

EA APPLICATION SUPPORTING REPORT

SAVANNAH GOLDFIELDS LTD

Appendix 14 Hydrogeological Assessment (C&R Consulting, 2025)



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AGATE CREEK GOLD MINE



Stage 2 EA Application – Hydrogeology

Report Prepared for:
Savannah Goldfields Limited

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Client: Savannah Goldfields Limited
Project: Agate Creek
Report: Stage 2 Hydrogeological Assessment
Date: October 2025



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EXECUTIVE SUMMARY

The Agate Creek is an open-cut gold mining operation proposal for a stage 2 expansion of mining activities which are to involve five different open-cut pits. The proposed expansion has been assessed for the level of impact on the surrounding aquifer systems.

The groundwater monitoring network consists of twenty-two monitoring bores within an area of approximately 1.5 km² that incorporates all five proposed voids (including one which has already been mined and backfilled). The network targets a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. Specifically, all bores are screened within metamorphic rocks that have been intruded by Siluro-Devonian-age Robin Hood Granodiorite – and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex.

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range. This was later confirmed – with pump tests completed on each monitoring bore, whereby hydraulic conductivities ranged between 6.57×10^{-8} m/sec and 5.06×10^{-7} m/sec.

Interpolated isopotentials were derived from the September 2023 standing water levels. Based on the current available data, the potentiometric surfaces of the Robin Hood Granodiorite and the Corbett Formation Metasediments flow in opposite directions. The Robin Hood Granodiorite bores depict groundwater flow from north to south, whereas the flow direction in the Corbett Formation Metasediments more typically follows the topography from south to northeast.

Excluding the designated Agate Creek monitoring bores, no groundwater bores were identified within a 5 km buffer from the mining lease boundary. Purpose-built production bores extract approximate 450 ML of groundwater per annum for dust suppression and, to a lesser extent, camp facilities. Further, the closest groundwater-dependent ecosystem is associated with the sandstone aquifer approximately 10 km away. Two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active.

The groundwater across the bore network represents good quality water, with most bores reporting properties below guideline values for drinking water and livestock drinking water, except for fluoride.

The groundwater assessment for the Agate Creek mine expansion found that the risk to groundwater systems was low, with poor hydraulic conductivities restricting the zone of influence to within the mining lease boundary for several decades.

1. INTRODUCTION

C&R Consulting Pty Ltd (C&R) have been engaged to complete the hydrogeological study of the Agate Creek Gold Mine (Agate Creek) stage 2 expansion. This study will form part of a site-specific environmental authority (EA) application and progressive rehabilitation and closure plan (PRCP) that Ardent Group Pty Ltd are currently preparing on behalf of Agate Creek's current owners, Savannah Goldfields Limited (Savannah). Savannah intends to progress Agate Creek into the stage 2 expansion phase, seeking approval to mine in up to 250,000 tonnes of ore under a site-specific EA.

Agate Creek is located in north Queensland, approximately 340 km (520 km by road) west of Townsville and 78 km (107 km by road) south of the township of Georgetown (Figure 1). Alluvial gold was reported at Agate Creek in the early 20th century and was followed by various prospecting activities – including panning, shallow digs and regional exploration.

In February 2015, Laneway Resources Ltd lodged a mining lease application for the Agate Creek prospect following a successful 5,000 tonne bulk trial pit. Mining lease (ML) 100030 was granted to Laneway Resources Ltd on 7 February 2019. More recently, Savannah (formerly known as Laneway Resources) intends to mine up to 250,000 tonnes of ore at Agate Creek under the new site-specific EA.

Agate Creek is required to assess the level of impact to surrounding groundwater systems due to mining activities. C&R performed the Agate Creek hydrogeological impact assessment in conjunction with the underground water impact report (UWIR). The UWIR is a requirement of the groundwater management framework legislated under Chapter 3 of the Queensland *Water Act 2000* (Water Act).

1.1 UWIR SCOPE AND STRUCTURE

The UWIR is a requirement of the groundwater management framework legislated under Chapter 3 of the Water Act. The main purpose of the UWIR is to describe the groundwater take due to mining (and any associated impacts) over a three-year period (the UWIR period). The UWIR has been prepared in accordance with Section 376 of the Water Act and the Department of Environment, Science, Tourism and Innovation (DESTI) guideline (the UWIR guideline), where relevant. The specific scope of the UWIR includes:

- A review of relevant groundwater, project development, geological and environmental reports from the mine site to develop an appreciation of the hydrogeological setting of the project;
- An updated review of hydrogeological data held on the Department of Local Government, Water and Volunteers groundwater database to identify water supply bores;
- An updated census of water supply bores to confirm the extent of groundwater use in the area and collect relevant groundwater monitoring data;
- Confirmation of the conceptual model of the groundwater regime of the mine site and its surrounds, based on all available data;
- Refinement of the existing groundwater conceptual, empirical and numerical models to allow the mining effects on groundwater levels to be presented for the first three years of mining;
- Confirmation of the groundwater impacts over the first three years of mining;
- Confirmation of the existing, approved EA groundwater monitoring programme and management measures.

The UWIR includes:



- An introduction to the UWIR (Section 1);
- Relevant regulatory UWIR requirements (Section 2);
- Site description (Section 3);
- Assessment methods (Section 4);
- Groundwater regime and sensitive environmental features (Section 5);
- Groundwater impact assessment (Section 6);
- Groundwater monitoring programme (Section 7);
- Directions for reviewing and updating the UWIR (Section 7.3); and
- Conclusions (Section 8).

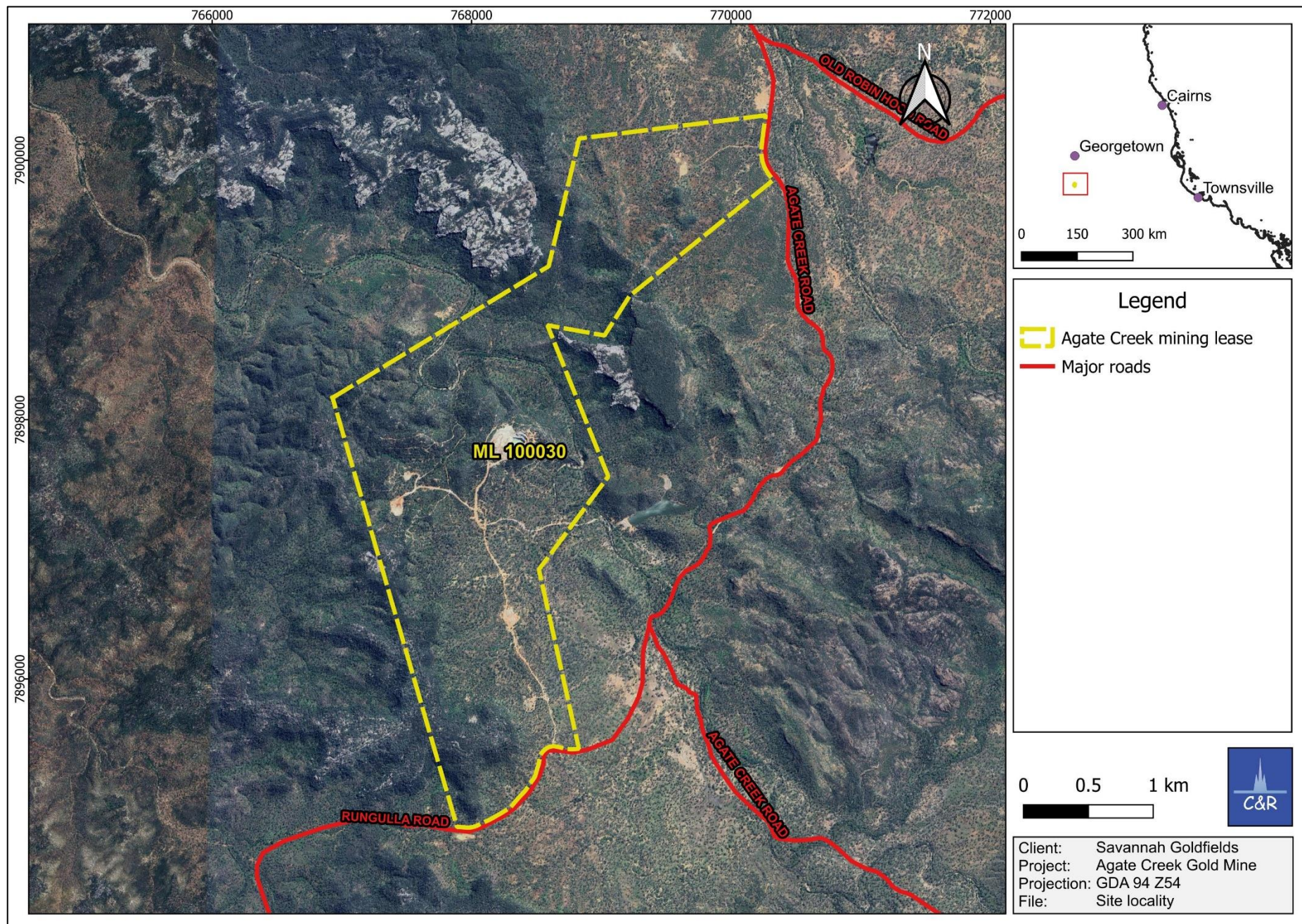


Figure 1: Agate Creek locality.

2. LEGISLATIVE REQUIREMENTS

The activities proposed under the project are regulated by the Water Act and the EP Act. The specific requirements under these regulations are the submission of an UWIR, which is required under The Water Act and a site-specific EA application (required under the Queensland *Environmental Protection Act 1994* [EP Act]).

This report addresses the UWIR content requirements for both acts (see Table 1).

2.1.1 ENVIRONMENTAL PROTECTION ACT 1994 (QLD)

The EP Act provides a regulatory framework for the protection and management of the Queensland environment. Under the EP Act, environmentally relevant activities (ERAs) – such as mining – are licensed under EAs, which prescribe specific conditions for conducting ERAs. The objective of the EP Act is to protect Queensland's environment while allowing for sustainable development.

For the purposes of the EP Act, underground water rights refer to the statutory right afforded under the *Mineral Resources Act 1989* of a mining lease holder to “*take or interfere with underground water in the area of the tenure if the taking or interference with that water is necessarily and unavoidably obtained in the process of extracting the resource*” (Department of Environment Heritage Protection [DEHP], 2016).

A guideline from the DESTI (formerly DEHP) outlines the groundwater information required for a site-specific EA application that involves the exercise of underground water rights under sections 126A and 227AA of the EP Act (DEHP, 2016). Section 126A of the EP Act requires specific information from applicants for a site-specific EA application (a new EA).

2.1.2 WATER ACT 2000 (QLD)

The Water Act was established primarily to provide a legal framework for the sustainable management of water and the management of impacts on underground water. Section 376 of the Water Act outlines the content of a UWIR. The requirements under section 376 of the Water Act are similar, but not identical, to that from Section 126A of the EP Act (see Section 2.1.1).

Table 1: UWIR content requirements.

Water Act section no.	Water Act section content	UWIR cross-reference
376(1)(a)	An underground water impact report must include each of the following—	

Water Act section no.	Water Act section content	UWIR cross-reference
	for the area to which the report relates— (i) the quantity of water produced or taken from the area because of the exercise of any previous relevant underground water rights; and (ii) an estimate of the quantity of water to be produced or taken because of the exercise of the relevant underground water rights for a 3-year period starting on the consultation day for the report.	(i) No groundwater has been produced or taken from the mine site due to the exercise of underground water rights to date. (ii) Section 6.1 describes the estimated groundwater take over the UWIR period.
376(1)(b)	For each aquifer affected, or likely to be affected, by the exercise of the relevant underground water rights— (i) a description of the aquifer; and (ii) an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers; and (iii) an analysis of the trends in water level change for the aquifer because of the exercise of the rights mentioned in paragraph (a)(i); and (iv) a map showing the area of the aquifer where the water level is predicted to decline, because of the taking of the quantities of water mentioned in paragraph (a), by more than the bore trigger threshold within 3 years after the consultation day for the report; and (v) a map showing the area of the aquifer where the water level is predicted to decline, because of the exercise of relevant underground water rights, by more than the bore trigger threshold at any time.	(i) and (ii) Section 5.1 describes the groundwater regime in the relevant aquifers. (iii) There has been no previous exercise of underground water rights. (iv) Figure 25 shows the areas where depressurisation due to mining is predicted to exceed the bore trigger threshold during the UWIR period. (v) Figure 25 shows the areas where depressurisation due to mining is predicted to exceed the bore trigger threshold during the life of the mine.
376(1)(c)	A description of the methods and techniques used to obtain the information and predictions under paragraph (b).	Section 4 describes the UWIR methodology.

Water Act section no.	Water Act section content	UWIR cross-reference
376(1)(d)	A summary of information about all water bores in the area shown on a map mentioned in paragraph (b)(iv), including the number of bores, and the location and authorised use or purpose of each bore.	Sections 5.5, 6.1 and 6.2.2 describe the water bore census undertaken for the UWIR and confirms that there are no water bores within the area of predicted depressurisation.
376(1)(da)	A description of the impacts on environmental values that have occurred, or are likely to occur, because of any previous exercise of underground water rights.	There have been no previous exercise of underground water rights and, hence, no previous groundwater impacts due to groundwater take.
376(1)(db)	An assessment of the likely impacts on environmental values that will occur, or are likely to occur, because of the exercise of underground water rights— (i) during the period mentioned in paragraph (a)(ii); and (ii) (ii) over the projected life of the resource tenure.	Section 6 presents an assessment of potential groundwater impacts due to groundwater take.
	A program for— (i) conducting an annual review of the accuracy of each map prepared under paragraph (b)(iv) and (v); and (ii) giving the chief executive a summary of the outcome of each review, including a statement of whether there has been a material change in the information or predictions used to prepare the maps.	Section 7 describes the UWIR review and reporting process for the affected aquifers.
376(1)(f)	A water monitoring strategy.	Section 7 describes the groundwater monitoring programme.
376(1)(g)	A spring impact management strategy.	There are no springs within the mine site or its surrounds. Hence, a strategy for spring management is not justified.
376(1)(h)	If the responsible entity is the office— (i) a proposed responsible tenure holder for each report obligation mentioned in the report; and	Not applicable.

Water Act section no.	Water Act section content	UWIR cross-reference
	(ii) for each immediately affected area—the proposed responsible tenure holder or holders who must comply with any make good obligations for water bores within the immediately affected area.	
376(1)(i)	The information or matters prescribed under a regulation.	No other relevant information or matters have been prescribed under a regulation.
376(2)	However, if the underground water impact report does not show any predicted water level decline in any area of an affected aquifer by more than the bore trigger threshold during the period mentioned in subsection (1)(b)(iv) or at any time as mentioned in subsection (1)(b)(v), the report does not have to include the program mentioned in subsection (1)(e).	Section 7 describes the UWIR review and reporting process for the affected aquifers.

Section 378 of the Water Act lists the content requirements for the water monitoring strategy. Table 2 lists the specific content requirements and provides an explanation of where each requirement is addressed in this UWIR.

Table 2: UWIR water monitoring strategy content requirements.

Water Act section no.	Water Act section content	UWIR cross reference
378(1)	A responsible entity's water monitoring strategy must include the following for each immediately affected area and long-term affected area identified in its underground water impact report or final report— (a) a strategy for monitoring— (i) the quantity of water produced or taken from the area because of the exercise of relevant underground water rights; and (ii) changes in the water level of, and the quality of water in, aquifers in the area because of the exercise of the rights; (b) the rationale for the strategy; (c) a timetable for implementing the strategy; (d) a program for reporting to the office about the implementation of the strategy.	Section 7 describes the groundwater monitoring programme.
378(2)	The strategy for monitoring mentioned in subsection (1)(a) must include— (a) the parameters to be measured; and (b) the locations for taking the measurements; and (c) the frequency of the measurements.	Section 7 describes the groundwater monitoring programme.
378(3)	If the strategy is prepared for an underground water impact report, the strategy must also include a program for the responsible tenure holder or holders under the report to undertake a baseline assessment for each water bore that is— (a) outside the area of a resource tenure; but (b) within the area shown on the map prepared under section 376(b)(v).	Not applicable. Sections 5.5, 6.1 and 6.2.2 describe the water bore census undertaken for the UWIR and confirm that there are no water bores within the area of predicted depressurisation.
378(4)	If the strategy is prepared for a final report, the strategy must also include a statement about any matters under a previous strategy that have not yet been complied with.	Not applicable.

2.1.3 WATER PLANS

The project area falls within two water planning areas: the Gulf Water Plan (2007) and the Great Artesian Basin and other regional aquifers water plan (2017). The Gulf Water Plan is only relevant to the project for any proposed surface water take. The Great Artesian Basin and other regional aquifers water plan (2017) and the associated management protocol are relevant to the project.

Table 3: Water plans and other documentation relevant to the project.

Water Plan	Subordinate documents	Groundwater management area	Groundwater management unit	Groundwater sub-area
Gulf Water Plan (2007)	N/A	N/A	N/A	N/A
Great Artesian Basin and other regional aquifers (2017)	Great Artesian Basin and other regional aquifers management protocol (2017)	Great Artesian Basin Groundwater Management Area	Springbok Walloon	Adori Injune Creek

3. SITE DESCRIPTION

Agate Creek is an open-cut gold mining operation located within the Etheridge Shire in north Queensland, approximately 107 km south of the township of Georgetown (Figure 1). Trial mining commenced at Agate Creek in 2013, with a transition to full-scale production in 2019. All mining activities undertaken at Agate Creek are permitted under the current EA EPSL03068015 (dated 6 September 2021).

The stage 2 expansion of the Agate Creek mine involves mining five different open-cut pits (including one which has been mined and backfilled). The mine is presently working Pit 6 under the current EA that allows up to 250,000 tonnes of material to be extracted. However, further approval is required to expand the mining operations – as well mining three additional satellite pits. This proposed Agate Creek stage 2 expansion comprises 3,662,00 tonnes of waste rock and low-grade waste material.

3.1 CLIMATE

Agate Creek is located within the seasonally arid tropics, with the area dominated by intense rainfall events throughout the summer months. These rainfall events are often highly variable in their spatial and temporal distribution, with the majority of the rain falling in distinct, spatially separated cells across the landscape. Rainfall throughout the remainder of the year is generally limited to an occasional shower in June or July and evaporation tends to exceed rainfall for almost all days of the year, with the exception of periods with intense rainfall events.

Climate statistics for Agate Creek have been compiled from the SILO (Scientific Information for Land Owners) database (grid point 19.0°S, 143.55°E; Jeffrey et al., 2001). Figure 2 displays annual rainfall, along with the 10-year rolling average and the long-term median (667.4 mm). A rising trend (in the 10-year rolling average) indicates a change towards wetter conditions, whilst a falling slope indicates a trend towards reduced rainfall. The rainfall pattern for Agate Creek shows an oscillating trend over time, with a steady decline currently observed for the 10-year rolling average.

Based on SILO data, the median annual rainfall experienced in the region is 667.4 mm, with approximately 93.4% of the rain falling between November and April each year (Figure 3). Conversely, the long-term median annual pan evaporation is 2,300.6 mm. Typical of climatic conditions within northwestern Queensland, evaporation significantly exceeds rainfall throughout most of the year. Furthermore, such conditions govern the flow regimes of the receiving environments surrounding Agate Creek, where creeks and rivers express intermittent flow conditions.

Historical temperatures based on SILO data at Agate Creek show marginal variation throughout the year, generally increasing in September and October each year with the 'build-up' to the monsoonal wet season, easing after the seasonal rainfall begins (Figure 4).

The closest data from the Bureau of Meteorology (BoM) is the Georgetown airport weather station (30124; BoM, 2025), which is approximately 107 km northwest of the Agate Creek mining lease.

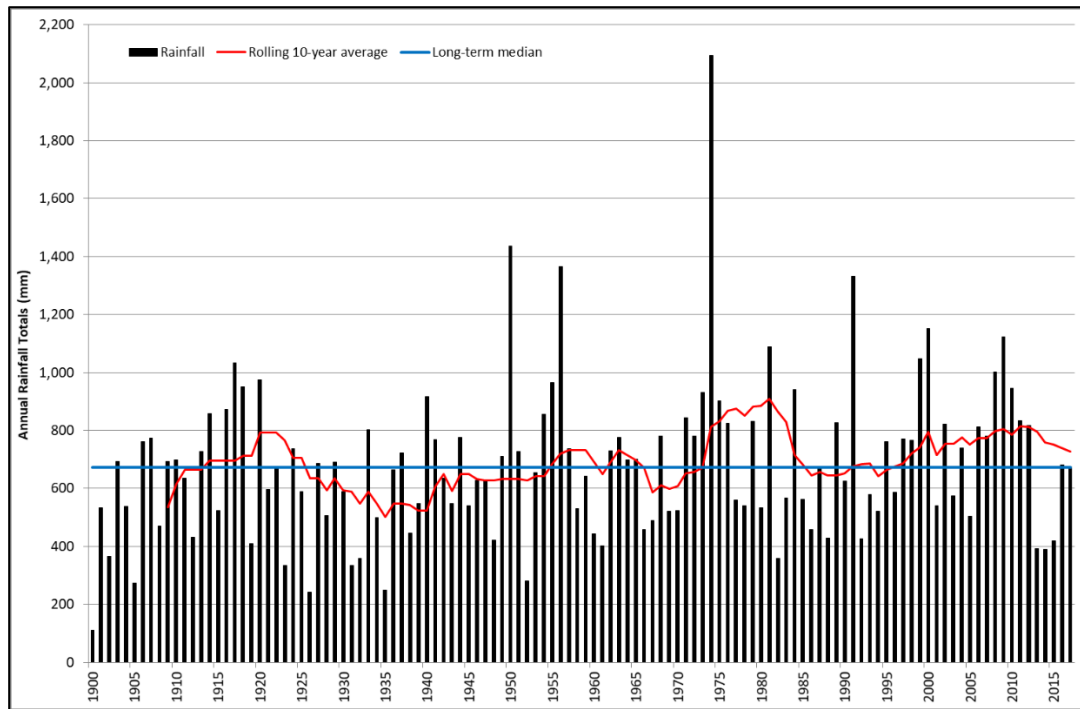


Figure 2: Historical rainfall for Agate Creek derived from SILO.

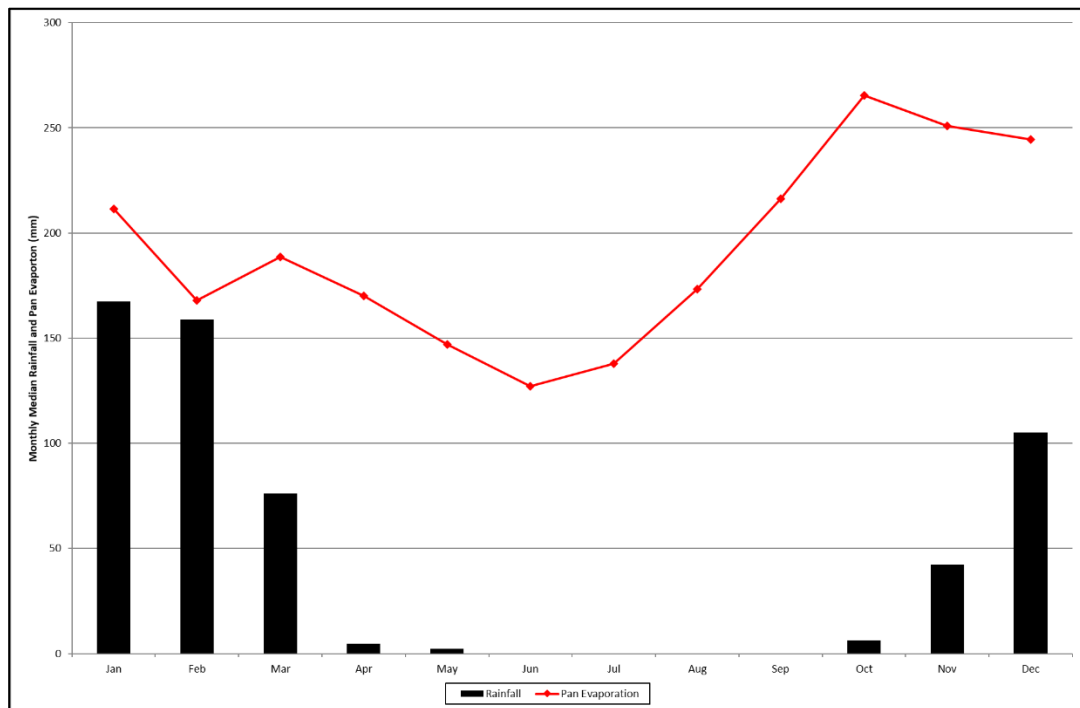


Figure 3: Agate Creek long-term median monthly rainfall and pan evaporation totals (SILO).

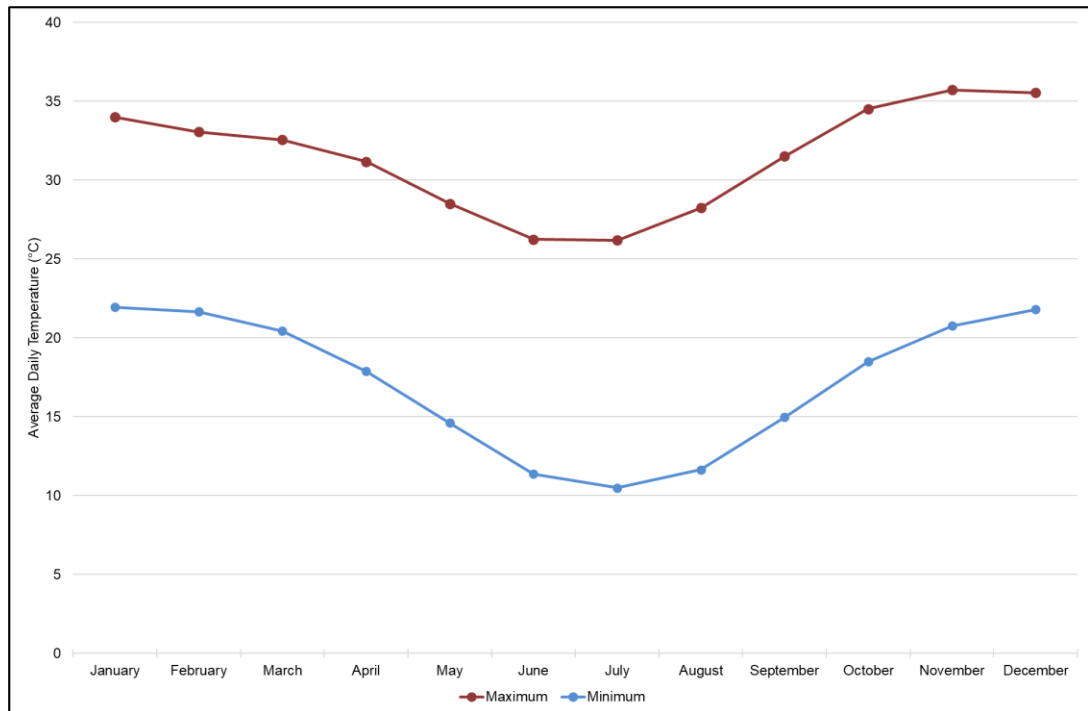


Figure 4: Mean monthly temperature variation typically experienced throughout the year (SILO).

3.2 LOCAL SOILS

The *Atlas of Australian Soils* (<https://www.asris.csiro.au/themes/Atlas.html>) – compiled by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) – provides a baseline description for regional soils found in and around the Agate Creek mining lease. The primary soil type found around the mine is a tenosol, specifically LL8 (Figure 5), characterised by low-hilly to hilly lands with abundant schistose rock outcrop. Occasional areas of shallow, stony sands also occur. In addition, loamy, red duplex soils with quartz-rich, gravelly A horizons are common on some slopes. Conversely, red friable earths are found on small basic intrusions.

Two other major soil units border the eastern boundary of the mining lease. Ta11 lies within the soil class chromosol. Within the chromosol class, soils typically display strong contextual contrast between the A and B horizons, whereby the B horizon is found to be neither acidic or sodic. Ta11 are typically found in undulating to moderately undulating lands – with long slopes and occasional steep rises with granite outcrop. They are generally associated with moderately deep, sandy duplex soils and often with gravel in the surface. These areas are also linked to red duplex soils and moderately deep, coarse sands. Shallow, coarse sands occur on steeper rises and near granite outcrop.

Fu20 represents the tenosol class. This soil type has typically a skeletal soil profile, with weak pedological organisation. Tenosols are found in low-hilly to hilly ranges, mostly with rounded crests. Massive rock outcrops are very common. Characteristically, all soils are very shallow and usually stony. Bleached loams are dominant but other shallow loams also occur with – less commonly – shallow bleached sands.

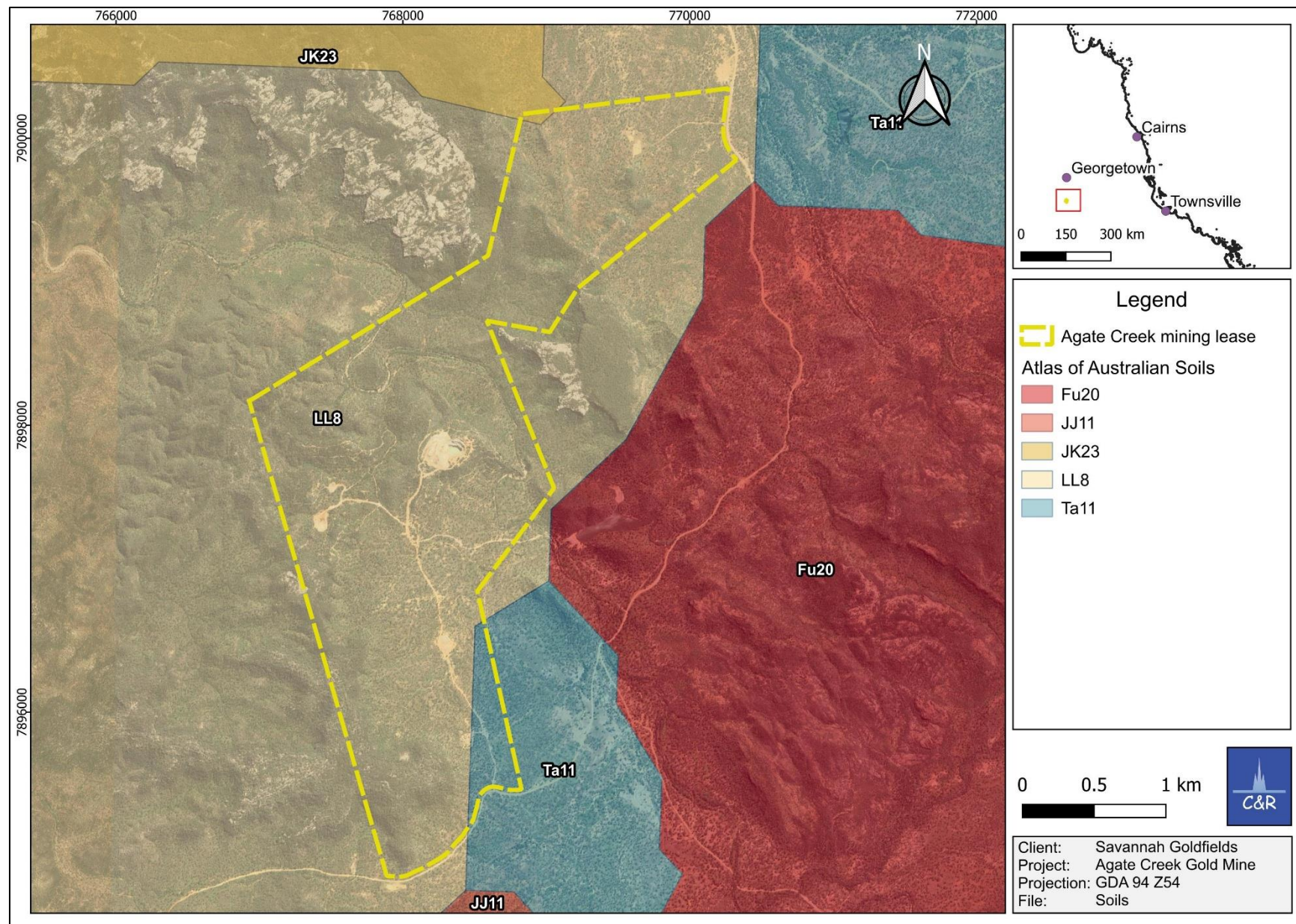


Figure 5: Local soils profile based on the CSIRO *Atlas of Australian Soils*.

3.3 GEOLOGY

The Agate Creek deposit is located in the central portion of the Proterozoic Etheridge Province. The primary identified deposit is known as Sherwood.

The Agate Creek mining lease includes a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. The basement rocks are Proterozoic metasediment, composed of mudstone, sandstone, phyllite, quartzite and metabasalt (Morrison et al., 2019). The metamorphic rocks have been intruded by Siluro-Devonian-age Robin Hood Granodiorite and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex. The volcanic complex is largely fault-bound and consists of andesitic lavas, rhyolitic tuff and ignimbrite. Jurassic Hampstead Sandstone consisting of basal conglomerate and quartzose sandstone forms plateau-like outliers capping the older rocks (Morrison et al., 2019).

These Proterozoic Etheridge metamorphic rocks were extensively intruded by Silurian to Early Devonian granitoid batholiths, and dominantly felsic Carboniferous to Early Permian magmatic complexes (Morrison et al., 2019). The mineralisation at Agate Creek is related to the emplacement of Permo-Carboniferous porphyritic rhyolite and andesite extrusives and intrusives, commonly referred to as the Agate Creek Volcanic Group.

The mineralisation at the main Sherwood deposit is best developed in breccias and vein networks hosted in shallow-dipping rhyolite dykes that occupy shallow, southeast-dipping thrust faults in the granodiorite. Thrust faults also separate the granodiorite from the metamorphic rocks throughout the prospect area and there are series of north- and northwest-trending, steep, normal faults that bound and disrupt the mineralised zones

The Sherwood gold mineralisation at Agate Creek is hosted by a low sulphidation epithermal system consisting of quartz-chalcedony veining, stockwork and breccia. Host rock lithology is predominantly porphyritic rhyolite or andesite that occupy shallow, southeast-dipping thrust faults in Silurian granodiorite (Morrison et al., 2019). This host rock is principally volcanic in origin.

A series of complex hydrothermal alteration assemblages surround the Agate Creek ore body. These assemblages range from a distal ubiquitous propylitic zone (chlorite +/- carbonate-epidote-pyrite-haematite) grading inwards to a more proximal variably argillic to sericitic zone (clay +/- quartz-sericite-pyrite) and locally phyllic zone (silica +/- pyrite or iron oxide) (Morrison et al., 2019). The hydrothermal alteration in the Agate Creek expansion area is predominantly clay +/- silica, sericite and/or pyrite (now weathered to iron oxide).

Table 4: Agate Creek site geology.

Group / Sub-group	Formation	Age	Description	Lithology Summary	Map Symbol
Qa-QLD		Quaternary	Alluvium	Clay, silt, sand and gravel, flood plain alluvium	Qa
Eulo Queen Group	Hamstead Sandstone	Middle to Late Jurassic	Sandstone	Clayey, commonly pebbly, quartzose sandstone and conglomerate	Jh
Agate Creek Volcanic Group	Black soil andesite	Early Permian	Stratified unit – mafite (lavas, clastics and high-level intrusives)	Greyish-green, locally sparsely porphyritic augite-hypersthene-basaltic andesite with agate-filled amygdaloids; probably includes intrusive equivalents	Pvab
	Kennedy Province intrusive	Late Carboniferous – Early Permian	Intrusive – felsite (lavas, clastics and high level intrusives)	Mainly buff, pale grey to dark grey or brown, aphyric to highly porphyritic, intrusive rhyolite; commonly flow-banded; locally grades into microgranite	CPir
White Springs Supersuite	Robin Hood Granodiorite	Silurian	Intrusive - granitoid	Pink to grey hornblende-biotite granodiorite with quartz phenocrysts	Sgr
	Pama Province	Silurian	Intrusive - granitoid	Mainly I-type, biotite granite to hornblende-biotite granodiorite and tonalite; some biotite-hornblende and pyroxene-bearing tonalite to diorite and gabbro	Sg
Etheridge Group Robertson River sub-group	Dead Horse meta-basalt	Paleoproterozoic	Stratified unit – mafite (lavas, clastics and high-level intrusives)	Meta-basalt, locally pilled, hyaloclastic and/or amygdaloidal; minor metadolerite and metagabbro (unmapped) and interbedded siltstone	PLd
	Daniel Creek Formation	Paleoproterozoic	Stratified unit (including volcanic and metamorphic) – arenite-mudrock	Mudstone, siltstone, and fine subfeldspathic sandstone, locally calcareous and/or dolomitic. Grades into mica schist, quartzite and minor calc-silicate rocks	PLa
	Corbett Formation	Paleoproterozoic	Pelite – stratified volcanic and metamorphic	Greenish-grey mudstone (+/- chloritoid); grades into mica schist, with metamorphic sequence of staurolite, andalusite, sillimanite, garnet	PLco

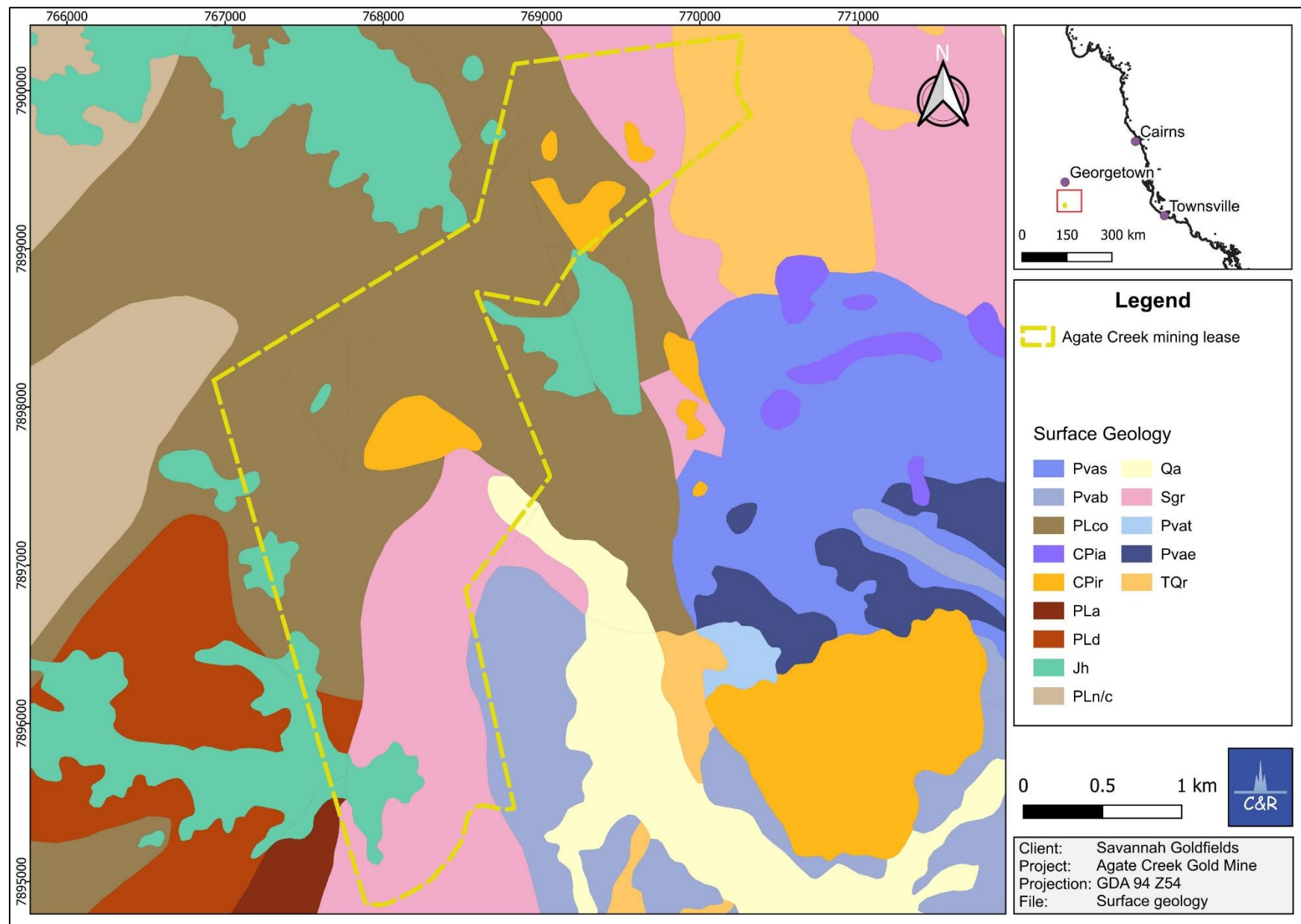


Figure 6: Detailed surface geology.

3.4 RECEIVING ENVIRONMENTS

The mining lease covers an area of approximately 688.86 ha and cuts directly through Agate Creek – a tributary of the Robertson River which flows into the Gilbert River before entering the Gulf of Carpentaria. The mining lease also encompasses several smaller drainage lines branching into Agate Creek (Figure 7) – and north into Cave Creek. Cave Creek joins Agate Creek upstream of the confluence with the Robertson River.

The watercourses throughout the project site are intermittent streams, only flowing for short periods after substantial rainfall events. Although small, semi-permanent pools are known to exist upstream of the project site, there are no naturally occurring, large, permanent waterbodies known within the Agate Creek catchment area upstream of the project site.

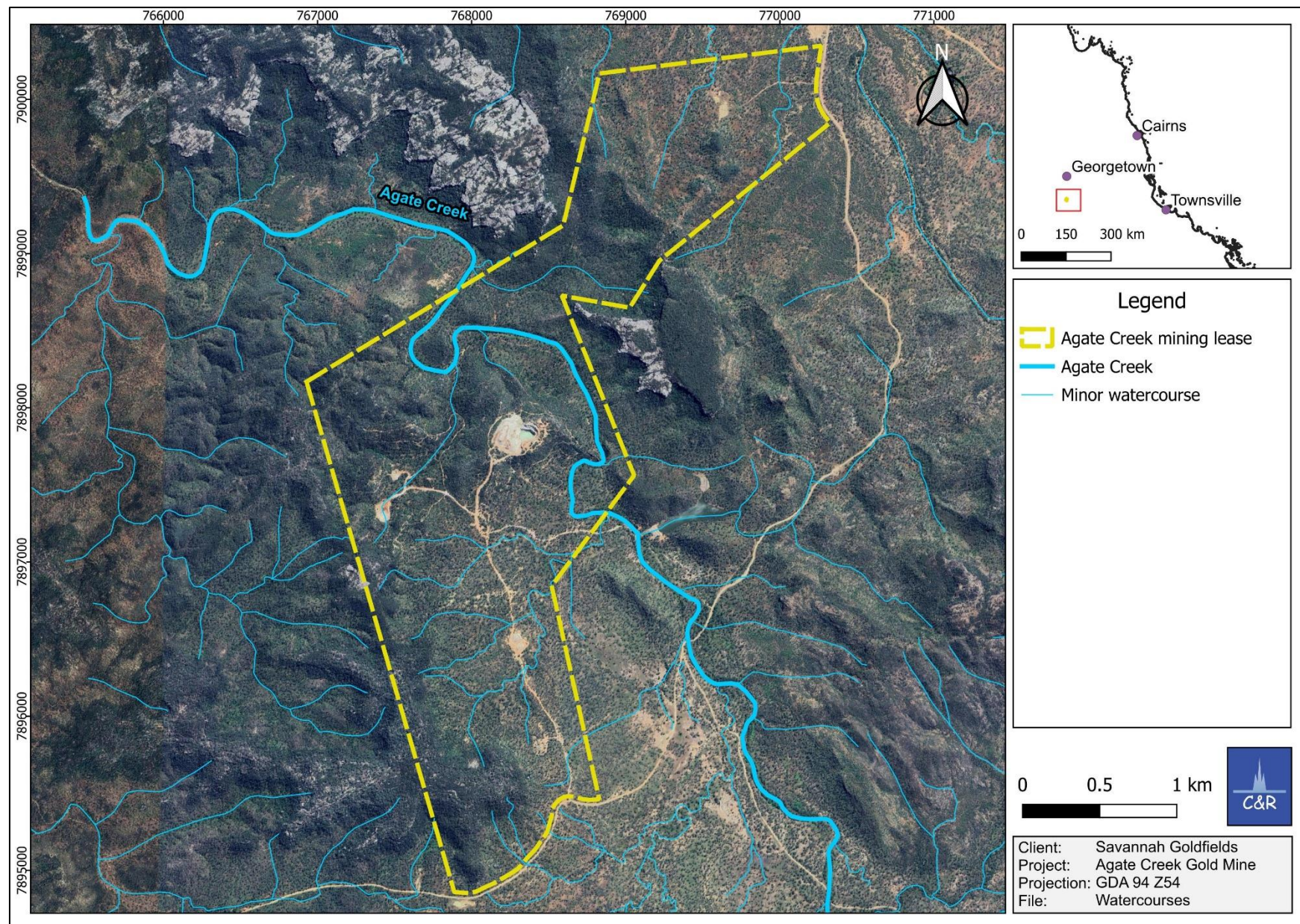


Figure 7: Primary receiving environment of Agate Creek and minor tributaries.

4. ASSESSMENT METHODS

This section describes the methods which have been adopted for the collection of hydrogeological data to inform the Agate Creek UWIR.

4.1 DATABASE SEARCHES FOR GROUNDWATER BORES

A search of relevant Queensland databases was undertaken to identify the presence of current water bores within and surrounding the mine. A water bore is a groundwater supply bore.

The following databases and mapping were searched:

- The Department of Local Government, Water and Volunteers groundwater database of registered water bore data from private water bores and Queensland Government groundwater investigation and monitoring bores: Accessed data include bore location, groundwater levels, construction details, stratigraphic logs, hydrogeological testing and groundwater quality.
- The Queensland Spatial Catalogue (QSpatial), via Queensland Globe: Records of petroleum and coal seam gas (CSG) exploration, production and monitoring wells are contained within this database.

Excluding the 24 groundwater bores installed by Laneway Resource Ltd in 2020 and 2021, these searches did not identify any registered bores within 5 km of the project mining area.

