Hydrogeology of the Stockton area and the assessment of impacts on groundwater from BPCP Stockton mining activities

(Bathurst Resources Limited)

17 August 2026

→ **The Power of Commitment**

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A	1	J Dommisse	R Virtue	-	S Douglass		17/08/26

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Glossary of Terms, Acronyms and Abbreviations

Term	Definition
Acid and Metalliferous Drainage (AMD)	Acidic, metalliferous or saline water generated when rock is disturbed, such as during mining/excavation or dewatering, particularly where sulfide minerals (like pyrite) are exposed and oxidise in the presence of air and water. Formerly referred to as acid mine drainage.
Adit	A horizontal or near-horizontal passage driven into a hillside to access underground mine workings, provide drainage, ventilation, or allow haulage. Millerton area at Stockton contains multiple adits into historical underground workings.
ANFO	Ammonium Nitrate Fuel Oil. Used as a blasting explosive in mining.
Bathurst	Bathurst Resources Limited, including its subsidiary companies Bathurst Coal Ltd and Buller Coal Ltd, and joint venture company BT Mining Ltd.
Buller Plateaux	A collective reference to the Stockton Plateau and Dennison Plateau.
Cleanwater	Runoff from undisturbed ground or rehabilitated areas where water quality is suitable for direct discharge into natural streams without treatment, and is comparable to natural background water quality.
Dewatering	Groundwater component of the water required to be abstracted in order to keep pits sufficiency dry to enable opencast mining.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (Cavanagh et al., 2018).
Millerton Block	AMD-impacted waterways draining various catchments within the Millerton and northern Rockies mining areas at Stockton.
Mining	The act of extracting a mineral existing in its natural state in land or a chemical substance from a mineral existing in its natural state in land.
Minewater	Runoff from disturbed, mining and historical areas where the water requires AMD correction and/or sediment capture prior to discharge into natural streams. Minewater is largely contaminated by coal fines (i.e. runoff from stripped coal and coal stockpiles). Can also be referred to as 'Mine Impacted Water'.
Mine Closure	The point at which Bathurst has ceased mining operations at Stockton and completed terrestrial rehabilitation of the site.
Opencast mining	This is the main mining method used at Stockton to extract coal. At Stockton, this involves the removal of topsoil and vegetation which are placed in specific terrestrial rehabilitation areas. The overlying rock is then broken up by drilling and blasting, removed and placed in nearby already mined areas ready for rehabilitation. An excavator then extracts the coal for processing.
Sludge	Comprised of physical sediments eroded from upstream mining activities and mineral precipitates formed during AMD treatment.
Stockton	Term used for Stockton Mine.
Stockton Mine	Mining Licence and Permit areas within the Deed of Commitment.
Stormwater	Runoff from disturbed areas where the water requires sediment capture prior to discharge into natural streams.
Syncline	A downward forming fold in rock layers forming a natural low point in the coal floor bedrock.
Tarn	Small mountain pond or lake, often glacial in origin. At Stockton, these include both natural and constructed tarns.

Term	Definition
Turbidity	A measure of the clarity of water based on the amount of light scattered by suspended particles in a sample, typically reported in nephelometric turbidity units (NTU).
Waterway	Receiving environment surface water body. Generally, a stream or river. Distinct from the cleanwater, minewater and stormwater run-off into the waterways.
West Coast Regional Council (WCRC)	The local government authority for the West Coast region of New Zealand responsible for environmental management, including flood control, air and water quality, and pest control.

Acronyms and abbreviations	Definition
Al	Aluminium
AMD	Acid and Metalliferous Drainage
BCM	Brunner Coal Measures
BPCP	Buller Plateaux Continuation Project
BRL	Bathurst Resources Limited
Bathurst	BT Mining Limited
Ca	Calcium
CaO	Calcium Oxide
CFSF	Coal Fines Storage Facility
CHPP	Coal Handling and Processing Plant
~	Approximately
cm	centimetre
CML	Coal Mining Licence (for Stockton)
DCA	Millerton Drainage Control Adit
DOC	Dissolved Organic Carbon
DoC	Department of Conservation
EC	Electrical Conductivity
ELF	Engineered Landform
EOML	Stockton End of Mine Life at 2033
ESE	Escarpment Extended (BPCP sub-area)
FTAA	Fast-track Approvals Act 2024
ha	Hectare(s)
km	Kilometres
LINZ	Land Information New Zealand
L/s	Litres per second
m	metres
m^3/s	Cubic metres per second
MaPPS	Millerton and Plateau Protection Society Incorporated
MFS	Mount Fredrick South (BPCP sub-area)
MSR	Mussel Shell Reactor
MWM	Mine Waste Management
mm	millimetres
Mg	Magnesium

