	9.6		<5	5	
5/05/2020	692	698		3.1	3.0		<5	<5	
15/05/2020	696	298		7.3	7.9		<5	<5	
19/05/2020	727	267		7.6	9.5		<5	6	
26/05/2020	702	269		7.9	9.7		<5	<5	
2/06/2020	702	265		7.9	9.9		<5	<5	
9/06/2020	7	265		7.9	9.7		<5	<5	
16/06/2020	7	3		7.8	9.7		<5	<5	
21/06/2020	7	3		7.7	9.7		<5	<5	
30/06/2020	6	3		6.1	7.6		<5	<5	
7/07/2020	7	3		7.7	8.9		<5	<5	
21/07/2020	700	278		8.0	8.6		11	<5	
29/07/2020	702	280		8.0	8.9		6	8	
4/08/2020	700	267		7.4	8.1		<5	<5	
11/08/2020	7	298		6.8	7.6		<5	<5	
18/08/2020	775	300		4.8	6.6		<5	<5	
26/08/2020	786	306		7.6	6.9		<5	<5	
3/09/2020	762	303		8.2	8.1		<5	<5	
8/09/2020	765	297		7.2	7.6		<5	14	
15/09/2020	791	289		8.0	12.4		<5	9	
22/09/2020	741	294		7.2	7.2		<5	<5	
30/09/2020	795	276		7.1	9.0		<5	<5	
7/10/2020	795	318		7.4	8.0		<5	64	
14/10/2020	783	360		9.3	8.6		<5	6	
10/11/2020	769	281		5.9	7.7		<5	18	
19/11/2020	759	289		6.9	7.2		<5	14	
24/11/2020	823	307		5.9	4.2		<5	<5	
2/12/2020	7	318		7.0	791.0		<5	<5	
7/12/2020	722	259		8.1	9.7		<5	5	
Maximum	823	698	760	9	791	8	11	64	
Median	704	279	736	8	9	8	6	9	
Minimum	6	3	712	3	3	7	5	5	

Table 23 Surface water release samples from 2020 in a drier climate

In 2020, which was a drier year, numerous surface water sample results did not meet surface water release criteria. Surface water release in 2023 is provided in Table 24 with discharge volumes and Pit 3 water sampling results.

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Parameter	EC (µS/cm)				pH				TSS (mg/L)				Flow		
EA Limit	< 900 µS/cm			n/a	6.5 (min) 8.5 (max)			n/a	< 100 mg/L			n/a	Discharge ML		
Date	F1	F2	C1	Pit 3	F1	F2	C1	Pit 3	F1	F2	C1	Pit 3	F1	F2	C1
13/01/2023			534				8.3				8				0.01
16/01/2023			520				8.3				11				0.02
24/01/2023			539				7.6				5				0.02
31/03/2023			546				8.0				9				0.02
2/02/2023			537				8.0				<5				0.02
7/02/2023			561				8.0				6				0.02
15/02/2023			564				7.8				<5				0.01
3/03/2023			573				7.9				12				0.01
15/03/2023			489				8.1				8				0.02
21/03/2023			485				8.3				7				0.02
28/03/2023			520				8.2				12				0.02
4/04/2023			592				8.1				15				0.01
11/05/2023			540	725			8.1	8.1			<5	<5			0.01
22/05/2023				726				8.1				15			
31/05/2023				740				8.2				<5			
6/06/2023				718				8.1				<5			
14/06/2023				710				8.2				5			
22/06/2023				745				8.4				<5			
27/06/2023				745				8.3				<5			
3/07/2023				729				8.1				7			
14/07/2023				780				8.0				<5			
18/07/2023			611	787			8.1	8.2			5	<5			0.01
27/07/2023	782			781	8.2			8.1	<5			<5	18.55		
2/08/2023	763			748	8.1			8.2	<5			<5	20.76		
9/08/2023	758			737	8.1			8.0	5			<5	22.28		
16/08/2023	739			748	8.2			8.1	<5			<5	22.38		
23/08/2023	769			763	8.2			8.2	<5			<5	21.97		
30/08/2023	729			727	8.1			8.1	<5			<5	21.47		
6/09/2023	756			755	8.2			8.1	<5			<5	10.03		
27/09/2023				769				8.0				<5			
1/11/2023				773				8.0				<5			
8/11/2023				770				8.2				<5			
Maximum	782		611	787	8		8	8			15	15			
Median	758		540	747	8		8	8			8	7			
Minimum	729		485	710	8		8	8			5	5			
Total													137.4		0.2

Table 24 Surface water release samples from 2023 with Pit 33 sampling results

In 2023 a total of 137.4ML was discharged at surface water release point F1. Surface water at this release point is sourced from Pit 3 and Pit 4. In 2023 additional sampling was undertaken of Pit 3. Pit 3 water quality is very similar to F1 water quality which indicates that F1 discharge was almost exclusively from Pit 3.

7.3 Groundwater inflow to pit void

7.3.1 Resource definition and production drilling

Geological drilling results from resource definition and production are housed in a database which currently contains 800 drillholes. Groundwater intersection data is routinely recorded and groundwater was intersected in 20 drillholes (3%). The drillholes which intersected groundwater are shown in Table 25.

Location Details				Drilling Details					
Hole ID	East	North	Natural surface mAHD	Drill Date	Hole Depth (m)	EOH mAHD (m)	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD
64T3	321148	7332854	47.7	29/08/1964	86.9	-39.2	CAVITY	13.7	34.0
65T14	320759	7333060	47.9	8/11/1964	19.1	28.8	LST	16.5	31.4
AH2	320623	7332994	45.6	18/11/1965	14.5	31.1	LST	12.9	32.7
1E	320092	7333729	49.1	1/01/1966	7.7	41.4	VOLC	7.6	41.5
F9524	321086	7334064	58.5	3/11/1995	19.5	39.0	AND	17.4	41.1
F9537	320751	7331949	39.0	3/11/1995	3.0	36.0	CLAY	0.0	39.0
F9631	321101	7332143	47.3	1/04/1996	21.0	26.3	CLAY	9.0	38.3
F9607	320939	7331928	41.6	21/12/1996	18.0	23.6	LST	10.0	31.6
F99058	321633	7331720	45.2	1/12/1999	24.6	20.6	LST	13.8	31.4
F99059	321639	7331771	46.6	1/12/1999	24.6	22.0	LST	13.8	32.8
F99068	321531	7331690	46.6	1/12/1999	24.6	22.0	AND	20.0	26.6
F99084	321474	7331683	48.3	1/12/1999	24.6	23.7	LST	17.4	30.9
F99093	321347	7331591	52.9	1/12/1999	24.6	28.3	LST	22.0	30.9
CAB0004	320849	7333263	46.2	20/01/2009	16.0	30.2	CLAY/LST	14.0	32.2
CAB0006	321397	7332651	40.0	5/07/2011	10.0	30.0	LST	9.9	30.1
CAB0007	321378	7332637	40.0	5/07/2011	10.0	30.0	LST	9.9	30.1
CAB0008	321427.41	7332611.55	50.0	5/07/2011	14.0	36.0	LST	13.9	36.1
CAB0009	321408.25	7332597.98	50.0	5/07/2011	16.0	34.0	LST	15.9	34.1
CRC02	320985	7333012	66.3	15/08/2022	108.0	-41.7	LST	49.0	17.3
CRC05	321346	7332597	17.4	18/08/2022	60.0	-42.6	LST	12.0	5.4

Table 25 Drilled groundwater intersections

There has been no groundwater intersected by drilling below 5.4mAHD. In 2020-22 Resource drilling was undertaken to create a life of mine geological model, which was then used to create the final void pit design. A total of 12 holes were drilled to a maximum depth of -105.1mAHD and groundwater was intersected in 2 drillholes (17%) at 17.3mAHD in CRC02 and 5.4mAHD in CRC05. A summary of groundwater intersection data form the 2020-22 Resource drilling is provided in Table 26.

Location Details				Drilling Details					
Hole ID	East	North	Natural surface mAHD	Drill Date	Hole Depth (m)	EOH mAHD (m)	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD
CDD01	321054.50	7332823.20	-5.1	18/03/2020	100.0	**-105.1**	LST	dry	
CRC01	320997.00	7333107.00	55.8	18/03/2020	22.1	33.8	LST	dry	
CDD02	321200.50	7332433.20	5.1	19/03/2020	63.9	**-58.8**	LST	dry	
CDD03	320794.50	7332699.10	43.8	20/03/2020	52.1	-8.3	LST	dry	
CRC02	320985	7333012	66.3	15/08/2022	108.0	-41.7	LST	49	17.3
CRC03	320974	7333040	66.0	17/08/2022	48.0	18.0	LST	dry	
CRC04	321230	7332846	16.0	17/08/2022	60.0	-44.0	LST	dry	
CRC05	321346	7332597	17.4	18/08/2022	60.0	-42.6	LST	12	5.4
CRC06	321148	7332576	-16.3	19/08/2022	60.0	**-76.3**	LST	4#	
CRC07	320876	7332231	19.2	20/08/2022	60.0	-40.8	LST	2#	
CRC08	320879	7332531	43.9	22/08/2022	78.0	-34.1	LST	dry	
CRC09	320800	7332900	28.2	23/08/2022	78.0	**-49.8**	LST	dry	

Water intersected is surface water in fractures from blasting based on shot drilling results

Table 26 Resource definition drilling groundwater intersections

Water was intersected at a shallow depth in holes CR06 and CR07 in fractures from blasting and was surface water as demonstrated by water in the drillhole drying up with further drilling. Resource and production drilling supports hydrogeological findings that there is little groundwater at Calliope.

7.3.2 Groundwater Monitoring Network

A total of six piezometers have been installed at the quarry as shown in Figure 34, but FM1-4 have been destroyed and so the network currently consists of piezometers FM5, FM5B and FM6. A summary of the construction details for piezometers FM1-6 is provided below in Table 27.