4.2 DATABASE SEARCHES FOR SENSITIVE ENVIRONMENTAL FEATURES

The potential for groundwater-dependent ecosystems (GDEs) to be present within the project site was reviewed, with the review consisting of:

- Queensland Springs Database (via Queensland Globe);
- BoM's GDE Atlas; and
- Field investigations.

The Queensland Springs database and BoM GDE Atlas indicated that no springs are located within the project site. However, two springs (SPR1411 and SR1412) were identified within the 10 km buffer from the mining lease centroid. The two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active (based on the BoM GDE Atlas and Queensland Springs Database). No field studies have been completed on either spring within the 10 km buffer from the Agate Creek mining lease.

4.3 PREVIOUS GROUNDWATER STUDIES

The hydrogeology of Agate Creek was initially assessed by Rob Lait and Associates Pty Ltd (Lait) in 2020 to provide advice and complete a preliminary assessment of the hydrogeological regime (Lait, 2020). This assessment included the provision of ten groundwater monitoring bore locations and construction, hydraulic conductivity testing and the preliminary assessment of the groundwater regime at Agate Creek.

4.4 GROUNDWATER MONITORING DATA

All relevant data were collated and analysed to develop a conceptual understanding of the groundwater regime. Groundwater data collected from the mine monitoring bores have been used to inform this groundwater conceptualisation.

4.5 GROUNDWATER MONITORING NETWORK

In June 2020, ten groundwater monitoring bores were drilled and constructed to improve the understanding of the hydrogeological regime at the Agate Creek mine. The locations and construction designs were provided by Lait, whereas all geological descriptions for the individual bores were supplied by Wulguru Technical Services.

The ten monitoring bores were drilled and constructed in June 2020, with water level and water quality monitoring commencing on a monthly basis from October 2020 onwards. Spatially distributed groundwater level data were used to characterise groundwater flow directions, gradients and velocities. In addition, temporal variations in groundwater level were used to interpret the rate and distribution of recharge/discharge, influence from mining, and variability in groundwater level.

Groundwater quality data provide useful information on the hydrogeological regime because they are influenced by interaction with the aquifer matrix, and groundwater recharge/discharge processes.

Twelve additional monitoring bores were installed across the mining lease in December 2021, in preparation for the expansion of mining activities. A further two production bores have also been constructed to provide water for operational activities and camp facilities.

Table 5: Groundwater monitoring bore network constructed in 2020 and 2021 (MGA: Map Grid of Australia).

Bore ID	RN ¹	Installation date	Easting	Northing	Ground level	Casing above ground	Total depth	Screened interval	Geology unit
			MGA zone 54		mAHD	m	m BGL		
CCWB517	193026	7/06/2020	768399.5	7896463	435.6	0.6	55	49 – 55	Robin Hood Granodiorite
CCWB518	193029	9/06/2020	767768.1	7897706	431.4	0.6	73	67 – 73	Andesite/Rhyolite
CCWB519	193030	9/06/2020	767302	7897863	517.18	0.62	85	79 – 85	Corbett Formation Metasediments
CCWB520	193031	10/06/2020	767947.2	7897838	434.96	0.59	73	67 – 73	Andesite
CCWB521	193027	12/06/2020	768700.6	7898079	420.94	0.6	73	67 – 73	Corbett Formation Metasediments
CCWB522	193032	13/06/2020	768761.9	7897724	434.2	0.6	73	67 – 73	Corbett Formation Metadolerite
CCWB523	193033	14/06/2020	768321.3	7897579	449.6	0.61	73	67 – 73	Robin Hood Granodiorite
CCWB524	193034	15/06/2020	768173.6	7897670	496.06	0.64	91	85 – 91	Robin Hood Granodiorite
CCWB525	193035	16/06/2020	768166.9	7897930	498.77	0.62	103	97 – 103	Corbett Formation Metasediments
CCWB526	193028	17/06/2020	767709.7	7896909	449.4	0.66	73	67 – 73	Corbett Formation Metasediments
CCWB527	TBA	9/12/2021	767660.085	7897457.883	461.50	TBA	31	26 – 31	Corbett Formation Metasediments

Bore ID	RN ¹	Installation date	Easting	Northing	Ground level	Casing above ground	Total depth	Screened interval	Geology unit
			MGA zone 54		mAHD	m	m BGL		
CCWB528	TBA	7/12/2021	767954.527	7898380.887	415.49	TBA	73	67 – 73	Corbett Formation Metasediments / Andesite
CCWB529	TBA	10/12/2021	770217.372	7900143.538	463.84	TBA	31	26 – 31	Robin Hood Granodiorite
CCWB530	TBA	8/12/2021	767947.952	7898377.991	422.80	TBA	7	4 – 7	Corbett Formation Metasediments
CCWB531	TBA	3/12/2021	767997.2	7898781.655	420.39	TBA	55	47 – 55	Corbett Formation Metasediments
CCWB532	TBA	8/12/2021	770220.767	7900137.95	469.61	TBA	7	4 – 7	Robin Hood Granodiorite
CCWB533	TBA	10/12/2021	769580.177	7900063.319	473.09	TBA	25	19 – 25	Robin Hood Granodiorite
CCWB534	TBA	11/12/2021	768654.578	7895515.511	454.09	TBA	25	19 – 25	Rhyolite
CCWB535	TBA	8/12/2021	768680.782	7897247.945	407.91	TBA	7	4 – 7	Alluvium / Robin Hood Granodiorite
CCWB536	TBA	11/12/2021	768622.03	7897214.13	440.67	TBA	19	13 – 19	Robin Hood Granodiorite
CCWB537	TBA	6/12/2021	768004.958	7898800.864	420.66	TBA	19	13 – 19	Corbett Formation Metasediments
CCWB538	TBA	8/12/2021	768650.756	7895513.462	468.83	TBA	7	4 – 7	Rhyolite

¹Registered Number

TBA – to be advised.

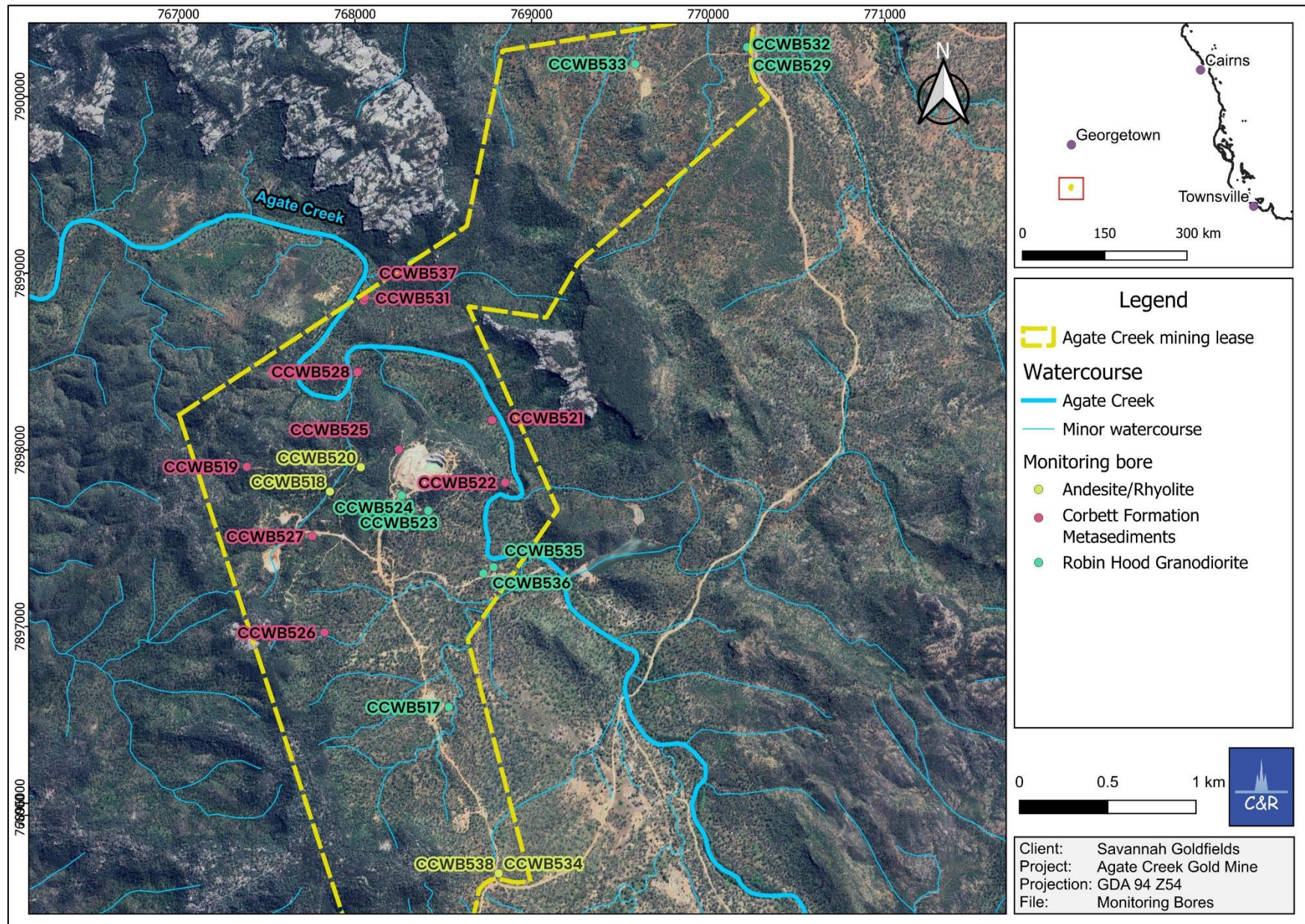


Figure 8: Agate Creek groundwater monitoring bore network.

5. GROUNDWATER REGIME

Mapping of aquifers – using the Australian Groundwater Explorer (<http://www.bom.gov.au/water/groundwater/explorer/map.shtml>) – identified the presence of three aquifers in the area, including an upper, middle and lower aquifer.

- The upper aquifer is associated with Quaternary alluvium that is present on the northeastern section of the ML, linked to Cave Creek, and just off the ML to the south on Agate Creek.
- The middle aquifer is associated with the Mesozoic sandstones. Mesozoic aquifers in this area form part of the Great Artesian Basin groundwater system. Although minor sandstone is represented in the lower part of the ML, mapping indicates that the middle aquifer is absent on the ML.
- The lower aquifer is associated with the weathered and fractured zones of the Palaeozoic and Palaeoproterozoic rocks.

Recent drilling and construction of monitoring bores in 2020 indicate very low hydraulic conductivity of the lower aquifer fractured rock formations. Construction logs for these bores indicate that screens were not set against intervals where groundwater was intersected – but rather at the bottom of the hole (Lait, 2020).

5.1 DISTRIBUTION

Project-scale mapping has identified structural complexity – associated with faulting and zones of brecciation along structures – across the site (Figure 9). The key faults on site include the Agate Creek Fault Zone, Zig Zag Fault and Sherwood West Fault. The primary source of groundwater within the Agate Creek mining lease is held within the fractured and weathered, igneous and metasedimentary rocks. Exploration drilling has reported that groundwater interception most commonly occurs within the zone of oxidation.

During the December 2021 drilling programme, several bores were installed within the alluvial aquifer, although no water was intersected at the time of drilling.

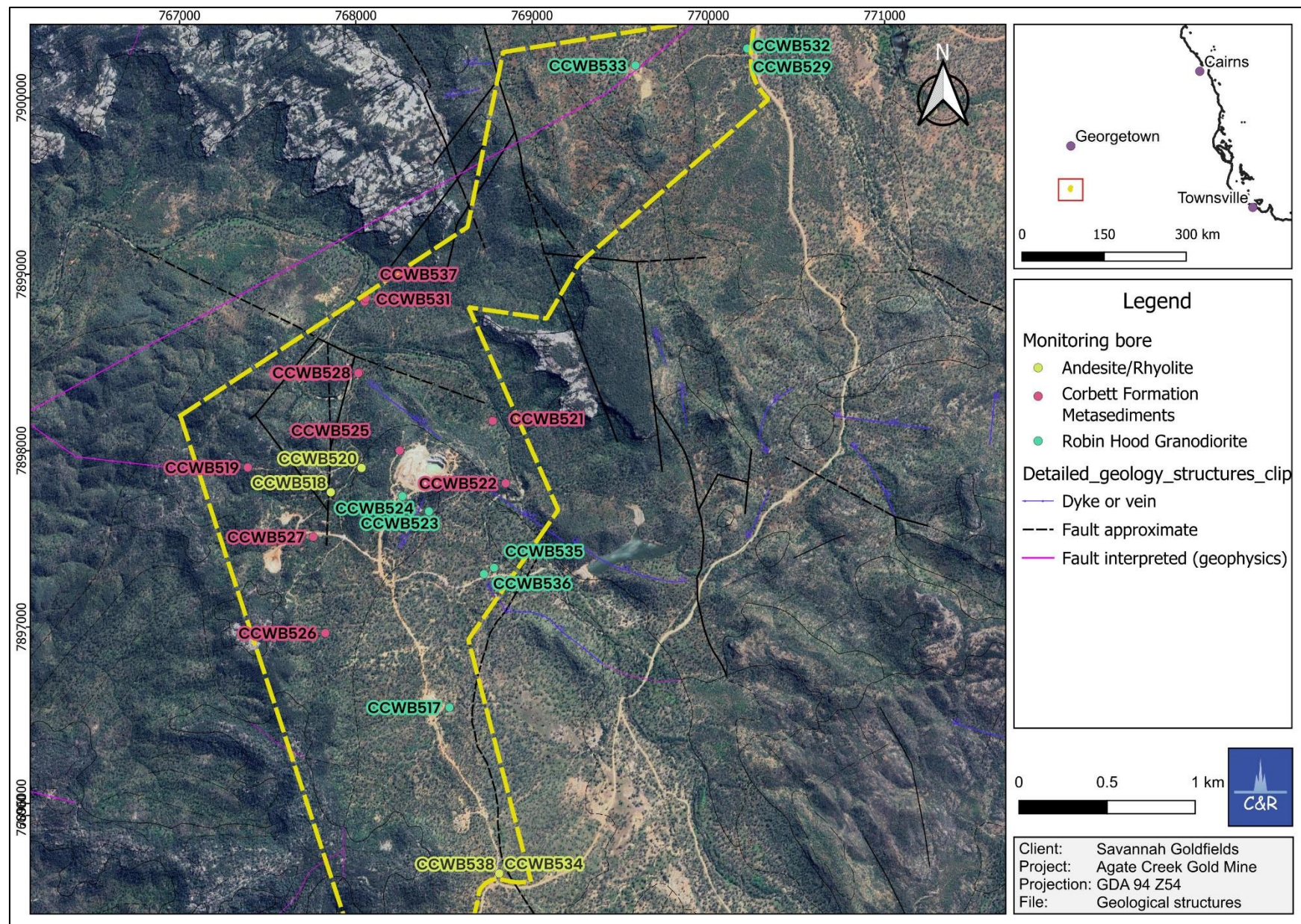


Figure 9: Complex geological structures influencing the Agate Creek deposit and hydrogeological systems.

5.2 HYDRAULIC PARAMETERS

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range.

The prime data for this investigation were taken from Lait (2020) – on slug tests on boreholes CCWB517 to CCWB526 in the Agate Creek ML. In addition, the methodology of Marinelli and Niccoli (2000) was used for the estimation of groundwater inflow to the pits on the mine site.

Based on Lait (2020), hydraulic conductivities range from:

- 6.57×10^{-8} m/sec for CCWB523 (Robin Hood Granodiorite) to
- 5.06×10^{-7} m/sec for CCWB518 (Andesite/Rhyolite).

Distances from individual bores to the Pit 6 range from:

- 50 m to 173 m for CCWB524;
- 150 m for CCWB525;
- 1068 m for CCWB526; and
- 1275 m for CCWB517.

From assessing the range in the hydraulic conductivities (5 orders of magnitude), both linear and logarithmic solutions for inflow rates were obtained for the methodology of Marinelli and Niccoli (2000).

Table 6: Inferred linear and logarithmic inflow rates based on hydraulic tests completed in 2020.

Bore CCWB	Lithology	Linear Inflow Rate m ³ /sec	Log Inflow Rate m ³ /sec
CCWB517	Robin Hood Granodiorite	4.464×10^{-5}	2.795×10^{-5}
CCWB523	Robin Hood Granodiorite	1.040×10^{-5}	1.271×10^{-5}
CCWB524	Robin Hood Granodiorite	3.570×10^{-5}	2.275×10^{-5}
CCWB519	Corbett Formation Metasediments	3.707×10^{-5}	2.348×10^{-5}
CCWB521	Corbett Formation Metasediments	1.756×10^{-5}	1.498×10^{-5}
CCWB525	Corbett Formation Metasediments	4.390×10^{-5}	2.735×10^{-5}
CCWB526	Corbett Formation Metasediments	1.954×10^{-5}	1.568×10^{-5}
CCWB522	Corbett Formation Metadolerite	1.306×10^{-5}	1.351×10^{-5}
CCWB518	Andesite/Rhyolite	4.825×10^{-5}	3.037×10^{-5}
CCWB520	Andesite	–	–

It should be noted that the bore hole design and construction suggest that the screened interval has been placed at the bottom of the hole instead of at water-making beds. Additionally, the aquifers at Agate Creek are believed to be primarily contained within fractured and weathered igneous and metasedimentary rocks – and groundwater was intercepted at depths ranging from 8 m to 68 m below ground level (BGL). Therefore, the indicated, very low conductivity values presented in Table 6 would only be representative of the solid rock formation.

No further hydraulic tests have been completed on the 2021 monitoring bore series or production bores – excluding extraction rates calculated at the time of bore development.

5.3 GROUNDWATER LEVELS, RECHARGE, FLOW AND DISCHARGE

Following the drilling and construction of the ten groundwater monitoring bores at Agate Creek in June 2020, groundwater levels were measured in July 2020 before monthly levels were captured in September and monthly thereafter. No site-specific rainfall data were available for the monitoring period. Therefore, rainfall data from BoM station 30124 (Georgetown airport) has been used to provide an insight into the potential totals recorded on site. However, it should be noted that the spatially heterogeneous nature of rainfall events in the tropics can result in large variations in rainfall totals from one area to the next.

5.3.1 ROBIN HOOD GRANODIORITE

This group of monitoring bores (CCWB517, CCWB523, CCWB524, CCWB529, CCWB536) displays groundwater levels ranging from approximately 425 mAHD to 452 mAHD (Figure 10). CCWB523 displays a continuous increasing trend over the reporting period, with groundwater levels varying from 434.83 mAHD to 441.53 mAHD.

Groundwater levels across most bores are relatively stable with gradual long-term trends. Notably:

- CCWB529 consistently records the highest levels (449.78–451.42 mAHD), with minimal fluctuation over the five-year monitoring period.
- CCWB536 shows a steady increase in groundwater level (0.5 m) from mid-2022 onwards, excluding the April 2025 results, suggesting a long-term rising trend.
- CCWB517 displays a stable level around 428–430 mAHD, with minor seasonal or inter-annual variation.
- CCWB523 and CCWB524 exhibit the greatest increase over the monitoring period between 5.49 m (CCWB524) and 6.7 m (CCWB523).

The stability of trends indicates a system that is less dynamically influenced by short-term climate variability, possibly due to lower permeability or greater aquifer thickness buffering the impacts of rainfall.

Interpolated isopotentials were derived from the September 2023 groundwater levels for the Robin Hood Granodiorite (Figure 13). Based on the current available data, the Robin Hood Granodiorite bores depict groundwater flow from north to south.

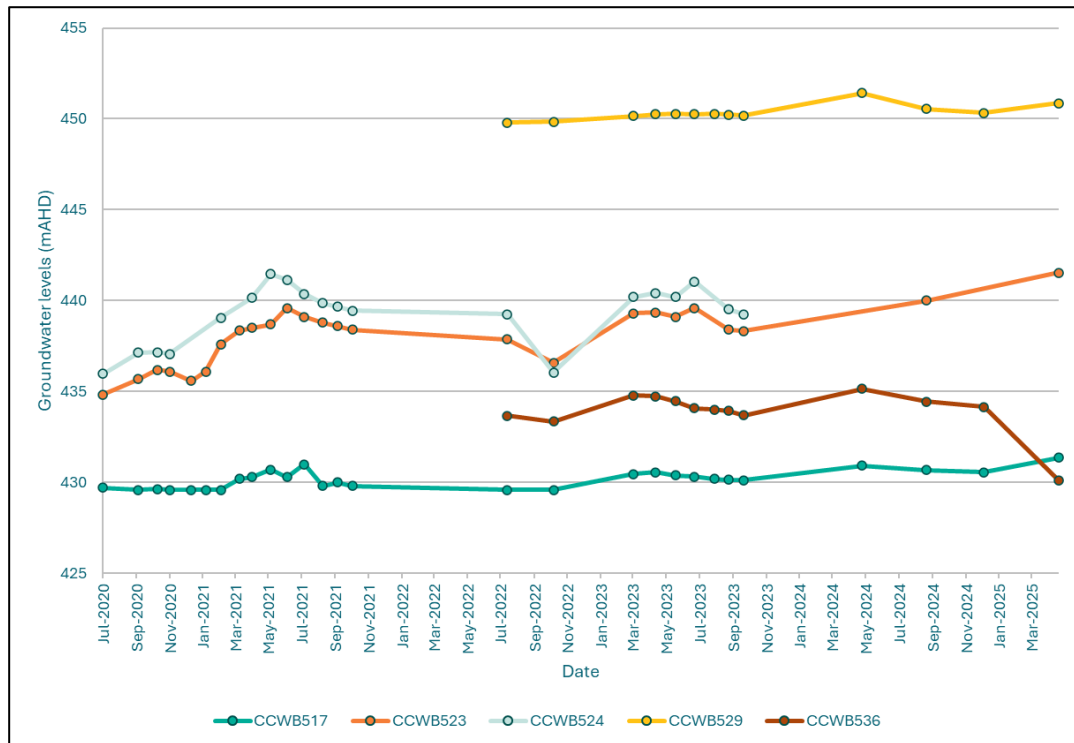


Figure 10: Groundwater levels in bores screened within the Robin Hood Granodiorite.

5.3.2 CORBETT FORMATION METASEDIMENTS

Bores screen within the Corbett Formation Metasediments (CCWB519, CCWB521, CCWB522, CCWB525, CCWB527, CCWB530, CCWB531, CCWB537, CCWB528) exhibits a broader range of groundwater levels between 375 mAHD to 470 mAHD (Figure 11).

- CCWB530 was recorded as dry throughout the reporting period.
- CCWB519 and CCWB525 record the highest groundwater levels (~450–470 mAHD), with CCWB525 showing a sharp spike in early 2021, suggesting a strong recharge response albeit this response is not repeated for the remaining reporting period.
- CCWB527 shows a more gradual declining trend until early 2024, followed by a marked rise, indicating possible seasonal recharge or delayed aquifer response.
- CCWB521 remains relatively flat (~415–417 mAHD) throughout, indicative of a relatively disconnected or slow-responding aquifer system.
- CCWB528 shows significant short-term variability, with levels dropping below 390 mAHD in 2023 before recovering to above 400 mAHD, pointing to a shallow, responsive system likely influenced by localised rainfall events.
- CCWB531 and CCWB537 show broadly similar trajectories with moderate increases through 2023 and 2024, suggesting some regional consistency in recharge effects.

Groundwater levels captured within the Corbett Formation Metasediments appears more sensitive to climatic conditions, as demonstrated by the noticeable spikes in early 2021 and variable trends in some bores. The high responsiveness of CCWB525 and CCWB528 suggests more permeable formations or shallow groundwater systems susceptible to direct rainfall infiltration or surface water connectivity.

Interpolated isopotentials were derived from the September 2023 groundwater for the Corbett Formation Metasediments (Figure 14). Based on the current available data, the

Corbett Formation Metasediments more typically follows the topography from south to northeast, opposite to the of the Robin Hood Granodiorite.

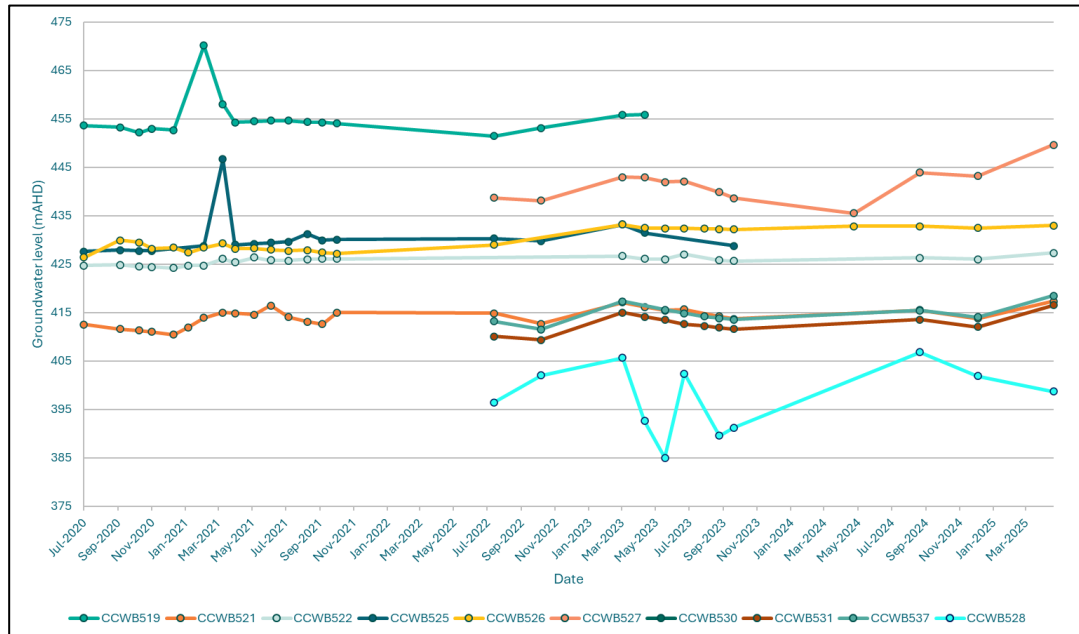


Figure 11: Groundwater levels in bores screened within the Corbett Formation Metasediments.

5.3.3 ANDESITE AND RHYOLITE

The final group (CCWB520, CCWB534, CCWB518) has groundwater levels ranging approximately between 410 mAHD to 440 mAHD (Figure 12).

- CCWB534 shows a consistent upward trend, rising from ~437 mAHD in mid-2022 to ~442 mAHD by March 2025, indicating a potentially pressurised or recovering system.
- CCWB518 exhibits relatively flat groundwater levels (around 425–428 mAHD) until late 2023, with minor fluctuations and a modest increase in the most recent data.
- CCWB520 presents with the lowest levels (~414–422 mAHD), though with gradual increase from 2022 onwards, suggesting some recharge influence over the long term.

While these bores do not demonstrate strong seasonal fluctuations, the upward trends in CCWB534 and CCWB520 may indicate cumulative recharge effects over time rather than immediate responses to isolated rainfall events. The subdued variability points to moderate transmissivity and a relatively buffered groundwater system.

CCWB538 remained dry throughout the reporting period.

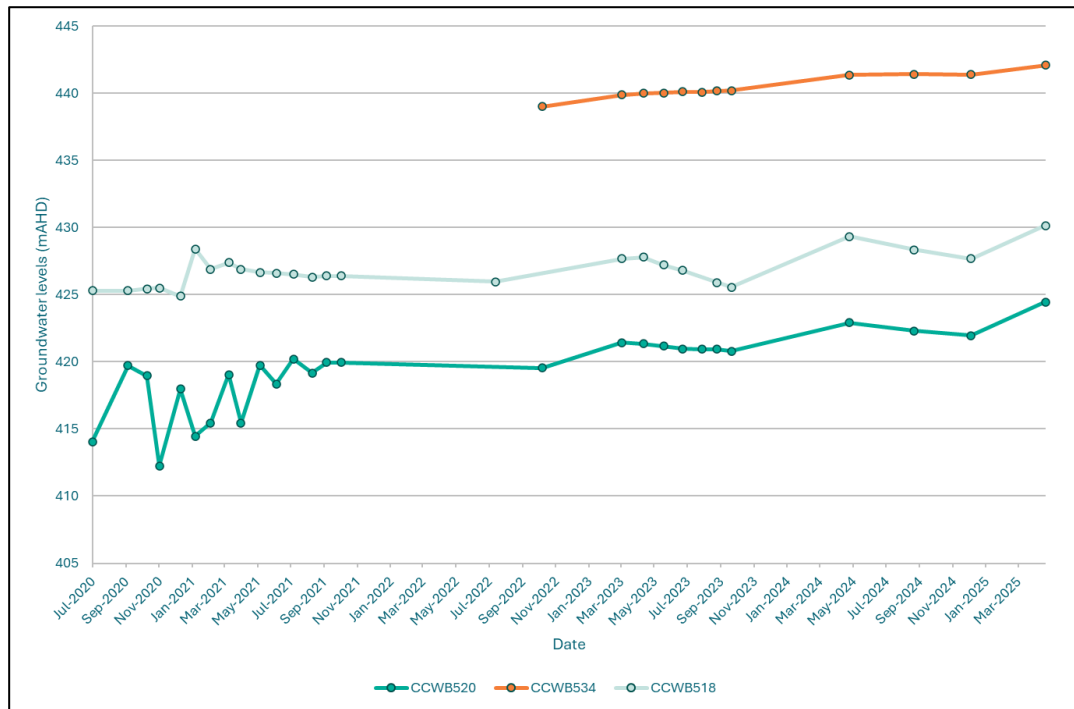


Figure 12: Groundwater levels in bores screened within the andesite and rhyolite structures.

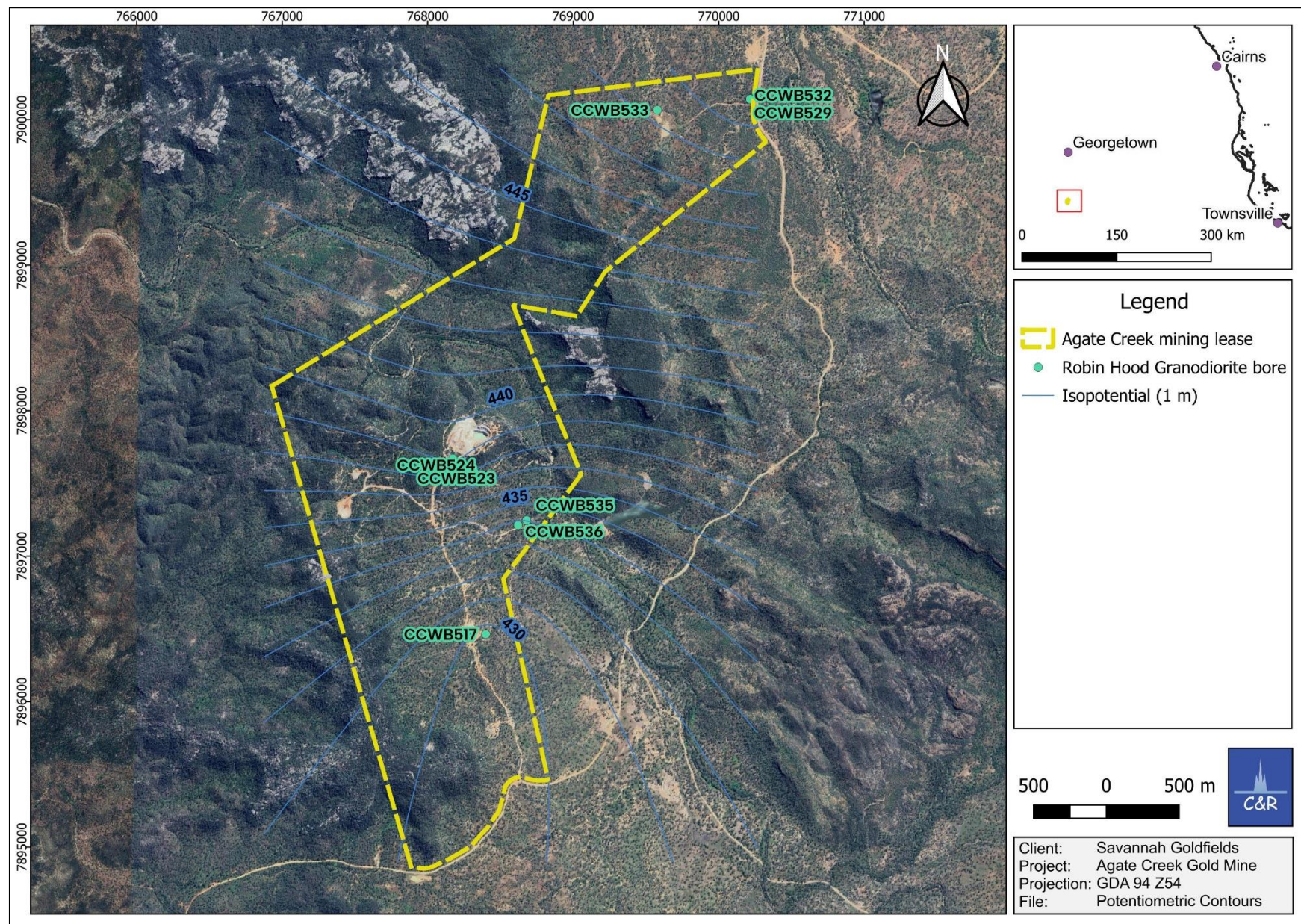


Figure 13: Potentiometric surface contours developed from the September 2023 groundwater elevations from bores screened in the Robin Hood Granodiorite.

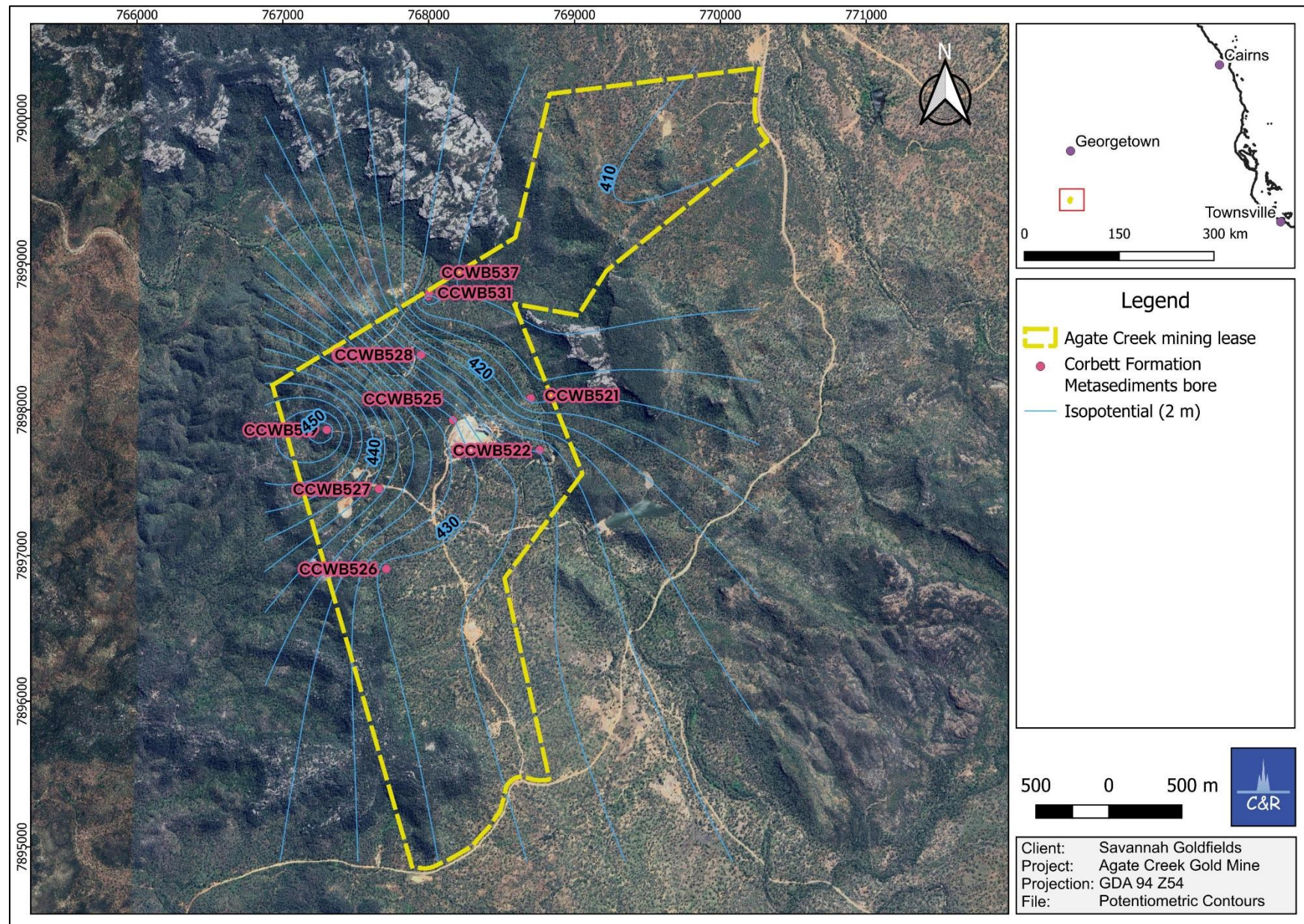


Figure 14: Potentiometric surface contours developed from the September 2023 groundwater elevations from bores screened in the Corbett Formation Metasediments.

Based on 1-m digital elevation models for the region, the banks and bed of Agate Creek are at approximately 430 mAHd and 425 mAHd, respectively. Four monitoring bores (CCWB530, CCWB532, CCWB535 and CCWB538) target the shallow groundwaters, with screened intervals between 4 and 7 m BGL. Based on the measured RLs, only CCWB30 (422.80 mAHd) and CCWB35 (407.91 mAHd) would likely intersect groundwater inflow to Agate Creek.

All shallow bores remained dry.

The two (CCWB536 and CCWB537) monitoring bores – constructed to design in 2021 (screened on 19 m BGL) and located within the closest proximity to Agate Creek and a smaller tributary – reflect the areas of lowest groundwater elevations, ranging between 411 and 433 mAHd (Figure 15). The elevation difference between the bed of Agate Creek and CCWB537 supports the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek. Figure 15 shows the groundwater levels of the two respective bores in April and September 2023, with minimal variation detected between the wet and dry season, particularly in CCWB536.

To ensure accurate representation of the system is obtained, the installation of pressure transducers is recommended to capture the changes in groundwater level that may occur directly after rainfall and subsequent flow events.

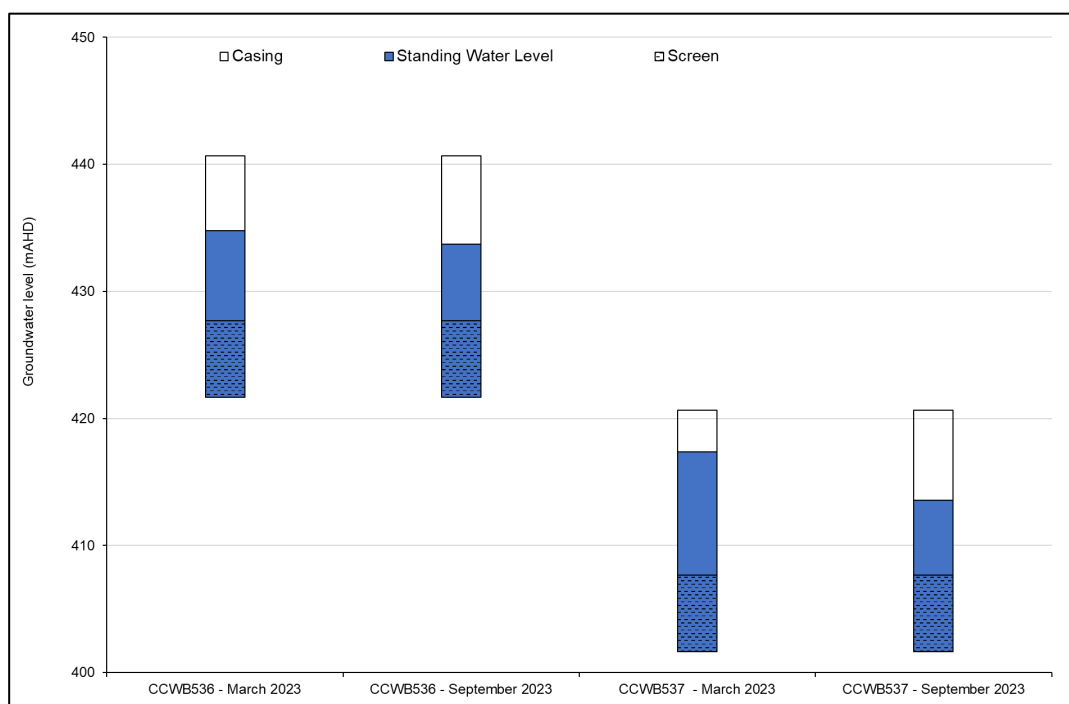


Figure 15: Groundwater levels of CCWB536 and CCWB537 beside Agate Creek.

5.4 GROUNDWATER QUALITY

5.4.1 ROBIN HOOD GRANODIORITE

The pH values of bores screened within the Robin Hood Granodiorite indicate neutral conditions, ranging from 5.45 (CCWB523) and 8.31 (CCWB529), with a median value of 7.40. As shown in Figure 16, there is some variation in pH across the network. However, the majority of bores have remained relatively consistent throughout the monitoring period.

Located south of the main pit (Pit 6), CCWB23 consistently records the lowest pH within the Robin Hood network, with a median value of 6.31. Conversely, CCWB529, situated in the northeast corner of the mining lease, displays the highest median value of 8.09.

EC values exhibit a greater degree of variation across the network compared to pH, ranging from 91 $\mu\text{S}/\text{cm}$ (CCWB523) to 7,540 $\mu\text{S}/\text{cm}$ (CCWB536). The slightly acidic CCWB523 aligns with the freshest groundwater onsite, with a median EC of 127 $\mu\text{S}/\text{cm}$, while CCWB536 yields the most saline water, with a median EC of 6,990 $\mu\text{S}/\text{cm}$ (Figure 17).

Figure 18 illustrates the variation in ionic composition of bores screened within the Robin Hood Granodiorite. The network displays a wide range of water types, including –

- CCWB517 – Sodium bicarbonate
- CCWB523 – Sodium-potassium bicarbonate
- CCWB524 – Sodium-calcium bicarbonate
- CCWB529 – Sodium bicarbonate
- CCWB533 – Sodium sulphate
- CCWB536 – Sodium chloride.

While majority of ionic compositions have remained stable throughout the monitoring period, CCWB523 and CCWB524 – both located south of Pit 6 – display variable levels of bicarbonate.

Fluoride levels in CCWB17 and CCWB29 are above the livestock drinking water guideline (2 mg/L), with values in all bores increasing during the reporting period. CCWB529 has recorded the largest increase, starting at 3.6 mg/L in May 2023 to a new maximum of 9 mg/L in August 2024, which is consistent with the same trend also occurring in CCWB517 whereby levels increased from 4 mg/L (October 2020) to 7.4 mg/L (August 2024).

Levels of boron, cobalt, nickel, and zinc fluctuate across the monitoring network, with no discernible significant trends identified. These variations are consistent with the adsorption of minerals from the lithology into groundwater. Dissolved arsenic and cobalt concentrations in CCWB523 increased over the reporting period from <0.001 mg/L to 0.006 mg/L and from 0.004 mg/L to 0.007 mg/L, respectively. Both dissolved arsenic and cobalt exhibit a statistically significant positive trend ($n = 24$, $p < 0.001$, $r = 0.786$). No other discernible trends were identified. The majority of parameters displayed a distinct increase in concentration between the November 2021 and October 2022 monitoring rounds. However, unlike arsenic and cobalt, most parameters subsequently returned to levels consistent with previous monitoring rounds (2020 and 2021). Dissolved arsenic and cobalt have remained relatively stable at the elevated concentrations recorded since early 2023. The interruption to monitoring and change in methodology have limited the ability to determine a potential cause.

CCWB536 shows the greatest variation in dissolved arsenic, with concentrations falling from a maximum of 0.187 mg/L (July 2022) to 0.03 mg/L (August 2024). This change in arsenic levels may be attributed to poor hydraulic conductivity, with field notes indicating very slow

recharge. Sampling is likely to have disturbed sediments, which in turn increased aluminium concentrations in the sample—potentially contributing to arsenic levels through adsorption onto colloids. Timeseries for each analyte is presented in Appendix A (Figure A1 to Figure A24).

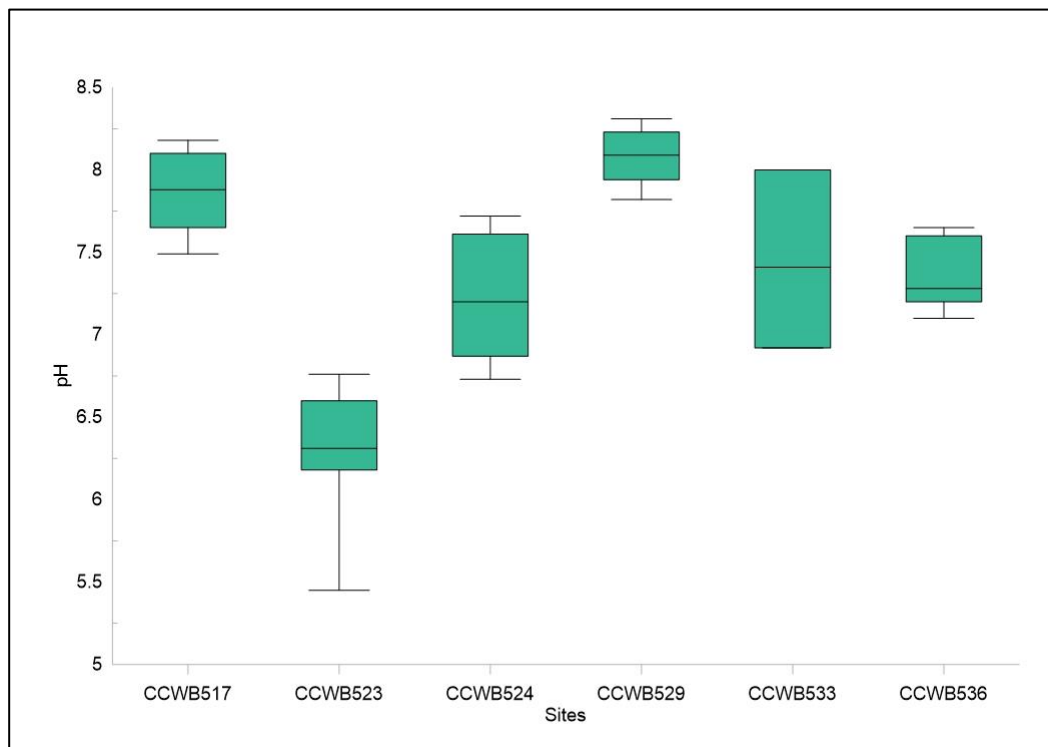


Figure 16: pH values of bores screened in the Robin Hood Granodiorite.