Acronyms and abbreviations	Definition
mg/L	milligrams per litre
NAF	Non-Acid Forming
NELF	Northern Engineered Landform
NIWA	National Institute of Water and Atmospheric Research (now Earth Science New Zealand (ESNZ))
NTU	Nephelometric Turbidity Units
PAF	Potentially Acid-Forming
pH	Potential of Hydrogen – A measure of acidity or alkalinity
RL	Relative Level
TSS	Total Suspended Solids
UWHR	Upper Waimangaroa Haul Road (BPCP sub-area)
VDT	Vegetation Direct Transfer
WCRC	West Coast Regional Council

1. Introduction

BT Mining Limited (BT Mining) own and manage the Stockton Mine ('Stockton' herein). Bathurst Resources Limited ('Bathurst') is New Zealand's largest coal producing company and a 65% joint venture owner of BT Mining with the Talley's Group.

Stockton is located on the Stockton Plateau, approximately 25 km northeast of Westport on the South Island's West Coast. Stockton (mined under Coal Mining Licence (CML) 37150) is part of the Buller Coalfield that includes Cypress Coal Mine ('Cypress' herein), Cascade Coal Mine, Escarpment Coal Mine, and historical workings on the Denniston Plateau. Stockton is the largest opencast coal mine in New Zealand, comprises multiple pits, engineered landforms and rehabilitated areas over approximately 2,500 hectares. The active mining area is 787 ha.

The main environmental impact from mining at Stockton and surrounding mines is the generation of acid and metalliferous drainage (AMD), and its impacts on waterways, especially aquatic ecosystems.

Bathurst have requested professional services to assess groundwater conditions at Stockton and surrounding areas, and to assess the potential impacts on groundwater from future mining at Stockton under the proposed Buller Plateaux Continuation Project (BPCP).

A full description of the BPCP project is provided within the Fast-track Approvals Act 2024 (FTAA) application.

1.1 Purpose of this report

This report assesses the hydrogeology within the Stockton Plateau and surrounding areas, describes the influences from historic and current mining activities, and how future mining at Stockton under the proposed BPCP could impact groundwater and connected surface water, both in terms of quantity and quality.

1.2 Scope of works

A summary of the scope of works is as follows:

- Summarise available hydrogeological data records from BT Mining's current operations at Stockton, and other nearby mining operations like Cypress where necessary.
- Review relevant geological, hydrogeological and hydrological data within the study area.
- Review relevant consents pertaining to groundwater.
- Review publicly available information on groundwater use, yield and/or groundwater protection zones.
- Interpretation of the desktop data / information to provide a conceptual understanding of the localised hydrogeology including hydraulic gradient, flow direction, potential for contaminant plume migration from Stockton, and the interaction between groundwater and surface waterways draining the Stockton Plateau.
- Develop a Hydrogeological Conceptual Model (HCM) of the pre-mining, current and proposed future state.
- Identify and assess the impacts from the BPCP on potential groundwater and surface water receptors.
- Develop a groundwater monitoring plan.

1.3 Study area

The study area (Figure 1.1) includes Stockton mining areas (historical, current and proposed), Stockton Plateau and the wider Stockton area. It is approximately 17 km long and 9 km wide and falls within the jurisdiction of the West Coast Regional Council (WCRC) and Buller District Council. It is bounded by the Tasman Sea (west), the St Patrick Stream catchment boundary and Waimangaroa River (east), and by the Ngākawau River and Waimangaroa River (north and south respectively). The southern area abuts the Mount Fred South (historical underground) and proposed opencast coal mine under the BPCP. Stockton is located near the middle of the study area, ~2 km from the coast at its shortest distance. Cypress, physically separate but operationally aligned with Stockton, is located on the eastern boundary of the study area near Cypress and St Patrick Streams.