Location Details				Drilling Details						Construction	
Hole ID	Easting	Northing	Natural surface mAHD	Drill Date	Hole Depth (m)	Clay Depth (m)	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD	Casing (mm)	Screen (m)
FM1	321336	7332963	47.4	28/10/2002	60	2	LST	12.5	34.9	50	24.0-60.0
FM2	321411	7332814	43.7	29/10/2002	24	9.6	Volc	dry	25.7	50	6.0-24.0
FM3	321331	7332864	44.5	29/10/2002	66	2	LST	dry	14.5	50	open hole
FM4	321256	7332789	45.0	30/10/2002	72	1	LST	dry	n/a	50	18.0-72.0
FM5	321430	7332650	50.7	3/07/2012	16		LST	15	n/a	50	5.7-14.7
FM5B	321431	7332650	50.7	12/01/2021	30		Volc	no record	n/a	50	17.0-30.0
FM6	321080	7334350	65.3	26/06/2012	60.5		Volc	54.5	n/a	50	48.5-60.5

Table 27 Quarry bore drilling and construction details

Piezometers FM1-4 were installed In October 2002 by Groundwater EMS Pty Ltd as part of a field investigation with an aim of installing groundwater and pumping bores east of Pit 4. The aim of installing a pumping bore was to obtain pump test data to support groundwater modelling. Exploratory drilling was undertaken but three of the four holes were dry while drilling except for very occasional and limited moist zones. Test bore results did not encourage continuation of constructing a pumping bore and FM1 was constructed as a monitoring bore along with FM2, FM3 and FM4. Bores FM1-4 have since been destroyed by mining. In 2012 two piezometers were installed and added to a new amalgamated EA. The installed monitoring bores were FM5 (State water database RN187863) and FM6 (State water database RN151688). Groundwater levels are monitored quarterly and groundwater quality data obtained 6-monthly to analyse and report trends. An additional monitoring bore FM5B (RN187863) was drilled approx. 1m east of FM5 in January 2021 due to low groundwater levels in FM5 during mid-2019 to late-2020.

Future Groundwater Monitoring Network

Graymont (Sibelco) have annually reported to DETSI (DES) on compliance and the suitability of the groundwater monitoring network since 2014. Bore FM5 benchmarks groundwater at the active Pit 4 whereas Bore FM6 benchmarks groundwater at the inactive Pit 1. Comparative Analysis of the bores is undertaken to assess FM5 variability against FM6 variability to determine whether FM5 may be impacted by mining. Long term monitoring has demonstrated that FM5 variability is similar to FM6 except for recent elevated sulphate associated with the construction of FM5B. See Section 7.3.5 The current network to date been considered suitable based on known groundwater behaviour at the site. The monitoring bores are upgradient of the mining activities/pit floor, and describe the surrounding/background groundwater conditions and a component of groundwater flow into the pit void. Groundwater has not been detected beneath the floor of Pit 4 and if any groundwater made its way to the pit floor it would be mixed with surface water. Surface water is discharged in accordance with surface water release EA conditions (Table 4) which are not aligned with the groundwater EA trigger levels (Table 5) and any exceedances of groundwater trigger levels does not influence the release of surface water. Recent investigative drilling has provided an improved understanding of groundwater levels and flow and has confirmed that there is little groundwater flow at the site. . Graymont plans to install three additional bores at investigation drilling sites D01, D07 and D016 to provide long term monitoring data for the future planned Pit 3-4. See Figure 44.

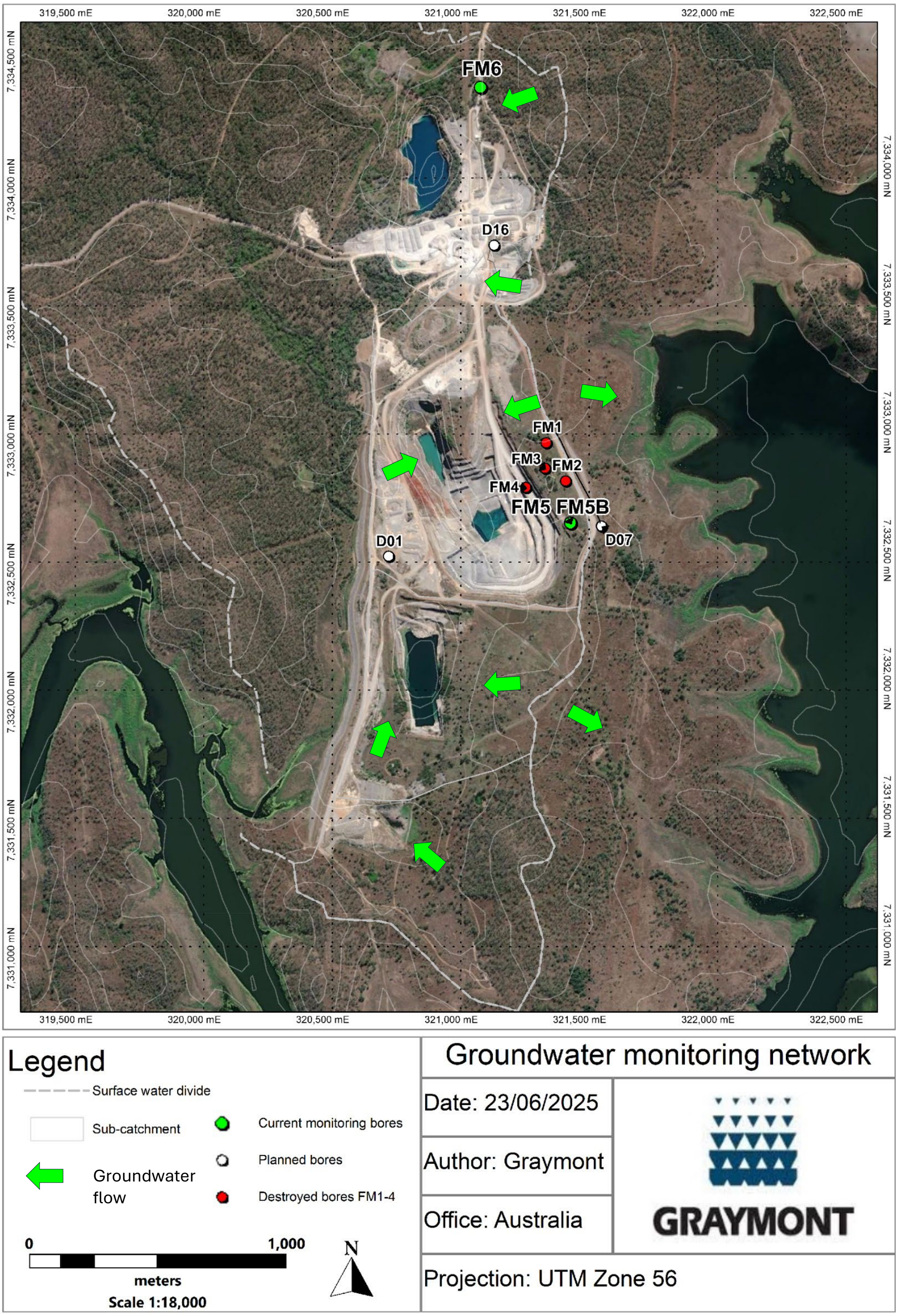

Figure 48 Groundwater Monitoring Network

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7.3.3 Aquifer hydraulic properties

Hydraulic properties of groundwater systems can be obtained from the pumping of bores constructed for groundwater pumping purposes. Hydraulic conductivity and transmissivity can be determined by pumping and slug tests. Pump tests stress the aquifer and the aquifer response is quantifiable. Slug tests provide an estimate of near bore hydraulic conductivity.

A pumping bore was not installed following water investigative drilling because a lift test yielded insufficient groundwater to proceed with drilling a larger diameter hole and constructing a pumping bore. No pumping bores have been installed at the quarry and pump testing cannot be undertaken. Piezometers have been installed, which are non-pumping bores, and are suitable for slug testing. The fracture zone in FM1 gave an estimated airlift of 0.4l/s and an estimated bore yield of <0.1l/s (Groundwater EMS, 2002). Air lift pump testing by drilling operators tend to be approximate instantaneous yield only rather than an estimate of long-term yield potential. Therefore, this information should not be taken as accurate yield estimates.

Recovery hydraulic conductivity testing was undertaken of bores FM1-4 in 2002 (Kalf, 2003) and slug testing of bore FM6 was conducted in 2025. A summary of results is provided in Table 28.

Year	Bore	Aquifer Screened	Slug Test method	Analysis Method	Hydraulic Conductivity m/day
2002	FM1	Limestone	Recovery	Hvorslev	0.0030
2002	FM2	Volcanic	Recovery	Hvorslev	0.0038
2002	FM3	Limestone	Recovery	Hvorslev	0.0030
2002	FM4	Limestone	Recovery	Hvorslev	0.0019
2025	FM6	Volcanic	Recovery	Bouwer-Rice	0.0360
2025	FM6	Volcanic	Drawdown	Bouwer-Rice	0.0560

Table 28 Slug test results

A seepage velocity estimate of 0.002m/day was made of advective travel time between drill holes 7 and 12, which are located near FM1-3, using a US EPA online tools for Site Assessment calculation tool. Drillholes 7 and 12 are both located near the groundwater divide.

7.3.4 Groundwater recharge and discharge

Regional recharge is in topographic elevated positions associated with thin soil cover and discharge is in topographic lows associated with deep soil and regolith.

Mining can disrupt groundwater flow with the creation of voids which in mines with low permeability host rock can result in groundwater seepage from benches faces, and in high permeability environments groundwater can be drawdown to the pit floor by groundwater pumping as the pit floor is being dewatered.

Investigative drilling demonstrated that groundwater flow at the quarry is southerly along the groundwater divide and from the groundwater divide groundwater flow is easterly and westerly. Groundwater testing at Calliope has shown that the limestone and volcanic rock have relatively low bulk permeability, which is also supported by dry benches faces with evaporation exceeding any seepage, with the exception of intermittent rainfall driven seepage at the north-east corner of Pit 4 at the volcanic -limestone contact. Groundwater flow in Pit 4 is inward towards the pit floor.

Groundwater seepage has been observed west of Pit 3 beneath the surface water flow from the Farm Dam Seep, as discussed in Section 5.2. Groundwater is present in the western wall of Pit 3 at approx. 32mAHD. A black large organic clay ed area located west of Pit 3 indicates that prior to mining a surface depression existed at this location as discussed in Section 4.1.3. The Seep is located in a natural topographic low and any water shedding from within or from the Waste Dumps, which are permeable as identified by GAWB in 2002, will naturally flow into the topographic low and then into Pit 3.