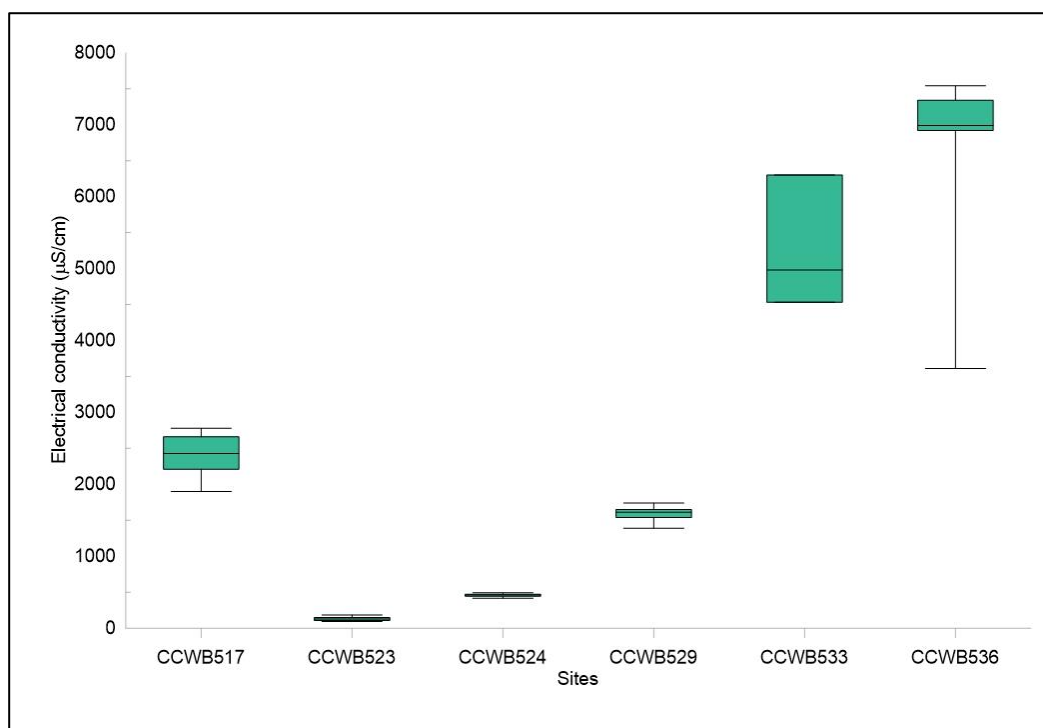


Figure 17: EC values of bores screened in the Robin Hood Granodiorite.

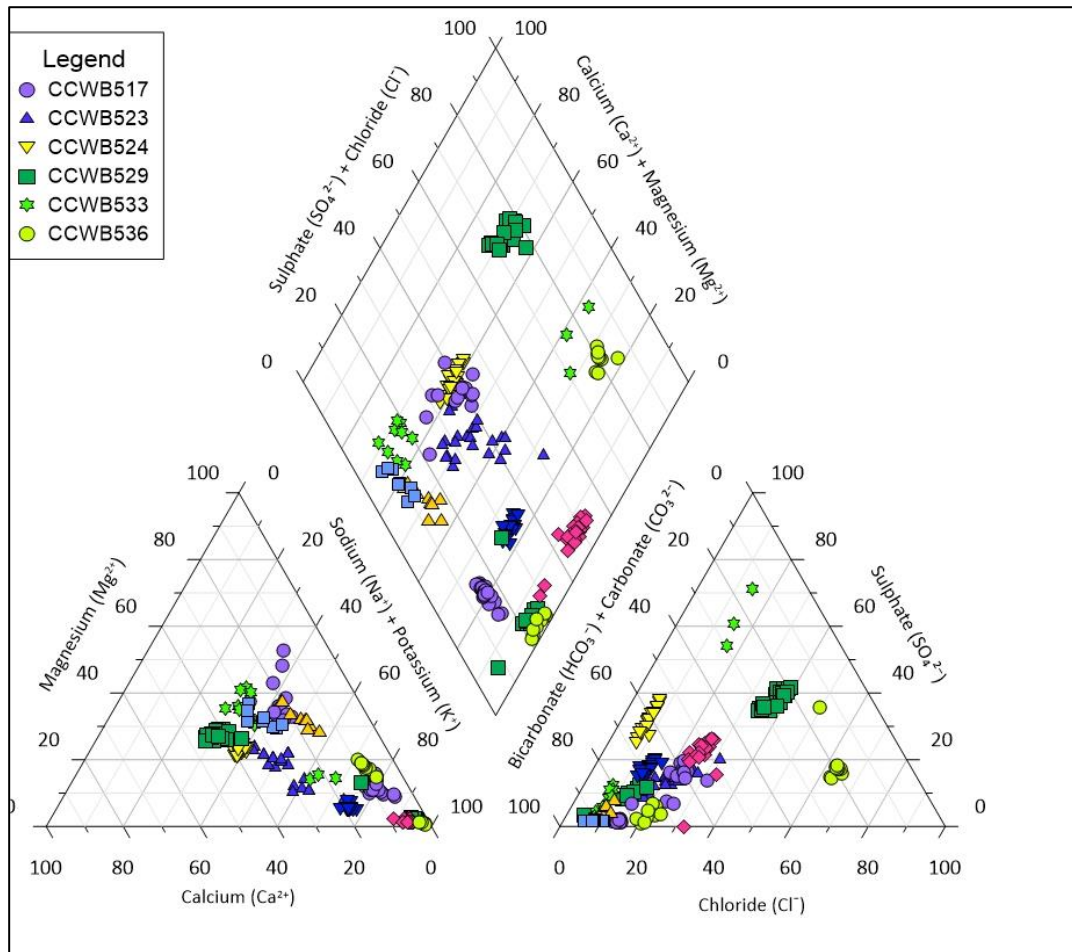


Figure 18: Ionic composition of bores screened in the Robin Hood Granodiorite.

5.4.2 CORBETT FORMATION METASEDIMENTS

CCWB530 was consistently dry throughout the reporting period.

The pH values of bores screened within the Corbett Formation Metasediments indicate generally neutral conditions, ranging from 6.13 (CCWB519) and 8.97 (CCWB528), with a median value of 7.43. As shown in Figure 19, there is some variation in pH across the network, as well as within individual bores over the monitoring period. This variability is visually evident in the boxplots, where the length of the whiskers represents the maximum and minimum pH values recorded during the reporting period.

Located east of Pit 4, CCWB19 consistently records the lowest pH within the Corbett Formation network, with a median value of 6.52. Conversely, CCWB528, situated on the banks of Agate Creek, displays the highest median value of 8.84.

EC values exhibit a lesser degree of variation across the network compared to the Robin Hood Granodiorite, ranging from 130 $\mu\text{S}/\text{cm}$ (CCWB519) to 2,000 $\mu\text{S}/\text{cm}$ (CCWB528). The slightly acidic CCWB519 aligns with the freshest groundwater onsite, with a median EC of 147 $\mu\text{S}/\text{cm}$, while CCWB528 yields the most saline water, with a median EC of 1,620 $\mu\text{S}/\text{cm}$ (Figure 20). However, the elevated salinity noted within CCWB528 are inconsistent, with a consistent decline in values recorded over the monitoring period, with EC values in April 2025 recorded at 1,090 $\mu\text{S}/\text{cm}$.

Figure 21 illustrates the variation in ionic composition of bores screened within the Corbett Formation Metasediments. The groundwater is primarily dominated by sodium-bicarbonate, although there are several different water types within the network, including –

- CCWB519 – Magnesium-sodium bicarbonate
- CCWB521 – Sodium bicarbonate-chloride
- CCWB522 – Sodium bicarbonate
- CCWB525 – Calcium-magnesium sulphate-chloride
- CCWB526 - Sodium bicarbonate
- CCWB527 – Magnesium-calcium bicarbonate
- CCWB528 – Sodium bicarbonate
- CCWB531 – Sodium bicarbonate
- CCWB537 – Sodium-magnesium bicarbonate.

While majority of ionic compositions have remained stable throughout the monitoring period, CCWB523 and CCWB524 – both located south of Pit 6 – display variables levels of bicarbonate. Additionally, CCWB526 shows a consistent decline in proportion of sodium, with the percentage of sodium has decreasing from 76% to 67%, and calcium positively trending from 10 % to 21 %.

Fluoride levels across the Corbett Formation Metasediment monitoring network have varied significantly over the monitoring period. CCWB521, and to a lesser extent CCWB522, exhibit concentrations substantially higher than the rest of the network, with median values of 14.4 mg/L and 4.1 mg/L, respectively.

Many bores showed high variability during the initial monitoring period from late 2020 to 2021, likely due to poor hydraulic conductivity affecting bore development. Over time, natural attenuation processes have allowed groundwater chemistry to stabilise and more accurately reflect the conditions of the target aquifer. This has contributed to several declining concentration trends observed over the reporting period.

Dissolved arsenic and cobalt concentrations in CCWB519 (<0.001 to 0.021 mg/L and <0.002 to 0.028 mg/L) and CCWB525 (0.011 to 0.021 mg/L and 0.003 to 0.028 mg/L) have steadily increased over the course of the monitoring period. These bores display a similar pattern observed within CCWB523 (Robin Hood Grandodiorite), whereby levels substantially increased between the November 2021 and October 2022 monitoring rounds. Monitoring at both bores ceased in November 2023. Timeseries for each analyte is presented in Appendix A (Figure A25 to Figure A48).

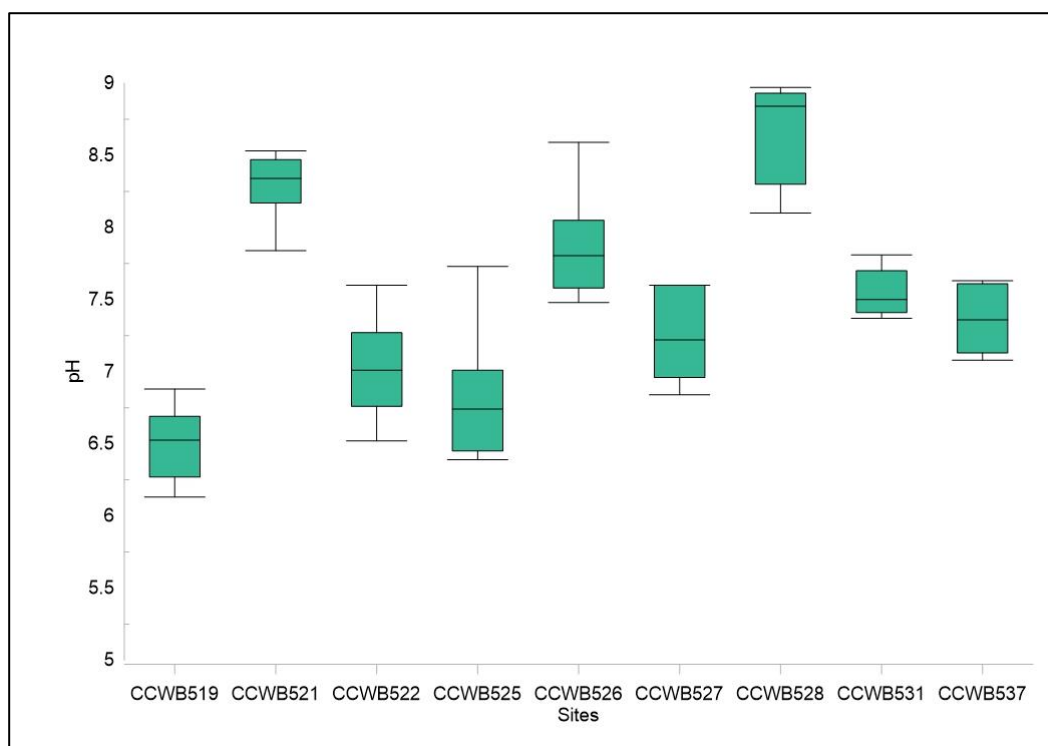


Figure 19: pH values of bores screened in the Corbett Formation Metasediments.

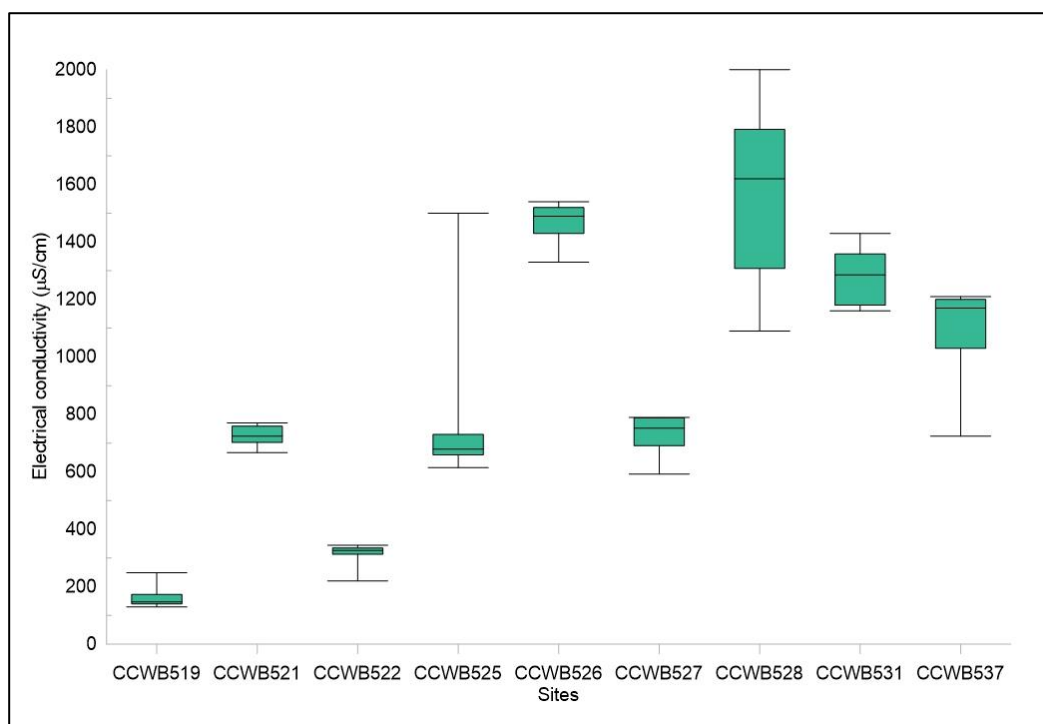


Figure 20: EC values of bores screened in the Corbett Formation Metasediments.

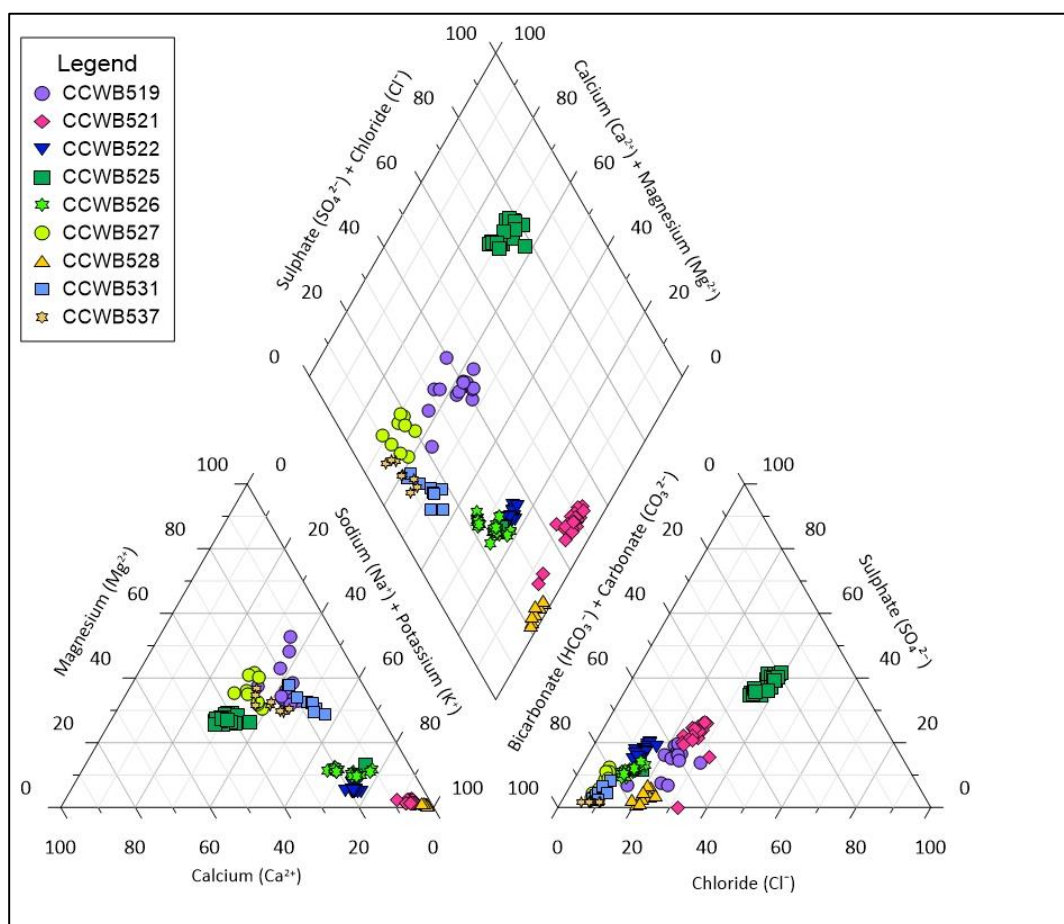


Figure 21: Ionic composition of bores screened in the Corbett Formation Metasediments.

5.4.3 ANDESITE AND RHYOLITE

Bores screened within andesite and rhyolite have been grouped together due to their shared hydrogeological characteristics and functional role within the groundwater system. These volcanic units form key structural features that act as preferential pathways for groundwater flow within the broader geological framework of the Robin Hood Granodiorite and Corbett Formation Metasediments. Their typically fractured and permeable nature facilitates enhanced connectivity and recharge, making them important conduits for subsurface water movement across lithological boundaries. As such, monitoring data from bores within these units provide valuable insights into the dynamic behaviour of groundwater within structurally controlled flow systems and their interaction with adjacent rock formations.

CCWB538 remained dry throughout the reporting period.

The pH values of bores screened within the andesite and rhyolite indicate neutral conditions, with both the minimum and maximum values (7.07 to 8.13) recorded in CCWB520. The median value across the dataset is 7.69. As shown in Figure 22, while some variation in pH is observed across the network, the majority of bores have remained relatively consistent throughout the monitoring period.

EC values exhibit greater variability across the network compared to pH, ranging from 466 $\mu\text{S}/\text{cm}$ (CCWB518) to 3,960 $\mu\text{S}/\text{cm}$ (CCWB534). Located along the southern mining lease boundary, CCWB534 consistently records saline water, with a median EC of 3,710 $\mu\text{S}/\text{cm}$ —over five times higher than that of CCWB518 (median: 666 $\mu\text{S}/\text{cm}$) and CCWB520 (711 $\mu\text{S}/\text{cm}$), both situated between Pit 4 and Pit 6 within the fault zone (Figure 23).

Figure 24 illustrates the variation in ionic composition of bores screened within the andesite and rhyolite units. The network displays a range of water types, including:

- CCWB518 – Calcium bicarbonate
- CCWB520 – Sodium bicarbonate
- CCWB534 – Sodium bicarbonate

While the ionic composition of CCWB518 has remained stable throughout the monitoring period, CCWB520 and CCWB534 show opposing trends in bicarbonate. In CCWB534, the bicarbonate proportion has increased from 57% to 75%, whereas in CCWB520 it has declined from a maximum of 61% to a minimum of 32% over the reporting period.

Metal concentrations reflect a similar trend is evident in bores screened within andesite and rhyolite, where natural attenuation processes over time have allowed groundwater chemistry to stabilise and better reflect the geochemical conditions of the host lithology. This has contributed to several declining concentration trends observed over the reporting period. Timeseries for each analyte is presented in Appendix A (Figure A49 to Figure A72).

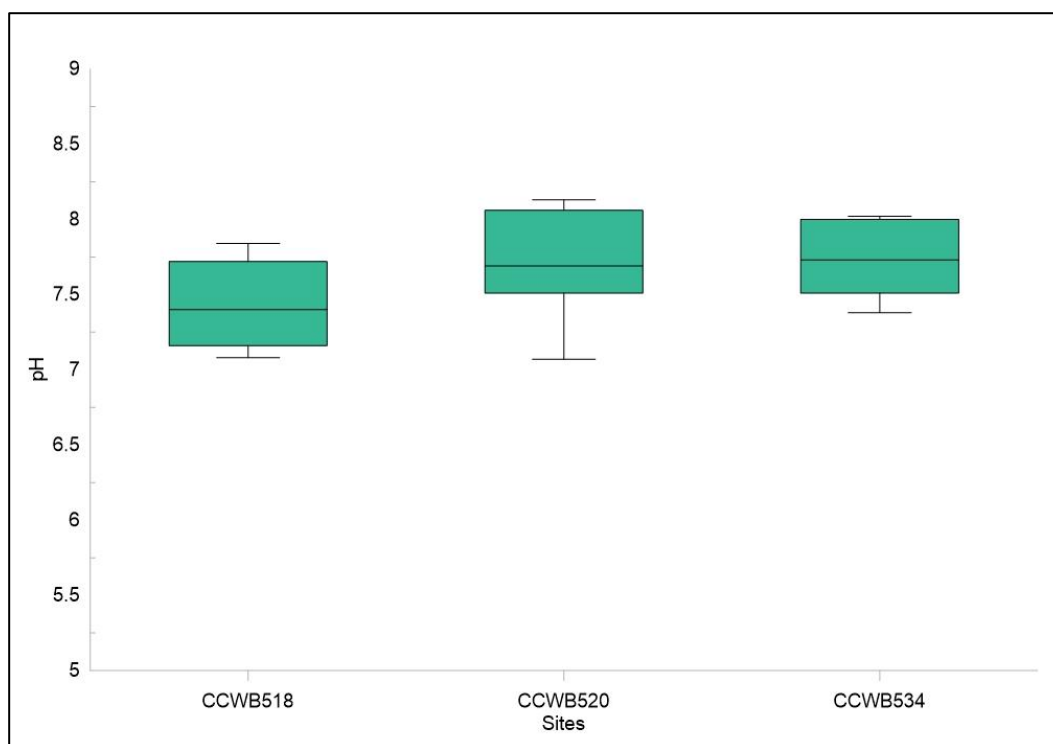


Figure 22: pH values of bores screened in andesite and rhyolite (fractured volcanic units).

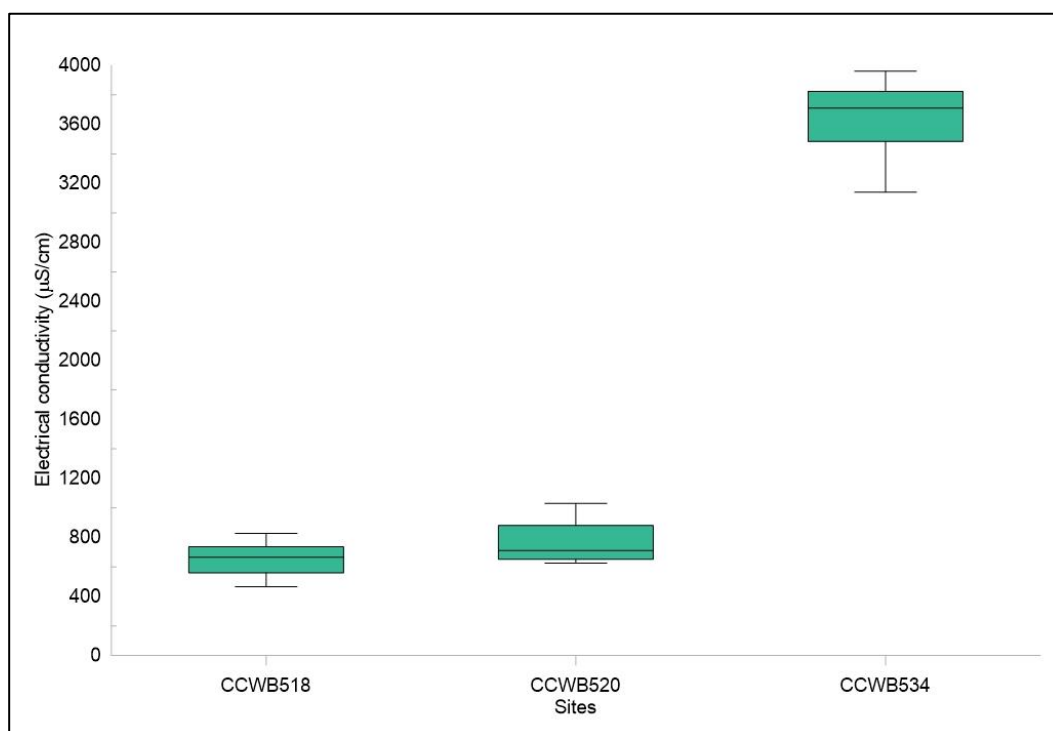


Figure 23: EC values of bores screened in andesite and rhyolite (fractured volcanic units).

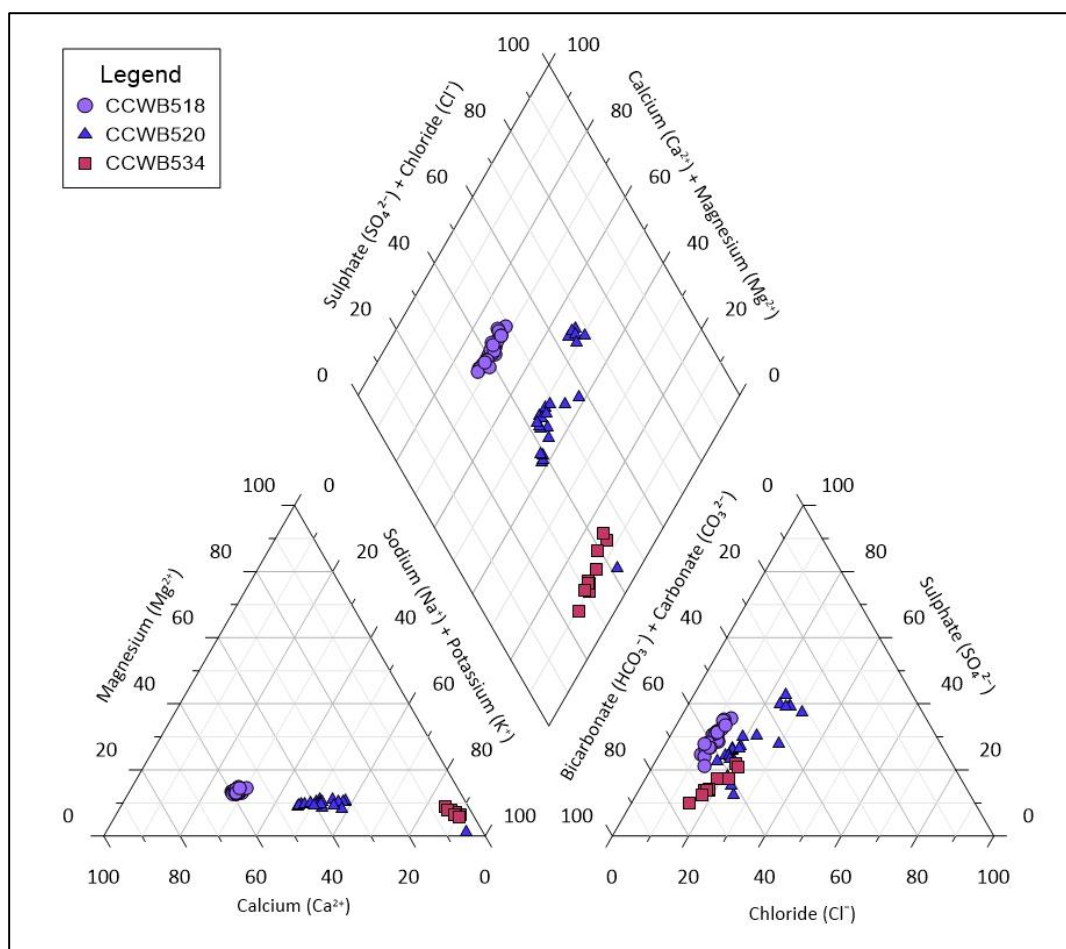


Figure 24: Ionic composition of bores screened in the andesite and rhyolite (fractured volcanic units).

5.5 YIELD AND USES

Exploration drilling data captured groundwater intersection depths and indicative airlift yields. Many of the drilled exploration holes intersected very low-yielding water. A number of exploration bores were drilled in the area between Sherwood West Fault and Zig Zag Fault – and areas where no groundwater monitoring bores were drilled. A number of these exploration holes – drilled along an east-west ridge line – indicate yields of 1 L/s to 10 L/s, aligning with a ridge line.

In January 2022, CCRC539 was drilled and constructed for the purpose of extracting water to adequately supply the site's water needs. CCRC539 was drilled to 109 m depth, primarily intersecting the Corbett Formation Metasediments prior to intersecting rhyolite between 99 m and 109 m BGL. During construction of the production bore, the final section of the bore collapsed, preventing the casing from reaching full depth, with the screened intervals subsequently placed between 87.8 m and 99.8 m BGL. The water bore drilling log states that the yield was 16.67 L/sec after one hour. The water quality classified the source as potable, with pH and EC of 7.92 and 735 $\mu\text{S}/\text{cm}$, respectively.

The assessment method for possible impacts from mining operations at Agate Creek included a bore network search. No other groundwater users were identified within a 5 km buffer. Therefore, it is concluded that the number of groundwater users in the vicinity of Agate Creek is minimal.

6. GROUNDWATER IMPACT ASSESSMENT

6.1 GROUNDWATER TAKE

Distances of the individual bores to the Pit 6 were measured. This measurement was generally straightforward – with the exception of CCWB524 where ambiguity existed owing to the presence of a haul road. Furthermore, CCWB519 was assessed in relation to the main pit and proposed pit located within close proximity to the bore.

The inflow rates outlined in Table 6 have been utilised to calculate the relationship between groundwater flows and the Pit 6, whereby the rate of m^3/sec is converted to m^3/year (by multiplication by 86,400 and 365.25). Assuming all groundwater flows are directed towards Pit 6, then:

- (a) For the linear case, an inflow of 8,521.31 m^3/year may be predicted (16.20 L/min); and
- (b) For the logarithmic case, an inflow of 5,958.51 m^3/year may be predicted (11.329 L/min).

Groundwater flows of CCWB519 into the small pits on the western flank are predicted to impact the void at a rate of 1.410 L/min.

It should be noted that these values must be considered worst-case scenarios.

From the flow rates and distances from Pit 6, the individual flows from bores CCWB518, CCWB524 and CCWB525 are those most likely to impact the main pit (Figure 8). Flows from the three bores may all combine to give a flow of 7.686 L/min on a linear model and 4.828 L/min on a logarithmic model. These are considered relatively low flows and are reasonable estimates of likely inflows.

During the current operating period, a site-estimated 450 ML of groundwater have been extracted for dust suppression and, to a lesser extent, camp facilities. Groundwater was extracted through three groundwater bores, which were converted from exploration holes to production bores.

6.2 ENVIRONMENTAL IMPACTS

The stage 2 expansion of the Agate Creek mine involves mining open-cut pits. The mine is currently working Pit 6 under the current EA that allows up to 250,000 tonnes of material to be extracted. However, further approval is required to mine Pit 6 deeper – exceeding the 250,000 tonnes limit – as well mining an additional satellite pits.

6.2.1 GROUNDWATER RESOURCES

6.2.1.1 Pit 6 – Drawdown and inflow

Based on the hydraulic parameters presented in Table 6, drawdown values were estimated by reverse-engineering results to derive the parameters inherent in the Bouwer and Rice (1976) and Hvorslev (1951) methodologies. This process involved the back-calculation of real values from the normalised data plotted.

The derived parameters were subsequently applied in the Cooper and Jacobs (1946), Jacobs (1947), and Jacobs and Lohman (1952) analytical approaches to predict drawdown, taking into account the spatial relationships between boreholes and the pit. An approximate error analysis of this approach was also undertaken.

Estimating drawdown within fractured or faulted systems is inherently complex due to variable recharge zones and the tendency for narrow fracture pathways to become occluded (“cemented up”) during prolonged dry periods. These factors can reduce aquifer transmissivity and limit the accuracy of drawdown predictions. To estimate the likely magnitude of drawdown, an analytical assessment was conducted for bores CCWB519, CCWB523, CCWB524, and CCWB525.

In this assessment, pit walls were assumed to act as the principal discharge boundary, resulting in an asymmetric cone of depression around the boreholes. This asymmetry was not explicitly accounted for in the present analysis.

Summary of drawdown values:

- CCWB519 – Most likely 0.08 m, most likely upper limit 0.10 m
- CCWB523 – Most likely 0.08 m, most likely upper limit 0.10 m
- CCWB524 – Most likely 0.08 m, most likely upper limit 0.10 m
- CCWB525 – Most likely 0.43 m, most likely upper limit 0.80 m

Hydraulic conductivities of the rock units within the Agate Creek site are classified as very low to low (10^{-8} to 10^{-7} m/s), indicating limited groundwater movement. Accordingly, inflows into Pit 6 are predicted to be minimal, ranging from approximately 11.3 to 16.2 L/min under a conservative (worst-case) scenario, and 4.8 to 7.7 L/min under more realistic conditions.

Any potential impacts are predicted to be negligible and are expected to remain confined within the mine lease area over an extended period. Given the very low hydraulic conductivities and limited estimated drawdown, both groundwater inflow and drawdown at Pit 6 and the adjacent minor pits are anticipated to be extremely low, indicating that overall hydrogeological impacts will be minimal.

6.2.1.2 CCRC539 - Drawdown

Limited information is available to determine the impact of groundwater extractions from various production bores on site. However, CCRC539 is understood to be the primary source of groundwater extractions. Anecdotally, CCRC539 can sustain an extraction rate of 3 L/sec. Conversely, most of the other production bores experience drawdown and therefore require extraction rates to be lowered to 2.5 L/sec and more intermittent use.

Monitoring bore CCWB518, CCWB19 and CCWB27 are located within 200 m of production bore CCRC539. These three bores target various geologies and depths from 26 m to 85 m BGL. The complex geology around Agate Creek restricts the ability to draw direct comparisons. Nevertheless, during the period of operation, the surrounding standing water levels displayed no evidence of drawdown as a result of groundwater extractions.

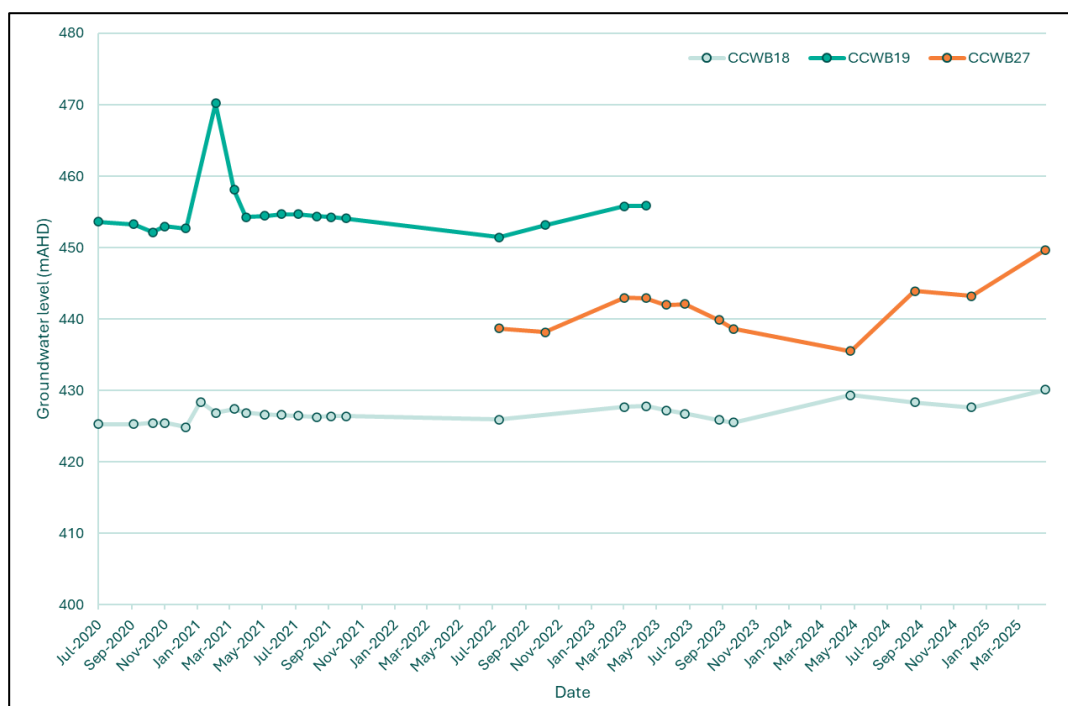


Figure 25: Standing water level of monitoring bores within 200 m proximity of production bore CCRC539.

6.2.2 GROUNDWATER USERS

The groundwater census completed within the 10 km buffer from Agate Creek found no registered groundwater bores, excluding the Agate Creek registered groundwater monitoring network. Accordingly, the impact to other groundwater users withing close proximity to Agate Creek is considered negligible.

6.2.3 GROUNDWATER-DEPENDENT ECOSYSTEMS

There are no formally identified groundwater-dependant ecosystems or springs within the mining extent. The nearest mapped groundwater-dependent ecosystem is a subterranean aquifer associated with the Hamstead Sandstone aquifer at Cobbold Gorge, downstream of the Agate Creek and Cave Creek confluence. The southern edge of this groundwater-dependent ecosystem is approximately 15 km northwest of the ML boundary. Considering the poor hydraulic conductivity measured and that the modelled minor drawdown will not surpass the mining lease boundary for several decades, it is unlikely that the activities at Agate Creek will interact with the associated groundwater-dependent ecosystems.

Based on 1-m digital elevation models for the region, the banks and bed of Agate Creek are approximately 430 mAHd and 425 mAHd, respectively. The potentiometric contours and associated difference between the bed of Agate Creek and CCWB521 (420 mAHd) support the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek. Furthermore, all shallow bores remained dry.

The major cations and anions from the entire groundwater monitoring network have been compared against surface waters captured within Agate Creek between November 2022 and February 2024. Figure 26 displays the ionic composition of CCWB531 and CCWB537 which reflects the most similarity to the Agate Creek. In addition to the groundwater, surface water collected from the main pit (Pit 6) shows a clear differential between both the surface water and closely associated groundwater.

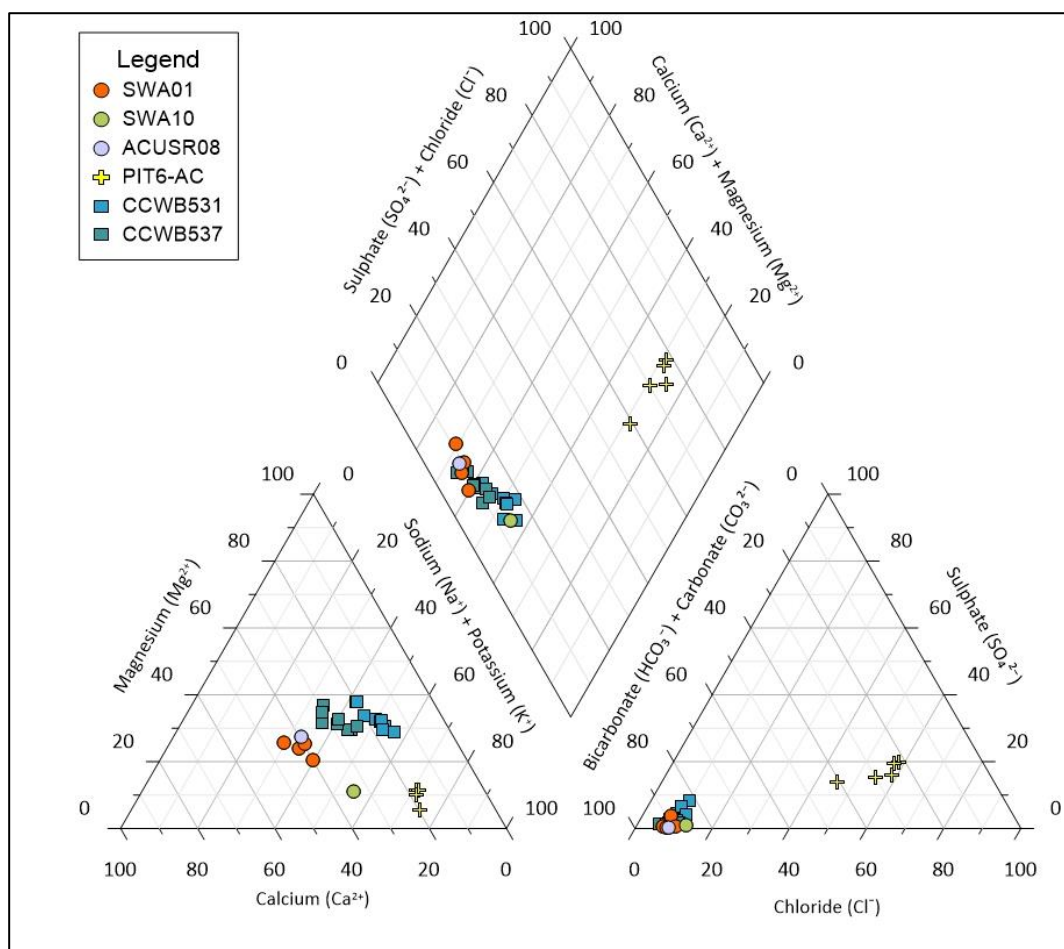


Figure 26: The ionic composition comparison of Agate Creek, Pit 6 and groundwater monitoring bores located within close proximity.

6.2.4 GROUNDWATER QUALITY

In general, the Agate Creek groundwater monitoring network currently expresses good quality water, with most bores meeting drinking water quality guidelines for both human and livestock consumption, excluding fluoride. The potential risk to groundwater from the mining operations at Agate Creek relate to the storage and interaction with waste rock. As part of this site-specific EA application, Savannah and C&R have completed a waste rock characterisation assessment to determine the environmental implications of producing up to 250,000 tonnes of waste rock. This section summarises the findings of the C&R waste rock assessment to date (refer to C&R, 2022).

6.2.4.1 Livestock Drinking Water

All pH values (excluding those from CCWB528) across the Agate Creek network remain within the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) guidelines for livestock drinking water (5 – 9; ANZG, 2018).

All other screened formations reflect stable conditions throughout the monitoring period.

Total dissolved solids (TDS) are a measure of all inorganic salt dissolved in water and is a guide to water quality. Electrical conductivity can be used to approximately calculate the concentration of TDS using the conversion of

$$\text{Electrical conductivity } (\mu\text{S/cm}) \times 0.67 = \text{TDS (mg/L)}$$

In accordance with this formula, all bores excluding CCWB517, CCWB526, CCWB34 and CCWB36 are below the Australian drinking water guideline value of 600 mg/L for TDS. The water of CCWB526 and CCWB529 is regarded as poor quality (900 – 1,200 mg/L), whereas the water quality of CCWB528, CCWB534 and CCWB536 is considered unacceptable (> 1,200 mg/L). However, all bores meet the livestock drinking water guideline value for TDS (4,000 mg/L). The elevated salinity is attributed to the water present within the weathered granite and mudstone.

ANZG (2018) recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. Where groundwaters are in good condition, the intent is to maintain existing water quality. Where groundwaters interact with surface waters, groundwater quality should not compromise identified environmental values and water quality guidelines for those waters. Due to the good nature of the groundwaters found in Agate Creek, excluding CCWB517 and CCWB526, analytes have been compared against the Australian guidelines for drinking water and ANZG (2018) guidelines for livestock drinking water quality. For the dissolved metals and metalloids, the Australian drinking water guideline values are assessed, whereas total metals and metalloids are compared against guideline values presented in the livestock drinking water guidelines. The mean value calculated from the fourteen rounds of monitoring has been compared against the respective guideline values.

All analytical times series graphs not presented within this section (i.e. for additional analytes tested) can be reviewed within Appendix A.

6.2.4.2 Waste Rock Seepage

The waste rock contains relatively benign lithology, which predominantly consists of felsic volcanics. The analysed pH values are impacted by the testing method (i.e. fluid extracted from crushed samples, with a very high surface area to solution ratio), it is expected that both the low and high pH results in the waste rock are a worst-case scenario. Therefore, it is envisaged that the pH of runoff from the proposed open-cut pits waste rock will not be as low or high as that reflected in the waste rock sample test results. Also, in order for significant runoff to occur at Agate Creek, the rainfall dilution factor should be greater than the 1:5 (sample:water) ratio used in the extract solutions. This, in turn, would counteract the resulting acidity or alkalinity. In general, most waste rock samples are in the neutral to slightly acidic range (Figure 27), indicative of the waste rock lithology (felsic volcanics).

The electrical conductivity of the Agate Creek waste rock samples ranges from 7 $\mu\text{S}/\text{cm}$ to 1,680 $\mu\text{S}/\text{cm}$ and has a very low median value of 43.5 $\mu\text{S}/\text{cm}$. Most Agate Creek waste rock samples have low electrical conductivity values (<300 $\mu\text{S}/\text{cm}$). Apart from an outlier in Pit 2 (1,680 $\mu\text{S}/\text{cm}$), EC values in all waste rock samples are below 500 $\mu\text{S}/\text{cm}$ (Figure 28). The relatively low electrical conductivity recorded in most waste rock samples correlates with the good quality reported in the groundwater, whereby the highest electrical conductivity is approximately 2,400 $\mu\text{S}/\text{cm}$. It is therefore unlikely that seepage and infiltrations from the waste rock dumps would result in increases in the salinity of the associated groundwater system.