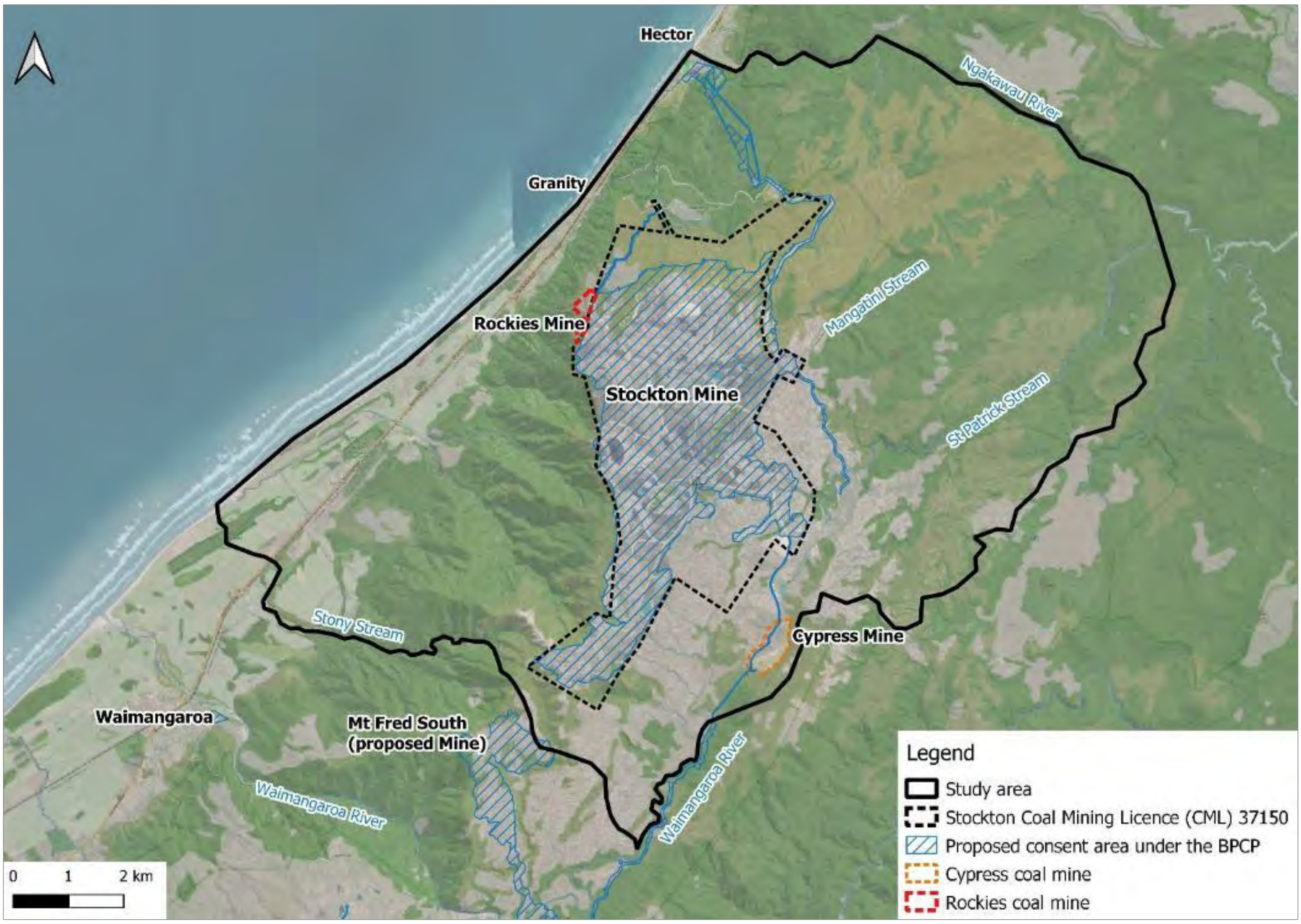

Figure 1.1 Stockton groundwater study area and other mine sites

1.4 Groundwater definition

In this report, groundwater is defined as *subsurface water that occurs beneath the water table in materials that are fully saturated*, consistent with standard hydrogeological definitions (Freeze and Cherry, 1979). These materials include:

– **Unconsolidated materials (superficial deposits)**: Natural soils and sediments that are not cemented into rock (e.g. sands, gravels, silts, and clays), in which groundwater is stored and transmitted through interconnected pore spaces.
– **Consolidated materials**: Lithified rock units in which groundwater occurs and moves primarily through fractures, joints, or other secondary permeability features. For example, the Basement, Brunner Coal Measures (BCM) and Kaiata Mudstone (KMS).
– **Anthropogenic or altered materials**: Materials disturbed or placed by human activities. Examples at Stockton include uncapped and encapsulated waste rock areas, coal fine storage areas, backfill material, embankments, historical underground coal workings, rehabilitated land and future Engineered Landforms (ELFs) proposed under the BPCP.

Within the Stockton groundwater study area (Figure 1.1), groundwater flow occurs predominantly via the following mechanisms:

– **Porous media flow**: Groundwater movement through intergranular pore spaces, typical of unconsolidated sediments.
– **Fracture flow**: Groundwater movement through fractures and joints in consolidated rock.
– **Conduit flow (mine workings)**: Flow through interconnected historical underground mine tunnels and voids, which function as preferential flow paths and may facilitate rapid groundwater movement.

Groundwater at Stockton and its surrounding areas exists in all the forms listed above. Groundwater occurrence within these materials is classified as follows:

– Regional groundwater representing the major groundwater flow paths and quality.
– Localised, commonly perched, groundwater above and separated from the regional water table by a zone of unsaturated material. This groundwater may represent smaller areas with characteristics that are different to the regional groundwater, and connected or not connected to the regional groundwater.

1.5 Buller Plateaux Continuation Project (BPCP)

Bathurst seeks approvals through the FTAA for the Buller Plateaux Continuation Project (BPCP). A key objective is to re-consent the existing infrastructure and mining operations at Stockton and provide access to additional mining areas as the coal resources at Stockton are depleted. A 35-year consent is being sought, covering the period from 2027 - 2062. The BPCP is broken into five key project sub areas listed below and shown in Figure 1.3.

– Stockton (including the Ngākawau Rail Loadout and associated aerial ropeway).
– Escarpment Extended (ESE).
– Mount Frederick South (MFS)
– Upper Waimangaroa Haul Road (UWHR) (transport corridor).
– Cypress.

This report focuses on the Stockton sub-area. The proposed consent area (yellow) is outlined on Figure 1.2. At Stockton, Bathurst proposes additional opencast mining areas in the north of the Stockton sub-area, continued use of the existing water infrastructure and facilities, carrying out further sourcing of granite material in the A Drive quarry, placement of PAF waste rock from other BPCP sub-areas, development of three additional Coal Fines Storage Facilities (CFSF) and continued rehabilitation. Most of the development potentially impacting groundwater is within the Millerton Block. The Stockton (sub-area) timeline and key activities under the BPCP are summarised in Table 1.1.

Table 1.1 Stockton timeline

Stage of works	Period	Key activities under the BPCP
Operation phase mining until Stockton coal runs out.	2027 - ~2033	Millerton Block - significant opencast mining, removal of underground workings, creation of long-term AMD water treatment sumps and a new ELF to store PAF waste rock. St Patrick catchment - minor opencast mining. Mangatini and Upper Waimgangaroa catchments - no opencast mining
Receival / processing of coal and receival / disposal of potentially acid forming rejects from other BPCP sub-areas.	2027 - ~2042	Mangatini catchment - transfer of excess PAF waste rock from Cypress and UWHR construction to the Webb South ELF. St Patrick catchment - new CFSFs
Receival of active treatment and mussel shell sludge containing heavy metals from MFS and ESE – being put forward as a potential option.	2027 - > 2062	Millerton Block.
Land rehabilitation (physical works)	2027 - ~ 2046	All catchments.
Mine closure.	2046	All catchments.
Post-closure monitoring, Bathurst 'Point of Exit' and handover to the Crown when final landform rehabilitation is completed and signed off.	2047- 2062	All catchments.
Continued AMD management:	Beyond 2062	All catchments.