7.3.5 Groundwater level and flow

A summary of groundwater intersections and first monitoring reading of groundwater for Bores FM1-4 is provided below in Table 29.

Bore	Groundwater Intersection		Groundwater Measurement		
	DBNS (m)	SWL mAHD	Monitoring Date	DBNS (m)	Hydraulic head mAHD
FM1	12.5-13.0m	34.9	1/11/2002	13.3	34.1
	43.5-44m	3.9			
FM2	hole dry, moist at 18 & 23m	25.7	1/11/2002	9.85	33.9
FM3	hole dry, moist at 30m	14.5	1/11/2002	12.2	32.3
FM4	hole dry, no moisture	n/a	1/11/2002	56.8	-11.8
FM5	15	n/a	3/07/2012	12.0	33.0
FM5B	no record	n/a	27/01/2021	16.5	28.5
FM6	54.5	n/a	26/06/2012	21.0	24.0

Table 29 Monitoring bores FM1-6

A hydrograph of FM5, FM5B and FM6 water monitoring results is presented below in Figure 49.

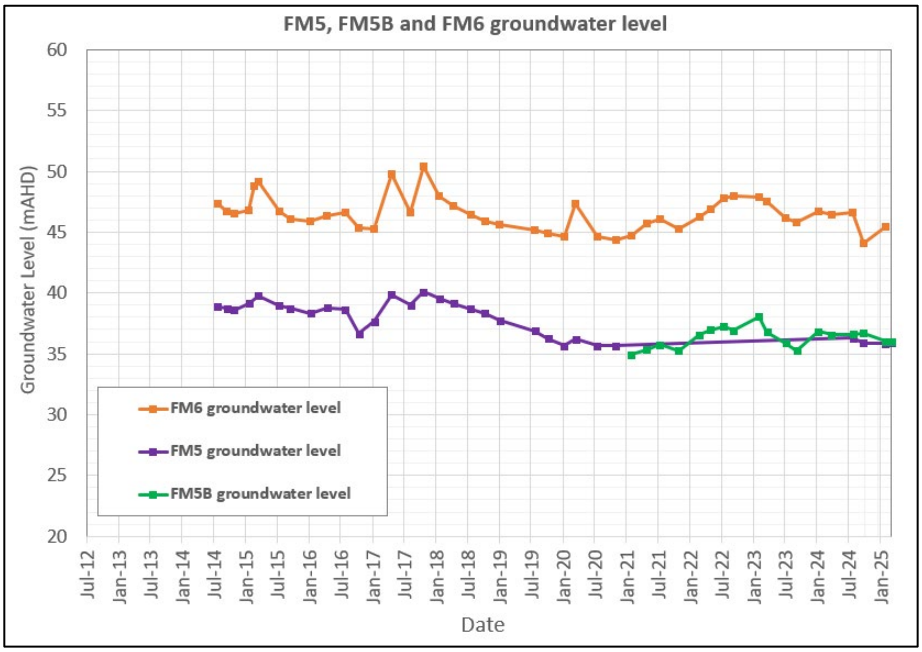

Figure 49 FM5, FM5B and FM6 groundwater levels

A groundwater level map was constructed from investigative drilling monitoring and current bores FM5, FM5B and FM6 in consideration of destroyed bores. See Figure 39.

Monitoring bore FM6 is located on the edge of the inactive Pit 2 whereas FM5 is located on the edge of the active Pit 4 but behave similarly. Groundwater in the bores respond to rainfall and drain equally well and naturally seasonal fluctuate greater than 2 metres/year. Groundwater levels declined from 2018-19 during a drier climate. A hydrograph of bores FM1, FM5 and FM5B are presented below with Awoonga Dam water levels. See Figure 50.

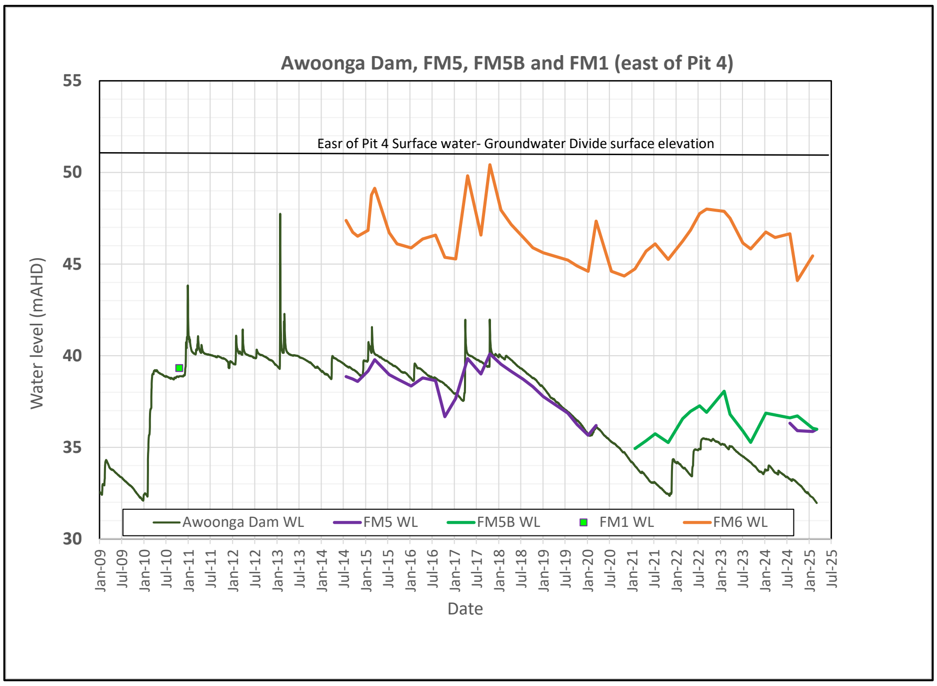

Figure 50 FM5, FM5B and FM6 groundwater levels with Awoonga Dam water level

The relationship between Awoonga Dam water and groundwater determines whether elevated Awoonga Dam water can potentially enter the mining voids by groundwater flow. If Awoonga Dam is hydraulic connected to groundwater at Calliope then investigation drilling should have the same pressure head but this is not the case. See Table 17. Drilling on the pit floor has not intersected groundwater but if it did it would be artesian if connected to Awoonga Dam. Groundwater levels in FM5 and FM6 behave similarly as does Awoonga Dam when water levels are above 36mAHD. See Figure 46. When groundwater levels are less then 35mAHD groundwater behaves differently from Awoonga Dam which proves that groundwater is not connected to Awoonga Dam water level. There is no relationship between FM6 groundwater and Awoonga dam water as FM6 is at the northern end of Calliope. Groundwater in FM6 and FM5 behave similarly to Awoonga Dam water level during wetter periods but during drier periods they drain differently. Awoonga Dam water level is regulated and water is released based on downstream user demands but releases do not affect the relationship between Awoonga Dam water level and groundwater. When Awoonga water level rises above 36maHD so does groundwater and this relationship provides a natural protection against elevated Awoonga Dam water levels. The surface elevation east of Pit 4 is 51mAHD (Figure 46) so the protection elevation, less some scouring of clay, is interpreted to be 50mAHD. The maximum elevation of Awoonga Dam water in 2013 measured at Calliope was 48.3mAHD. Egress of Awoonga Dam water level into Pit3-4 mining void will occur when Awoonga Dam water levels are elevated above 50mAHD and egress will cease when Awoonga Dam water levels are below 50mAHD. Conversely pit water will flow into Awoonga Dam when elevated above 50maHD and will cease when pit water is below 50mAHD.

Groundwater behaviour near Pit 1

Pit 1 has been back-filled and the post mining land use at this location is grazing. Groundwater was intersected in the recently drilled hole 16 which is planned to be constructed as a bore and added to the Groundwater Monitoring Network (Figure 34). The investigation is ongoing.

7.3.6 Groundwater Chemistry

Groundwater chemistry data from bores FM5 and FM6 and is annually reported and analysed. Graphs of salinity, pH and major ion chemistry results from FM5, FM5B and FM6 are presented below in Figures 51-57.