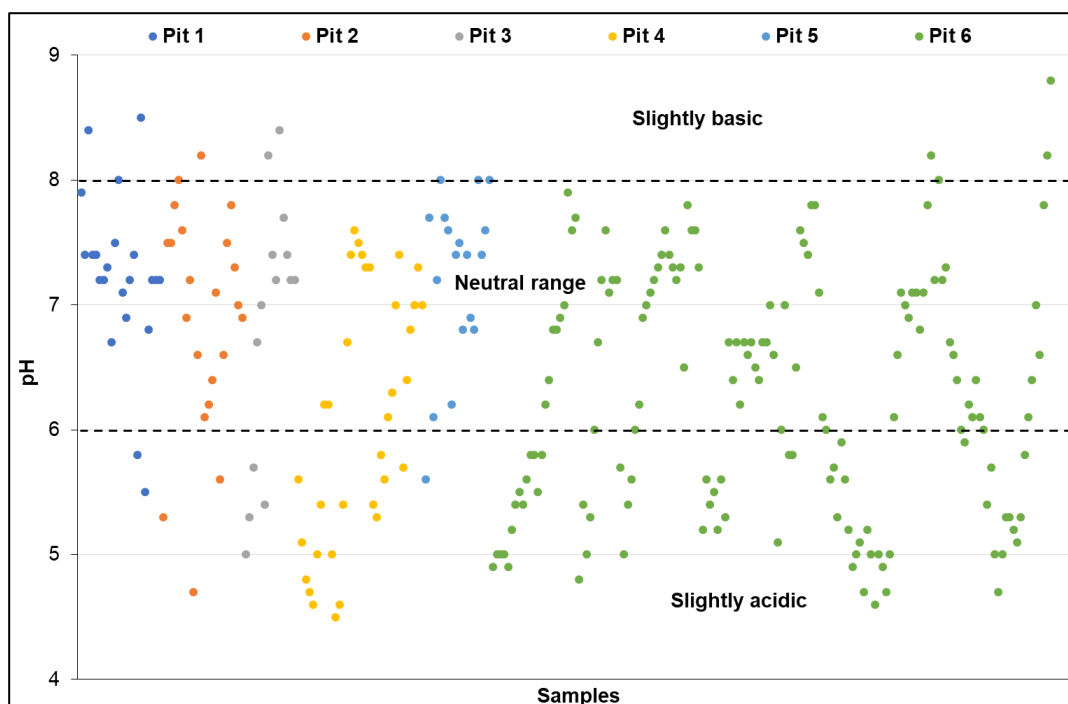


Figure 27: pH values for Agate Creek waste rock samples (extracted from C&R, 2022).

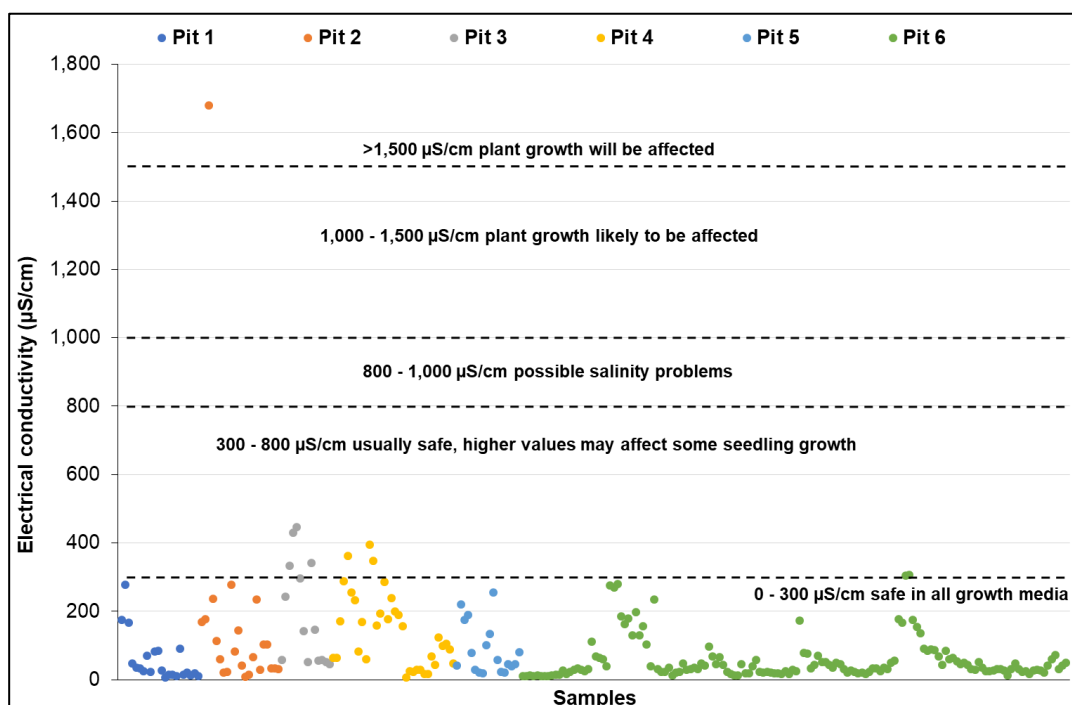


Figure 28: Electrical conductivity for Agate Creek waste rock samples (extracted from C&R, 2022).

The net acid generation (NAG) test is used to directly measure the net amount of acid produced by a waste rock sample.

Figure 29 demonstrates that most Agate Creek waste rock samples have a NAG(pH) greater than 4.5 and a NAPP value below 0. Therefore, they are not acid generating. In contrast,

two samples have a NAG(pH) greater than 4.5 and a net acid production potential (NAPP) value above 0 (these are classified as uncertain PAF [potentially acid-forming]), whereas at least one sample is certainly PAF, having a NAG(pH) less than 4.5 and a positive NAPP value (Figure 29).

A summary of the NAG(pH) versus total sulphur geochemical classification criteria for the waste rock samples is presented in Table 7 and Figure 30.

Table 7: Geochemical classification criteria for Agate Creek waste rock samples.

Geochemical Classification	Total Sulphur (%)	NAG _(pH)	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6
NAF (barren)	≤0.1	-	22	18	14	34	17	142
NAF (very low sulphur)	>0.1 to ≤0.55	≥ 4.5	0	1	0	0	0	1
NAF (low sulphur)	0.55 to 1.5	≥ 4.5	0	0	0	0	0	0
PAF (very low sulphur)	0.1 to ≤0.55	< 4.5	0	2	0	0	1	6
PAF (low sulphur)	0.55 to 1.5	< 4.5	0	0	0	0	0	1
PAF (moderate to high sulphur)	>1.5	< 4.5	0	1	0	0	0	0
Percentage of NAF samples			100%	86.4%	100%	100%	94.4%	95.3%
Percentage of very low sulphur PAF samples			0%	9.1%	0%	0%	6%	4.0%
Percentage of low sulphur PAF samples			0%	0%	0%	0%	0%	0.7%
Percentage of moderate to high sulphur PAF samples – actionable levels			0%	4.5%	0%	0%	0%	0%

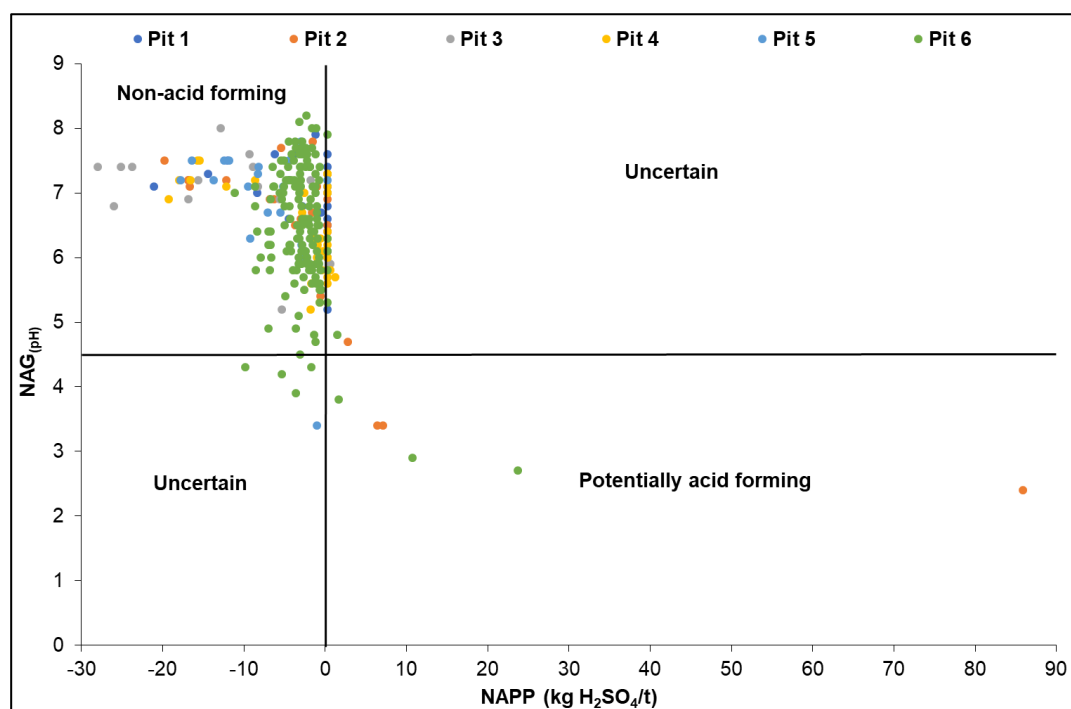


Figure 29: NAG_(pH) versus NAPP for Agate Creek waste rock samples (extracted from C&R, 2022).

Applying the NAG(pH) and total sulphur geochemical classification criteria (Table 7), it can be shown that most waste characterisation samples are non-acid forming (NAF) or barren (Figure 30).

Of the 260 Agate Creek waste rock samples, there are only 11 samples that could be categorised as PAF when the NAG(pH) and total sulphur values are considered:

- Three samples in Pit 2;
- One sample in Pit 5; and
- Seven samples in Pit 6.

These samples make up less than 14% of the total sample size for their respective areas – and their sulphur values are still very low to low except for one sample in Pit 2. It is therefore expected that only one of these eleven samples presents an acid drainage issue because:

- The amount of produced acid would be negligible; and
- Any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock.

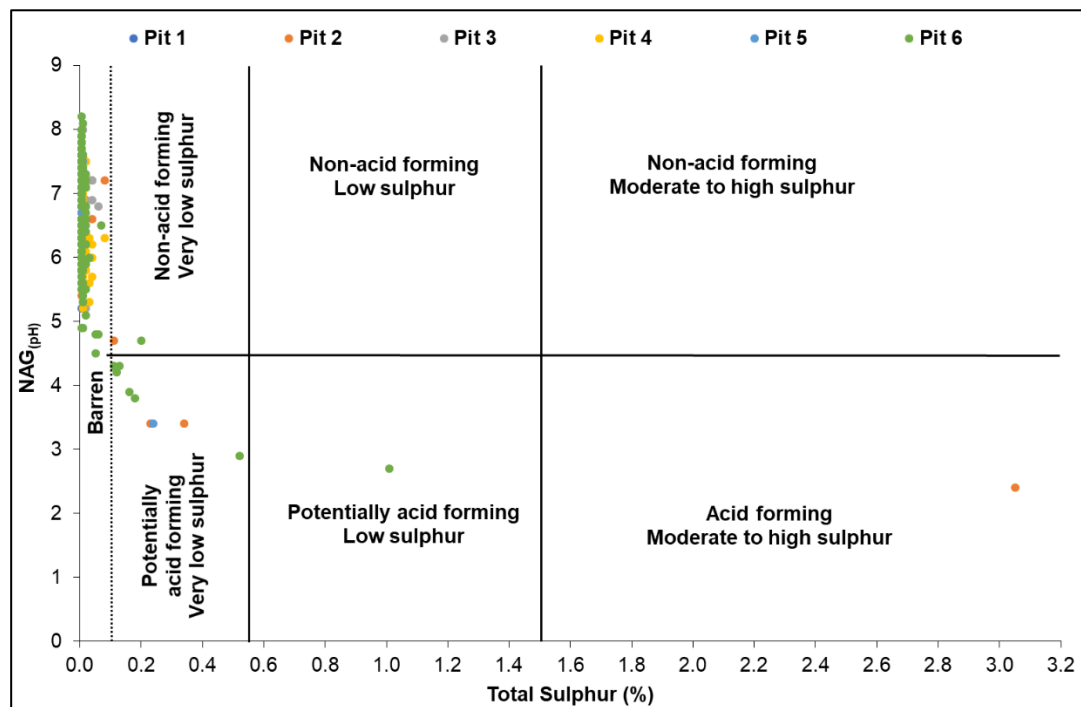


Figure 30: NAG_(pH) versus sulphur for Agate Creek waste rock samples (extracted from C&R, 2022).

A broad range of analytes were assessed using both static tests and kinetic leach column (KLC) tests. While irregular exceedances of conservative guideline values (i.e. values not necessarily appropriate for comparison with leachate results) were identified for a number of quality characteristics, including aluminium, boron, copper and zinc, only fluoride was found to be at levels of concern to the associated receiving environments (i.e. regularly above the livestock drinking water guideline value (C&R, 2022)). However, fluoride was already noted to be elevated, above livestock drinking water values, in several bores across the project site, with levels recorded greater than 16 mg/L. KLC test results found that while maximum values of 6.6 mg/L were observed in initial leaches, these values quickly became compliant with the livestock drinking water guideline value of 2 mg/L during subsequently leaches. Based on these levels and the levels of fluoride already observed within the groundwater systems across the project site, seepage and infiltration from the waste rock dumps are predicted to have negligible influence on the groundwater quality throughout the area.

The complex geology of Agate Creek and limited historical data diminished the ability to develop an accurate numerical groundwater model for the site. However, a simplified block numerical model was developed to better understand how climatic conditions and the groundwater low hydraulic conductivity moderate the risk to groundwater environmental values.

For the purpose of evaluating the risk, both waste rock dumps and voids were modelled to assess the potential risk to groundwater. However, the low rainfall and high evaporation rates – in conjunction with very low porosity – caused the model to fail when modelling the infiltration to groundwater from the proposed waste rock dumps (i.e. infiltration did not reach groundwater levels). It should be noted that further information is required to accurately assess the groundwater response to rainfall.

The risk of contamination from void water seeping into the surrounding groundwater was successfully modelled and accurately reflects the low hydraulic conductivity. Seepage into the surrounding groundwater is considered to pose a low risk due to high evaporation rates and the presence of a depressurised zone, with Pit 6 acting as a sink. The averaged K value of 5.06×10^{-7} was applied. Contaminants were modelled as entering into the groundwater system via Pit 6. Figure 31 displays the modelled pathway of contaminants in centuries due to the low hydraulic conductivity. The historical dataset prevented calibration in relation to standing water levels and the error margin in terms of directional flow for the model is therefore high. However, the model does substantiate the empirical model, with particulates modelled to travel approximately 247 m over 300 years (Figure 31).

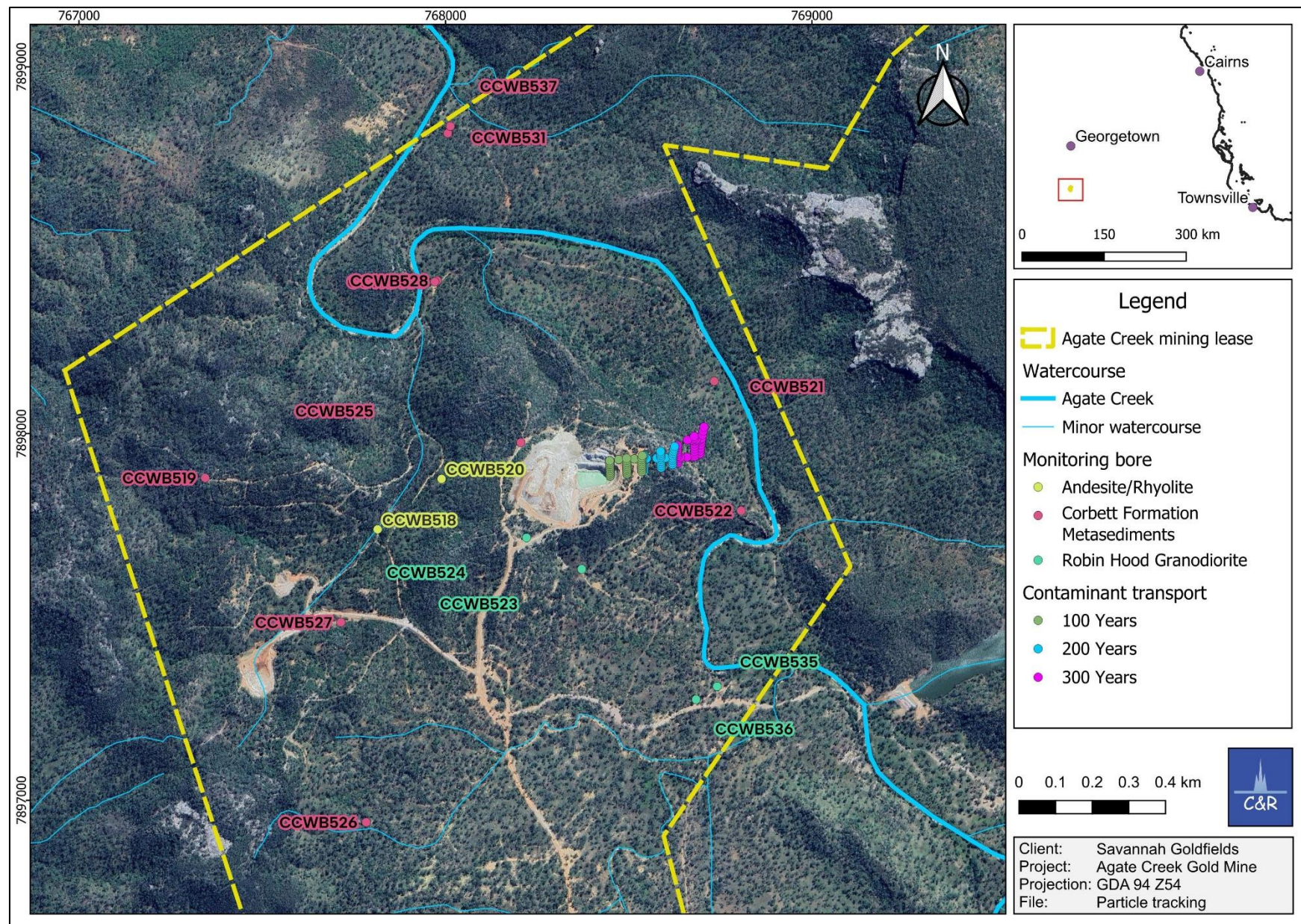


Figure 31: Contaminant transport modelled from the primary Agate Creek void.

7. GROUNDWATER MONITORING PROGRAMME

The Agate Creek operations currently monitor an extensive groundwater bore network which comprises 22 monitoring bores located across the mining lease (Table 8). The purpose of the groundwater monitoring network is to monitor groundwater levels and quality in the primary aquifers potentially impacted by mining activities.

7.1 GROUNDWATER LEVEL AND QUALITY MONITORING

Groundwater levels will be measured and recorded on a quarterly basis, which will enable the observation of natural groundwater level fluctuations – such as seasonal responses to rainfall. Standing water level monitoring must be able to distinguish the difference between natural fluctuations and potential mining activities.

Groundwater quality monitoring will be undertaken on a quarterly basis to enhance the existing baseline dataset available prior to commencement of the project. This will be used to detect any changes in groundwater quality during and post-mining. Water quality samples will be analysed for physico-chemical parameters – including pH, electrical conductivity, total dissolved solids, total suspended solids, alkalinity, hardness, major ions (Ca, Mg, Na, K, Cl and SO₄), and dissolved and total metals and metalloids (Al, As, Cd, Cu, Fe, Pb, Mn, Hg, Ni, Se, and Zn).

Groundwater samples will be collected in accordance with the relevant guidelines and conventions specified in the *Monitoring and sampling manual* (DES, 2018), and in compliance with, for example, AS/NZS 5667:11 1998 (Australian/New Zealand standards, 2016). The samples will be preserved and forwarded to a National Association of Testing Authorities (NATA) accredited water laboratory for analysis.

The groundwater monitoring data will be reviewed annually, and the groundwater monitoring programme revised, as necessary. In the event that the monitoring programme identifies a significant departure from the prediction, an investigation will be undertaken to identify the cause and manage any unexpected impacts associated with the project.

Sufficient data has been collected since 2020 to allow trigger limits to be set for all groundwater monitoring bores within the Agate Creek network (where water is present) in accordance with the guideline “*Using monitoring data to assess groundwater quality and potential environmental impacts*” (DES, 2021).

Additionally, large data gaps exist during the wet season, which has reduced the ability to assess the connectivity between groundwater and surface water. Where safe access is restricted, the deployment of pressure transducers would enable changes in groundwater levels to be monitored and capture how groundwater levels respond to largescale rainfall and flow events.

7.2 NETWORK SUITABILITY

Minimal data have been provided for this assessment regarding the two extraction bores used on site for production and camp purposes. To ensure compliance with the UWIR, each extraction point has been fitted with a flow meter to accurately measure take volumes. This will provide additional scope for assessment when the annual groundwater reviews are completed to determine whether any impact has occurred to water levels and/or quality.

This assessment has reviewed the monitoring network and confirms that the 2020 monitoring bore series is effectively meeting its design objective — to detect potential impacts from approved mining activities.

Groundwater hydrochemistry data collected since 2022 from bores constructed to appropriate standards supports the understanding that each lithological unit exhibits distinct water quality characteristics. These variations are influenced by preferential flow pathways that extend across both designated aquifer systems. Structural features such as fractured andesite and rhyolite appear to facilitate hydraulic connectivity between these systems, acting as conduits for groundwater movement.

This interpretation is supported by observed hydrochemical differences between the Robin Hood Granodiorite and Corbett Formation Metasediments, as well as borehole logs and structural mapping, which together indicate the influence of geological structure on groundwater flow and mixing between aquifers. Additionally, these findings highlight the importance of considering structural controls — particularly within volcanic units — when assessing aquifer connectivity and contaminant transport pathways in the region.

Table 8: Current groundwater monitoring programme (MGA: Map Grid of Australia; TBA: to be advised).

Bore ID	Easting	Northing	Ground level	Casing above ground (m)	Total depth	Screened interval
	MGA94 zone 54		mAHD	m	m BGL	
CCWB517	768400	7896463	435.6	0.6	55	49 – 55
CCWB518	767768	7897706	431.4	0.6	73	67 – 73
CCWB519	767302	7897863	517.18	0.62	85	79 – 85
CCWB520	767947	7897838	434.96	0.59	73	67 – 73
CCWB521	768701	7898079	420.94	0.6	73	67 – 73
CCWB522	768762	7897724	434.2	0.6	73	67 – 73
CCWB523	768321	7897579	449.6	0.61	73	67 – 73
CCWB524	768174	7897670	496.06	0.64	91	85 – 91
CCWB525	768167	7897930	498.77	0.62	103	97 – 103
CCWB526	767710	7896909	449.4	0.66	73	67 – 73
CCWB527	767660	7897458	461.50	TBA	31	25 – 31
CCWB528	767955	7898381	415.49	TBA	73	67 – 73
CCWB529	770217	7900144	463.85	TBA	31	25 – 31
CCWB530	767948	7898378	422.80	TBA	7	4 – 7
CCWB531	767997	7898782	420.39	TBA	55	49 – 55
CCWB532	770221	7900138	469.62	TBA	7	4 – 7
CCWB533	769580	7900063	473.09	TBA	25	19 – 25
CCWB534	768655	7895516	454.09	TBA	25	19 – 25
CCWB535	768681	7897248	407.91	TBA	7	4 – 7
CCWB536	768622	7897214	440.68	TBA	19	13 – 19
CCWB537	768005	7898801	420.66	TBA	19	13 – 19
CCWB538	768651	7895513	468.83	TBA	7	4 – 7



7.3 UWIR REVIEW

It is deemed the role and responsibility of Savannah to guarantee the implementation of the UWIR at Agate Creek. The UWIR is designed to align with the site's EA. Therefore, it is recommended that the monitoring programme stipulated in Section 7.1 forms part of the EA application for the expansion of mining at Agate Creek.

8. CONCLUSIONS

The Agate Creek is an open-cut gold mining operation proposal for a stage 2 expansion of mining activities which are to involve five individual open-cut pits. The proposed expansion has been assessed for the level of impact on the surrounding aquifer systems.

The groundwater monitoring network consists of 22 monitoring bores within an area of approximately 1.5 km² that incorporates all five proposed voids. The network targets a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. Specifically, all bores are screened within metamorphic rocks that have been intruded by Siluro-Devonian-age Robin Hood Granodiorite – and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex.

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range. This was later confirmed – with pump tests completed on each monitoring bore, whereby hydraulic conductivities ranged between 6.57×10^{-8} m/sec and 5.06×10^{-7} m/sec. Although not ideal, the construction of the bores has not significantly impacted on these results because the calculated hydraulic conductivity represents the fastest of all aquifers present. Even under conservative assumptions, drawdown values are predicted to range only between 0.08 m and 0.80 m, consistent with the very low to low hydraulic conductivities (10^{-8} – 10^{-7} m/s) and confirming that any pit-related groundwater impacts will be negligible. Therefore, the expansion of mining activities at Agate Creek presents an overall very low to low risk to the aquifers sampled from the relatively small inflows into both the Pit 6 and the minor pit to the west of CCWB519.

Interpolated isopotentials were derived from the September 2023 standing water levels for both the Robin Hood Granodiorite and Corbett Formation Metasediments (Figure 13 and Figure 14). Based on the current available data, the potentiometric surfaces of the Robin Hood Granodiorite and the Corbett Formation Metasediments flow in opposite directions. The Robin Hood Granodiorite bores depict groundwater flow from north to south, whereas the flow direction in the Corbett Formation Metasediments more typically follows the topography from south to northeast. Additional monitoring is required to ensure that the derived potentiometric surfaces accurately reflect the groundwater conditions on site.

Groundwater extraction is estimated to remove 450 ML per annum. Production bore CCRC539 produced water at 16 L/sec during construction. In operation, the flow rate is said to have declined to 6 L/sec. Based on the available monthly and quarterly standing water levels from monitoring nearby bores, no discernible downward trend as a result of extractions could be ascertained. However, it is recommended that all production bores are fitted with flow meters and pressure transducers to accurately measure usage and drawdown. Additionally, the impact to users is deemed to be negligible. Excluding the designated Agate Creek monitoring bores, no groundwater bores were identified within a 5 km buffer from the mining lease boundary. Further, the closest GDE is associated with the sandstone aquifer approximately 10 km away. Two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active.

Based on 1-m digital elevation models for the region, the banks and bed of Agate Creek are approximately 430 mAHD and 425 mAHD, respectively. CCWB530 (422.80 mAHD) and CCWB535 (407.91 mAHD) would likely intersect groundwater inflow to Agate Creek. Over the three monitoring rounds completed in 2022 (April, July and October), all shallow bores remained dry. The two (CCWB536 and CCWB537) monitoring bores – constructed to design in 2021 (screened on 19 m BGL) and located within the closest proximity to Agate Creek and

a smaller tributary – reflect the areas of lowest groundwater elevations, ranging between 411 and 433 mAHD (Figure 15). The elevation difference between the bed of Agate Creek (425 – 430 mAHD) and CCWB537 supports the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek. However, the minor elevation difference between CCWB536 and Agate Creek suggests that continued monitoring is required, with only two data points available for CCWB536. To ensure accurate representation of the system is obtained, the installation of pressure transducers is recommended to capture the changes in standing water level that may occur directly after rainfall and subsequent flow events.

The groundwater across the bore network represents good quality water, with most bores reporting properties below guideline values for drinking water and livestock drinking water, except for. The greatest threat to water quality with the expansion of the Agate Creek mining operations comes from the increased volume of waste rock present on the surface. However, most waste rock samples returned pH, electrical conductivity and NAF properties which present low environmental risk to surrounding groundwaters. Typical of the surrounding geology, much of the waste rock is benign, with elevated levels attributed to samples collected from within the ore body.

A simple block groundwater numerical model was developed in support of the derived empirical model used to calculate the potential impact of drawdown and contaminant transport with the project site. Initial modelling failed to provide results when modelled contamination was released from the waste rock dumps – due to the infiltration failing to reach surrounding groundwater levels. Conversely, transport modelling of contaminants released into the groundwater from the primary void depicts a progression of 247 m from the void over a 300-year period.

Sufficient groundwater data has been collected since 2020 to support the establishment of trigger limits for all active monitoring bores within the Agate Creek network, in accordance with the Department of Environment and Science (2021) guideline *Using monitoring data to assess groundwater quality and potential environmental impacts*.

This evaluation confirms that the monitoring network, particularly the 2020 bore series, is fulfilling its intended purpose of detecting potential impacts from authorised mining activities.

Since 2022, hydrochemical data obtained from bores constructed to appropriate standards has reinforced the understanding that groundwater quality varies between lithological units. These variations are largely governed by preferential flow pathways that span across the identified aquifer systems. Fractured volcanic rocks, such as andesite and rhyolite, appear to play a key role in facilitating hydraulic connectivity, enabling groundwater movement between the Robin Hood Granodiorite and Corbett Formation Metasediments.

This interpretation is further supported by consistent hydrochemical differences between these units, in conjunction with borehole logs and structural mapping, which collectively illustrate the influence of geological structures on subsurface flow dynamics. The findings underscore the need to account for structural controls—particularly those associated with volcanic lithologies—when assessing aquifer interaction and the potential for contaminant migration.

Based on the available data, this groundwater assessment has determined that the expansion of the Agate Creek mining operations would present a low environmental risk to the hydrogeological systems present.

9. REFERENCES

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Appendix A – Analyte timeseries

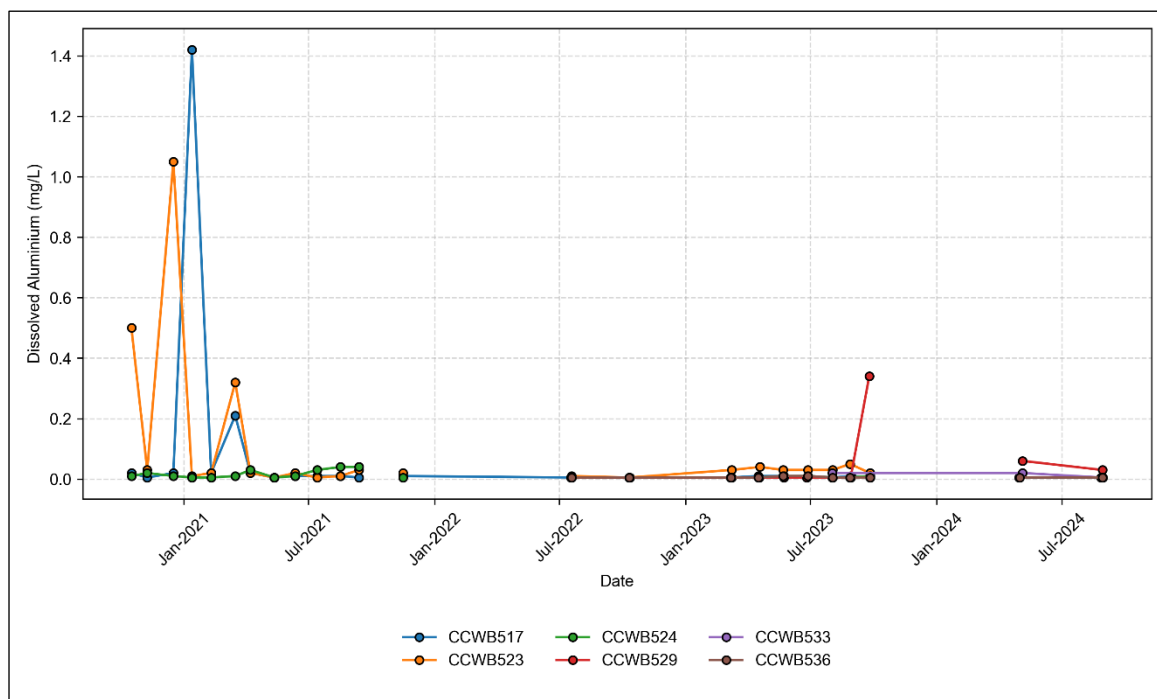


Figure A1: Time series of dissolved aluminium in Robin Hood Granodiorite groundwater monitoring bores

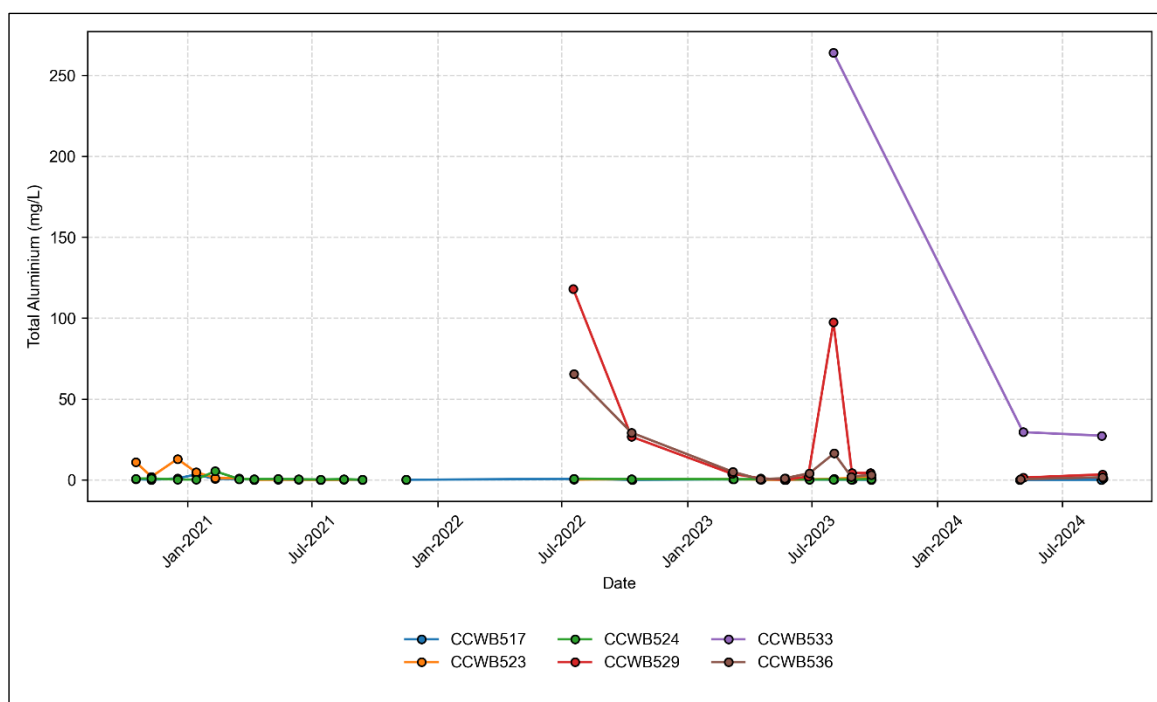


Figure A2: Time series of total aluminium in Robin Hood Granodiorite groundwater monitoring bores.

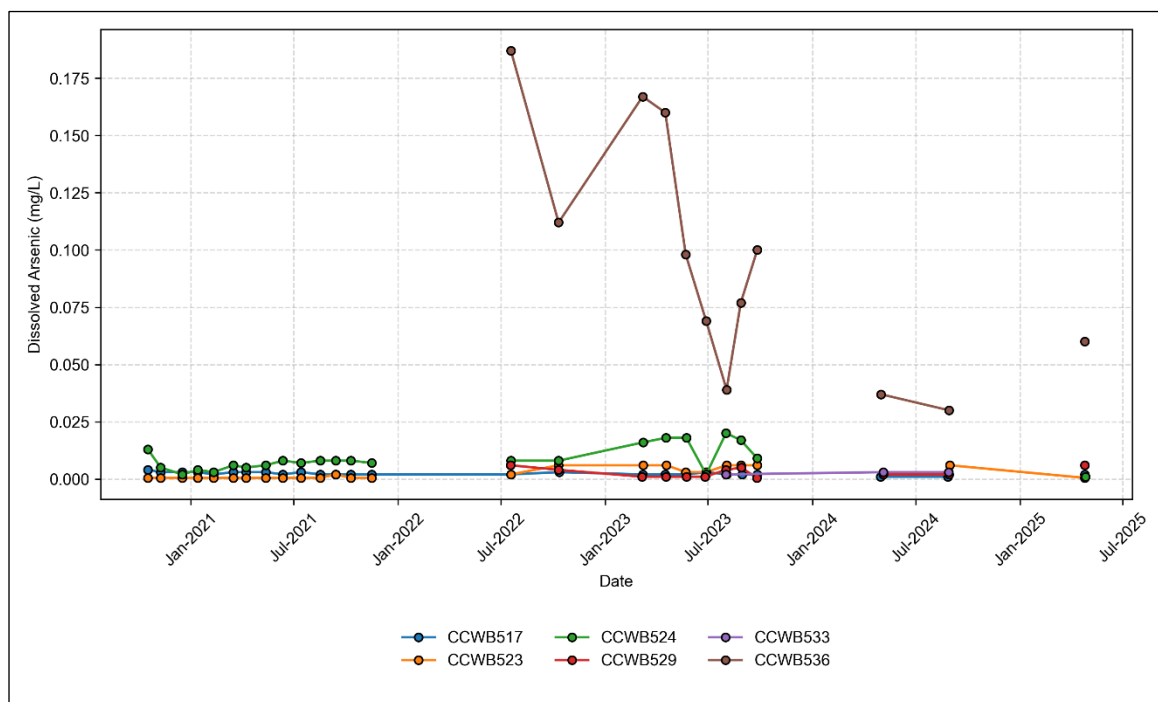


Figure A3: Time series of dissolved arsenic in Robin Hood Granodiorite groundwater monitoring bores.

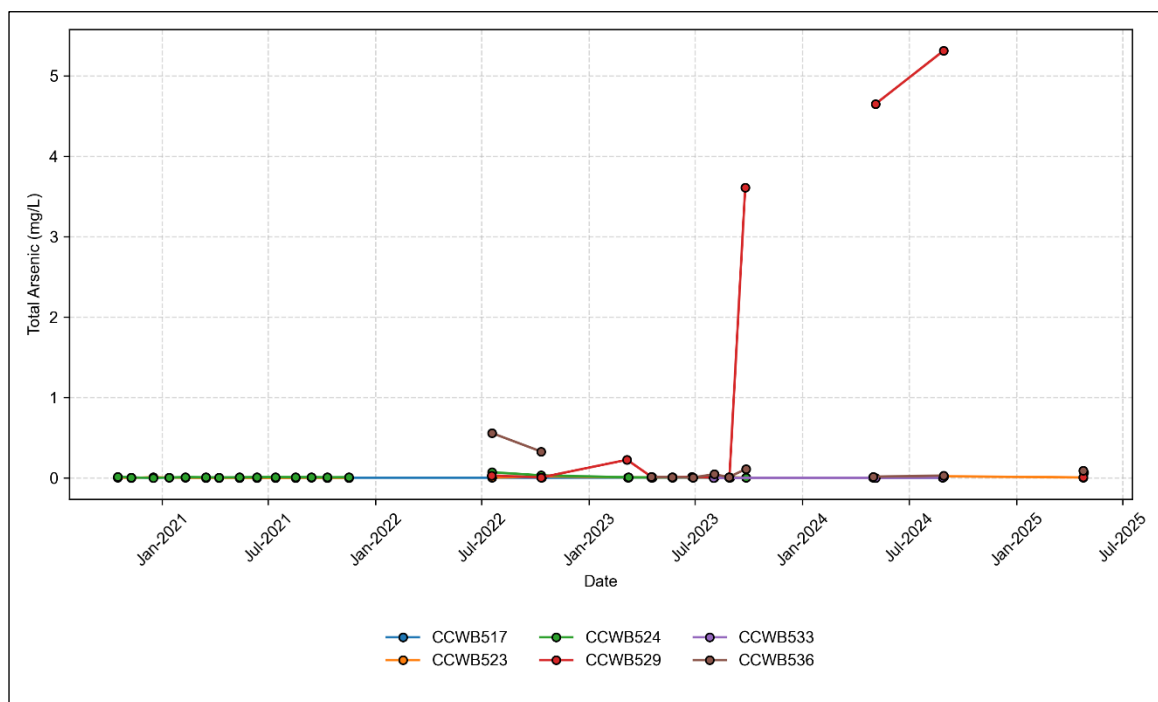


Figure A4: Time series of total arsenic in Robin Hood Granodiorite groundwater monitoring bores.

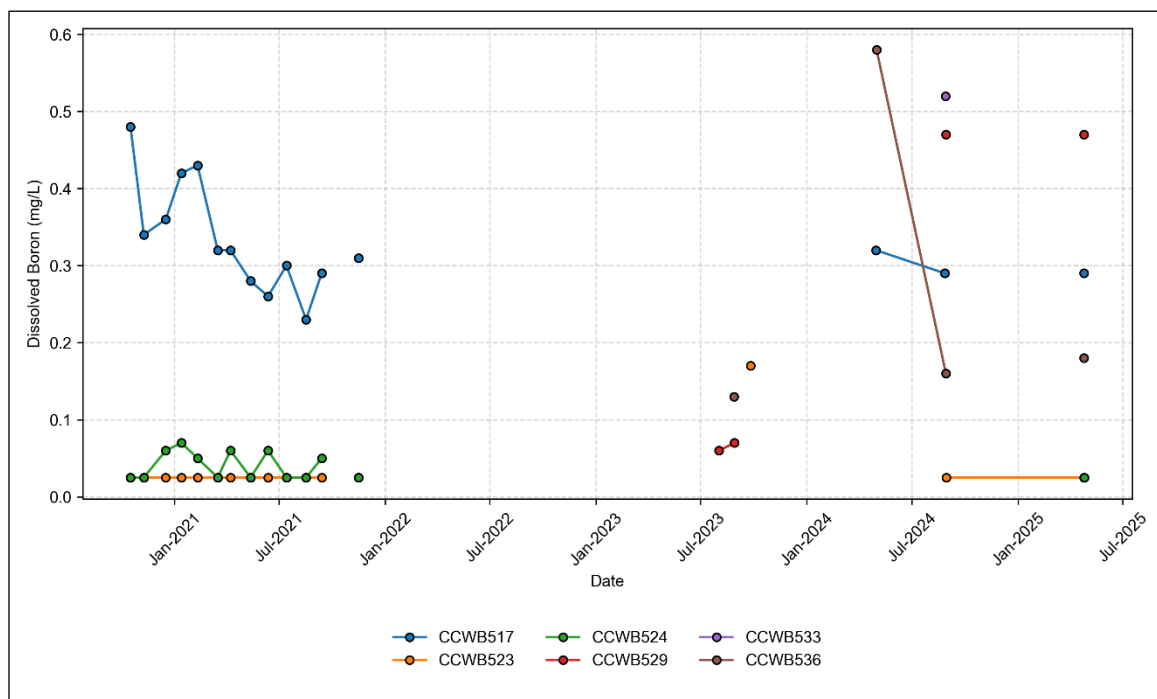


Figure A5: Time series of dissolved boron in Robin Hood Granodiorite groundwater monitoring bores.

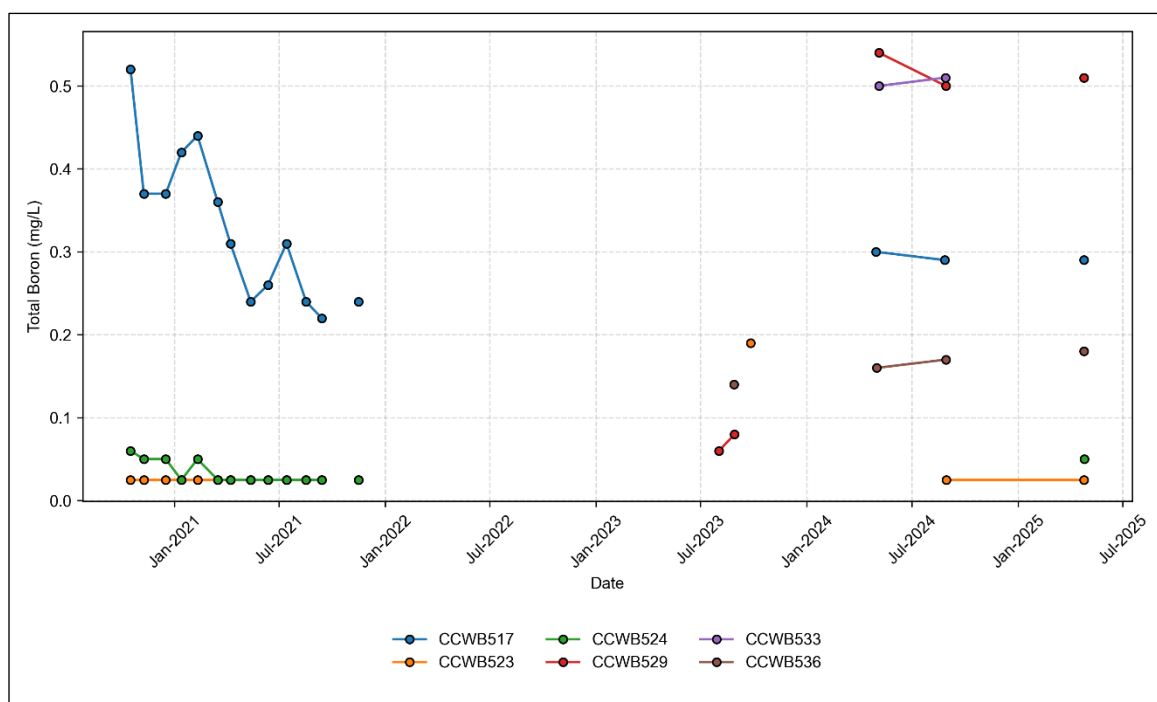


Figure A 6: Time series of total boron in Robin Hood Granodiorite groundwater monitoring bores.