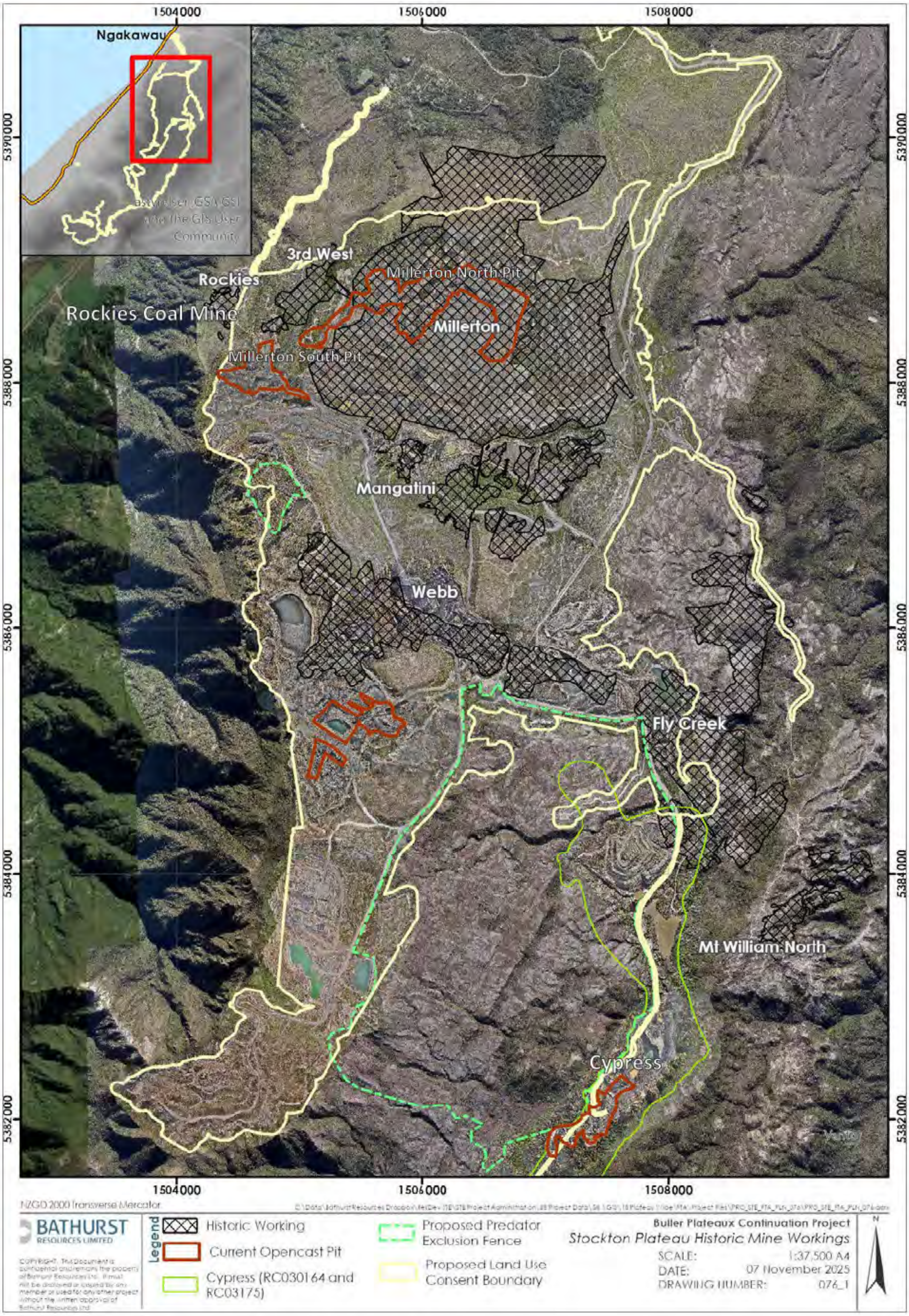

Figure 1.2 ***BPCP Stockton sub-area and relevant features***