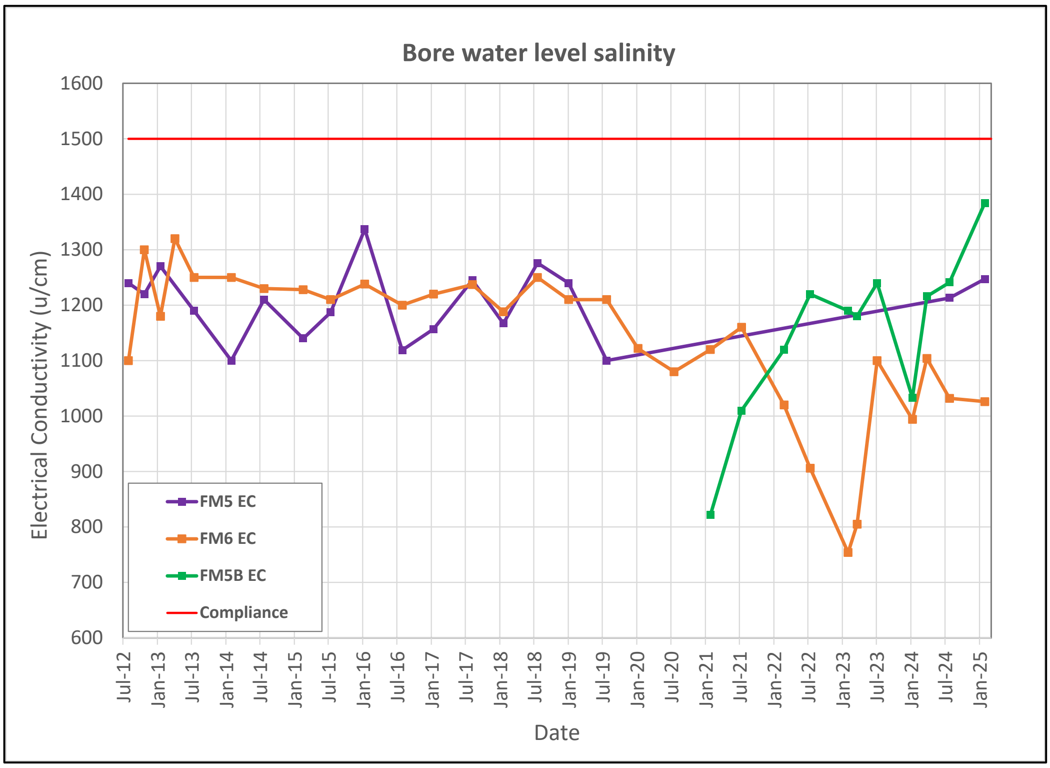

Figure 51 FM5, FM5B and FM6 salinity

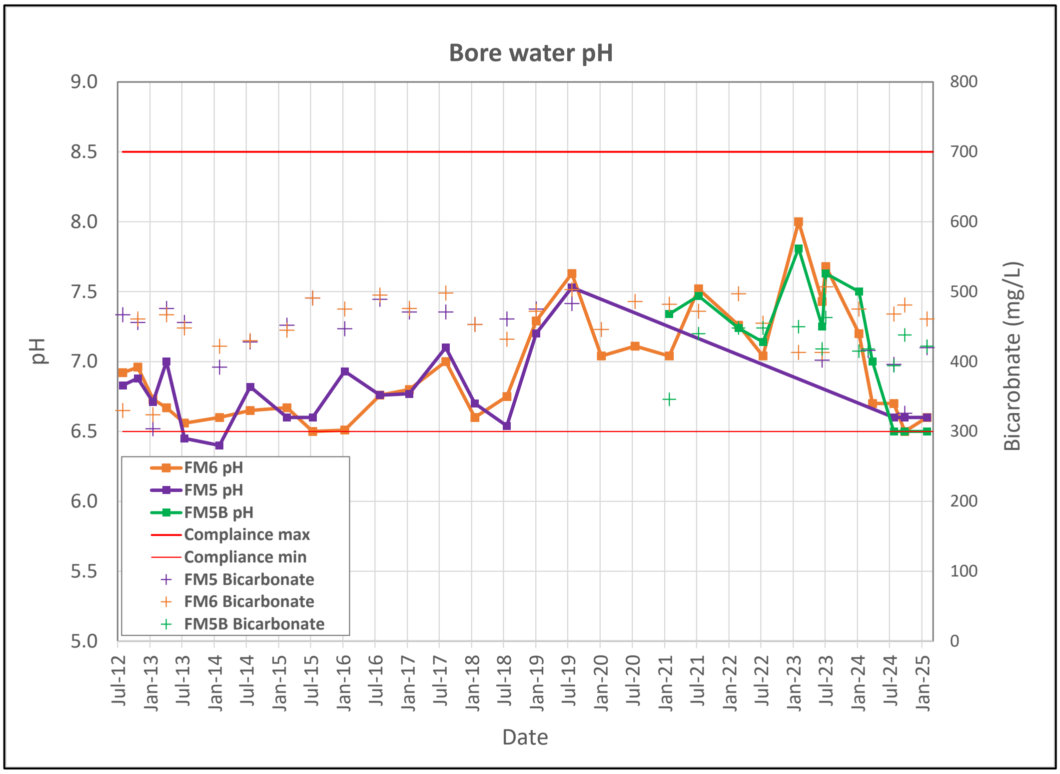

Figure 52: FM5, FM5B and FM6 groundwater pH with bicarbonate

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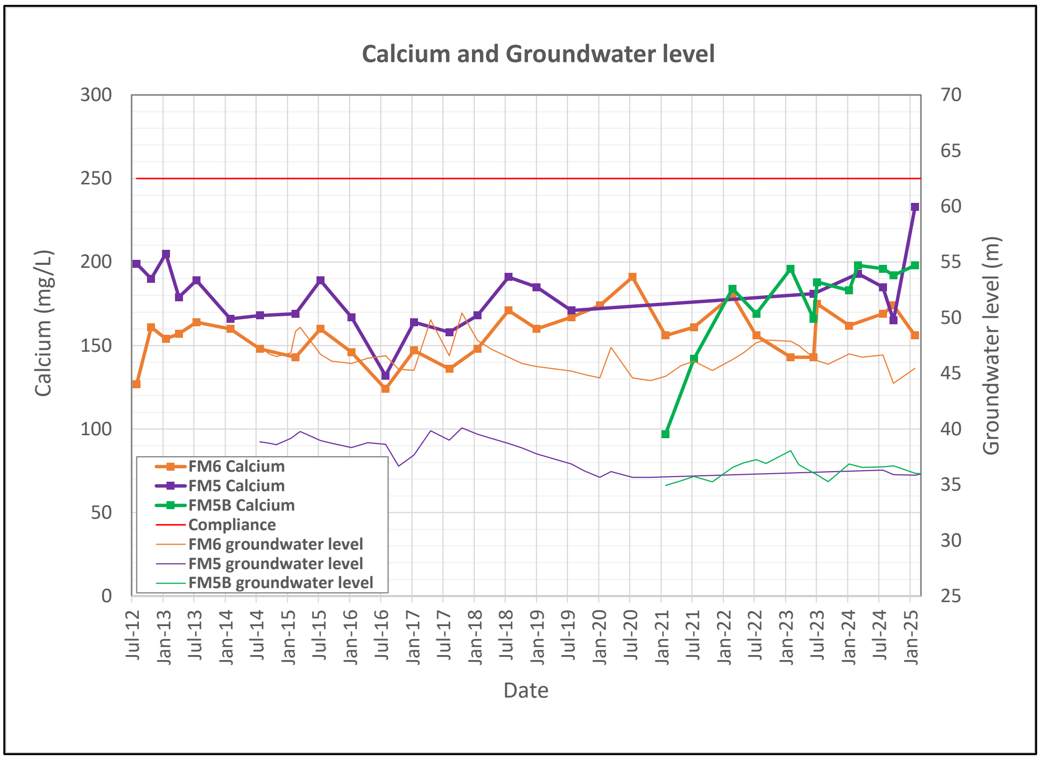