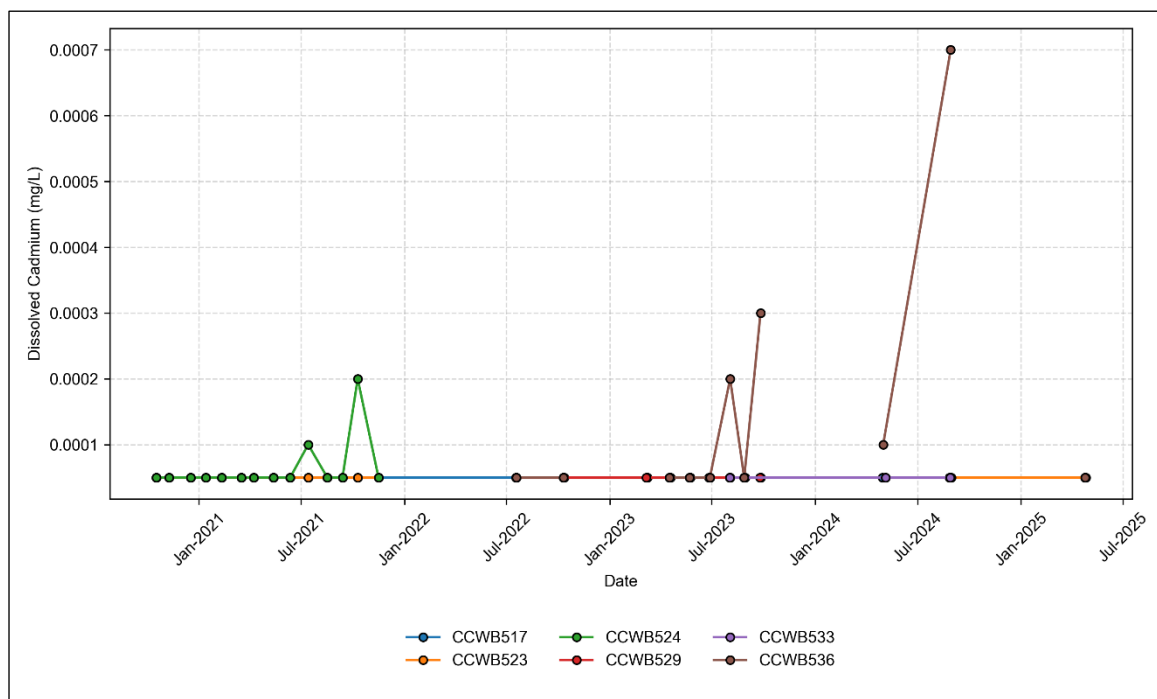


Figure A7: Time series of dissolved cadmium in Robin Hood Granodiorite groundwater monitoring bores.

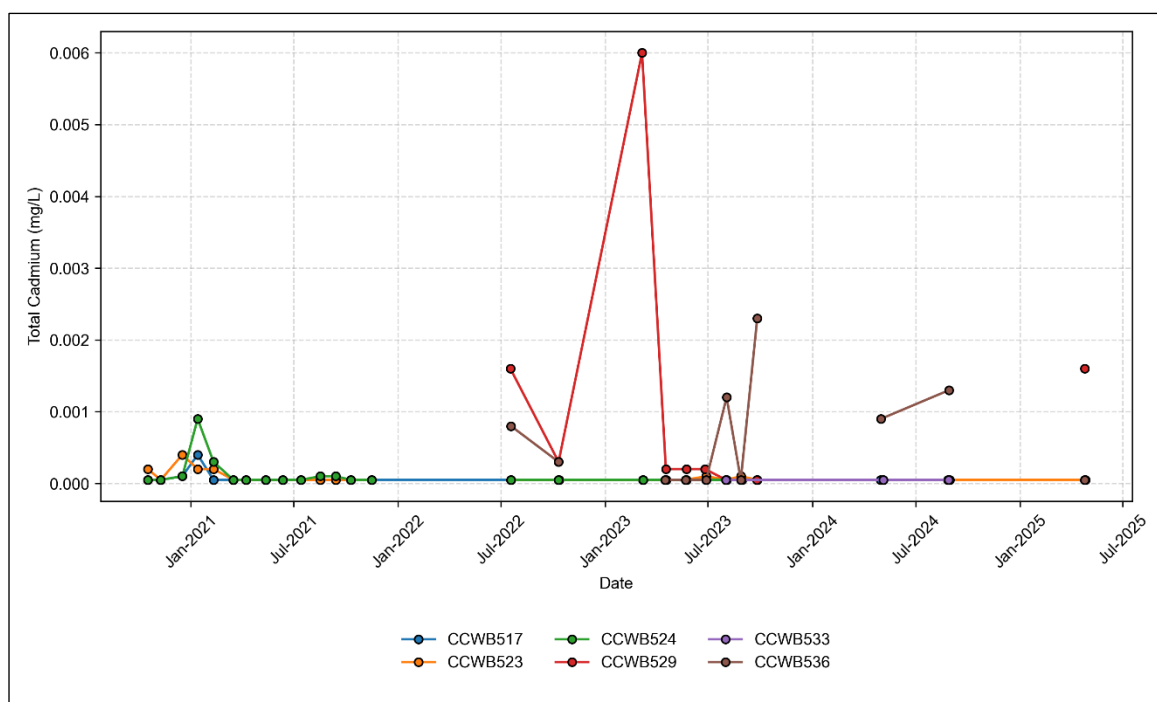


Figure A8: Time series of total cadmium in Robin Hood Granodiorite groundwater monitoring bores.

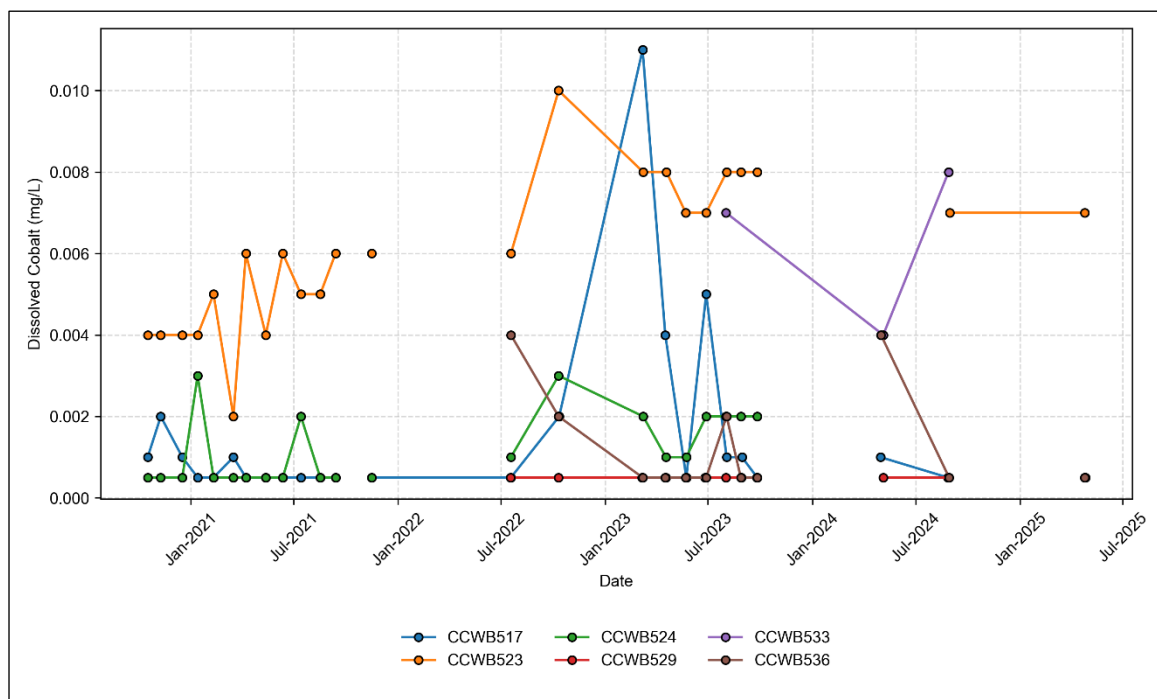


Figure A9: Time series of dissolved cobalt in Robin Hood Granodiorite groundwater monitoring bores.

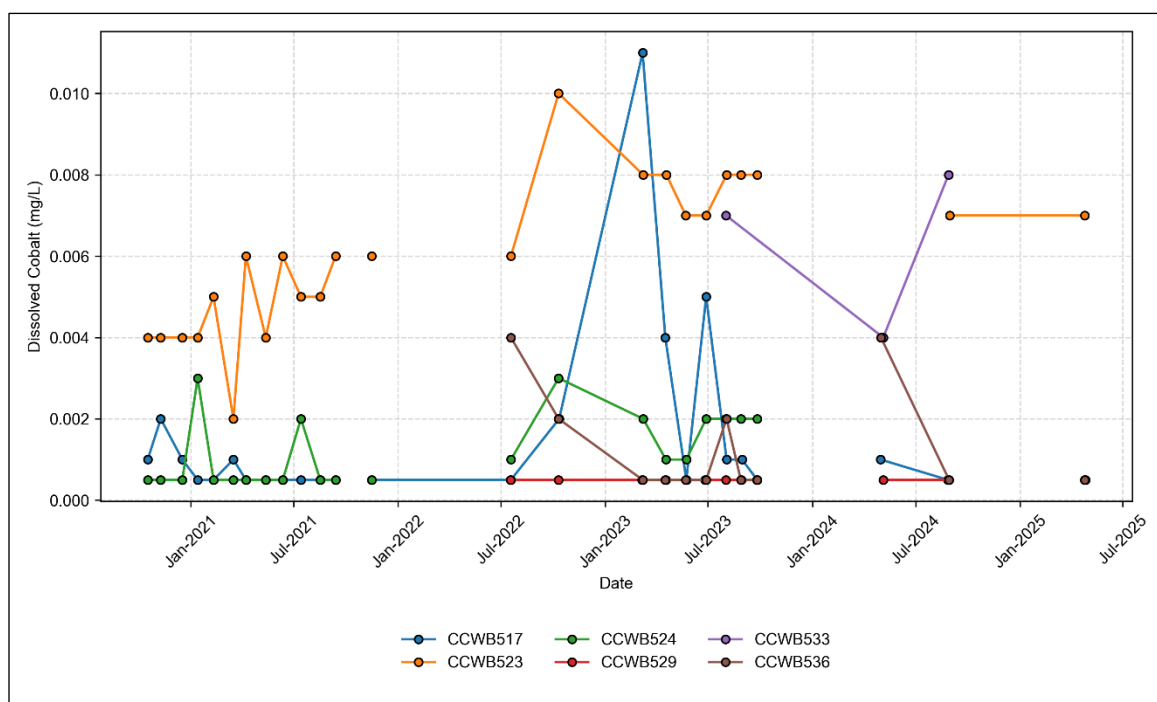


Figure A10: Time series of total cobalt in Robin Hood Granodiorite groundwater monitoring bores.

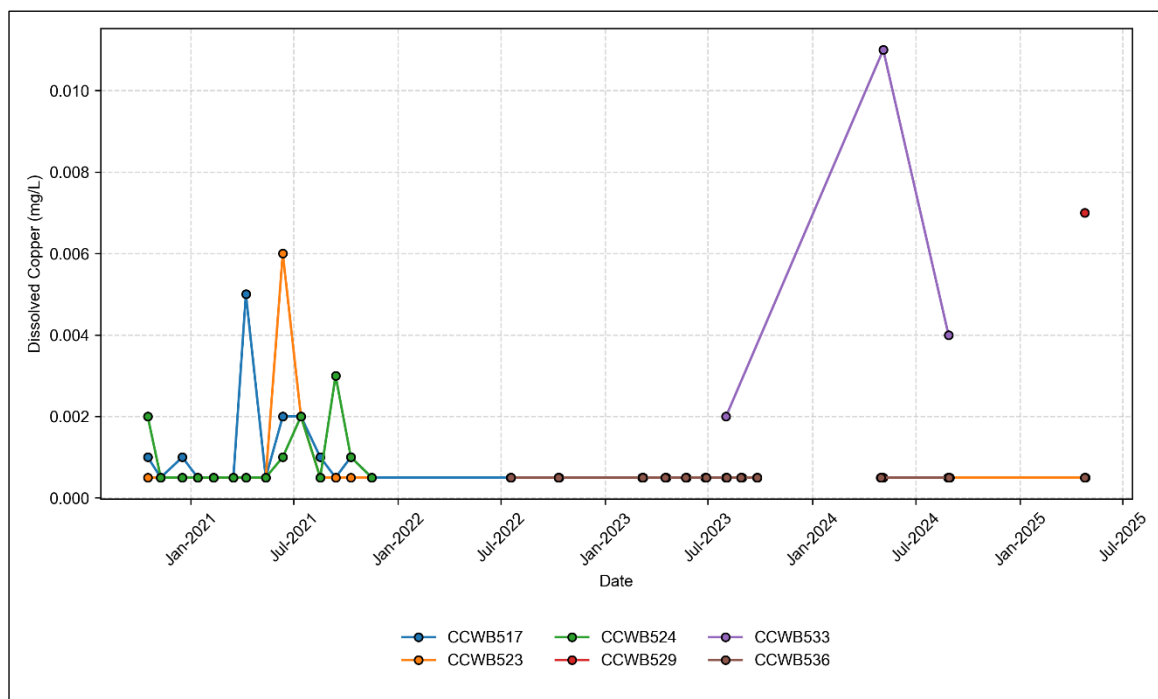


Figure A11: Time series of dissolved copper in Robin Hood Granodiorite groundwater monitoring bores.

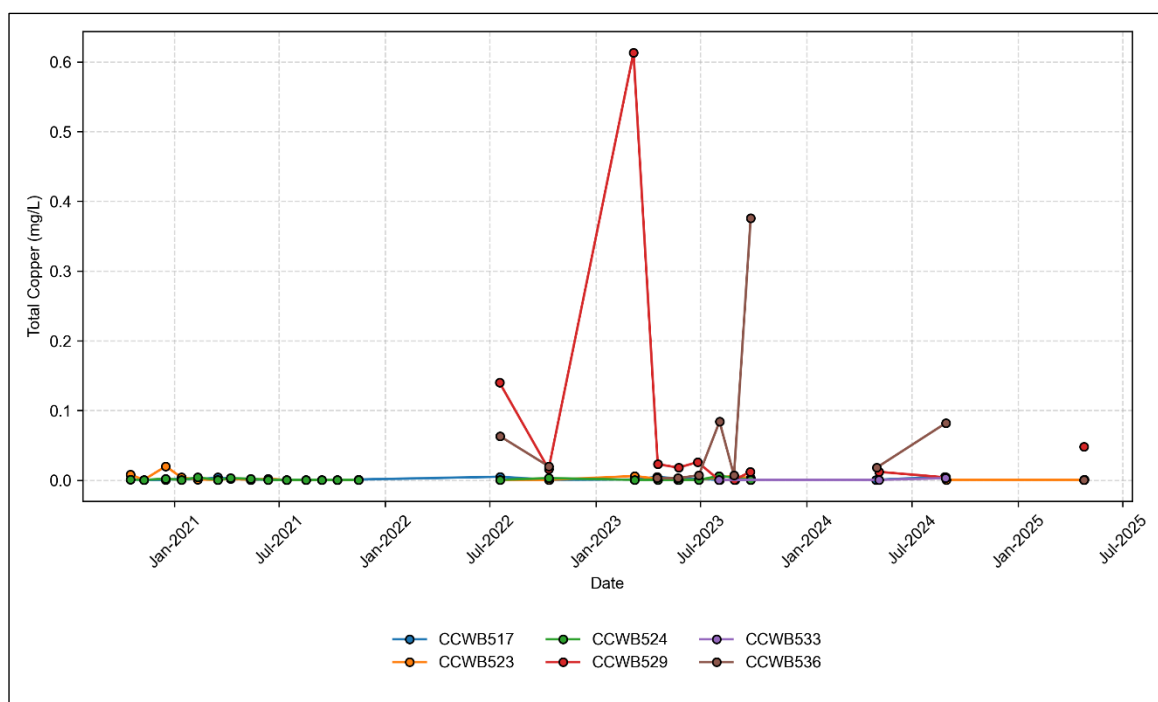


Figure A12: Time series of total copper in Robin Hood Granodiorite groundwater monitoring bores.

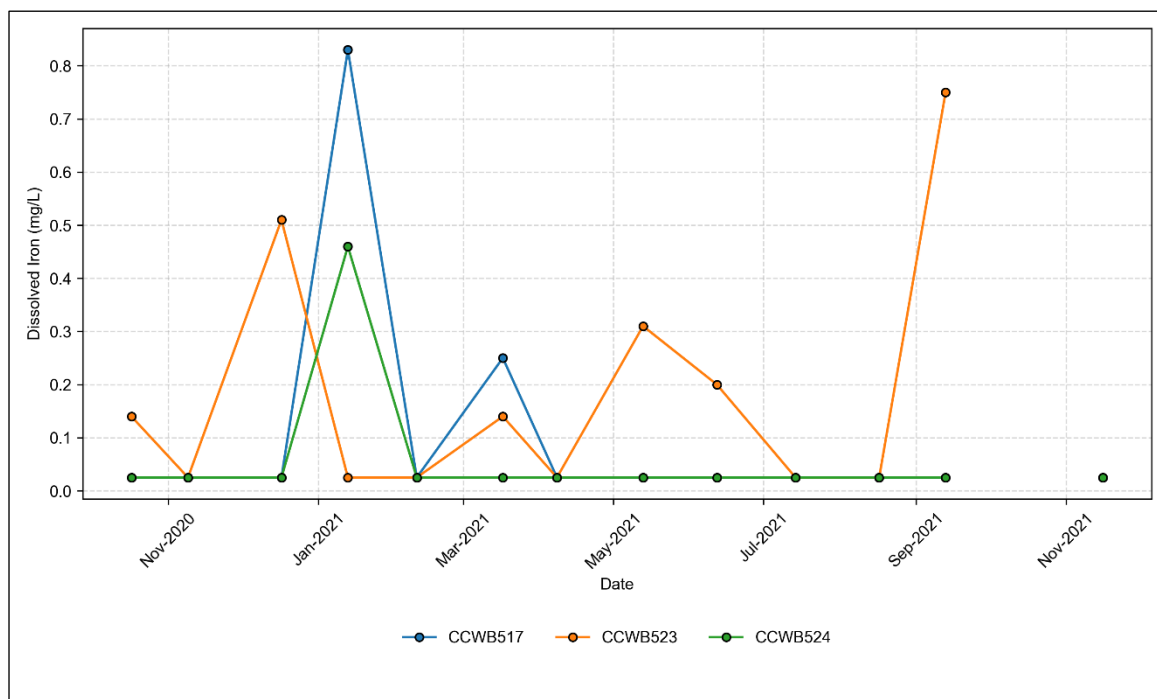


Figure A13: Time series of dissolved iron in Robin Hood Granodiorite groundwater monitoring bores.

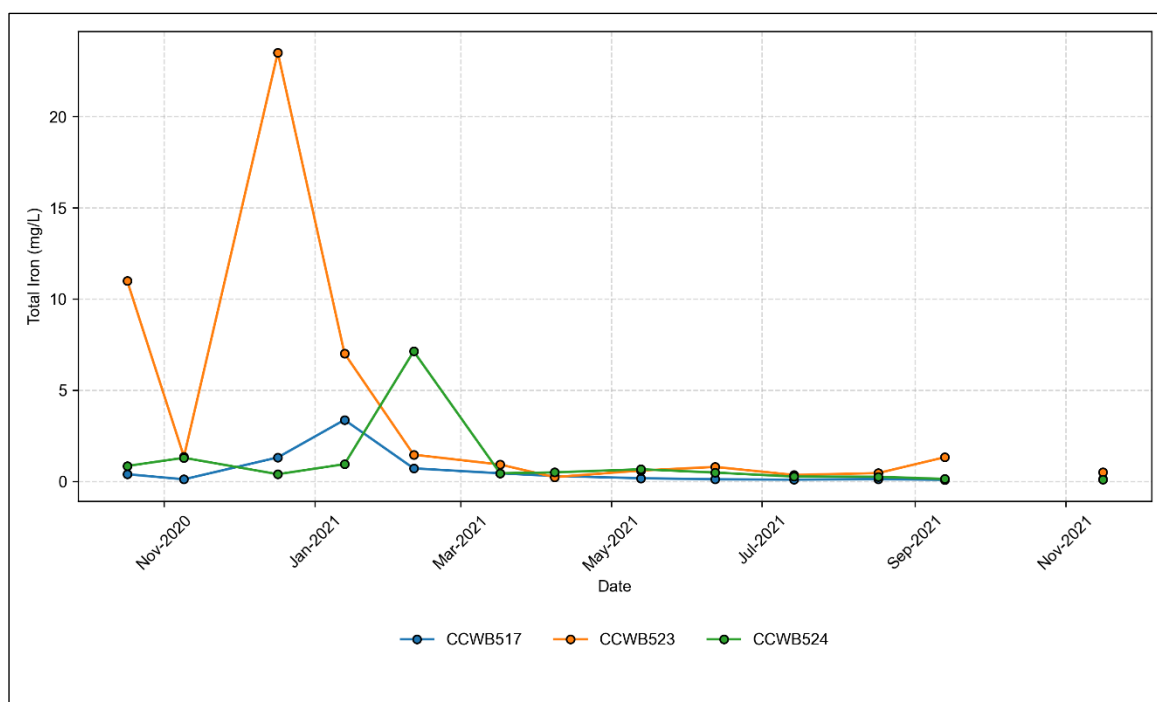


Figure A14: Time series of total iron in Robin Hood Granodiorite groundwater monitoring bores.

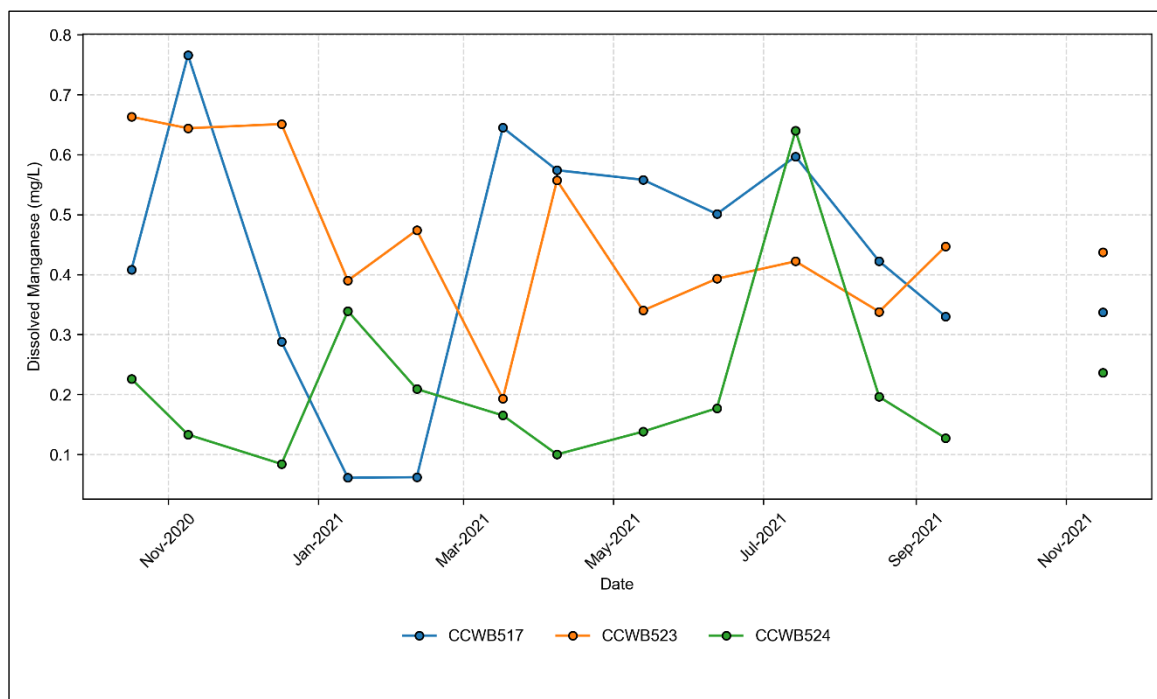


Figure A15: Time series of dissolved manganese in Robin Hood Granodiorite groundwater monitoring bores.

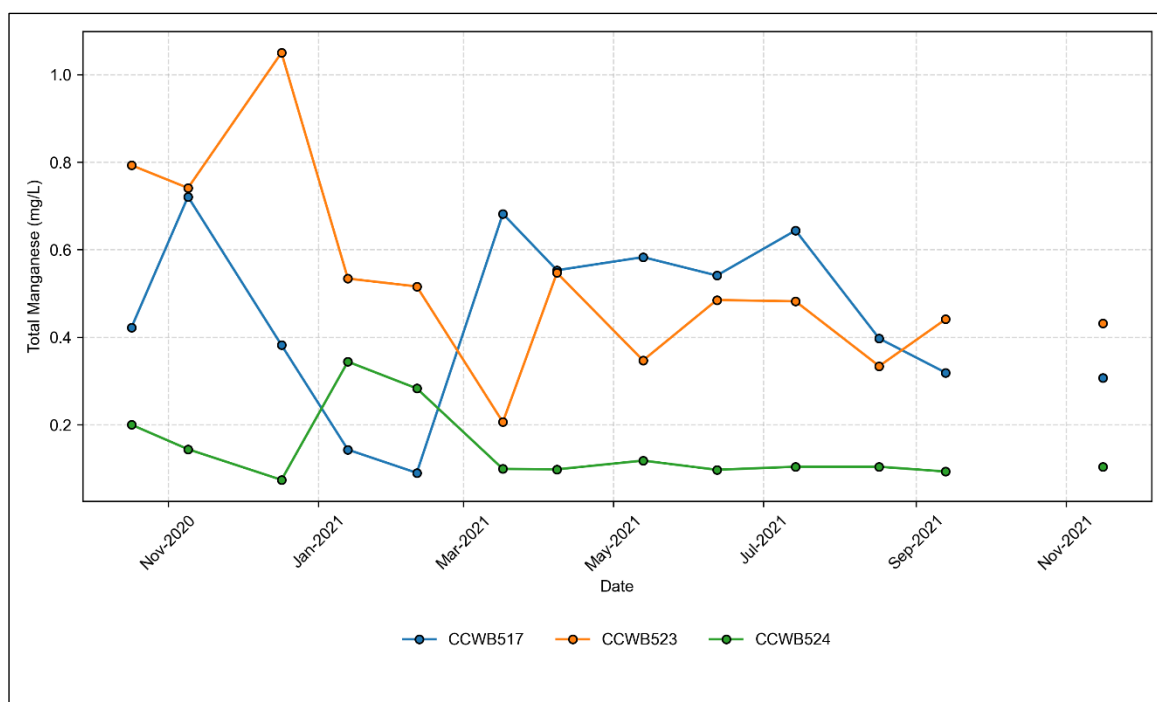


Figure A16: Time series of total manganese in Robin Hood Granodiorite groundwater monitoring bores.

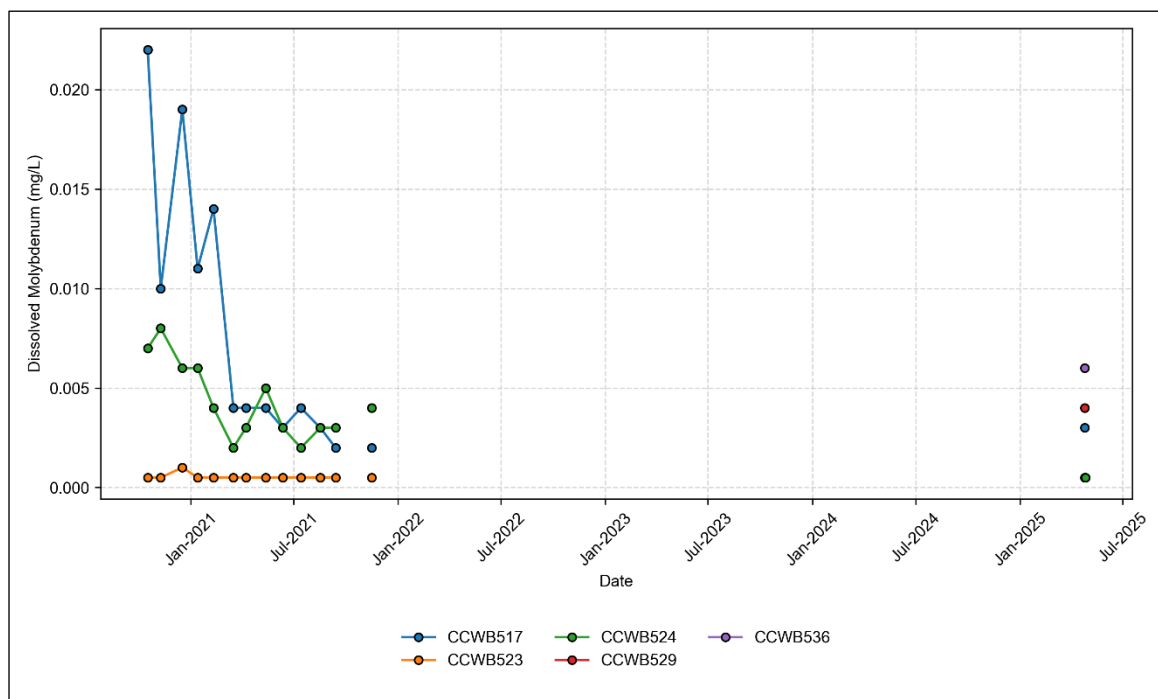


Figure A17: Time series of dissolved molybdenum in Robin Hood Granodiorite groundwater monitoring bores.

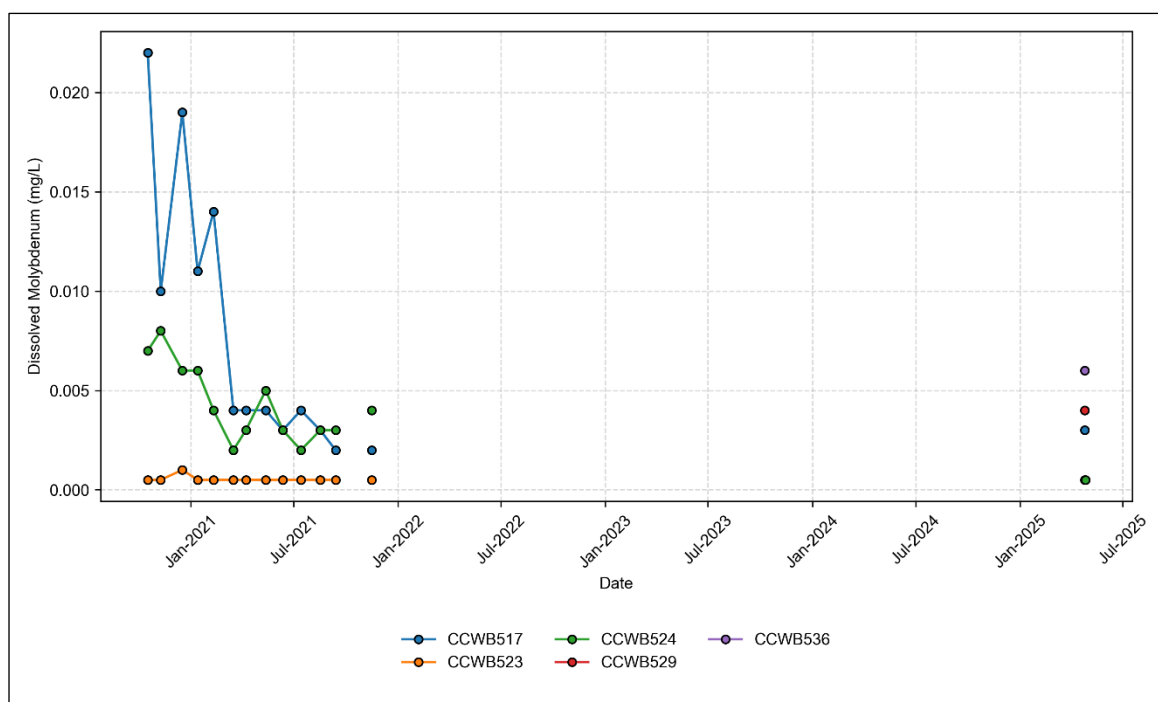


Figure A18: Time series of total molybdenum in Robin Hood Granodiorite groundwater monitoring bores.

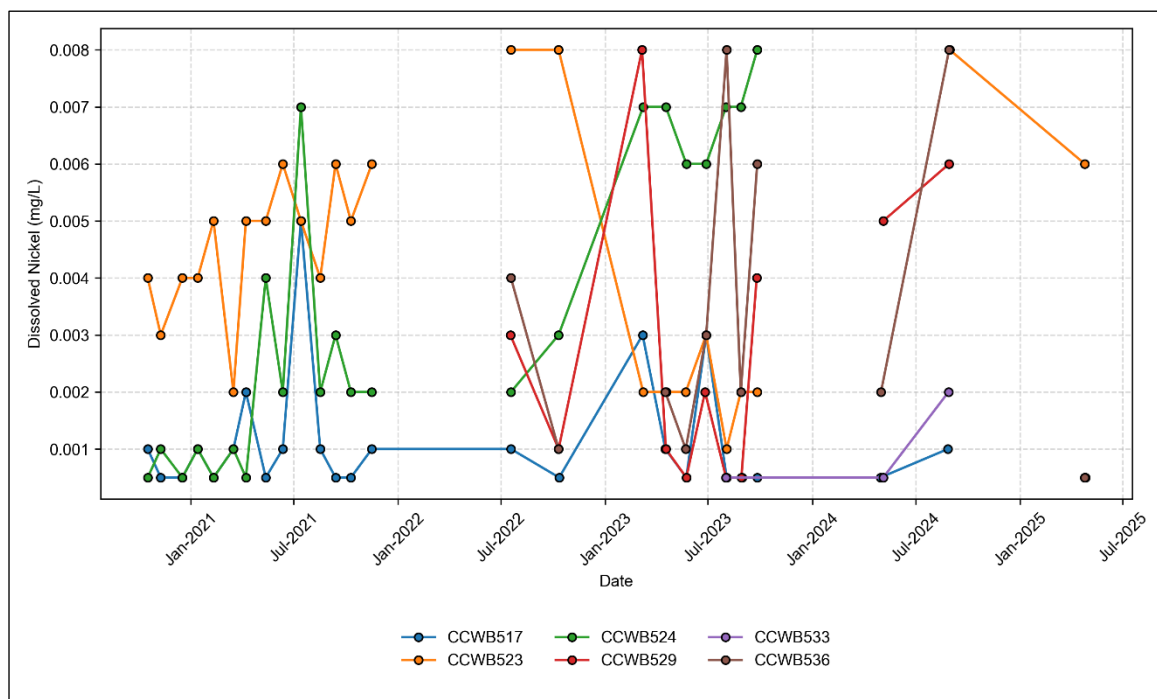


Figure A19: Time series of dissolved nickel in Robin Hood Granodiorite groundwater monitoring bores.

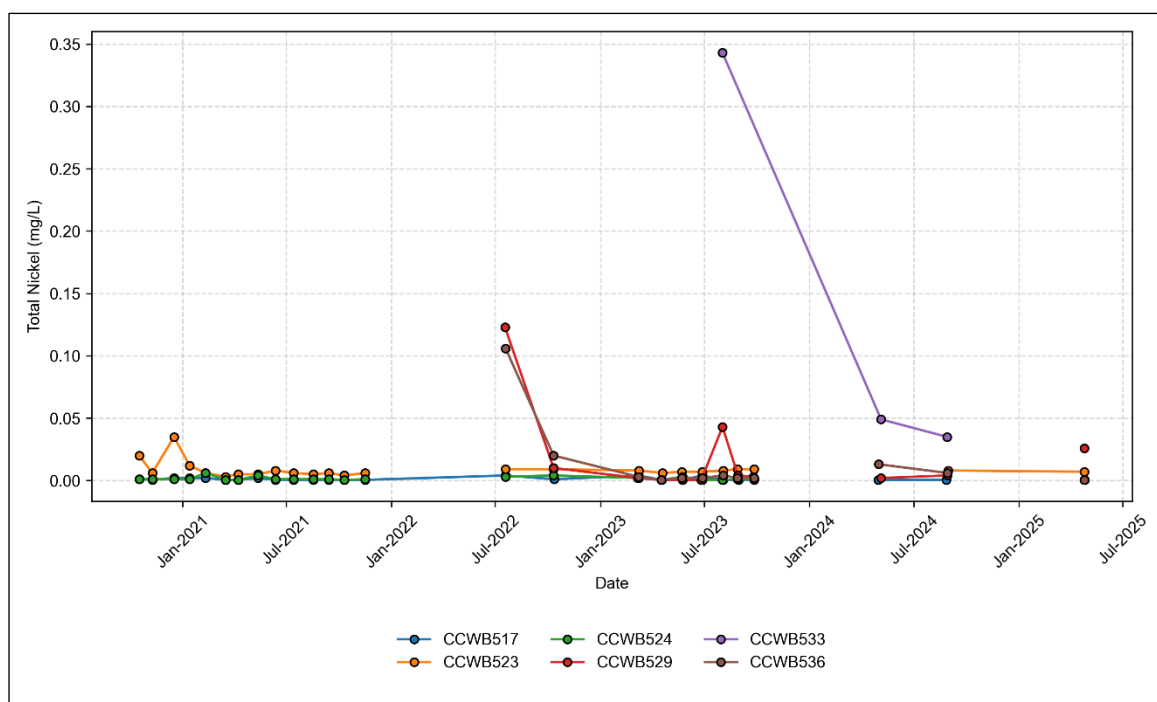


Figure A20: Time series of total nickel in Robin Hood Granodiorite groundwater monitoring bores.

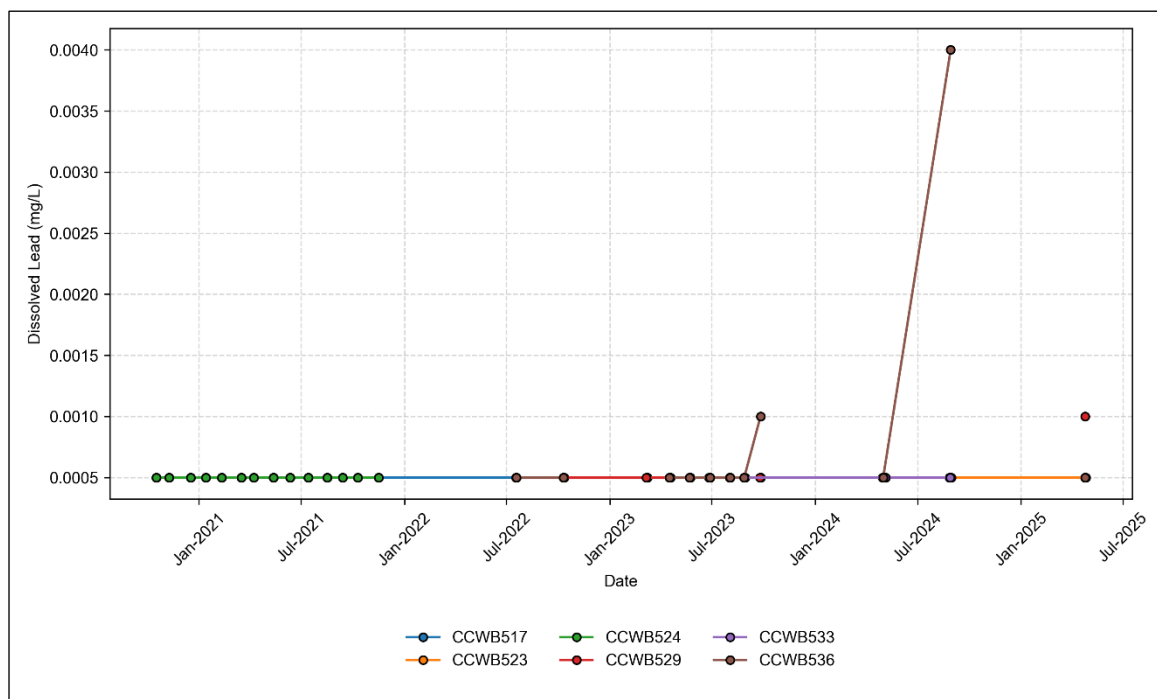


Figure A21: Time series of dissolved lead in Robin Hood Granodiorite groundwater monitoring bores.

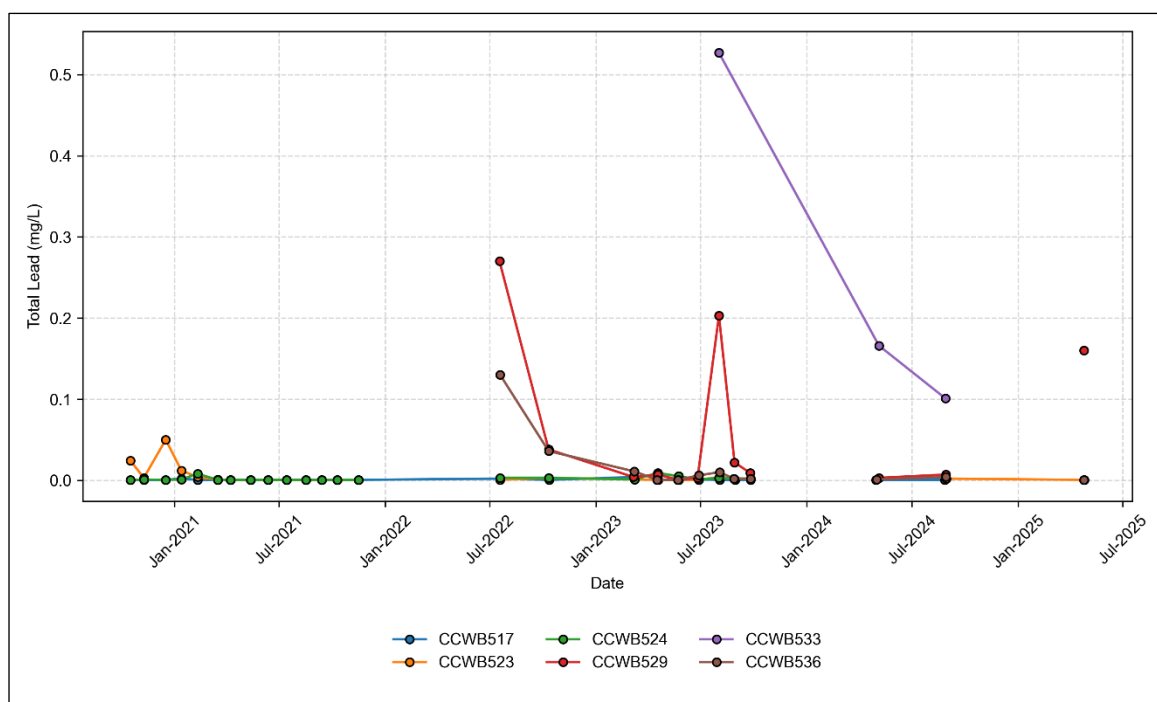


Figure A22: Time series of total lead in Robin Hood Granodiorite groundwater monitoring bores.

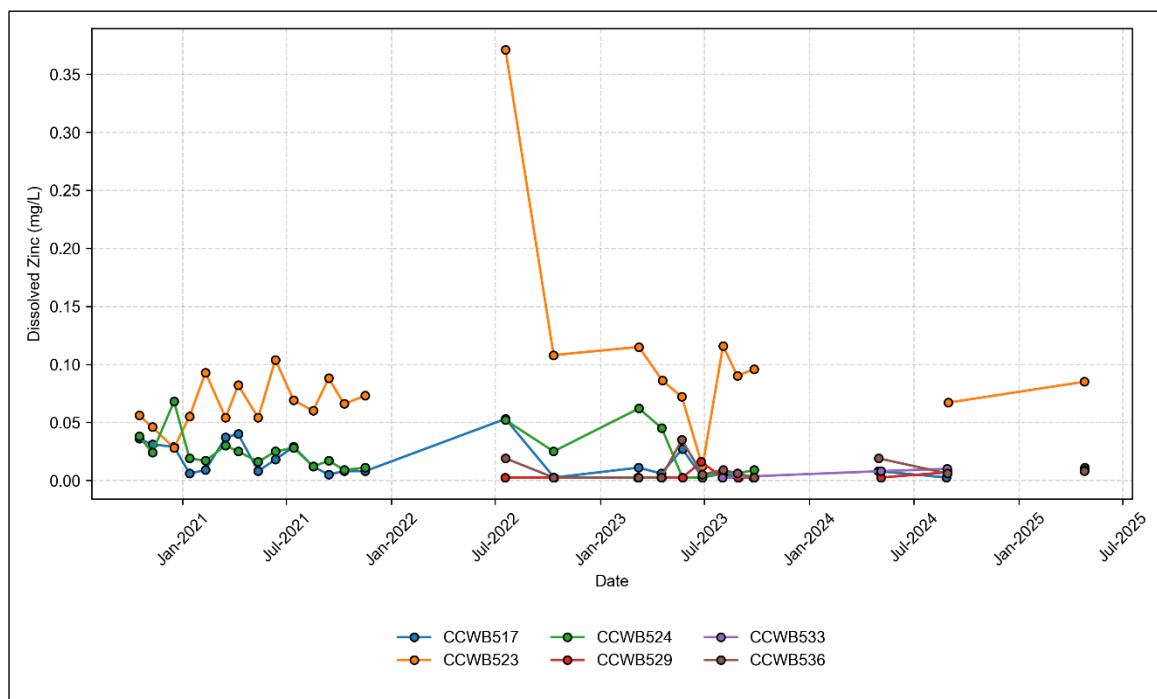


Figure A23: Time series of dissolved zinc in Robin Hood Granodiorite groundwater monitoring bores.