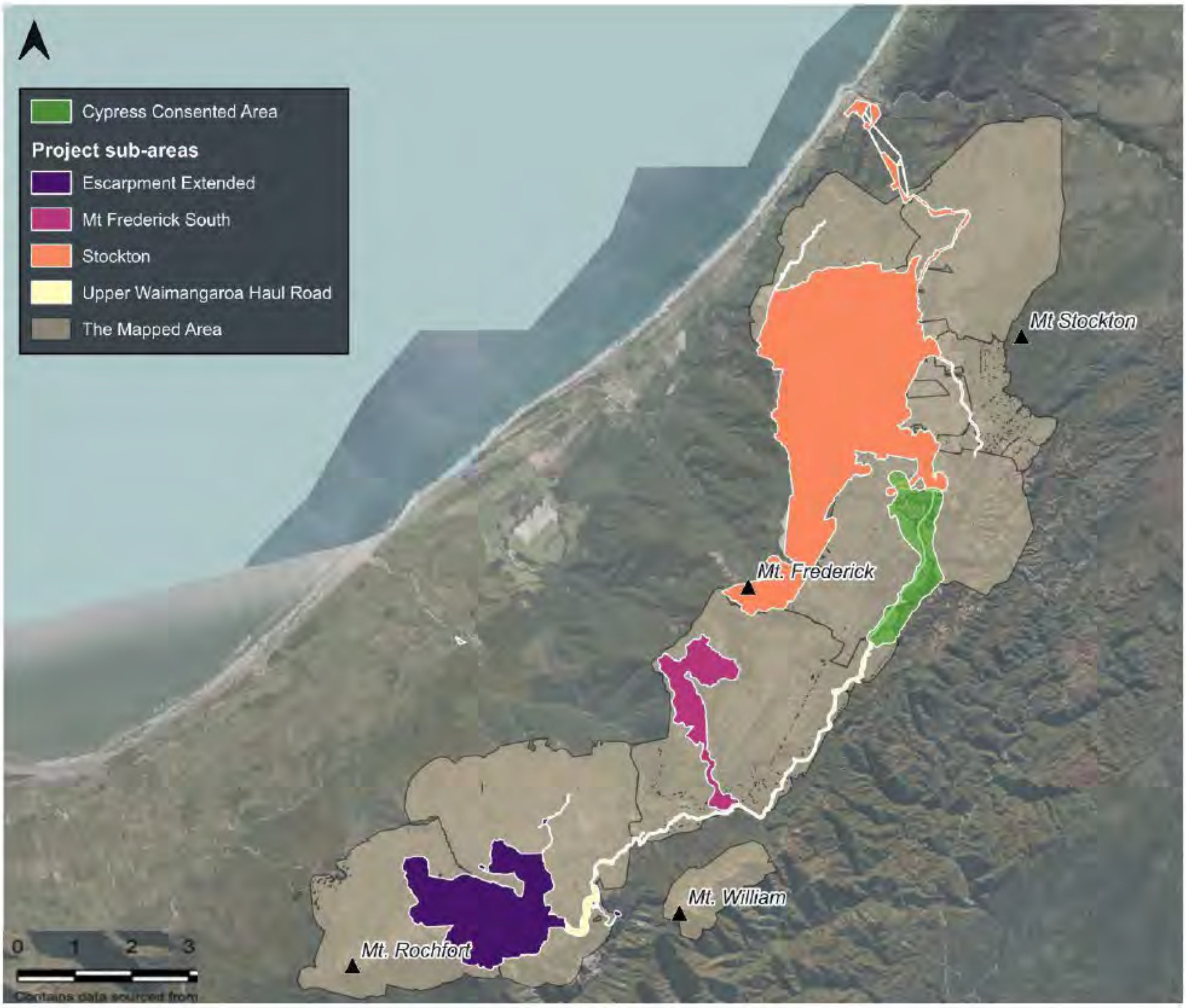

Figure 1.3 BPCP sub-areas (adapted from Ecological Solutions Ltd, 2026)