Figure 53: FM5, FM5B and FM6 calcium and groundwater level

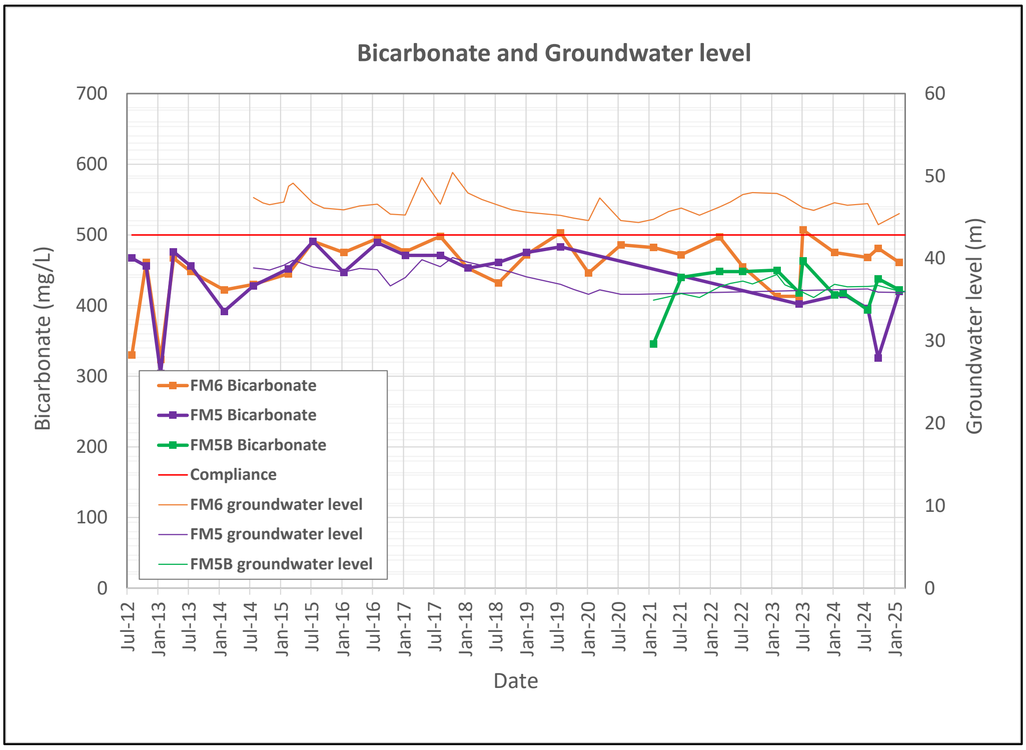

Figure 54: FM5, FM5B and FM6 bicarbonate and groundwater level

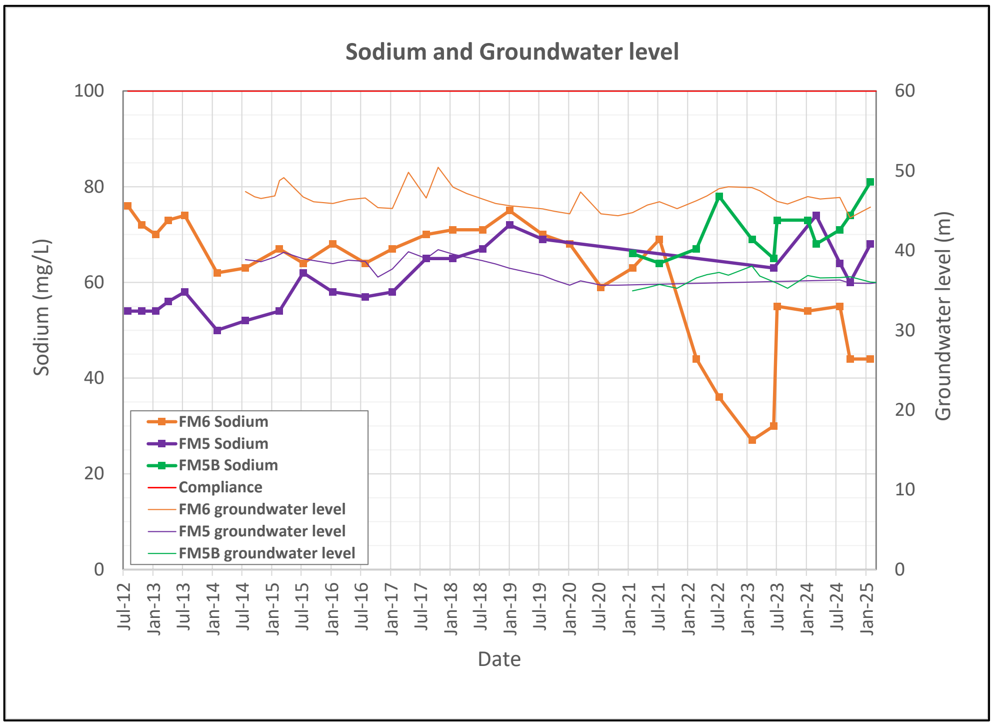

Figure 55: FM5, FM5B and FM6 sodium and groundwater level

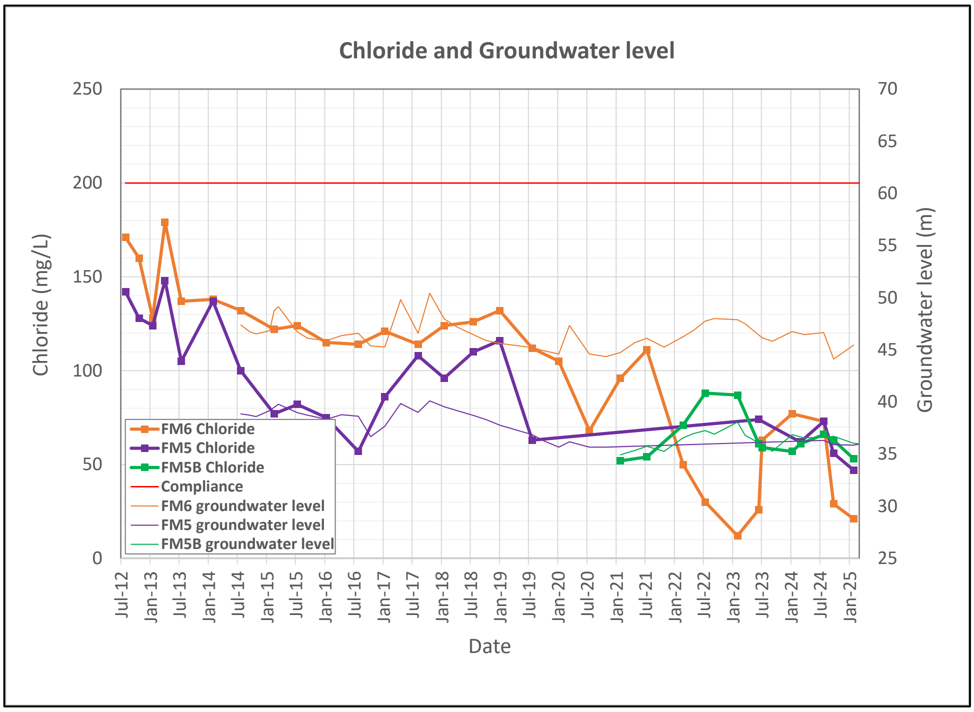

Figure 56: FM5, FM5B and FM6 chloride and groundwater level

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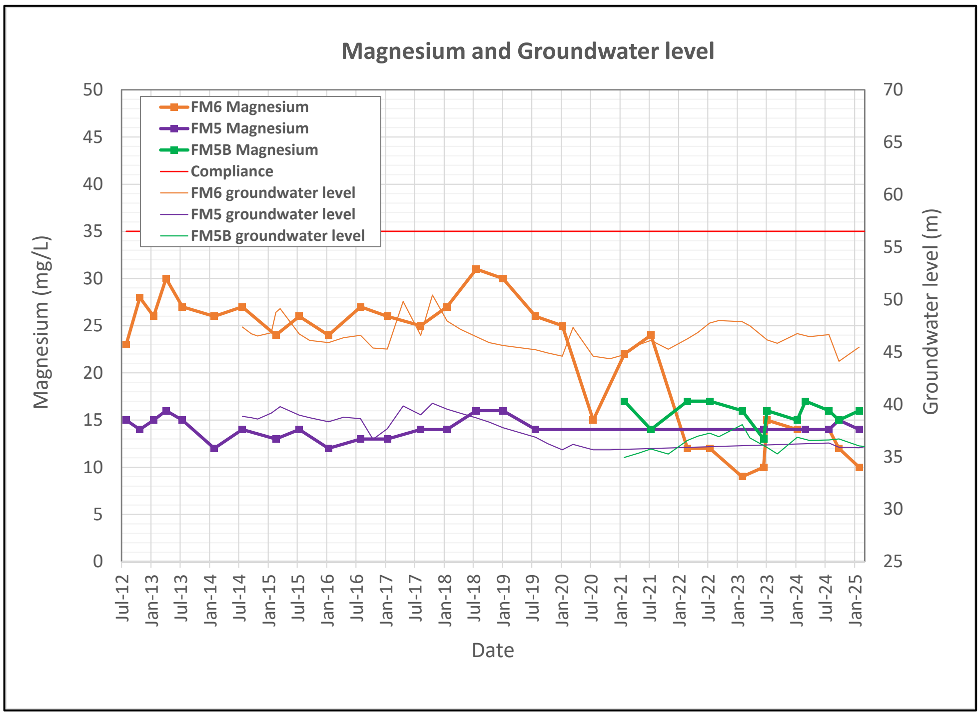

Figure 57: FM5, FM5B and FM6 magnesium and groundwater level

The salinity of FM5 and FM6 is similar, generally being approx. 1200 µ/cm. Groundwater in limestone is similar to groundwater in volcanics. The major ion chemistry between FM5 and FM6 is generally similar, with the exception of sulphate in FM5B and FM5 since 2024, Sulphate in FM5 and FM6 was similar until the installation of Bore FM5B. Similar groundwater levels and the observation of drawdown in FM5 during sampling of FM5B indicates hydraulic connection between the two wells

Limestone vs Volcanic rock aquifer

A Piper Plot of major ion water chemistry of all groundwater was presented as Figure 24. Groundwater in the volcanic rock is more variable than in limestone, but both have a similar salinity, being fresh to moderately saline and similar chemistry being Ca-Mg-HCO3 type water, so the aquifers are considered to behave as one hydraulically connected system, comprising an unconfined aquifer.

7.3.7 Potential contaminants in groundwater

Groundwater is generally microbiologically safe and chemically stable; however, shallow or unconfined aquifers can be subject to contamination from discharges or seepages associated with agricultural practices (pathogens, nitrates and pesticides), septic tank discharges (pathogens and nitrates) and industrial wastes.

Surface water potential contaminants include salinity, pH, suspended solids, sulphate, nutrients (nitrate) and metals as well as hydrocarbons and pesticides See Section 7.1.7. These are also potential contaminants for groundwater noting that pesticides are not used on site.

Sulphate

A hydrograph of groundwater level and sulphate with rainfall is presented as Figure 58.

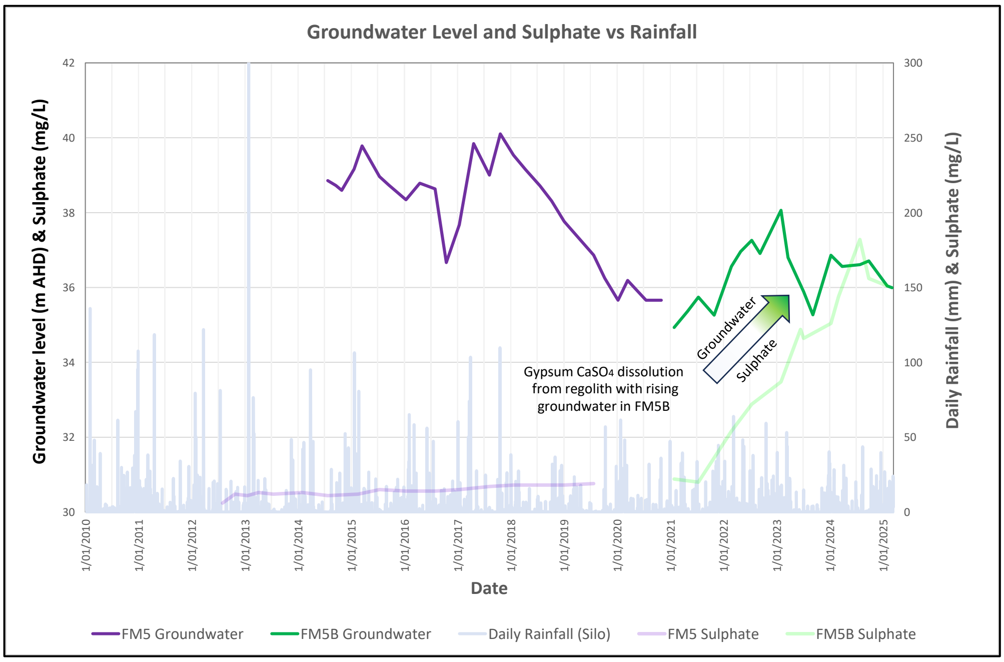

Figure 58: FM5, FM5B and FM6 sulphate and groundwater level

The cause of sulphate increase in FM5B and FM5 is attributed to dissolution of gypsum ($CaSO_4$) and leaching sulphate ions into groundwater. The groundwater chemistry of Groundwater chemistry in Bores FM5 and FM5B appears to be equilibrating following the installation of FM5B.

The primary source of major ions is the deposition of cyclic salts by precipitation and aeolian dust with additional cations added by mineral weathering and CO_3 anion from the dissolution of CO_2 in soil water.

Groundwater quality is driven by the nature of rainfall and properties of the unsaturated zone. Rainfall entering the soil zone undergoes significant changes in chemical composition and pH by processes such as root respiration and decomposition of organic matter via chemical reactions such as sorption and redox. The chemical constituency of infiltrating water in turn modifies groundwater chemistry by processes such as leaching, dilution/concentration as well as dissolution/precipitation. Water quality is dependent upon the nature of rainfall (ie. timing, intensity, duration...etc) and salt storage in the regolith, which determines whether infiltration provides a diluting effect and/or a leaching effect on ions and/or metals. (Graymont, 2019)

In near coastal Central Queensland rainfall typically provides a leaching effect with infiltration causing a deterioration of water quality as salts are flushed into groundwater whereas water quality improves in extended dry periods (Graymont, 2021).