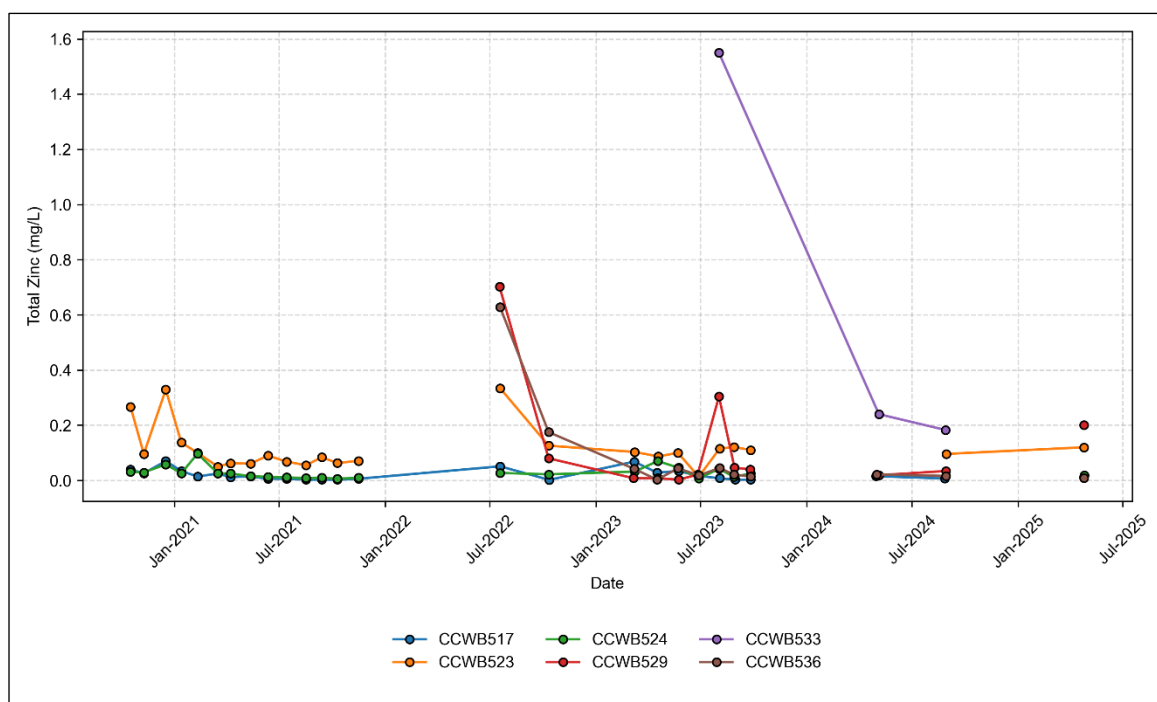


Figure A24: Time series of total zinc in Robin Hood Granodiorite groundwater monitoring bores.

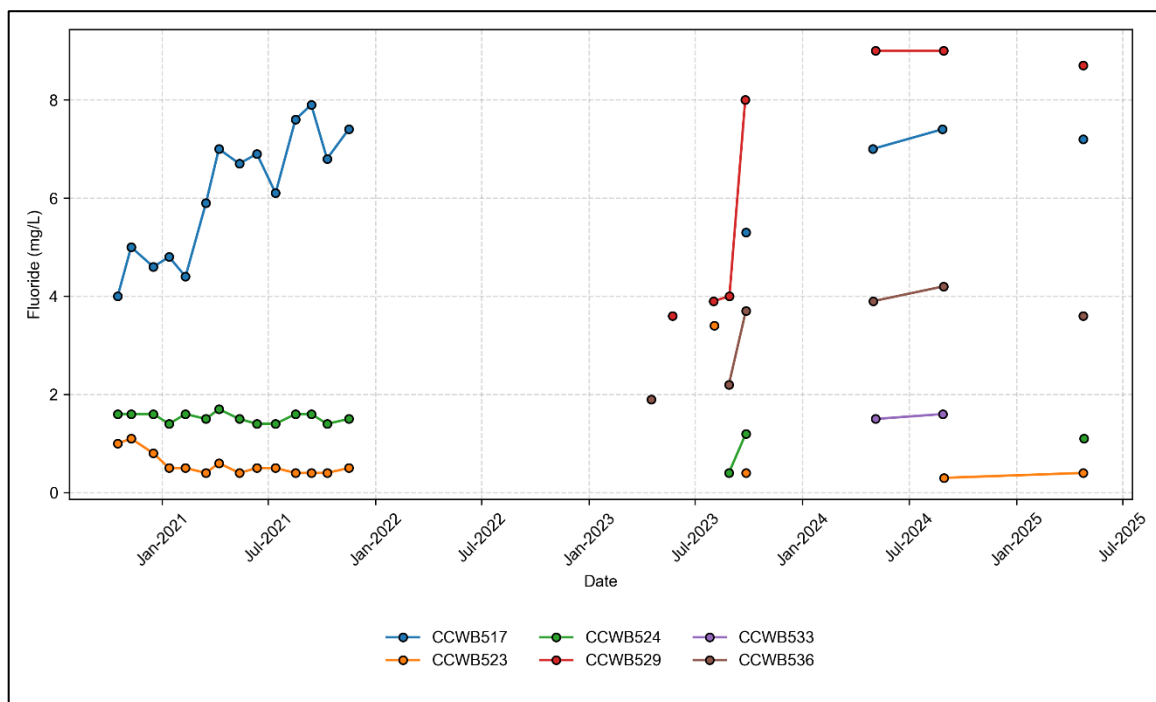


Figure A23: Time series of fluoride in Robin Hood Granodiorite groundwater monitoring bores.

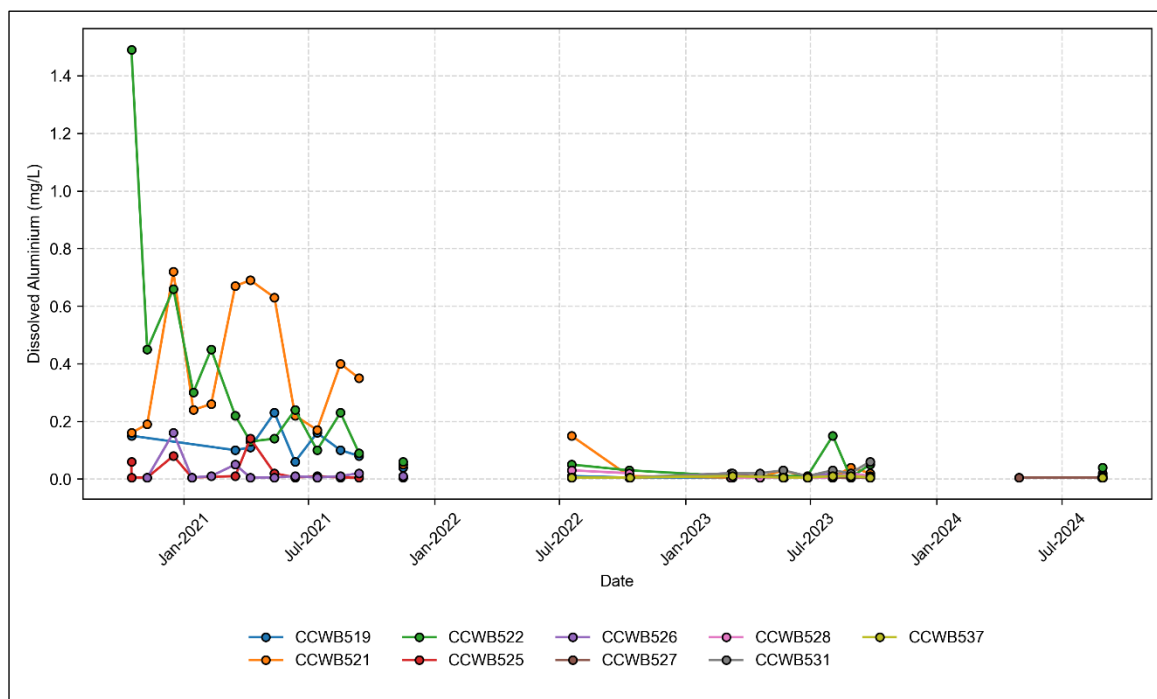


Figure A25: Time series of dissolved aluminium in Corbett Formation Metasediments groundwater monitoring bores

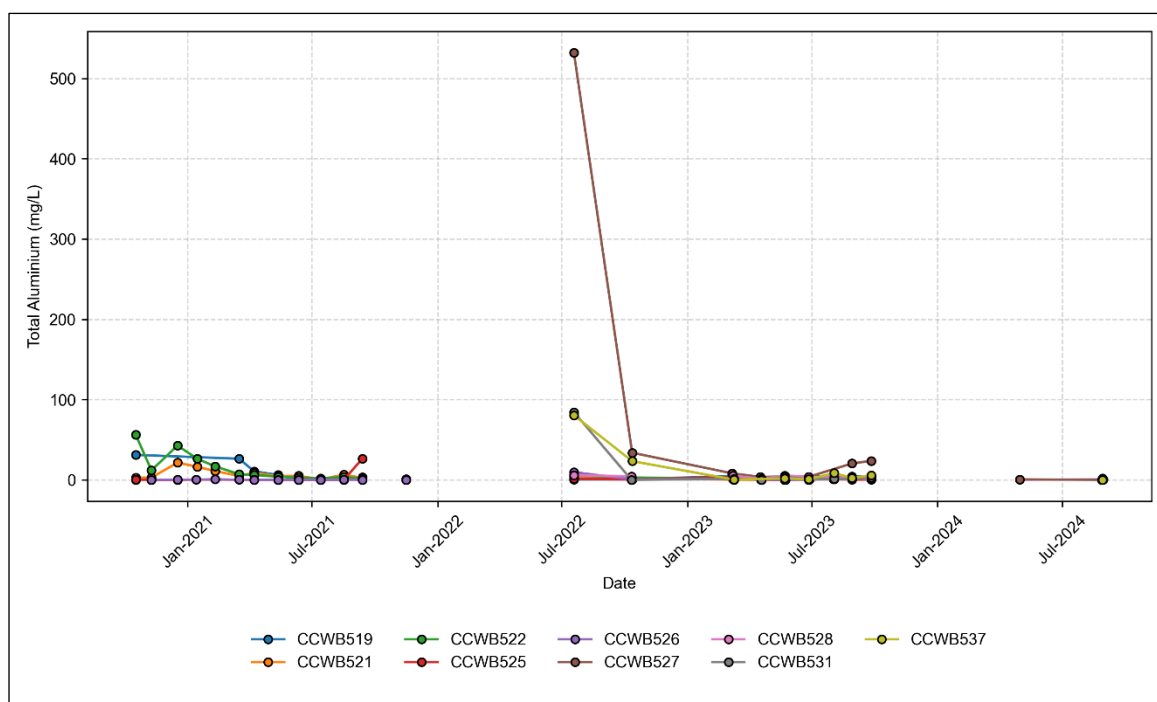


Figure A26: Time series of total aluminium in Corbett Formation Metasediments groundwater monitoring bores.

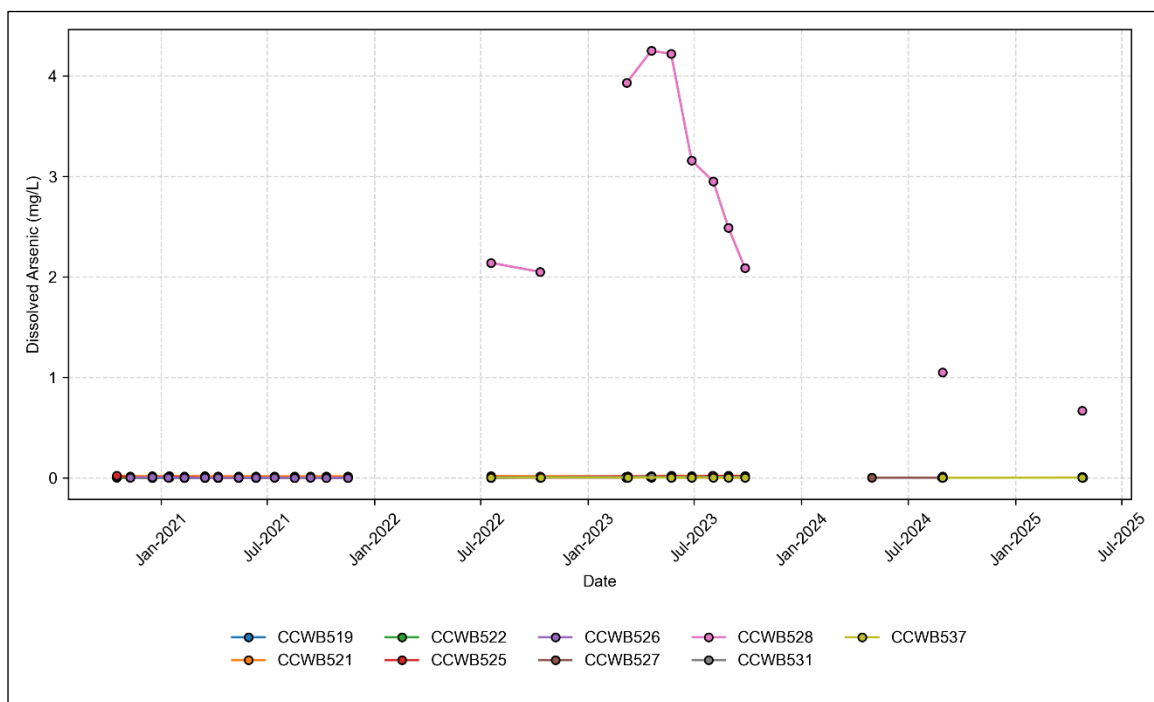


Figure A27: Time series of dissolved arsenic in Corbett Formation Metasediments groundwater monitoring bores.

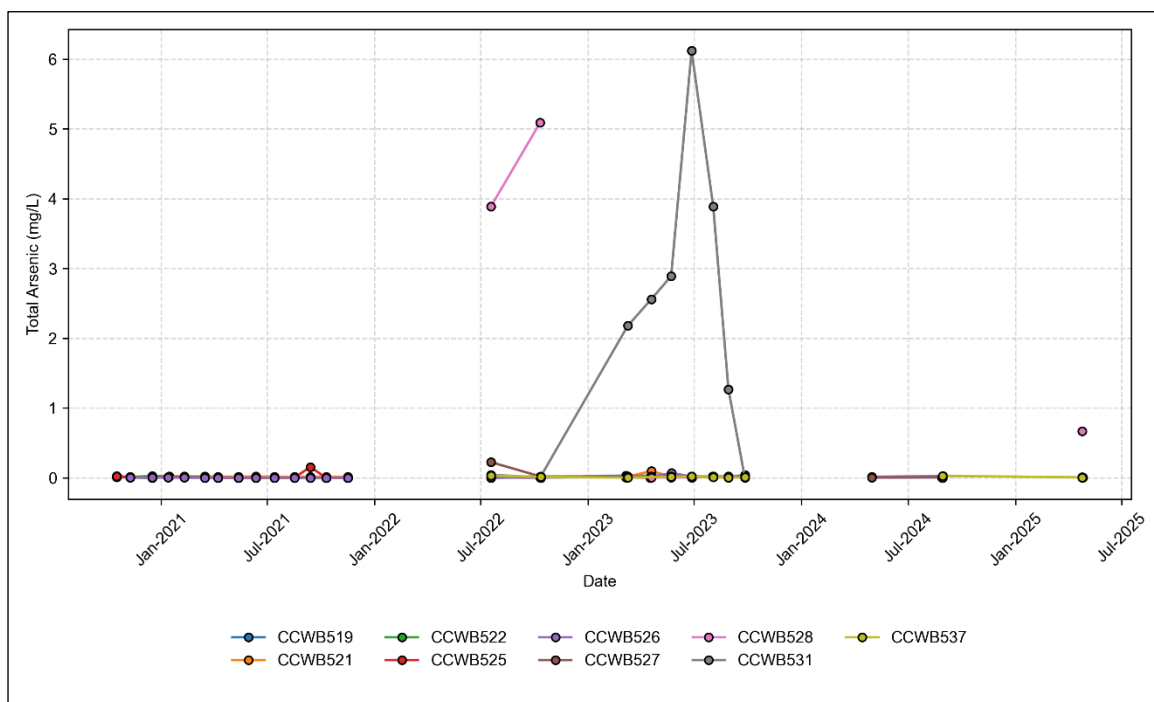


Figure A28: Time series of total arsenic in Corbett Formation Metasediments groundwater monitoring bores.

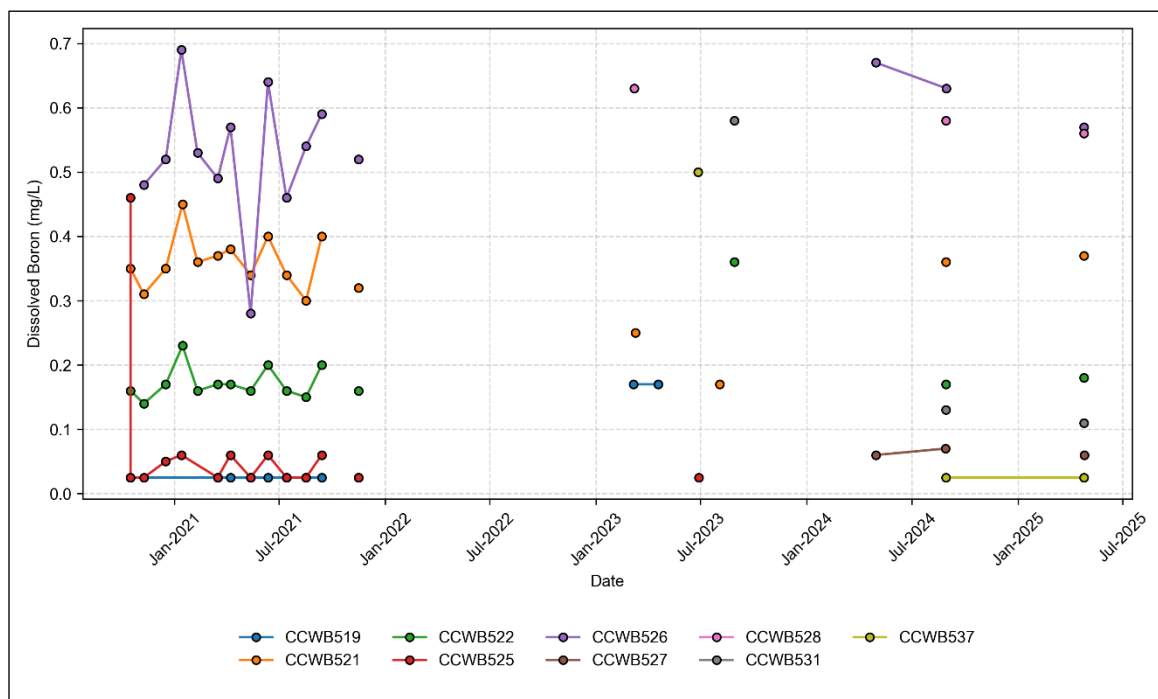


Figure A29: Time series of dissolved boron in Corbett Formation Metasediments groundwater monitoring bores.

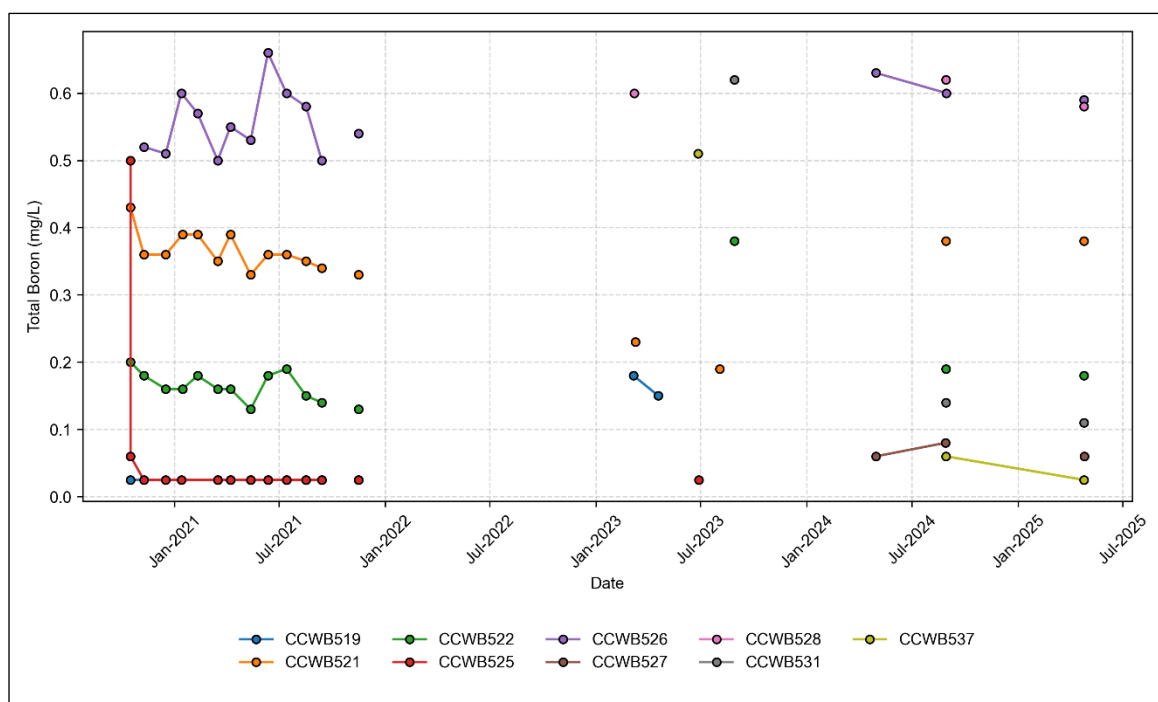


Figure A 30: Time series of total boron in Corbett Formation Metasediments groundwater monitoring bores.

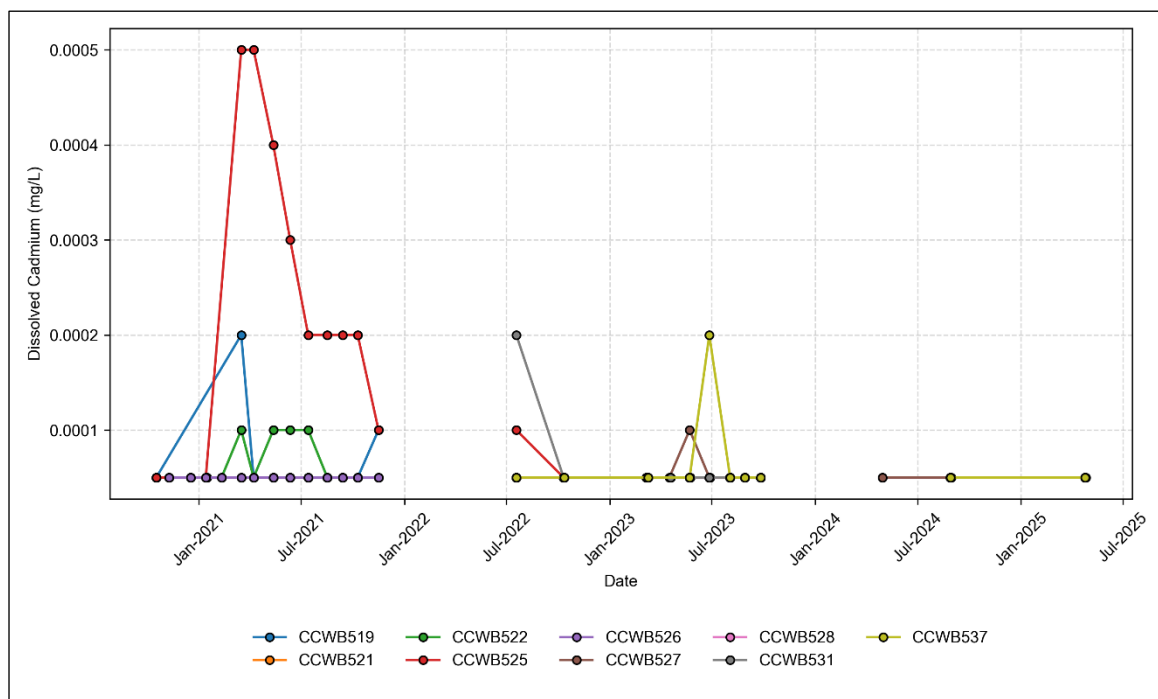


Figure A31: Time series of dissolved cadmium in Corbett Formation Metasediments groundwater monitoring bores.

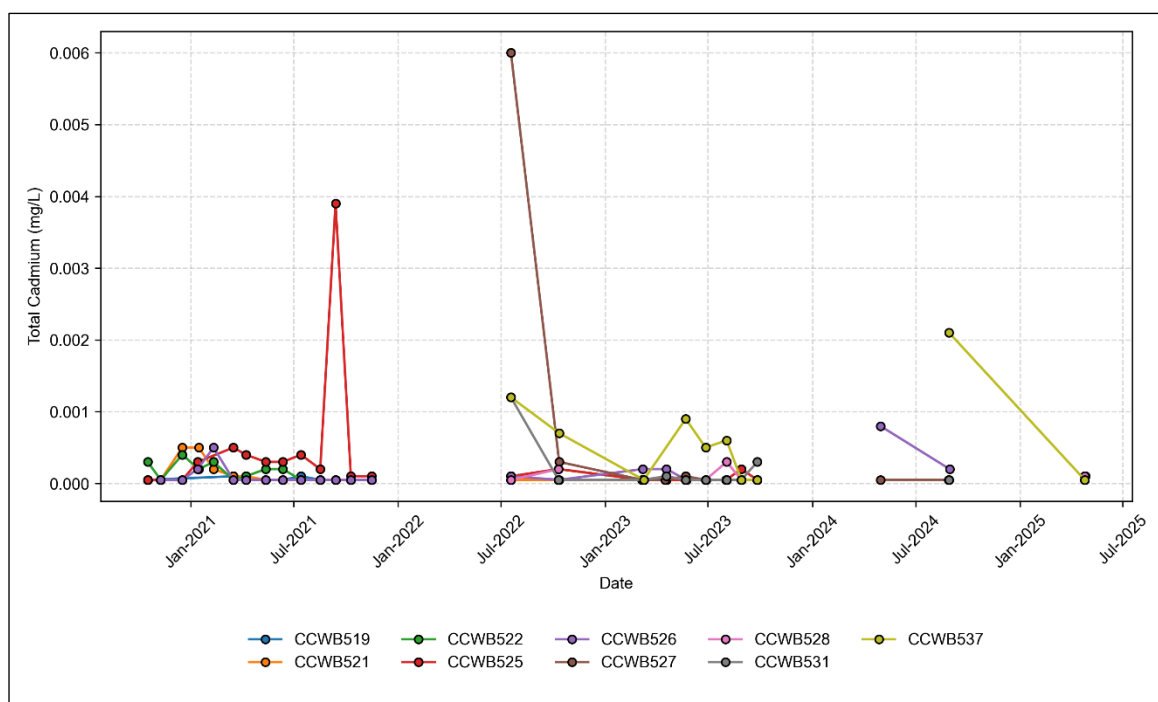


Figure A32: Time series of total cadmium in Corbett Formation Metasediments groundwater monitoring bores.

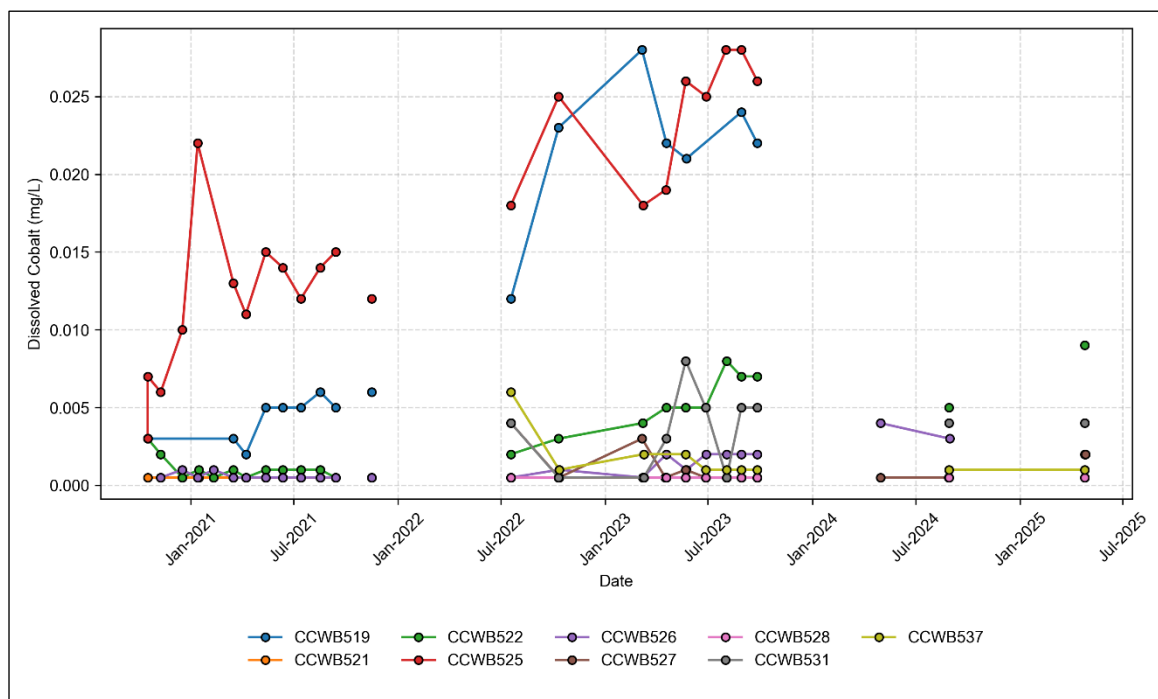


Figure A33: Time series of dissolved cobalt in Corbett Formation Metasediments groundwater monitoring bores.

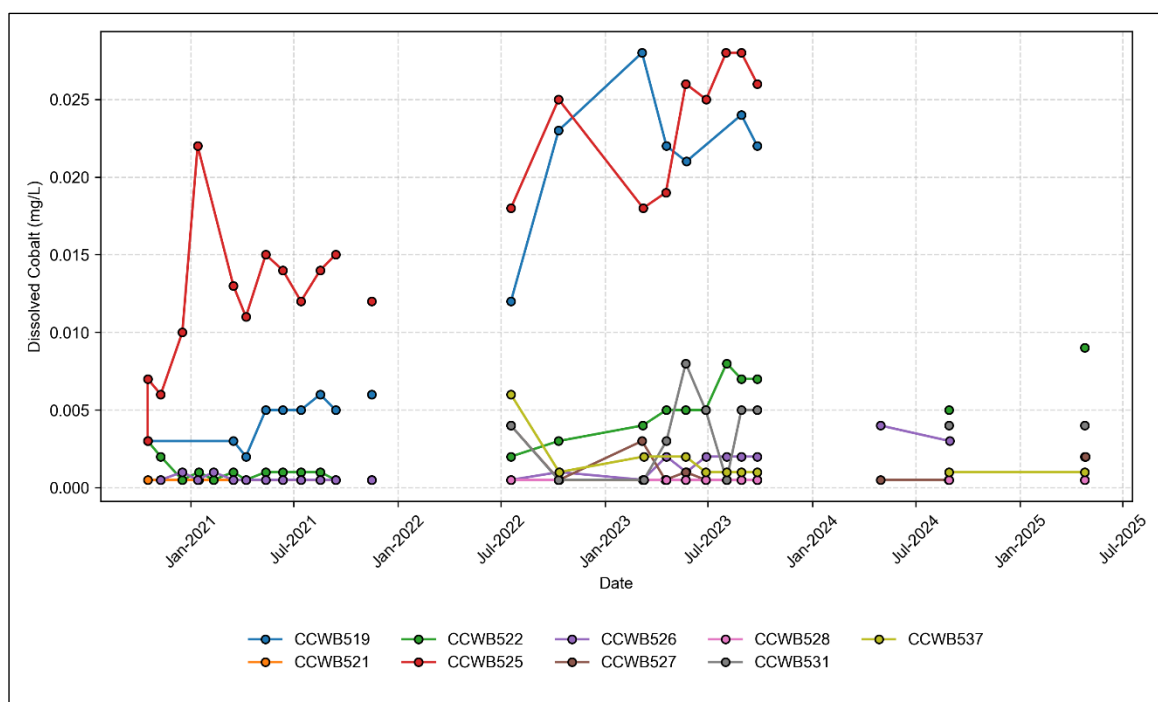


Figure A34: Time series of total cobalt in Corbett Formation Metasediments groundwater monitoring bores.

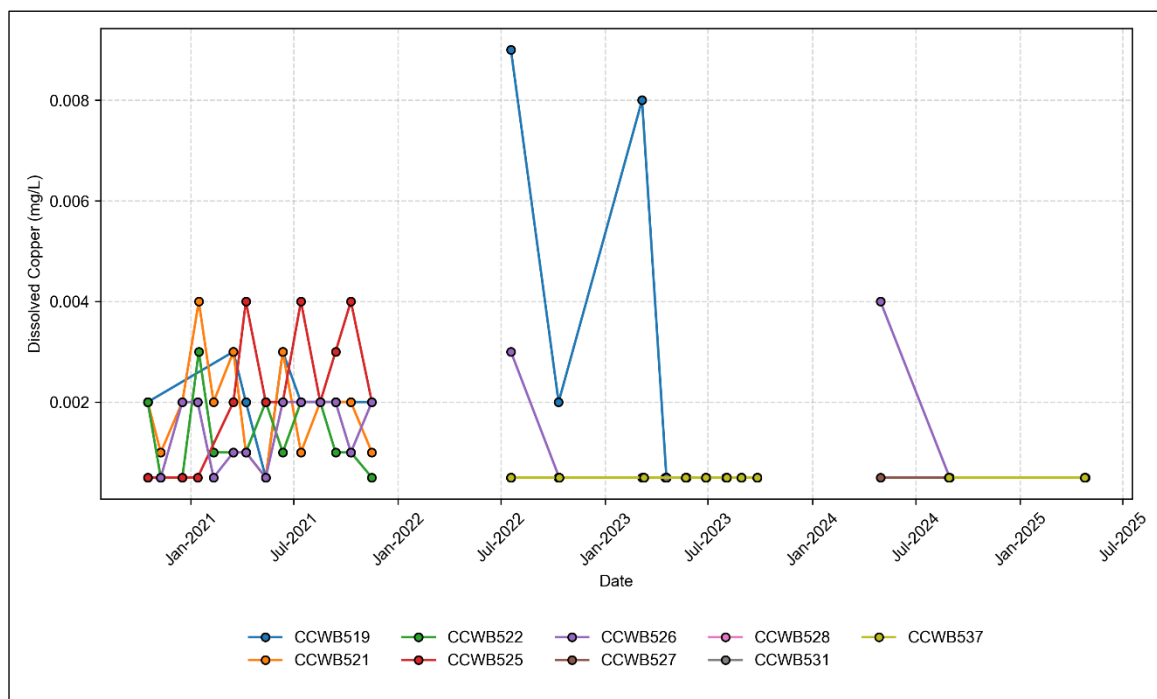


Figure A35: Time series of dissolved copper in Corbett Formation Metasediments groundwater monitoring bores.

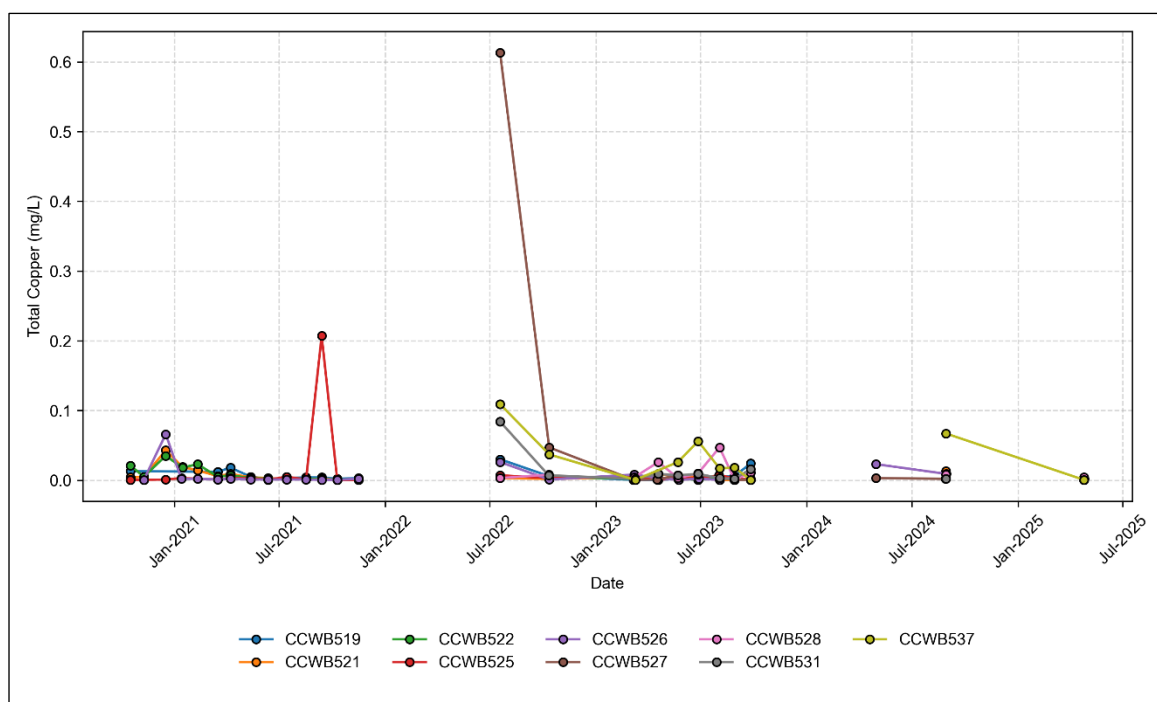


Figure A36: Time series of total copper in Corbett Formation Metasediments groundwater monitoring bores.

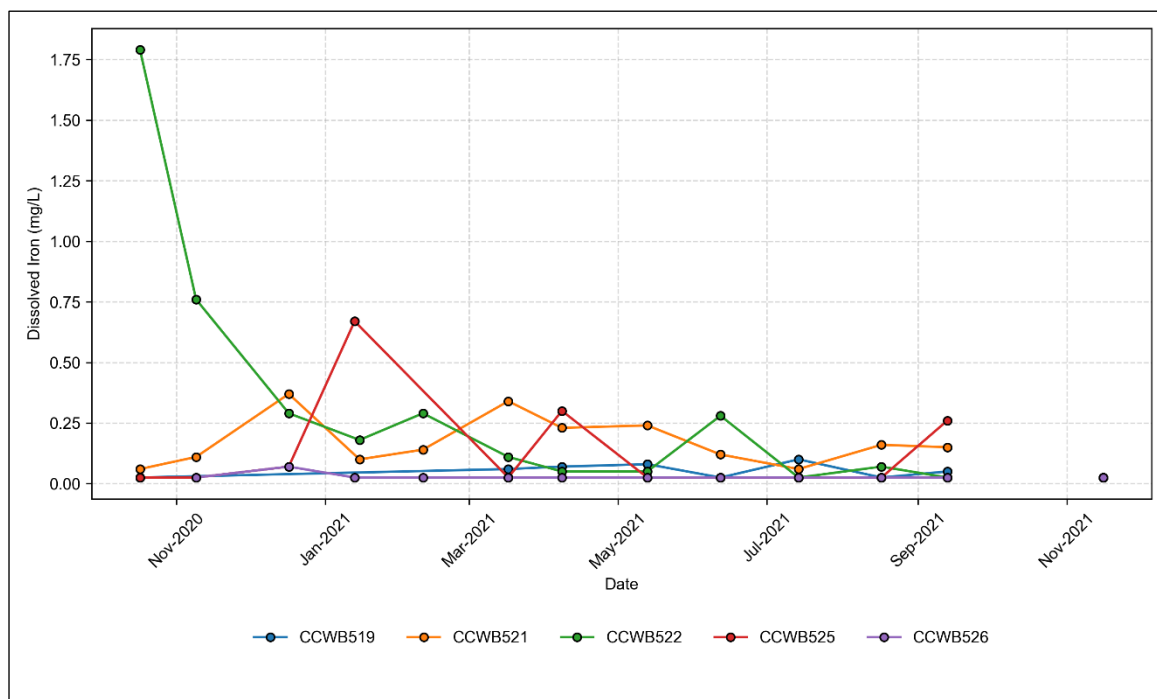


Figure A37: Time series of dissolved iron in Corbett Formation Metasediments groundwater monitoring bores.

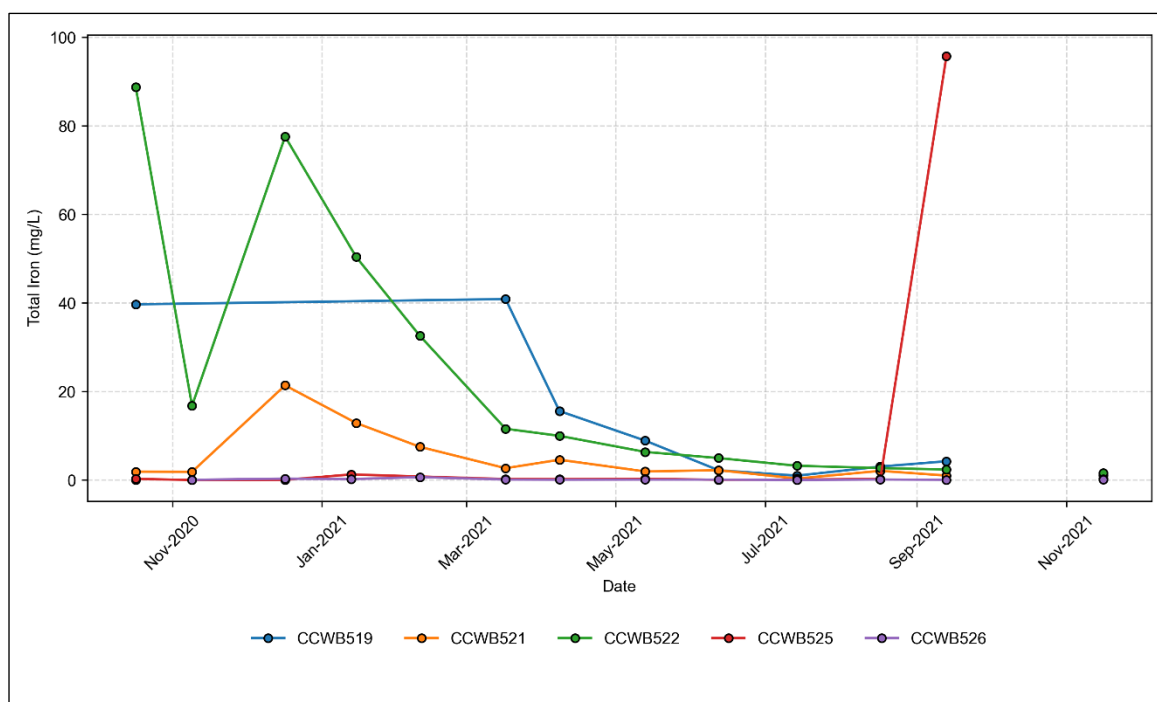


Figure A38: Time series of total iron in Corbett Formation Metasediments groundwater monitoring bores.

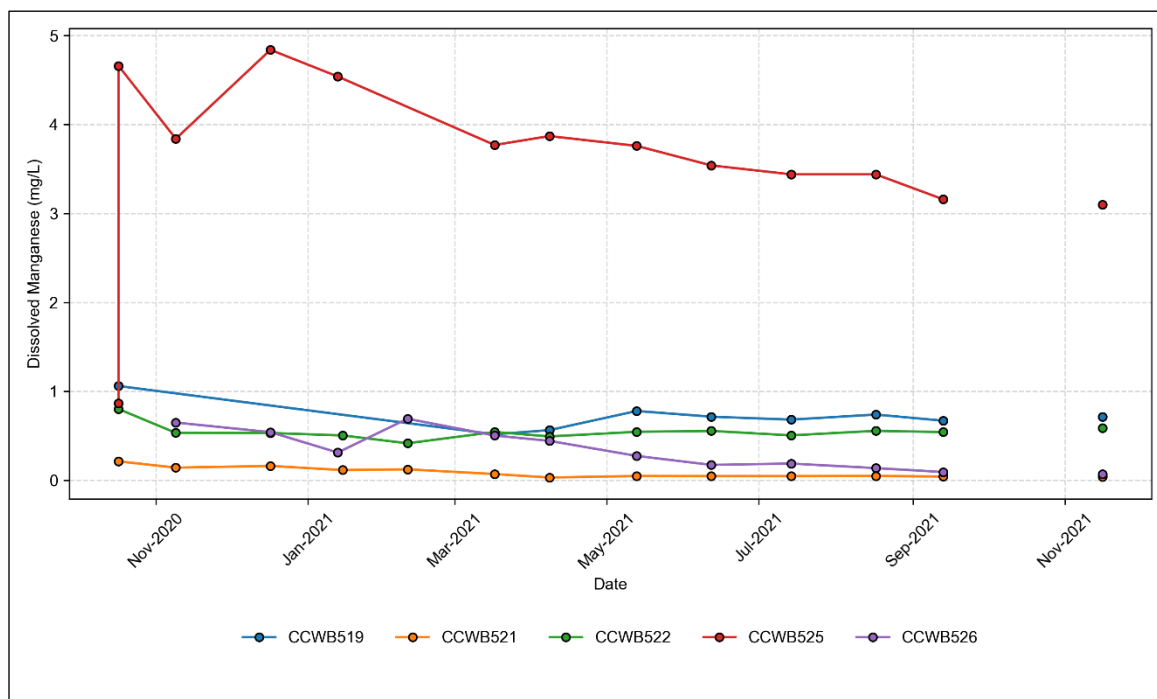


Figure A39: Time series of dissolved manganese in Corbett Formation Metasediments groundwater monitoring bores.

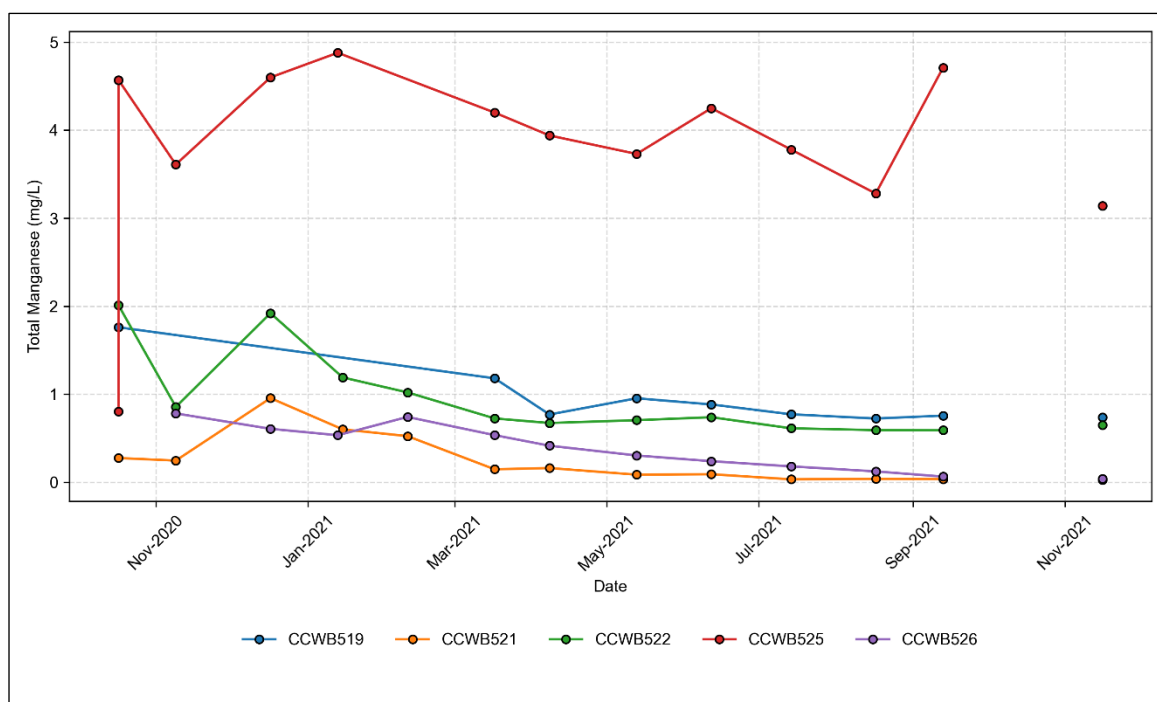


Figure A40: Time series of total manganese in Corbett Formation Metasediments groundwater monitoring bores.

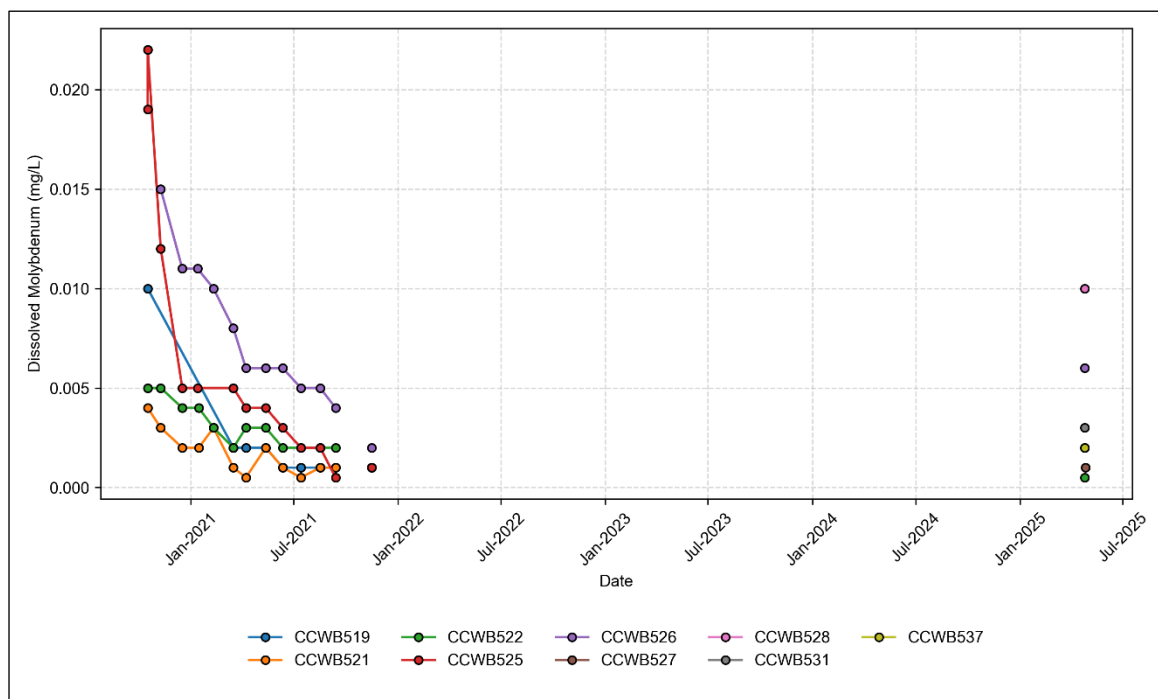


Figure A41: Time series of dissolved molybdenum in Corbett Formation Metasediments groundwater monitoring bores.

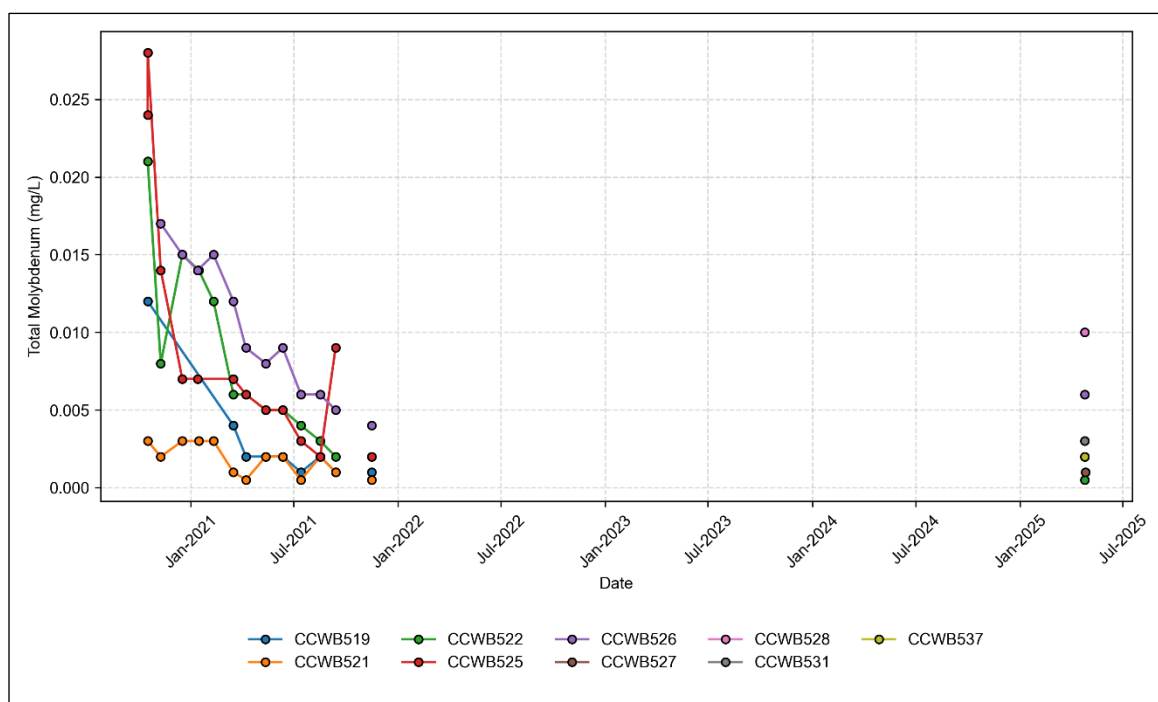


Figure A42: Time series of total molybdenum in Corbett Formation Metasediments groundwater monitoring bores.

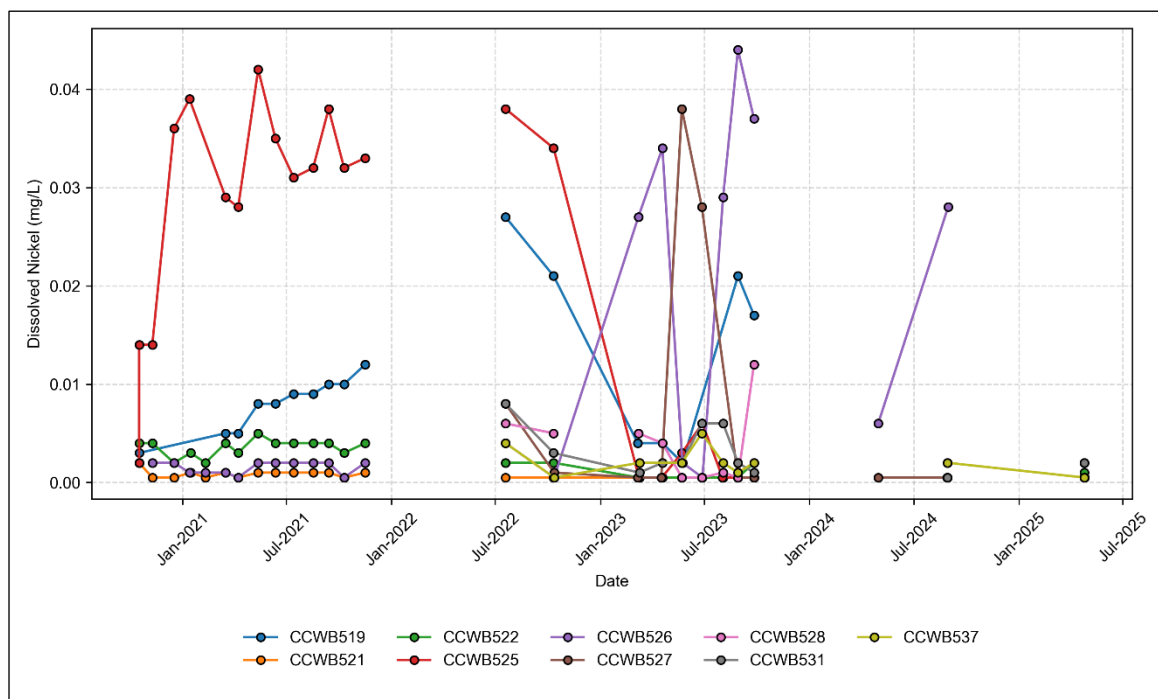


Figure A43: Time series of dissolved nickel in Corbett Formation Metasediments groundwater monitoring bores.

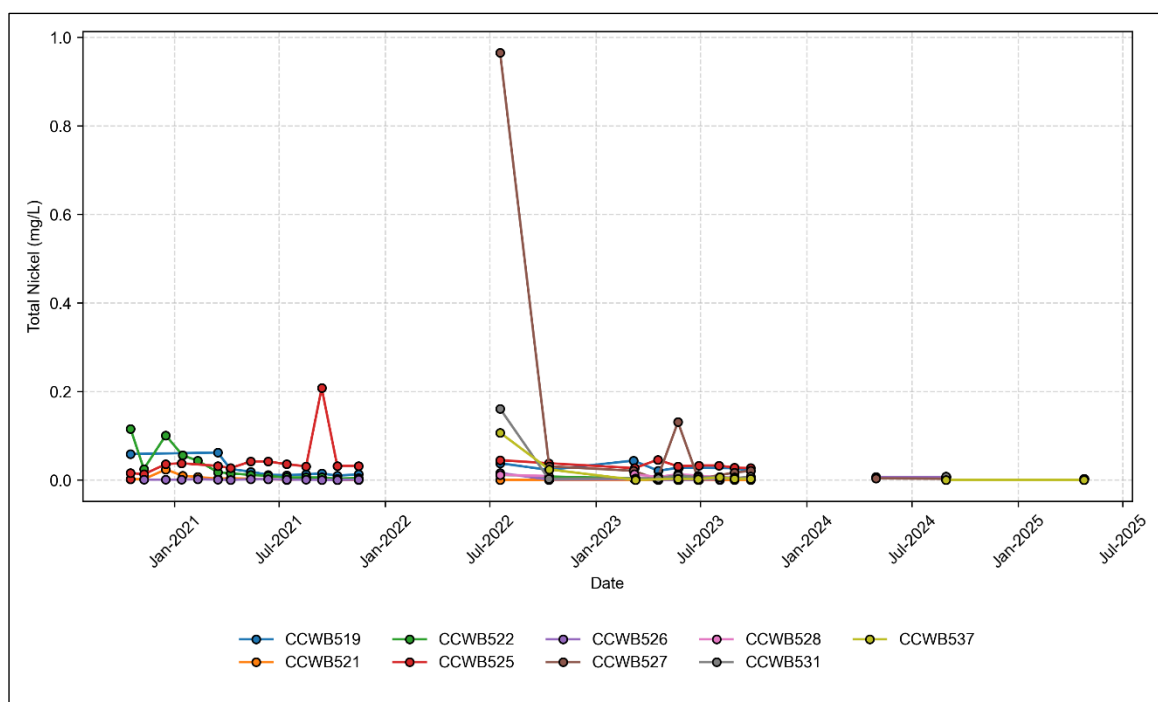


Figure A44: Time series of total nickel in Corbett Formation Metasediments groundwater monitoring bores.

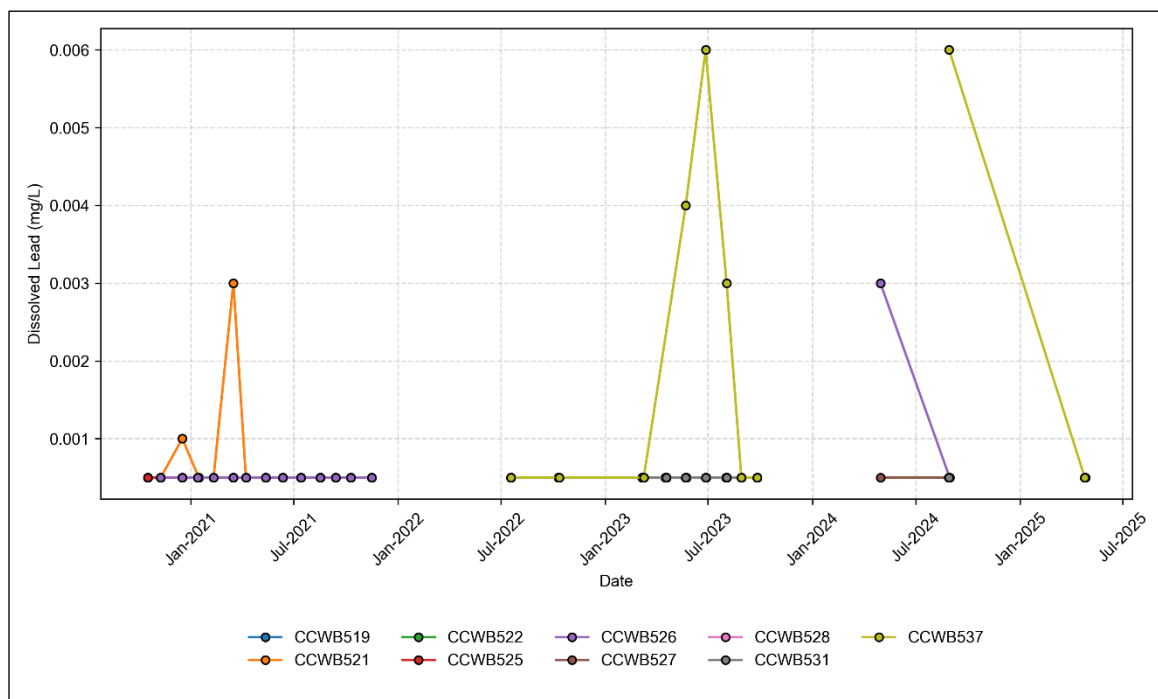


Figure A45: Time series of dissolved lead in Corbett Formation Metasediments groundwater monitoring bores.

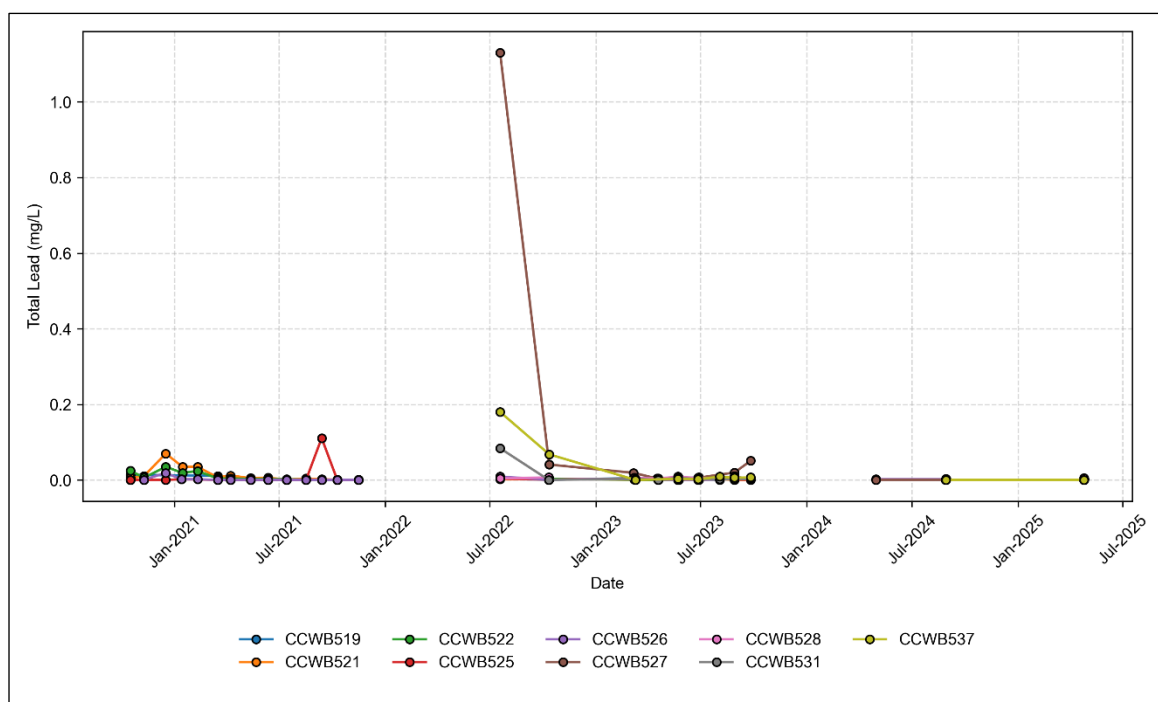


Figure A46: Time series of total lead in Corbett Formation Metasediments groundwater monitoring bores.

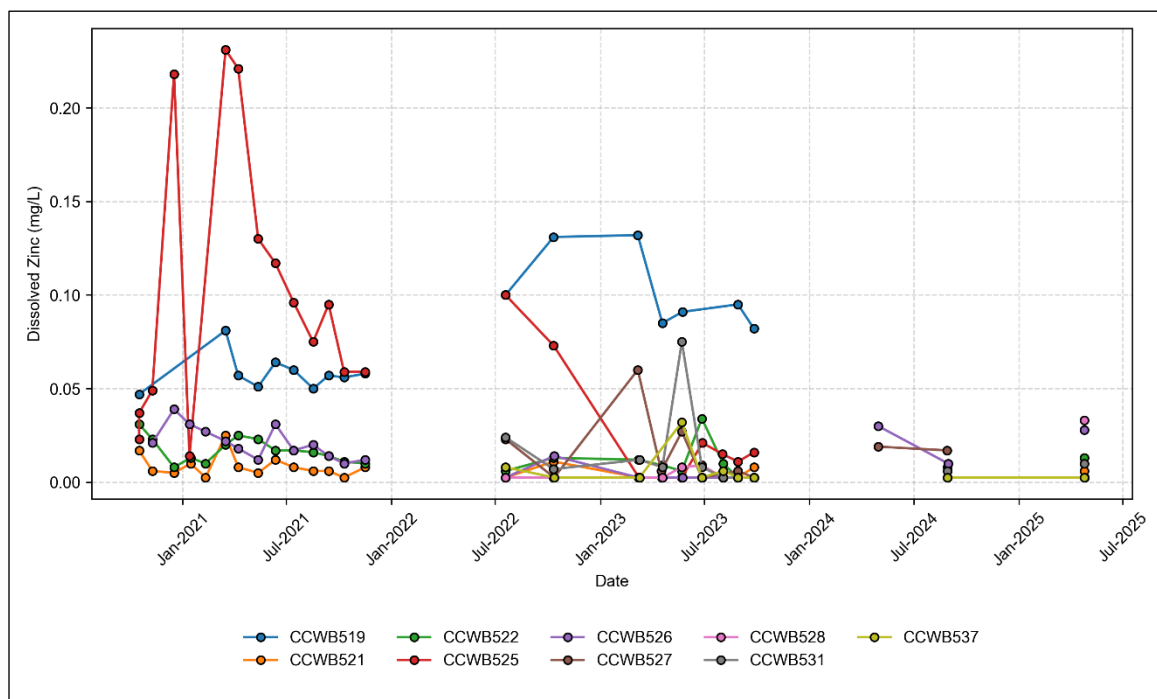


Figure A47: Time series of dissolved zinc in Corbett Formation Metasediments groundwater monitoring bores.

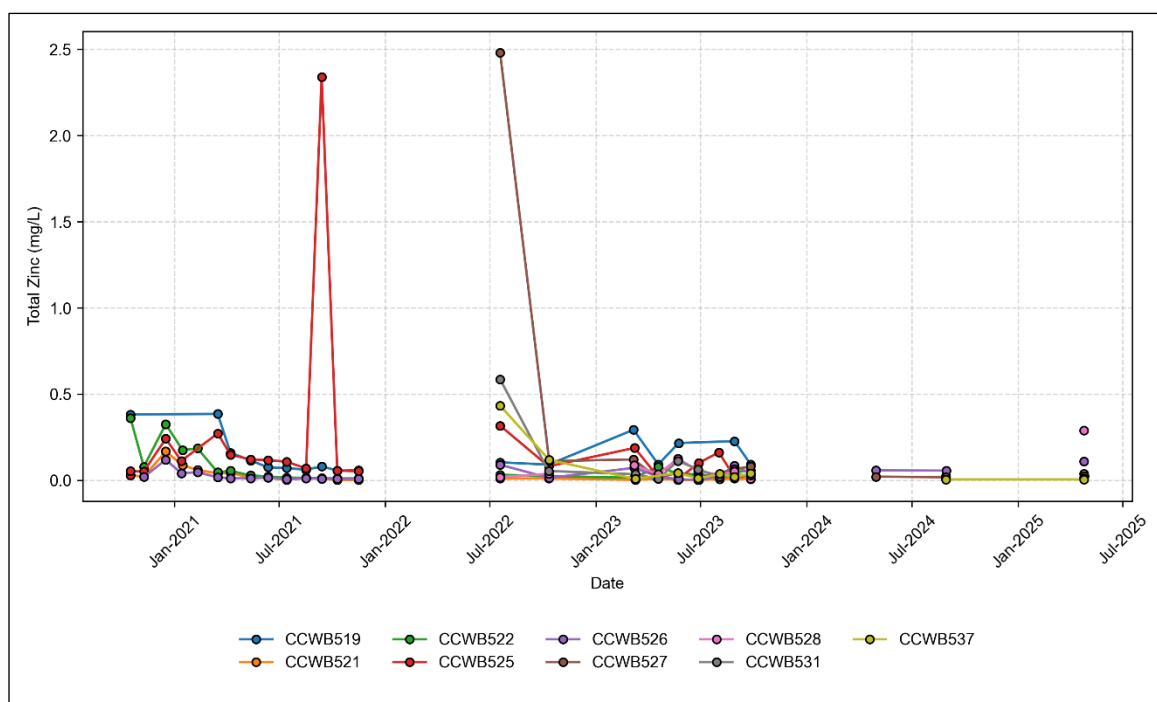


Figure A48: Time series of total zinc in Corbett Formation Metasediments groundwater monitoring bores.

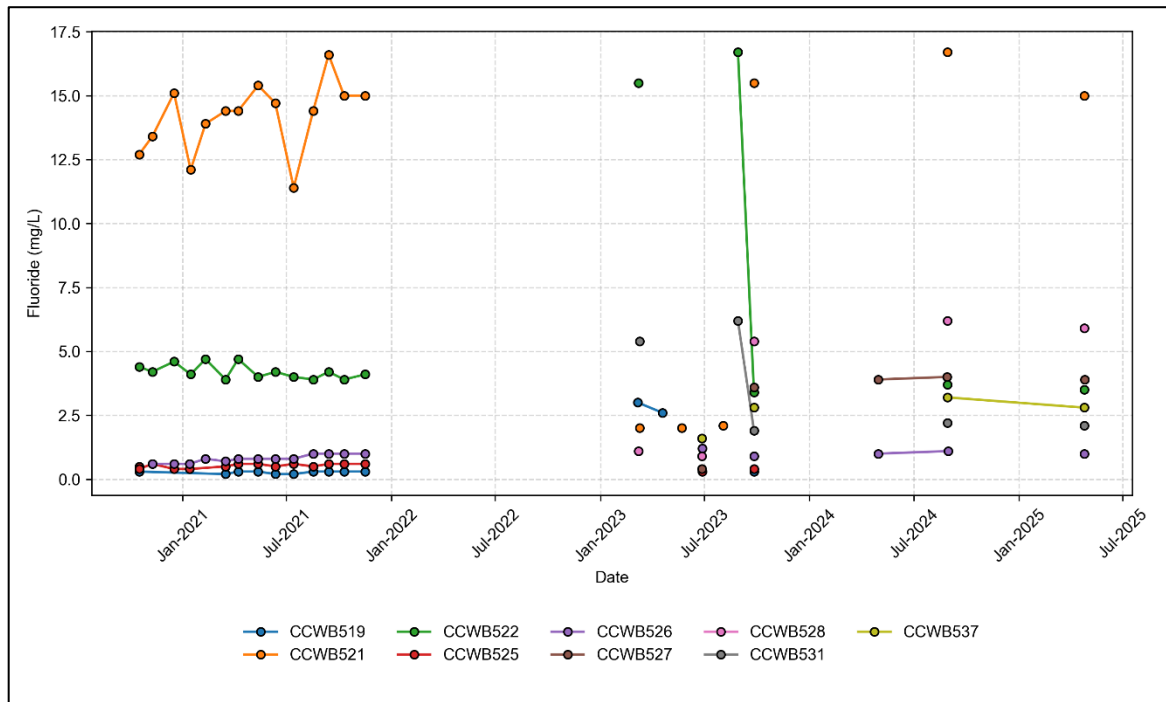


Figure A23: Time series of fluoride in Corbett Formation Metasediments groundwater monitoring bores.

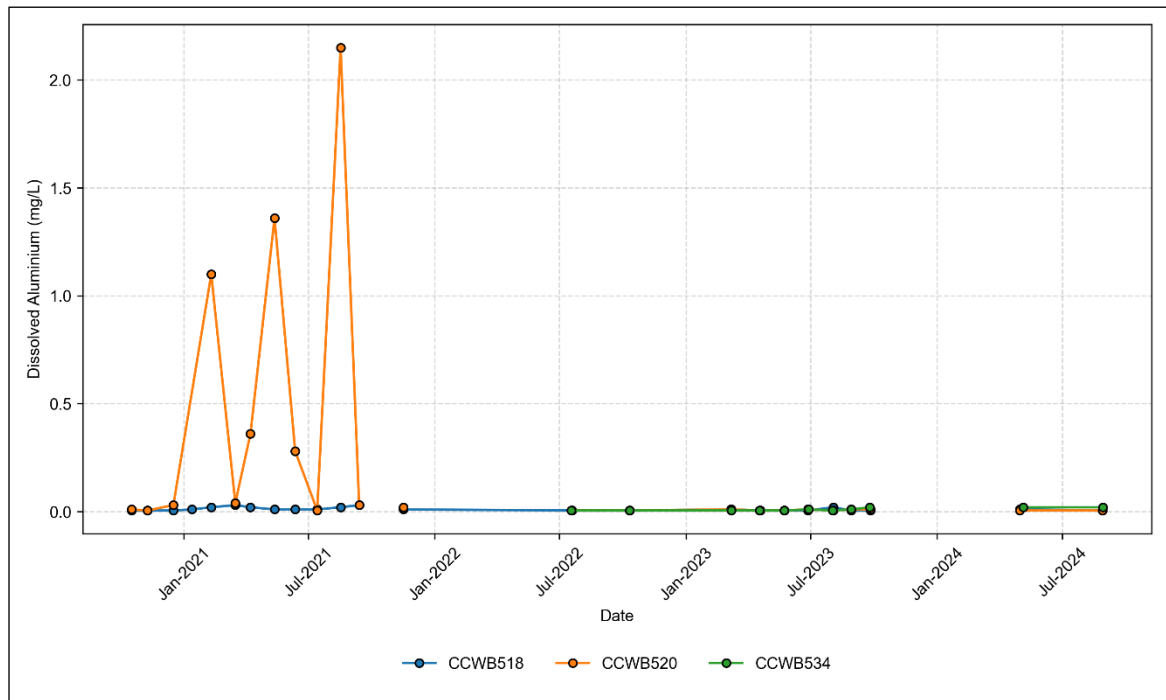


Figure A49: Time series of dissolved aluminium in Andesite and Rhyolite groundwater monitoring bores

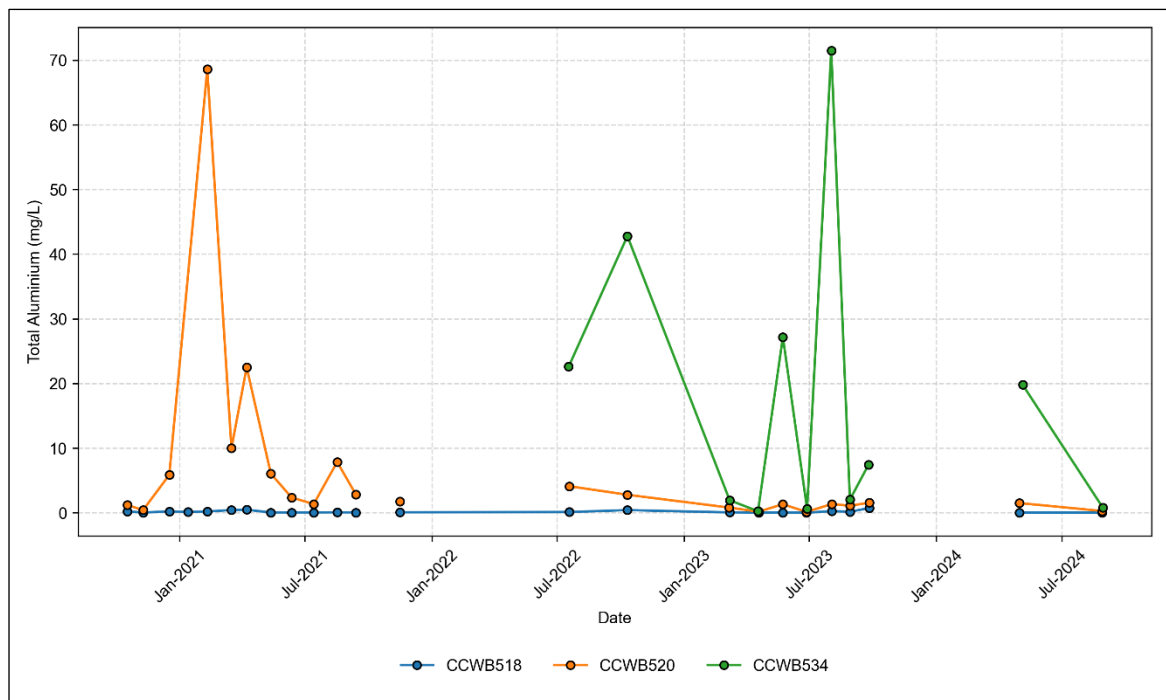


Figure A50: Time series of total aluminium in Andesite and Rhyolite groundwater monitoring bores.

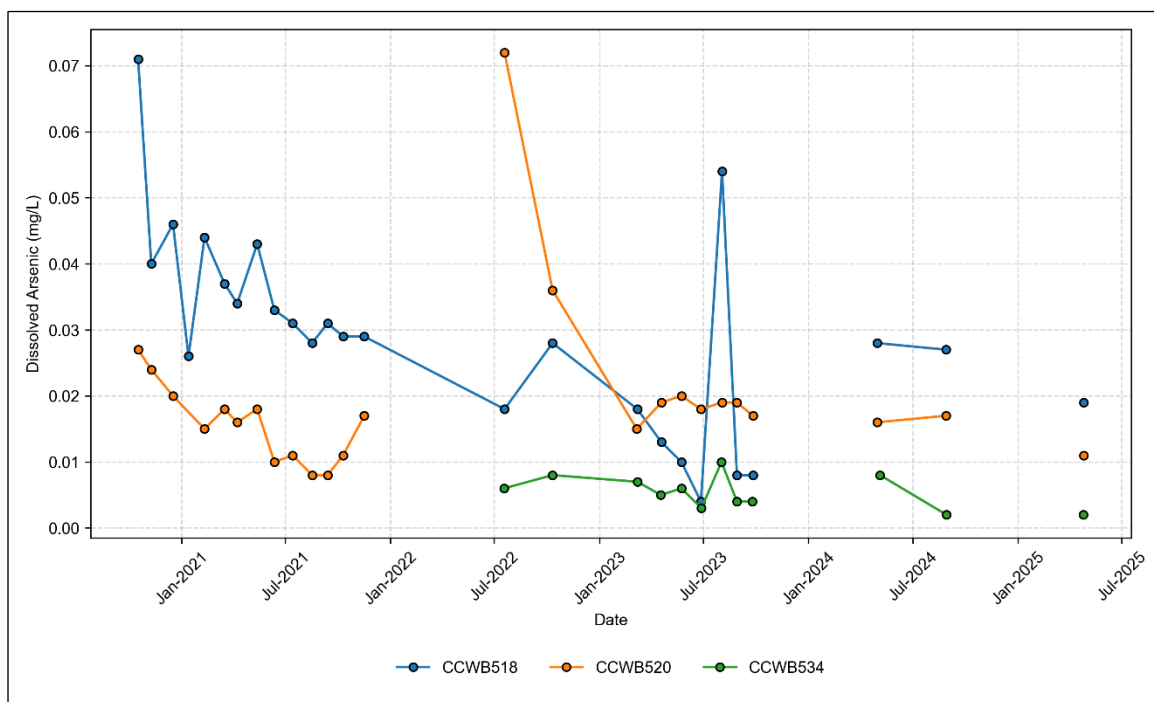


Figure A51: Time series of dissolved arsenic in Andesite and Rhyolite groundwater monitoring bores.

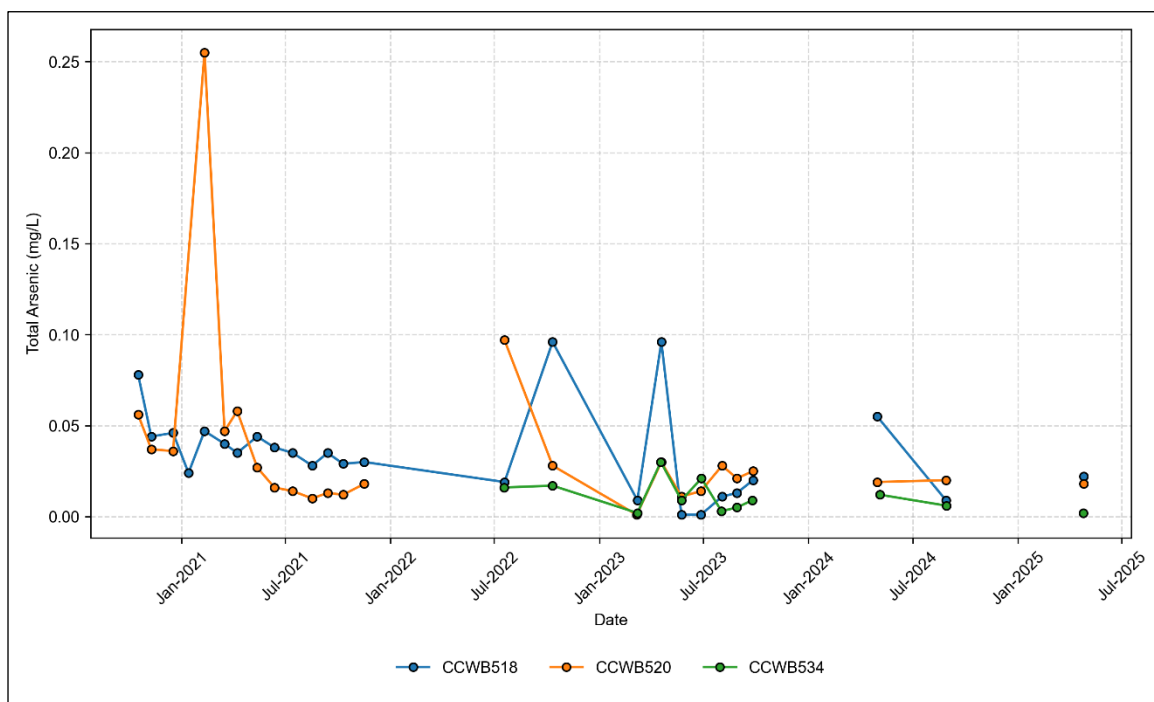


Figure A52: Time series of total arsenic in Andesite and Rhyolite groundwater monitoring bores.

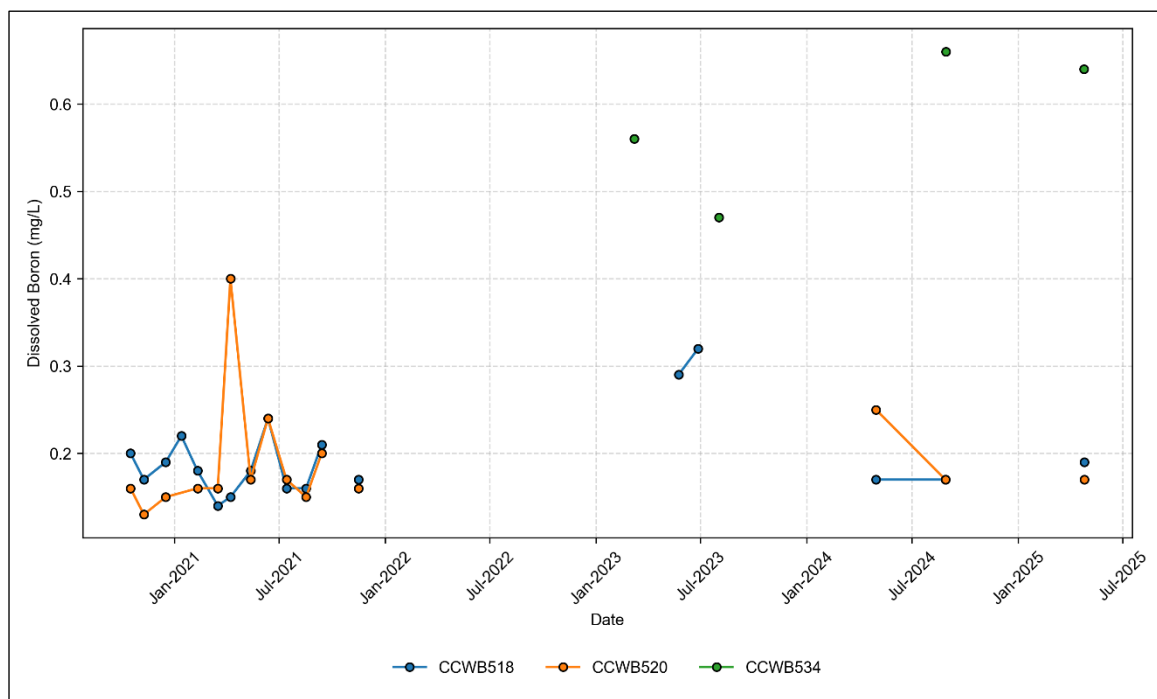


Figure A53: Time series of dissolved boron in Andesite and Rhyolite groundwater monitoring bores.

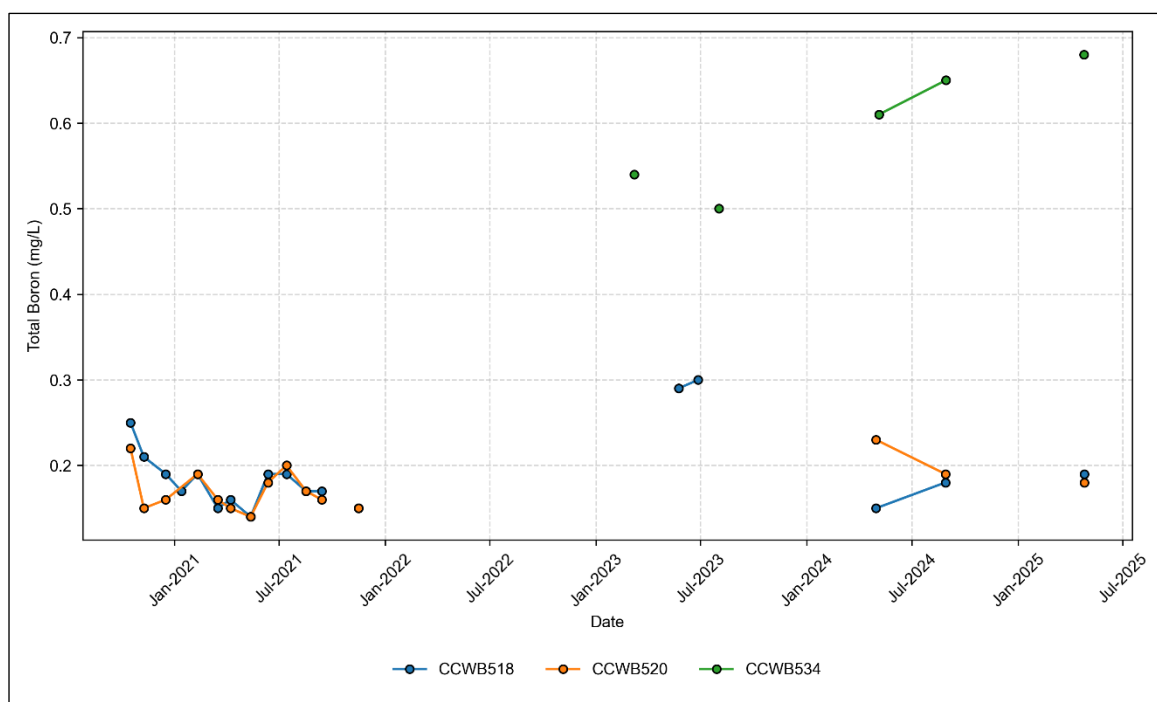


Figure A54: Time series of total boron in Andesite and Rhyolite groundwater monitoring bores.

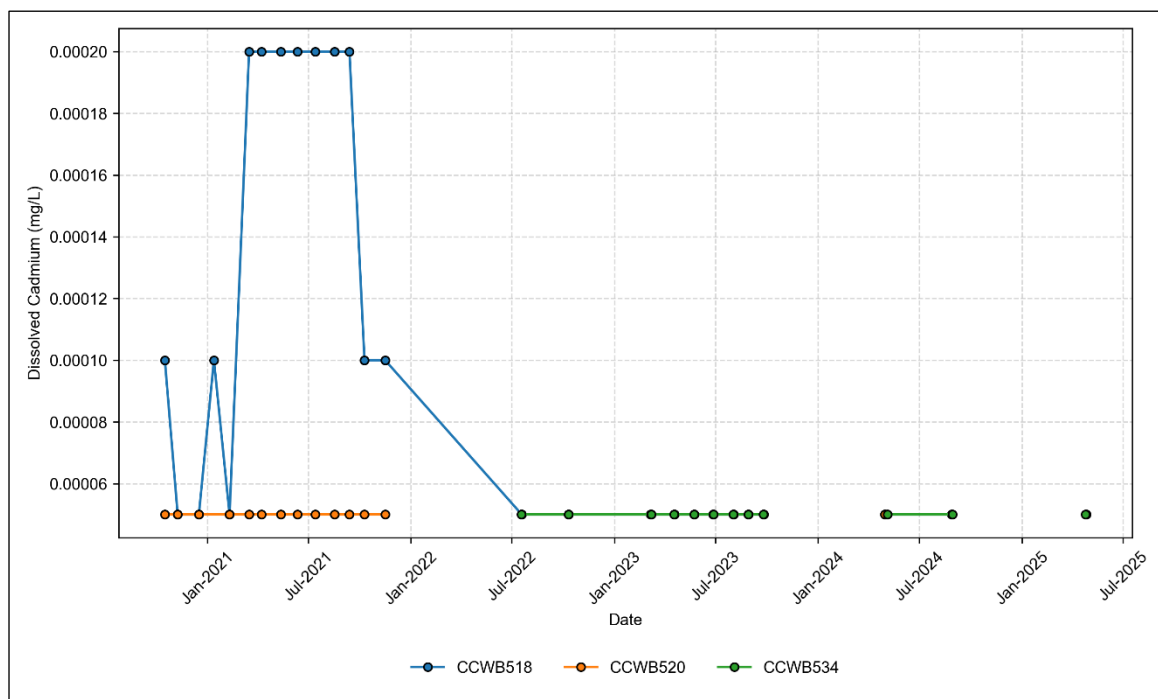


Figure A55: Time series of dissolved cadmium in Andesite and Rhyolite groundwater monitoring bores.

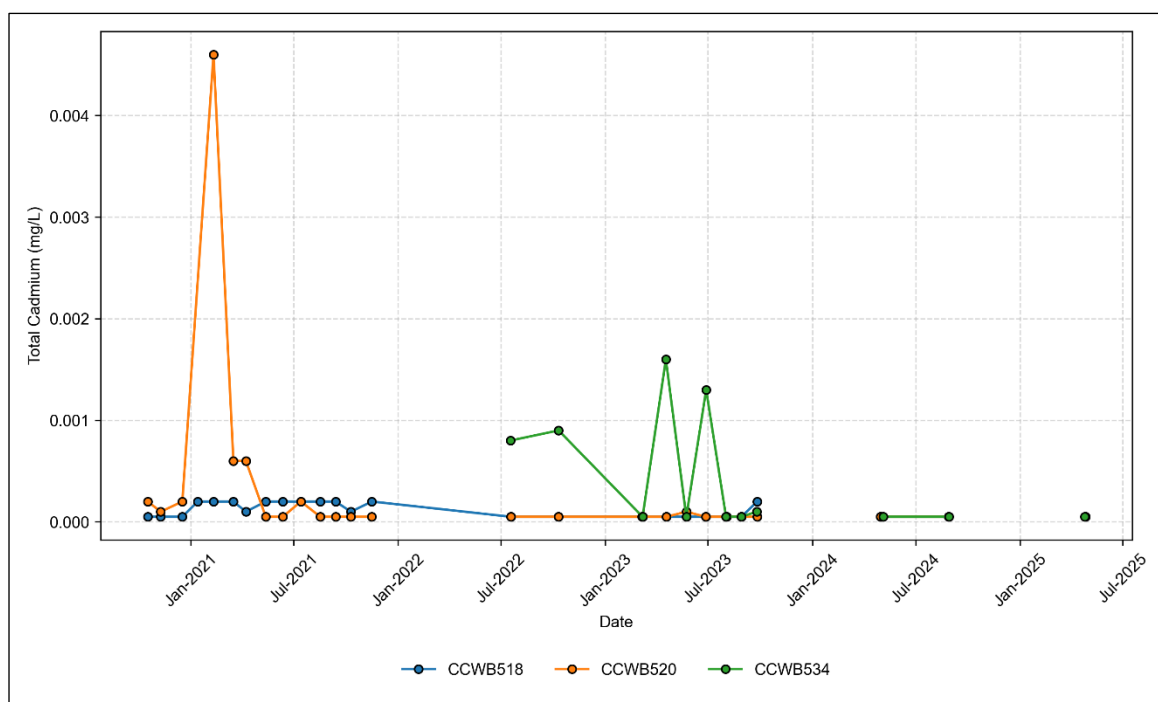


Figure A56: Time series of total cadmium in Andesite and Rhyolite groundwater monitoring bores.