Nitrate

Nitrates are naturally occurring in surface water and groundwater from nitrogen transforming processes. See Section 5.3.3.

Metals

Metals in groundwater are analysed six monthly and a table of results for Bores FM5, FM5B and FM6 are presented in Table 30.

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Date	Site	Arsenic mg/L		Cadmium mg/L		Chromium mg/L		Copper mg/L		Nickel mg/L		Lead mg/L		Zinc mg/L	
		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
20/07/18	FM5	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005
	FM5B														
	FM6	0.008	0.010	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.067	0.014
24/07/19	FM5														
	FM5B														
	FM6														
17/07/20	FM5														
	FM5B														
	FM6	<0.001		<0.0001		<0.001		<0.001		0.008		<0.001		0.128	
12/07/21	FM5	<0.001		<0.0001		<0.001		0.002		0.002		<0.001		0.006	
	FM5B														
	FM6	0.006		<0.0001		<0.001		<0.001		<0.001		<0.001		0.092	
24/02/22	FM5	0.001		<0.0001		<0.0001		0.047		0.003		0.003		0.064	
	FM5B														
	FM6	0.002		<0.0001		<0.0001		0.052		0.004		<0.001		0.035	
13/07/22	FM5	0.001		<0.0001		0.003		0.108		0.005		0.038		0.155	
	FM5B														
	FM6	0.003		<0.0001		0.003		0.032		0.006		0.011		0.083	
31/01/23	FM5														
	FM5B														
	FM6														
5/07/23	FM5														
	FM5B		0.004		<0.0001		0.004		0.081		0.004		0.019		0.094
	FM6		0.001		<0.0001		<0.001		<0.001		0.002		0.009		0.007
9/01/24	FM5														
	FM5B		0.004		<0.0001		0.004		0.081		0.004		0.019		0.094
	FM6		0.001		<0.0001	0.001	0.001		<0.001		0.002		0.009		0.007
1/03/24	FM5	<0.001	<0.001	<0.0001	<0.0001	0.001	0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005
	FM5B	<0.001	<0.001	<0.0001	<0.0001	0.001	0.001	0.006	0.006	<0.001	<0.001	<0.001	<0.001	<0.005	0.007
	FM6														
25/07/24	FM5	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.001	0.002	0.005	0.001	0.001	0.003	0.013	0.023	0.011
	FM5B	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.006	0.006	0.001	<0.001	<0.001	<0.001	0.054	0.010
	FM6	0.002	0..003	<0.0001	<0.0001	<0.001	0.002	0.002	0.006	0.002	0.004	0.002	0.010	0.019	0.028

Table 30 FM5, FM5B and FM6 metals

7.3.8 Groundwater use and re-use

Groundwater use in the region, apart from re-use of mine pit water, is primarily for stock and domestic use. The mine operations re-use water collected in the operating pit void for the plant operation and dust suppression on roads. The reason for low regional groundwater use is attributed to low yields associated with low hydraulic conductivity and high rainfall makes surface water a more cost-effective water supply option.

Currently the mine operation uses approximately 33,000 litres per month for the wash plant (5% of all pit re-use water) and 727,000 litres average per month for dust suppression (95% of all re-used pit water). The water is a combination of rainfall run-off and groundwater seepage.

The site does not have a pumping bore because of poor yields and so there will be no future groundwater use at or near the site.

7.4 Awoonga Dam water interaction with pit voids

7.4.1 Awoonga Dam water level

Awoonga Dam full storage level was raised to 30mAHD in 1984 and then to 40mAHD in 2002. Historical water levels for Awoonga Dam from 1969 to 2019 is shown in Figure 59.

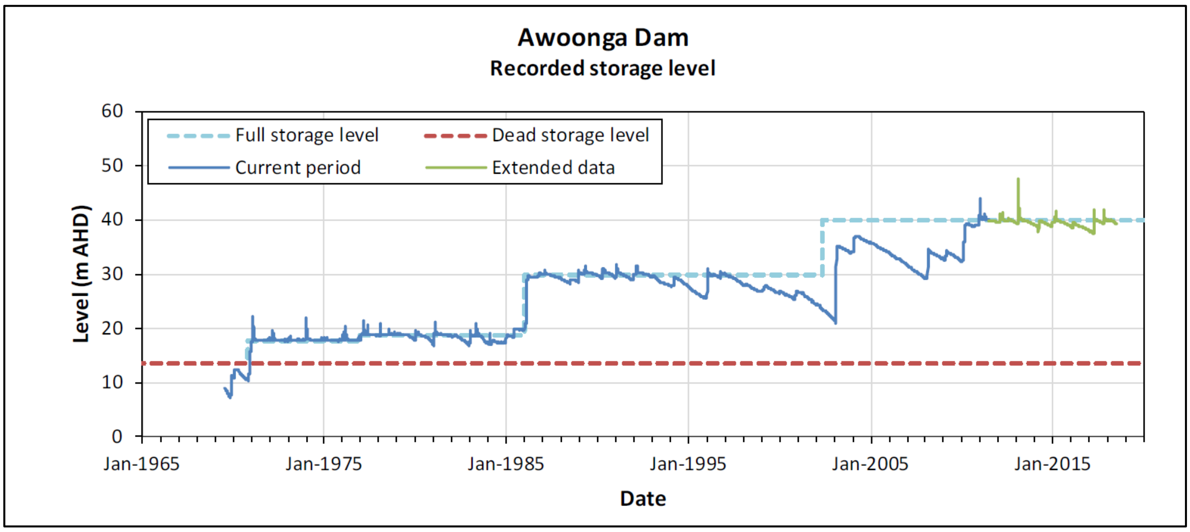

Figure 59 Awoonga Dam water level 1969-2019 (Boyne River Water Basin Plan, 2019)

The Awoonga Dam full supply level is 40mAHD and the dead storage level is 13.6mAHD.

7.4.2 Pit water discharge to Awoonga Dam

Pit water is discharged to Awoonga Dam in accordance with EA conditions as outlined in Table 2.

7.4.3 Awoonga Dam interaction with Pit 3

The limestone quarry is partially bounded by Awoonga Dam and the interaction between Awoonga Dam and pit water has been subject to numerous investigations. See Section 5.2. There is no direct interaction between Awoonga Dam and Pit 3 water.

7.4.4 Awoonga Dam interaction with Pit 4

A surface water and groundwater divide exists lies between Pit 4 and Awoonga Dam and there is no evidence of interaction between Awoonga Dam water and Pit 4 water. There is negligible risk from Awoonga Dam water entering Pit 3-4 from the eastern side of Pit 4 if dam levels rise to the recorded maximum of 48.3mAHD. Egress of Awoonga Dam water level into Pit3-4 mining void will occur when Awoonga Dam water levels are elevated above 50mAHD and egress will cease when Awoonga Dam water levels are below 50mAHD as discussed in Section 7.3.5.

8 WATER BALANCE MODEL OF FINAL PIT VOID

8.1 Methodology

An analytical Water Balance model has been developed to predict water fill of the final void at life of Mine. This modelling approach is commensurate with the lack of groundwater at Calliope and the negligible risk that mining poses to groundwater beneficial users. The simplest modelling approach would be to meter for a long enough period to establish a relationship between pumped pit water and rainfall and then predict pit water fill based on the rainfall record without having to quantify all the water inflows and outflows. Additional meters were installed in January 2025 for this measure.

8.1.1 Pit 3 Water Balance modelling

Data loggers were installed in Pit 3 in 2017/18 to further investigate the source of excess pit water as discussed in Section 5.2 and a hydrograph pf this data was presented as Figure 34. The identified seepage calibration events were reassessed in the context that the "seepage" is surface water flow from the Farm Dam and that there is <1/s of groundwater inflow at the Calliope as observed and supported by photographs of dry pit walls; low yielding regional bores in the Calliope beds; insufficient groundwater at Calliope to install a bore and low hydraulic conductivity from slug tests. The reassessed calibration events are presented in Table 31.

Parameters	Investigation Period	15 Mar 2017 - 31 Mar 2017	15 Apr 2017 - 30 Jun 2017	8 Mar 2018 - 7 Apr 2018
Climate	Calibration Events	Cool Wet	Cool Dry	Hot Dry
	Days	17	77	31
	Rainfall (mm)	491	48.6	25
	Rainfall rate (mm/day)	28.9	0.6	0.8
	Pit 3 Evaporation (mm)	70	264	159
	Evaporation rate (mm/day)	4.1	3.4	5.1
	Pit 3 Evaporation (ML)	-3	-13	-8
Pit 3 void	Pit 3 Rainfall Capture Area (sqm)	48000	48000	48000
	Pit 3 Direct Rainfall capture (ML)	**24**	**2**	**1**
	Pit 3 water level change mAHD	14-19	20-22.5	21.5-22.5
	Pit 3 water volume storage change	**252**	**152**	**61**
Pit 3 void sub-catchment	Pit 3 Void sub-catchment excluding void (sqm)	496000	496000	496000
	Run-off coefficient	**0.8**	**0.3**	**0**
	Surface water runfoff to Pit 3 input (ML)	195	7	0
Farm Dam sub-catchment	Farm Dam sub-catchment (sqm)	595000		
	Run-off coefficient	**0.8**		
	Surface water runfoff to Farm Dam input (ML)	234		
	Farm Dam flow to Pit 3 calculated from run-off coefficient (ML)	**28.8**		
	Surface water flow from Farm Dam to Pit 3 rate (ML/day)	**1.7**	1.7	1.7
	Farm Dam flow to Pit 3 calculated from Hot Wet flow rate (ML)		130.3	52.5
Groundwater	Groundwater seepage rate (litres/sec)	1	1	1
	Groundwater seepage rate (ML/day)	0.1	0.1	0.1
	Groundwater seepage to Pit 3 (ML)	1.5	6.7	2.7
Total surface water runoff inflow		**251**	**153**	**61**

Table 31 Pit 3 Water Balance Model

8.1.2 Surface water runoff coefficents

A run-off coefficient of 0.7 was initially applied to the Cool Wet 15 March 2017 – 31 March 2017 calibration event which yielded a surface flow rate of 3.1 ML/day from the Farm Dam to Pit 3 which is identical to the 3.1ML/day "seepage rate" calculated by a Sibelco hydrogeologist (Feiss). Applying a constant Farm Dam flow rate of 3.1ML/day to the Cool Dry 15 April-30 June 2017 calibration event gave an in-balanced calculation of

Total surface water run-off inflow of 263ML. Based on the assumption that surface water flow from the Farm Dam is constant the run-coefficient and the Farm Dam flow were adjusted to honour all calibration events data. Surface water flow from the Farm Dam, when water is present in the Farm Dam, is calculated to be 1.7mL/day. Based on this calculation the surface water run-off coefficient for the Cool Dry 15 April-30 June 2017 calibration event was 0.3. The surface water run-off coefficient for the Hot Dry 8 March 2018-7 April 2018 was zero meaning that there was no surface water run-off when the catchment became very dry and rainfall was captured in the soil and regolith.