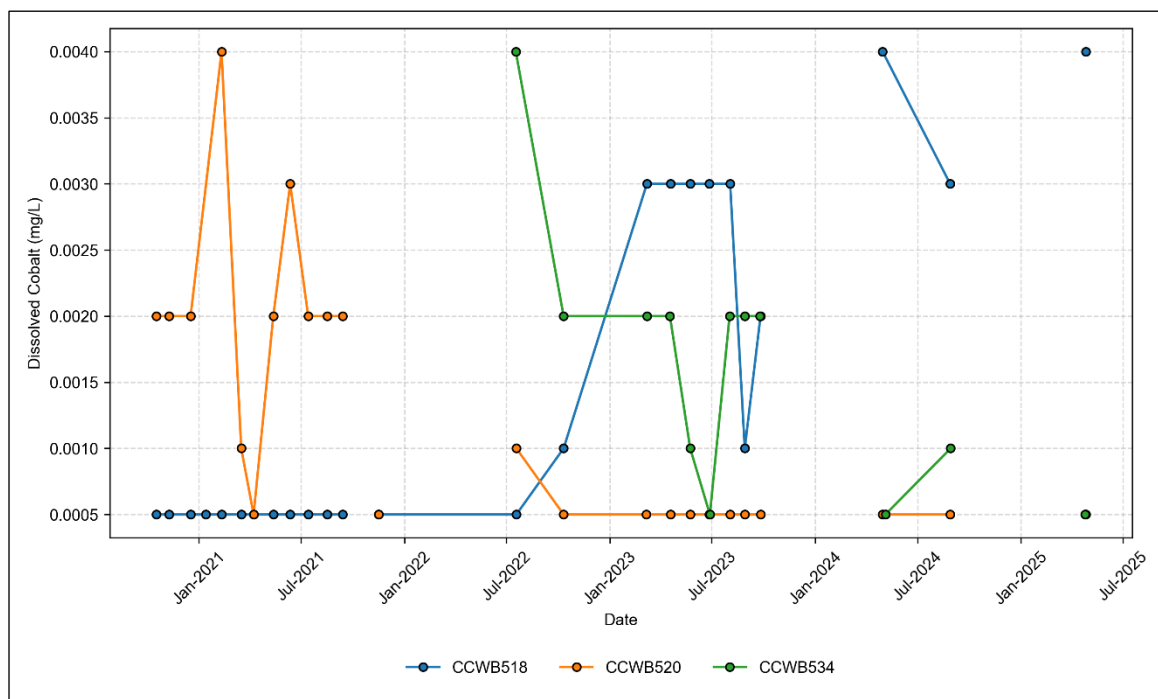


Figure A57: Time series of dissolved cobalt in Andesite and Rhyolite groundwater monitoring bores.

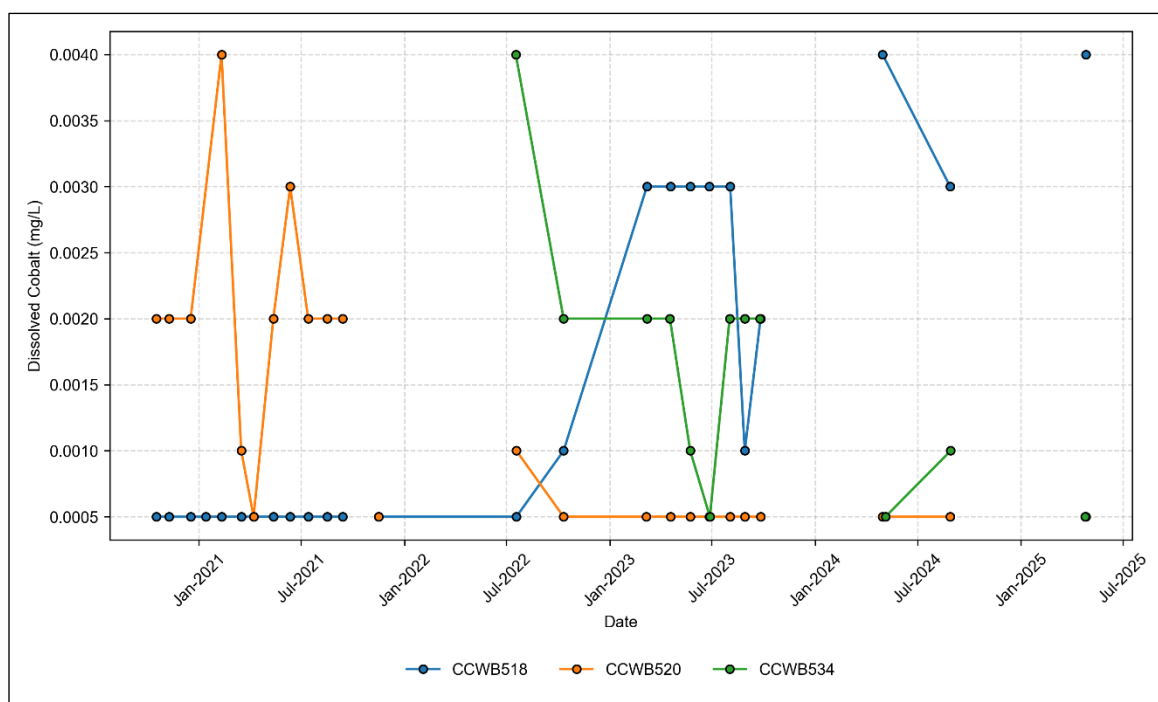


Figure A58: Time series of total cobalt in Andesite and Rhyolite groundwater monitoring bores.

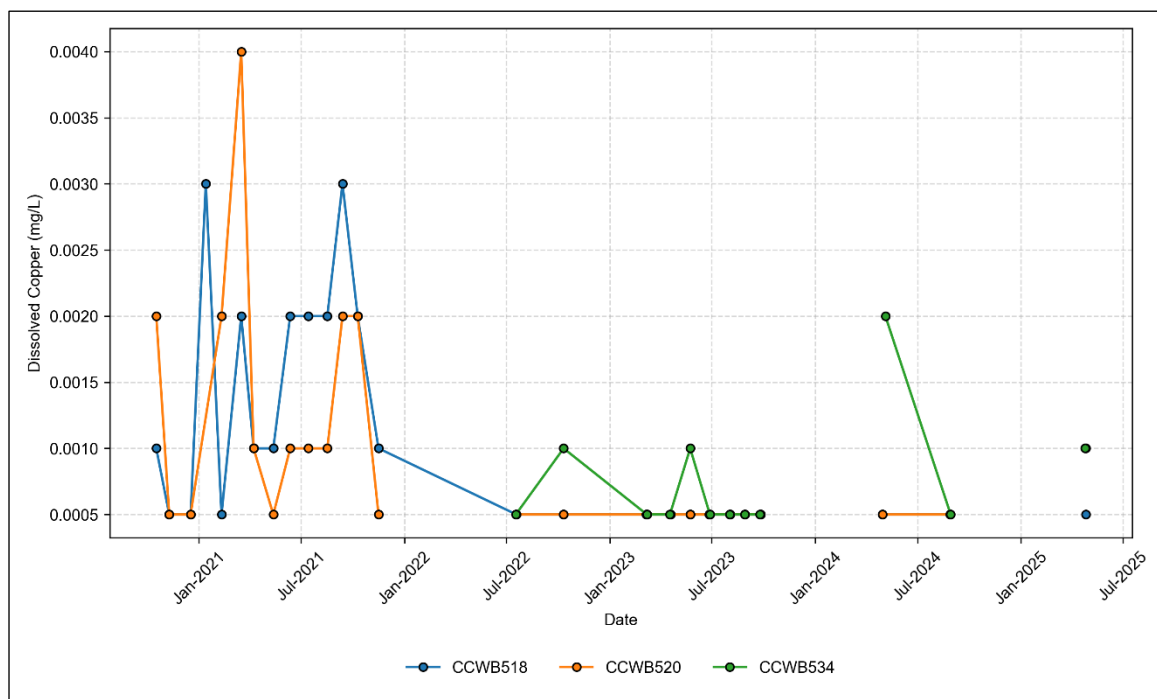


Figure A59: Time series of dissolved copper in Andesite and Rhyolite groundwater monitoring bores.

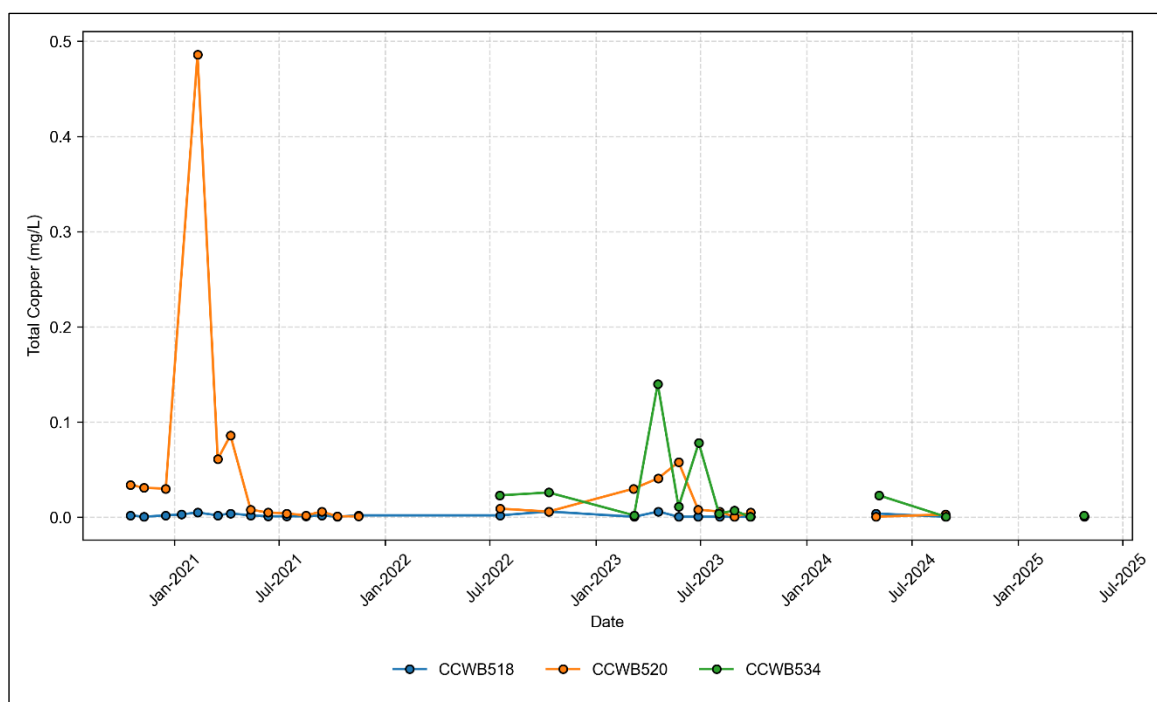


Figure A60: Time series of total copper in Andesite and Rhyolite groundwater monitoring bores.

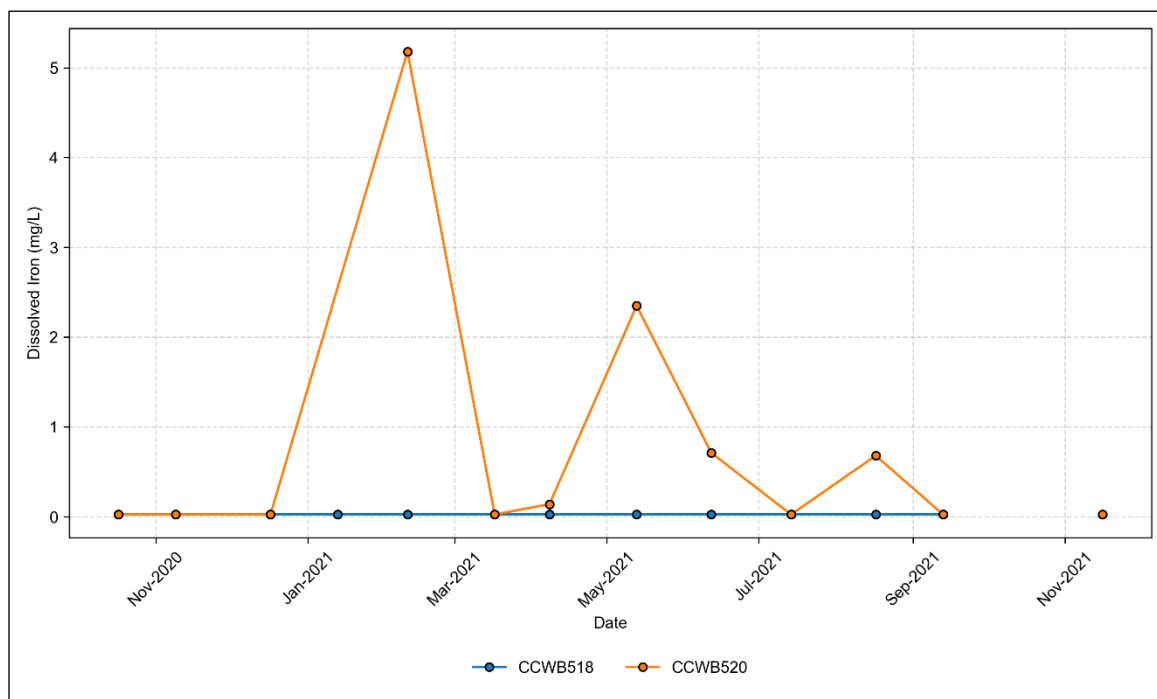


Figure A61: Time series of dissolved iron in Andesite and Rhyolite groundwater monitoring bores.

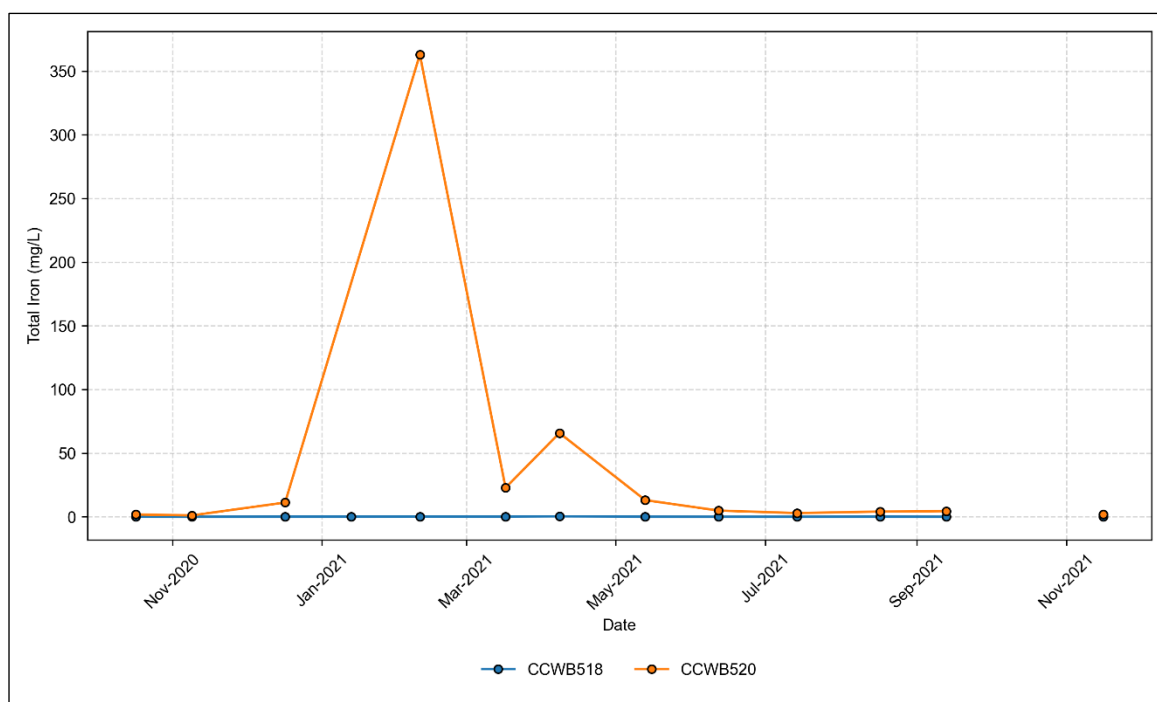


Figure A62: Time series of total iron in Andesite and Rhyolite groundwater monitoring bores.

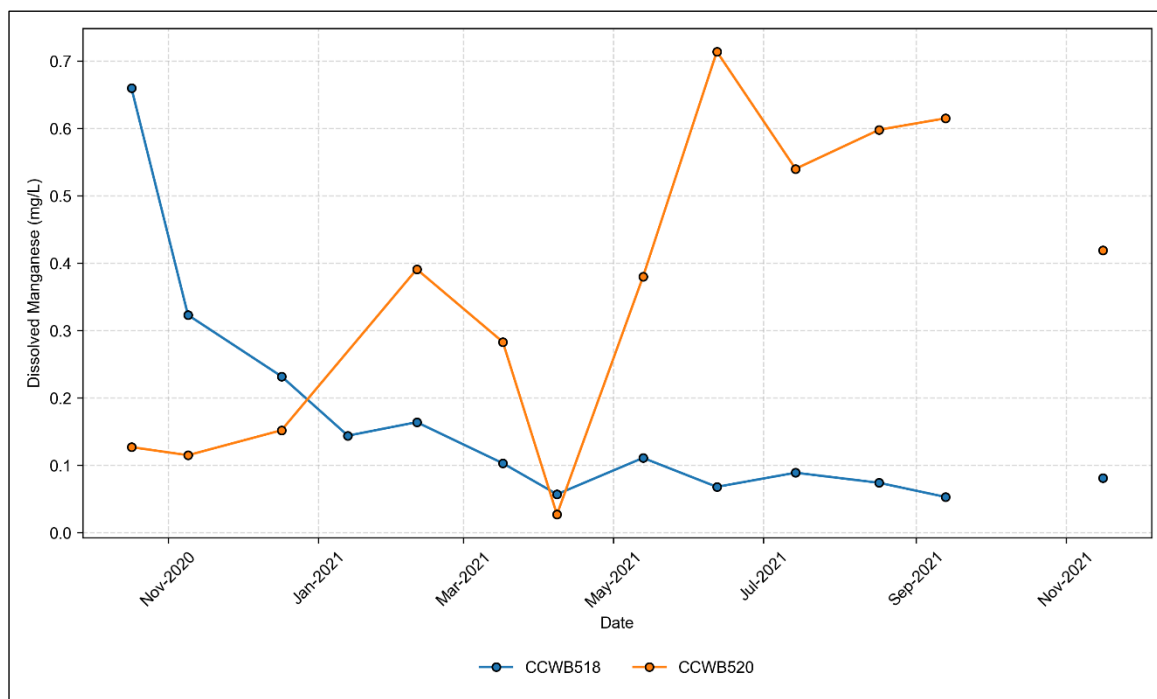


Figure A63: Time series of dissolved manganese in Andesite and Rhyolite groundwater monitoring bores.

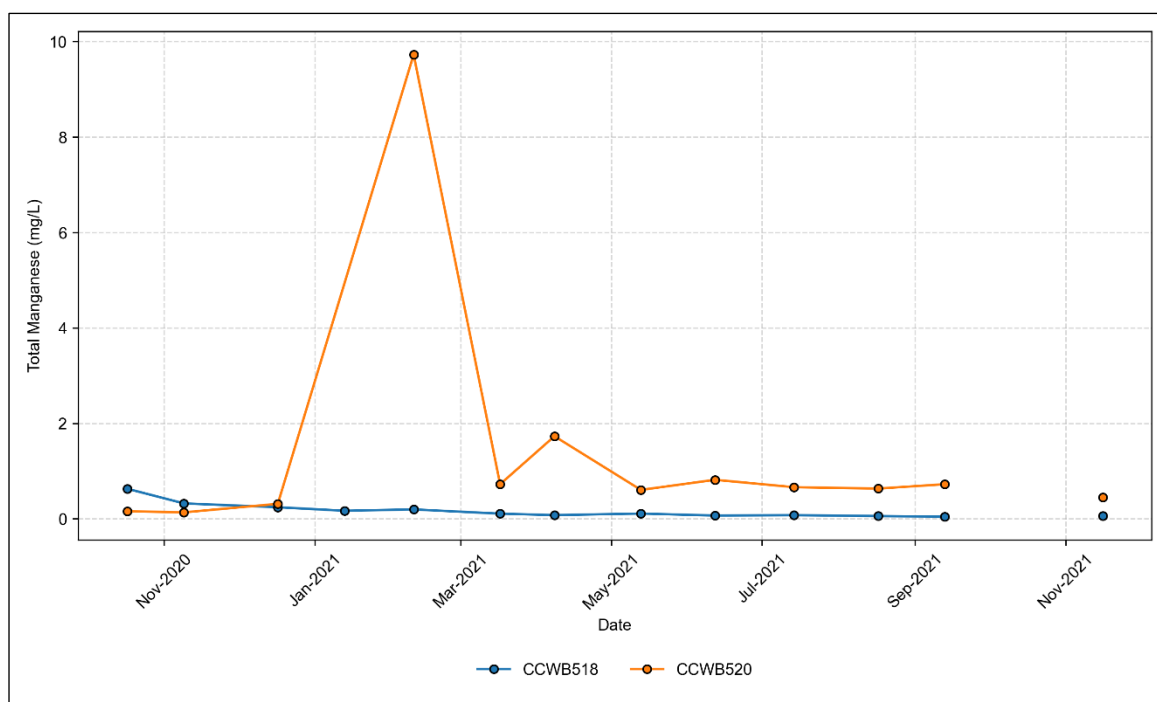


Figure A64: Time series of total manganese in Andesite and Rhyolite groundwater monitoring bores.

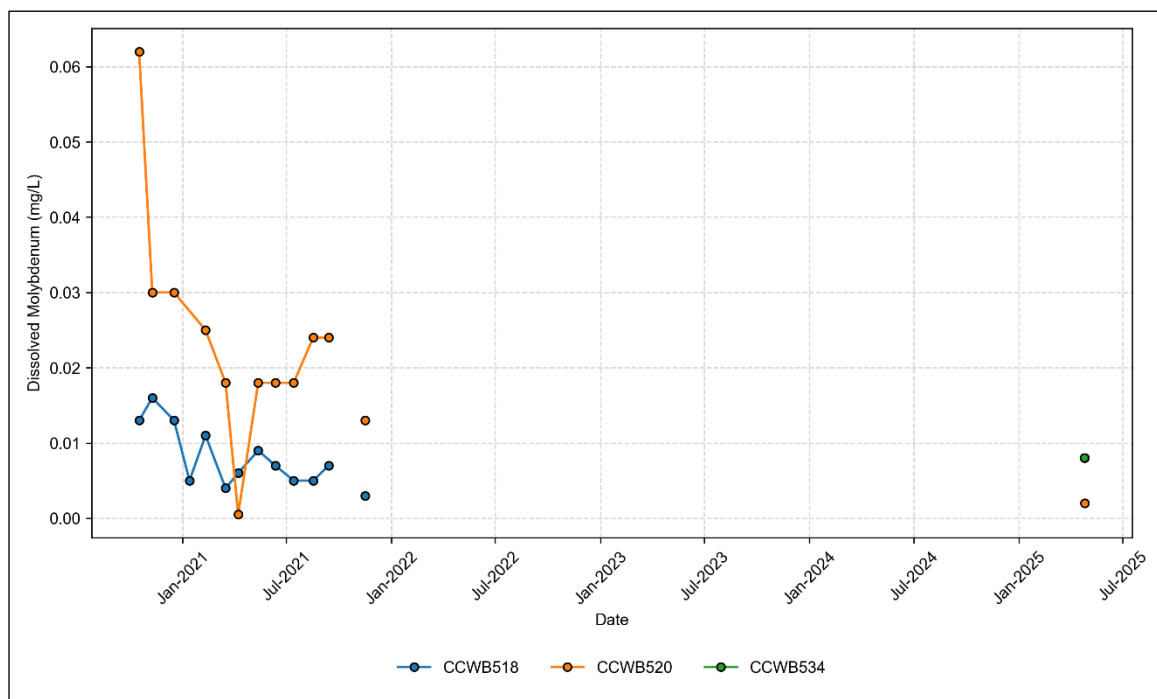


Figure A65: Time series of dissolved molybdenum in Andesite and Rhyolite groundwater monitoring bores.

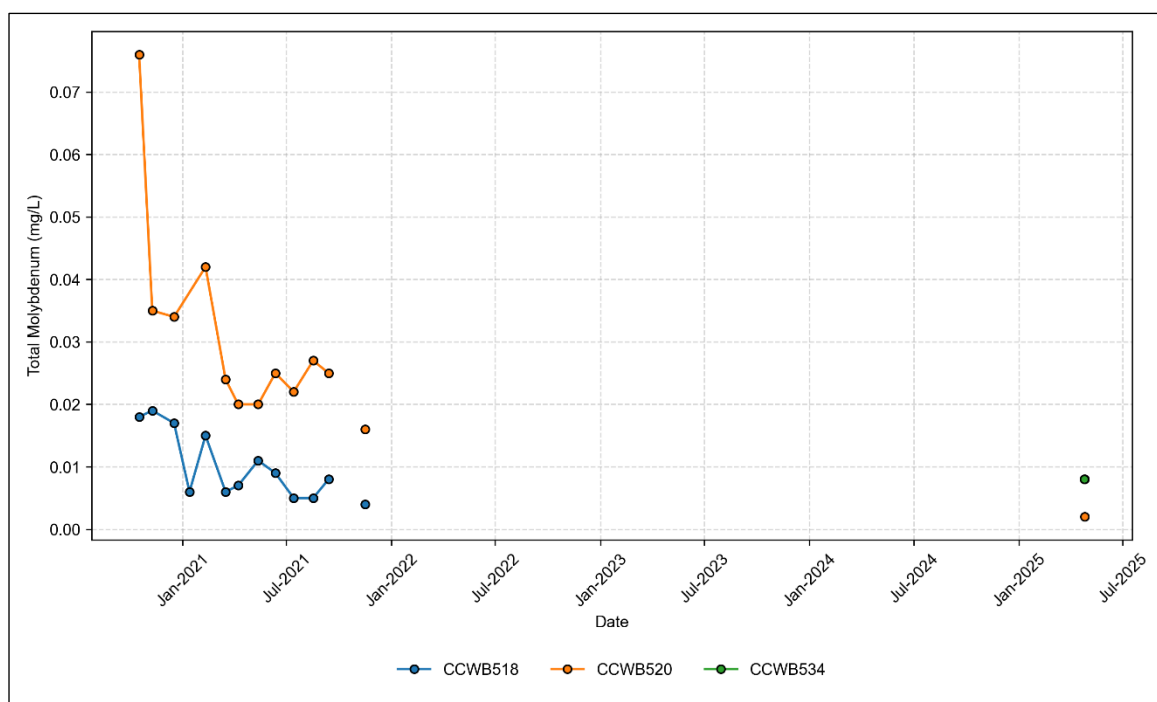


Figure A66: Time series of total molybdenum in Andesite and Rhyolite groundwater monitoring bores.

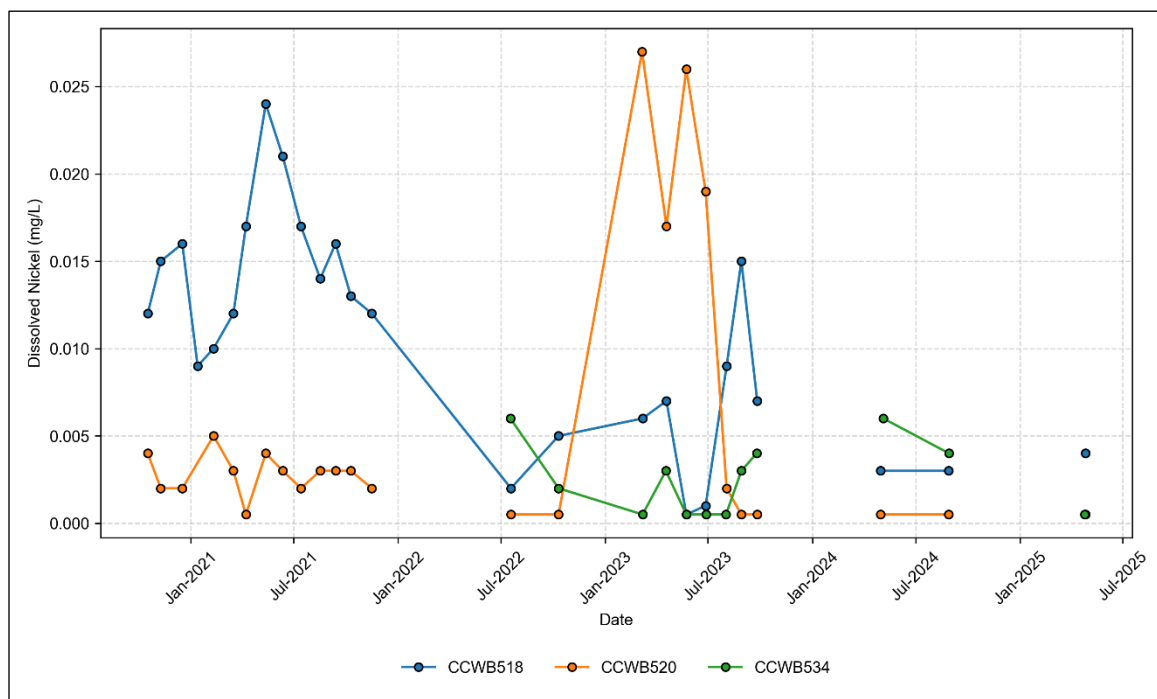


Figure A67: Time series of dissolved nickel in Andesite and Rhyolite groundwater monitoring bores.

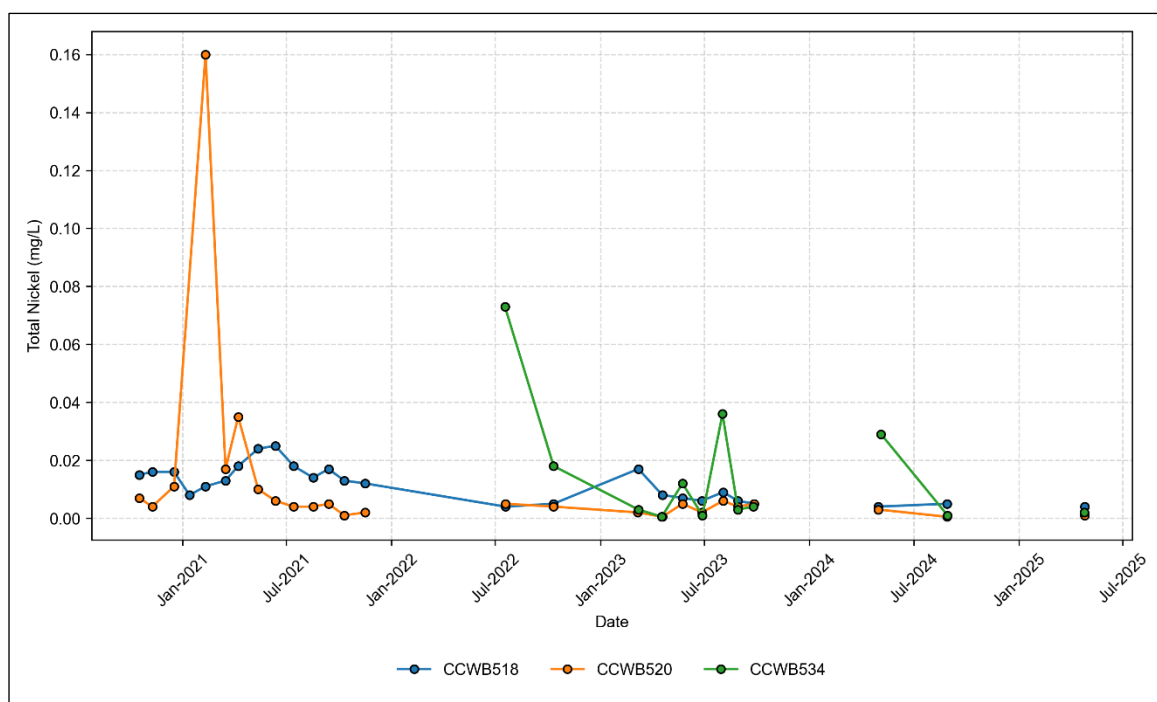


Figure A68: Time series of total nickel in Andesite and Rhyolite groundwater monitoring bores.

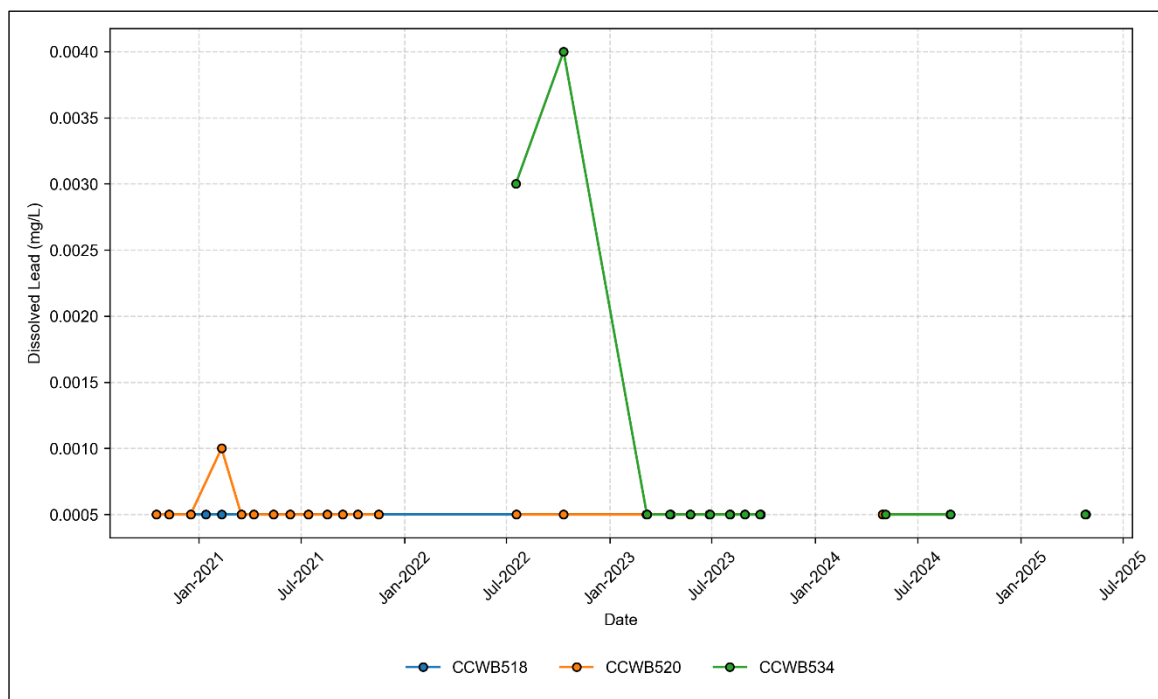


Figure A69: Time series of dissolved lead in Andesite and Rhyolite groundwater monitoring bores.

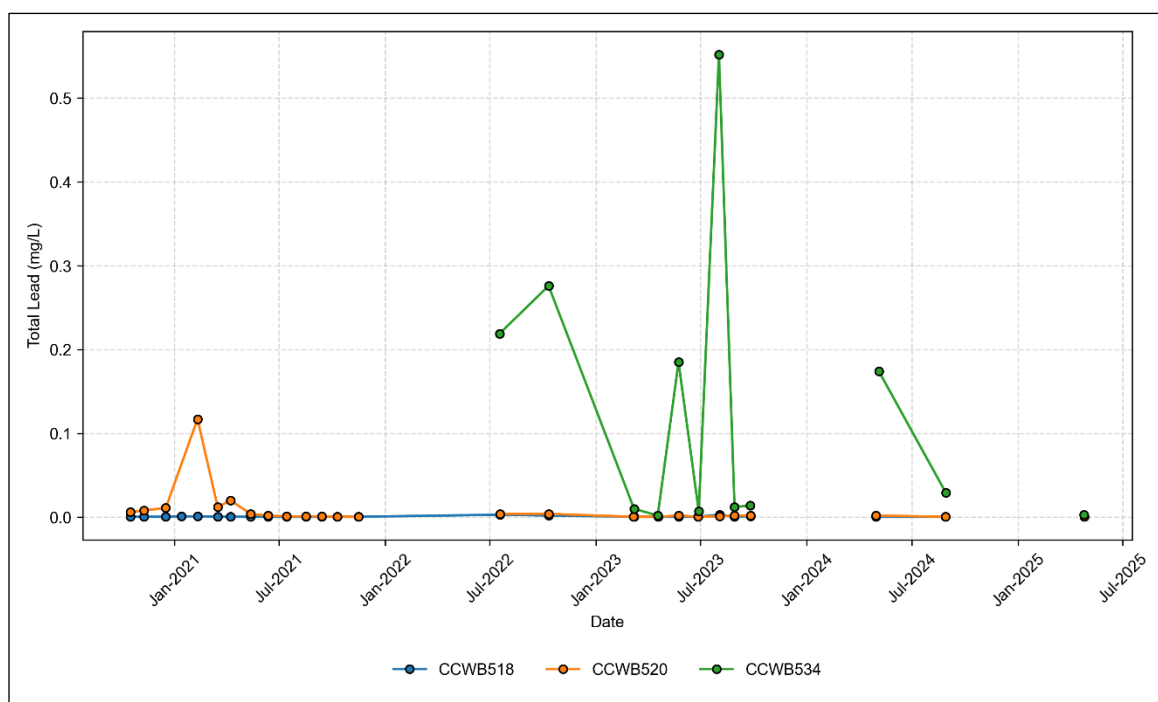


Figure A70: Time series of total lead in Andesite and Rhyolite groundwater monitoring bores.

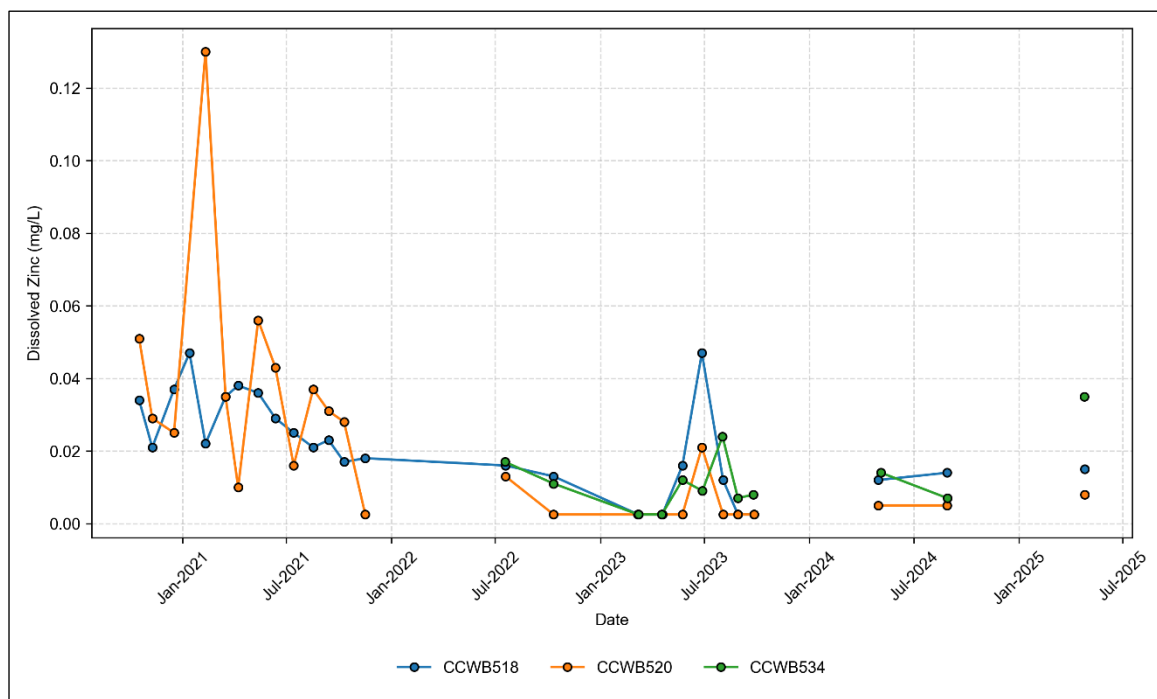


Figure A71: Time series of dissolved zinc in Andesite and Rhyolite groundwater monitoring bores.

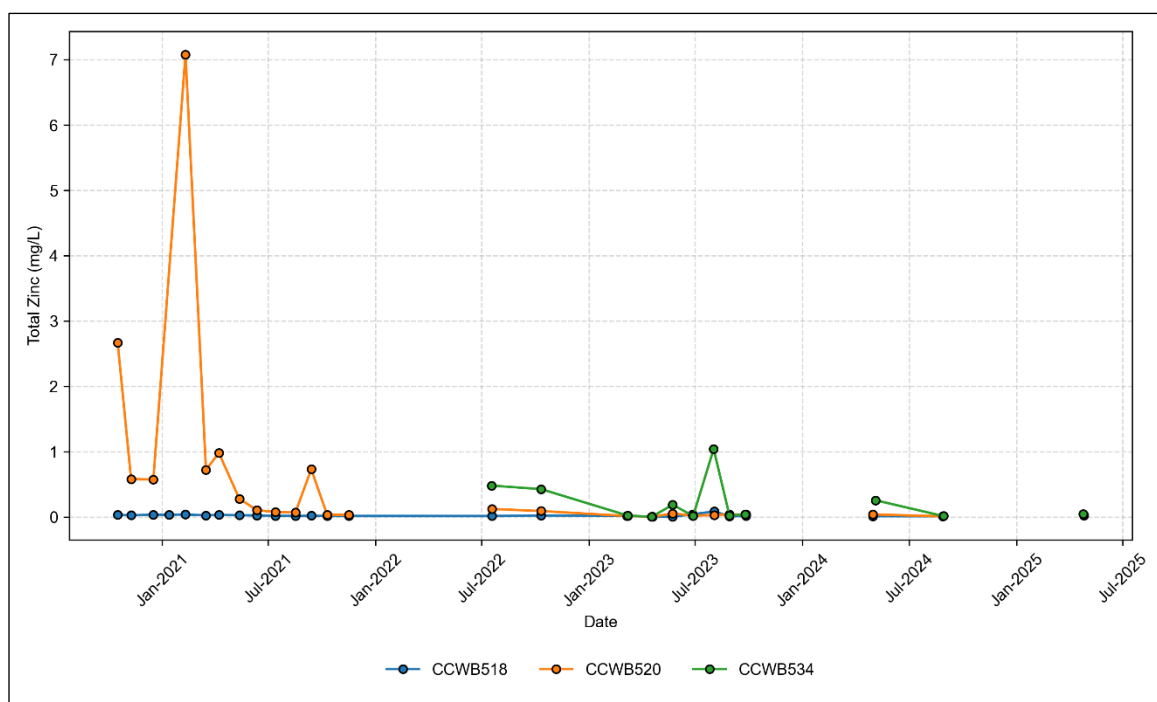


Figure A72: Time series of total zinc in Andesite and Rhyolite groundwater monitoring bores.

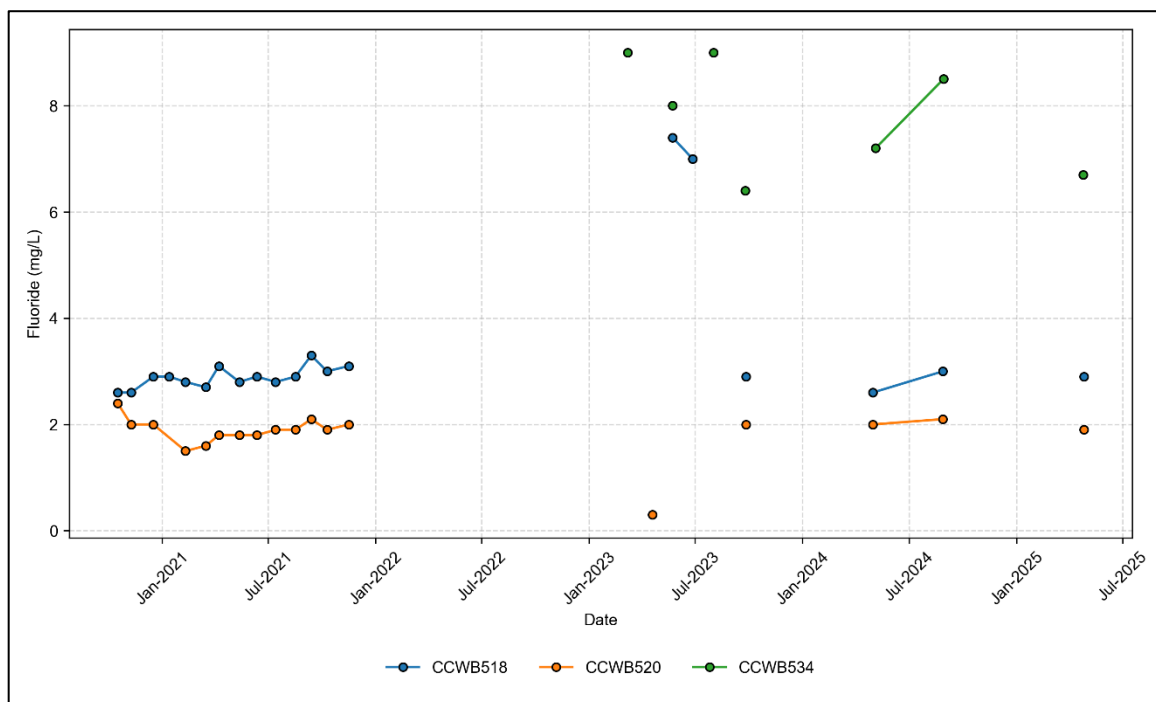


Figure A23: Time series of fluoride in Andesite and Rhyolite groundwater monitoring bores.