A 50 year rainfall and evaporation record from 1975-2025 was obtained from the BOM Long Paddock website (Figure x). Monthly rainfall and evaporation data for 1975-2025 was replicated for 2 centuries to provide a long rainfall record for the Pit 3-4 Water Balance Model. The 50 year rainfall and evaporation record was analysed and it was determined that:

- Monthly median rainfall is 45mm
- Monthly median evaporation is 157mm

This data was used to categorise monthly climate into the four categories of Hot Dry, Hot Wet, Cool Dry and Cool Wet. The surface water run-off coefficients of monthly data shown in Table 31 were assessed to be representative of climate for the calibration events and an estimate for Hot Wet months was estimated to be 0.5. The Monthly climate categories and their surface water run-off coefficients are presented in Table 32.

Category	Hot Dry	Hot Wet	Cool Dry	Cool Wet
Rainfall (mm)	<45	>45	<45	>45
Evaporation (mm)	>157	>157	<157	<157
Coefficient	0	0.5	0.3	0.8

Table 32 Pit 3-4 Water Balance Model climate categories with run-off coefficients

8.1.3 Pit 3-4 Water Balance Model setup from from Pit 3 Water Balance Model

Climate Models (GCM) show a general warming across the state and for the Boyne River Basin the higher GHGE scenarios indicate a 6.3% increase in evaporation and the lower GHGE a 3.8% in evaporation. A 2% decrease in rainfall is predicted for both scenarios. Monthly rainfall and evaporation records from 1975-2025 for the Calliope are provided in Section 4.2. The 1975-2025 rainfall and evaporation record was used to predict rainfall and evaporation from 2100 by applying GHGE estimate high and lower scenarios to the monthly rainfall and evaporation data. The predicted pit water fill is based on the lower GHGE scenario and is presented with current climate and a higher GHGE scenario.

The analytical final void Pit 3-4 Water Balance model has been created based on the formula:

Pit water inflow = direct rainfall capture +surface water run-off + groundwater inflow – pit evaporation

Model Assumptions were:

- No dam leakage
- Groundwater inflow of 1l/s
- Farm Dam flow has a base flow of 1.7ML/day but there is no flow during Hot Dry conditions

The model was setup using the final landform of the Pit 3-4 pit design which was sliced into 1m blocks with a calculated volume (ML) and an associated elevation (RL). Surface water areas used in this Water Balance are:

- Pit 3-4 Void (for direct rainfall capture)

- Pit 3-4 Void Boundary Catchment (for surface water run-off entering Pit 3 and Pit 4 voids excluding surface water run-off from the Farm Dam catchment)
- Farm Dam Catchment (for surface water currently entering Pit 3 void)

Water Inputs

- Direct rainfall capture to Pit 3-4 void.
- Surface water inflow to Pit void.
- Groundwater inflow

Water Outputs

- Evaporation of pit water

Water Balance

End of month Void Water Volume (and resultant water level) = previous month Void water volume + water volume IN – water volume OUT (ML/month)

Source data

- Monthly rainfall and evaporation 50 year record from 1975-2025 replicated for 2 centuries under the different GHGE scenarios
- Pit void surface area from pit design for Pit 3-4
- One meter high bench blocks derived in SURPAC from the pit design. The area of the top of the bench block provides the evaporation surface area of pit water. The volume of the pit block is the water volume which the model fills and then rises to the next 1 meter block.
- Catchment areas were derived in MapInfo
- Surface run-off co-efficient derived for Pit 3 by analysing pit water data-logger data against rainfall applied to Pit3-4 void
- Model calibrated against recent discharge gauging
- Monthly Evaporation acquired from a node in Long Paddock

A monthly timescale was adopted for the model. The final landform design has the main open pit void being the combined present day Pit 3 and Pit 4 with an abandonment bund surrounding the void and partial backfill of the north end of the pit. The abandonment bund is planned as rock fill and not a flood mitigation structure. Surface water run-off inflow into Pit3-4 void was capped at 42.4mAHD because of the natural ground elevation. The broad bench floor evaporates most water as compared to sumps and internal voids on the pit floor which store some water.

A summary of model setup is provided in Table 33.

Climate	Rainfall (mm)	Evaporation (mm)
Current climate		
50 year record 1975-2024 repeated for base data	100%	100%
Climate Change Modelling		
Predicted Higher Greenhouse gas hotter drier climate	98%	106%
Predicted Lower Greenhouse gas hotter drier climate	98%	104%
Water input (variables)		
Groundwater inflow l/s		1
Groundwater inflow ML/month (calculated from l/s)		2.6
Farm Dam flow to Pit 3 (ML/day)		1.7
Catchment areas (constants)		
Pit 3-4 Catchment (sqm)		1,929,200
Pit 3-4 Void Direct Capture (sqm)		905,600
Pit 3-4 Void Boundary sub-catchment (sqm)		428,100
Farm Dam cub-catchment (sqm)		595,500

Table 33 Pit 3-4 Water Balance Model set-up

8.2 Predicted pit water fill

Pit void water balance and final water level equilibrium is shown below for the predicted lower greenhouse gas emission scenario. See Figure 60.

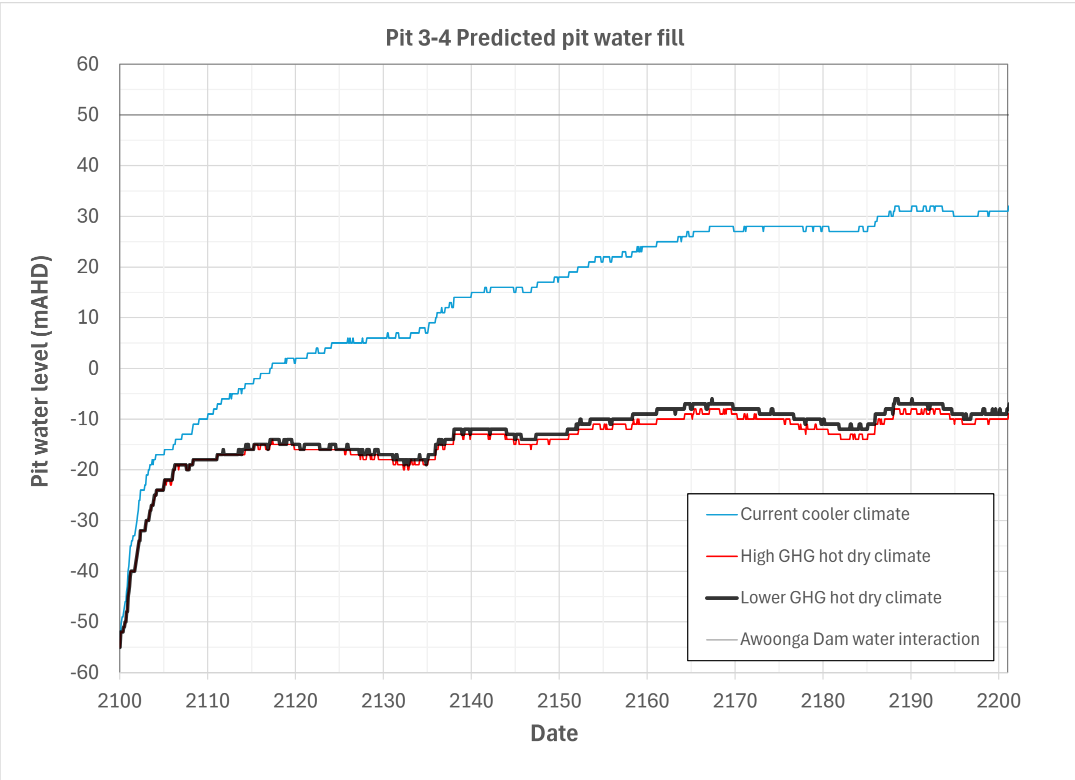

Figure 60 Water Balance Model precited water level behaviour post mining

The pit water is predicted not to fill beyond -10mAHD in the predicted future lower greenhouse gas emission scenario. If the current climate remains unchanged then pit water will fill to 30mAHD.

8.3 Model uncertainty and sensitivity testing

The model was sensitivity tested by changing parameters variables in consideration of model assumptions. The variable with the greatest influence on water inputs is climate change. The model is not sensitive to monthly total water inflow changes of 10-20 ML because it can be a relatively small percentage of total inflow. The modelled outcome is sensitive to groundwater inflow and groundwater inflow volumes is a determining factor on whether pit water equilibria is achieved within the pit void and pit water is contained within the pit void or if pit water escapes the pit void to Awoonga Dam.

Increase groundwater flow to 25 l/s (See Figure 61)

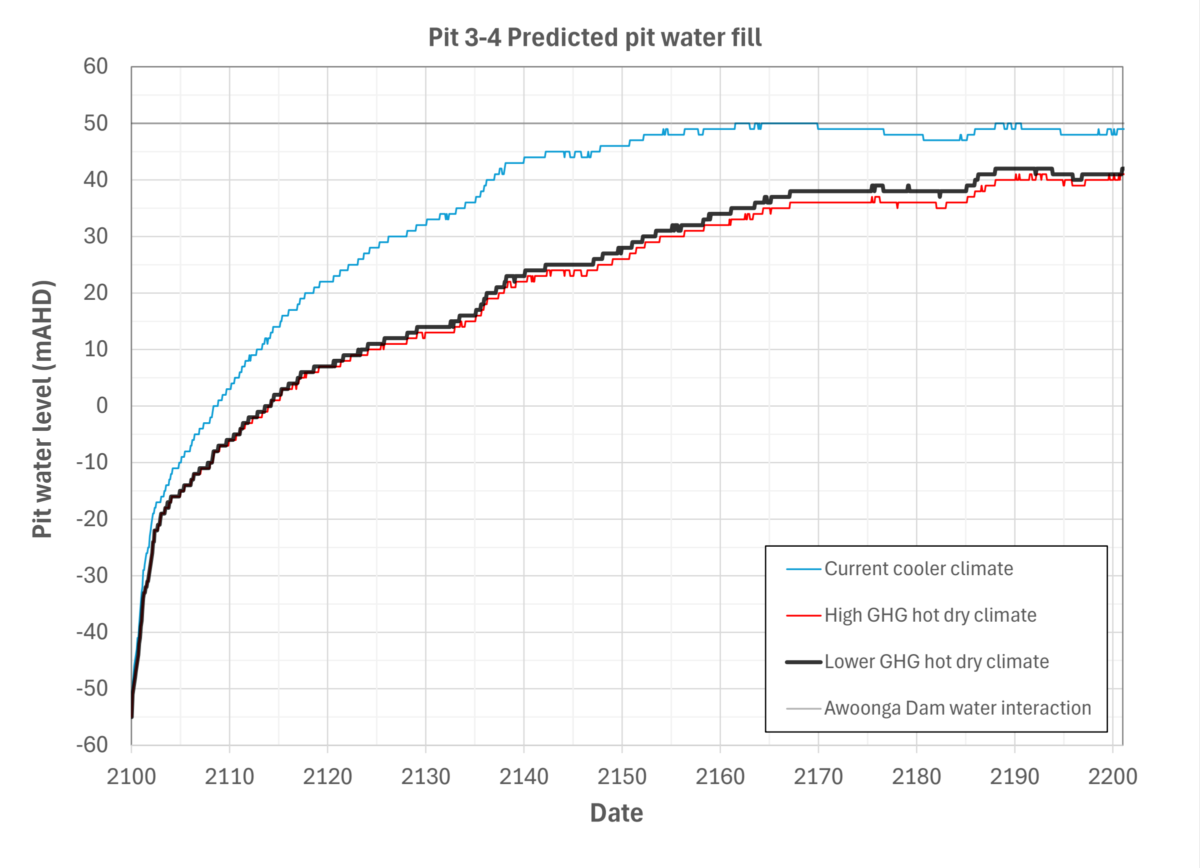

Figure 61 Water Balance Model with groundwater increased to 25l/s

Groundwater inflows were increased from the current observed and modelled 1 l/s to 25l/s and the pit, which is currently a sink (Section 5.3.3), will remain a sink because groundwater will be at 40mAHD which is less than 50mAHD groundwater interaction threshold with Awoonga Dam.(Section 7.3.5).

8.4 Predicted water quality

The water quality of the final pit void is predicted to be a mix of current Pit 3 and Pit 4 water quality. Pit 3 water is a mixed type whereas Pit 4 a Ca-Mg-HCO3 type water and with surface water inflow s predicted to exceed groundwater inflows the final pit void is predicted to be a mixed type with some stratification near the surface.

9 WATER MANAGEMENT

9.1 Water Management Plan

The Water Management Plan (WMP) forms part of site's Environmental Management Plan. The WMP describes the risks and control measures required to manage water flow and quality on site, monitor water quality and regulate safe water discharge from site to achieve ---the following objectives:

- Manage discharge waters leaving site to within water quality limits as prescribed in the EA.
- Manage rainfall run-off to ensure 'clean' (uncontaminated by mine operation areas) is separated from 'dirty water' (rainfall run-off that has been in contact with disturbed areas of the operation).
- Design, construct and maintain Water management structures to effectively control the flow of rainfall run-off and store excess run-off to prevent uncontrolled releases and allow continued mining operations.
- Transfer captured dirty water between water management structures on site to optimise the reuse of dirty water on site for mine plant use and dust management, minimising the need for off-site discharge.
- Treat captured 'dirty water' through natural settling processes via sediment dams and natural drainage filtration routes prior to discharge.
- Ensure hydrocarbon sources are suitably bunded to prevent contamination off-site.
- Monitoring of water including in-pit accumulation, discharge, water transfer and re-use
- Monitoring of condition and performance of water management structures

Historically the Site has operated four mining pits at various periods. The current status is as follows.

- Pit 1 has been infilled and currently forms part of the stockpile storage facility.
- Pit 2 is an inactive mine pit and provides water storage in the void.
- Pit 3 is currently inactive from mining but will become active again in the future.
- Pit 4 is the current active mining pit.

Pit 2 is an inactive pit void for mining purposes and acts as a water storage facility for the Site. Process water for the plant operation is obtained from Pit 2 storage. Water is also used for dust suppression purposes and washdowns. Excess water runoff from the limestone processing area is directed to the Slurry Dam where overtopping discharges back to Pit 2.

Drainage channels and diversion bunds control rainfall run-off from mine affected areas to the relevant pit void or sediment control structure. Clean water drainage control bunds separate clean rainfall run-off from mine affected run-off. Run-off from 'Sediment Dam' catchment, which includes the Production office area and mobile crushing plant area, is directed to the sediment dam for settling prior to discharge through a small wetland system and then past the C1 discharge site.

Pit 3 is currently a water storage facility collecting run-off water. Water transfer is undertaken as required via a mobile pump and pipe system to and from Pit 2 or direct extraction by water carts and used for dust suppression. Excess Pit 3 water is discharged at the F1 discharge site.

Mining in Pit 4 requires dewatering intermittently to allow mining operations to continue. Water is primarily pumped from Pit 4 to Pit 2, and if required, excess water can be pumped to discharge location C1.

9.1.1 Water Use and Water Supply

Minimal water is used on site for production purposes. The Plant uses on approximately 25 L/s when in use and is sourced from Pit 2 water storage via a pontoon based pump and pipe system. Water use includes.

- Dust suppression at the crushing and screening plant
- Wash plant

- Vehicle washdown
- Filling radiators
- Roadway dust suppression
- Mixing of wet road bases and
- Hosing down and cleaning under conveyers

Metering

There is no legislative requirement to meter pumped water but pumps in Pts 2-4 are metered with incomplete meter records. Additional meters have been installed in 2025 to evaluate groundwater seepage in dry periods and to determine the groundwater percentage of pit water.

9.1.2 Potential surface water contaminant sources

Potential contaminant sources include:

- Pit Water
- Runoff of Mine Affected Water
- Runoff of Non-Mine Affected Water
- Sewage Effluent
- Fuels, Oils and Lubricants

Pit water accumulates in the pit voids due to rainfall run-off that can mobilise sediment from the catchment including the roads and walls of the open pit. The pit water will also include a component of groundwater seepage through the fractured bedrock. The pit water quality to date does not vary significantly because sediment settles out and increase in salinity is negated by dilution from rainwater.

Pit water within the Calliope Limestone Operation is considered a low risk source of contaminants. The generation of salts within the mining operations and accumulated within the pits is low, and on-going monitoring has shown the pit water is within the EA limits. Other potential contaminants such as pH and suspended solids within in the pits also achieve the required EA criteria.

The site essentially operates as a closed system with flood protection bunds and natural topographic highs preventing overland flow off-site to Awoonga Dam and conversely, protection from inundation from high water levels from Awoonga Dam.

Run-off from disturbed areas of the mine would be classified as mine-affected run-off water. Some of this end up in the pit voids and some is managed through the slurry dam and sediment dam. This can include run-off from stockpiles, processing areas, waste dump and connecting roads. A component of the run-off can originate from 'Non-Mine affected' areas such as the west and northeast sides of Pit 2 and the east side of Pit 3.

Treatment and disposal of sewage effluent is managed by a dedicated septic system and is not considered significant in the water management system.

Fuels and oil storages are located east of Pit 2. The storage area for fuel is bunded for containment purposes. Any overflow or leakages are directed via a drain to a humeceptor. Any potential overflow from this system is directed to Pit 2 and therefore remains within a closed system. Management of hydrocarbon waste is dealt with under the site Environmental Management Plan.

9.1.3 Surface water Release

Monitoring is undertaken of water planned to be released from a licensed surface water release point (Table 3, Figure 4). If water sampling results meet Release limit requirements (Table 4) then the surface water is released. If water sampling results do not meet Release limits then this water is not released but is used in operational activities. Surface water is released only when Release limit requirements are met.

9.2 Groundwater Management and Monitoring Plan

The current level of groundwater management and monitoring at the Calliope Quarry is simple, yet sufficiently robust to minimise risks to related environmental values.

9.2.1 Water Use and Water Supply

There is no direct pumping of groundwater at the site for production or dewatering purposes.

9.2.2 Potential groundwater contaminant sources

Groundwater intercepted by mining activities accumulates in sumps and is pumped to surface water storages on site, transferring potential contaminants. The potential contaminant sources for groundwater are:

- Sewage Effluent
- Fuels, Oils and Lubricants

The Quarry utilises a septic system located to the west of the site office to treat its sewage effluent and has a separate, dedicated and contained treatment system of its own.

The storage area for fuels, oils and lubricants is located directly east of Pit 2 and north of Pit 1. There is potential for any leakage from these storages to seep into groundwater beneath the site. Ongoing maintenance of these storages and control systems is required to minimise the potential for leaks to occur. Because the pits appear to be capture zones for all groundwater on site, there would be no off-site discharge of contaminated groundwater if any leaks were to occur.

Mining operations can sometimes lead to Acid Mine Drainage however, this is not considered to be likely at this site given the nature of the geology, carbonate based, which leads to near neutral groundwater.

9.2.3 Groundwater affecting activities and impacts

The primary groundwater affecting activity at the site is the mining void creation which can disrupt groundwater flow, although there is little groundwater at the site and flow. There is no direct groundwater discharge from the site, there are no receiving environments potentially exposed to groundwater level drawdown or potential contamination. The groundwater that discharges internally at the site (to the pits) is mixed with surface water and this is monitored regularly to ensure quality specifications are met before being released to the Awoonga Dam.

9.3 Compliance Monitoring and Reporting

Compliance monitoring and any identified non-compliances are investigated and reported in accordance with EA conditions. Water monitoring and compliance against EA conditions are annually reported in Annual Returns and the Annual Groundwater Report.

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