1.6 Scope and limitations

This report: has been prepared by GHD for Bathurst Resources Limited (including its subsidiary companies BT Mining Ltd, Bathurst Coal Ltd, and Buller Coal Ltd) (together Bathurst) and may only be used and relied on by Bathurst for the purpose agreed between GHD and Bathurst Resources Limited as set out in Section 1.1 of this report. Without limiting the foregoing, this report is intended to support Bathurst Resources Limited's application under the Fast-track Approvals Act 2024 and may be relied upon by the Expert Panel and relevant administrating agencies for the purposes of assessing the application.

GHD otherwise disclaims responsibility to any person other than Bathurst arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

GHD has prepared this report on the basis of information provided by Bathurst and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

1.7 Other groundwater reports

Previous groundwater investigations and reporting at Stockton are limited. The earliest known groundwater investigations at or near Stockton are those of Coote (1991) in the Webb-Baynes Block (Mangatini catchment) and Dudding (1989) in the Marshall Block (Upper Waimangaroa catchment) which focus on the BCM.

In 2024, GHD (2024b) undertook a desktop assessment of groundwater at Stockton and surrounding areas to provide an initial assessment of the hydrogeological conditions' potential impacts from future mining.

The remaining groundwater investigations and reports come from other areas adjacent to Stockton. Significant groundwater investigations and modelling have been, and continue to be, undertaken at Cypress with recent reports from GHD (2024a and 2025) related to opencast pit dewatering and management of AMD generation from waste rock areas.

South of Stockton, additional recent groundwater investigations by Mine Waste Management (MWM) has been undertaken for the ESE (MWM, 2026b) and the adjacent MFS (MWM, 2026a) sub-areas to support the BPCP.

1.8 Assumptions and exclusions

This assessment is subject to the following assumptions:

- Data obtained from publicly available sources are current and reflect the potential existing groundwater and surface water users in the surrounding area.
- The interpretations of the likely subsurface conditions are based on a desktop investigation which included available published and reported information at this time. GHD accepts no liability for any unknown or adverse ground conditions which may be identified in future investigations, including field work, sampling, and testing been undertaken.

2. Mining

The study area includes Stockton and Cypress – two large mines operated by BT Mining, historical mining areas, the Rockies Coal Mine (currently ceased operations) and 'smaller' historical mines, adits, and waste rock areas owned by third parties. There is limited information on these latter 'smaller' mining operations. Immediately south of the study area is the MFS sub-area, which includes proposed open-cast mining, construction of ELFs and various water treatment infrastructure.

2.1 Stockton

2.1.1 Mining overview

Mining on the Stockton Plateau began in 1896, with the Westport-Stockton Coal company. Initially, this was limited to underground operations in the Millerton area, before moving to other areas between 1908 and 1944. The history of Stockton mining is summarised below:

– Underground coal mining from 1896 – 1969.
– Opencast mining from 1944 to present day, then ramping up from 2000 onwards.
– 1,100 ha disturbance with ~400 ha rehabilitated.
– The historical and current mining have resulted in AMD impacts to groundwater and surface water.

2.1.2 Historical underground workings

Historical underground workings are a conduit for underground AMD-impacted water and influence groundwater and surface water flow / quality at Stockton. Most remaining workings are located within the Millerton Block and outside the Stockton CML, in the St Patrick catchment (Figure 2.1). The Mangatini catchment had significant underground workings, most of which have been mined out. Opencast mining (to the base of the coal deposits) is now being used to extract the coal left behind from underground mining. The underground workings are shown on Figure 2.1. Workings are:

– 5 – 10 m wide / high and spaced 20 – 30 m apart for the coal extraction Drives.
– 10 – 20 m depth below natural ground level.
– Fuel sources for underground fires still burning in parts of the Millerton Block and Mangatini catchment.

The dense, interconnected nature of the underground tunnels is shown in Figure 2.2 – an extract from an historical underground coal workings map. Figure 2.3 further illustrates the tunnel network and fire locations. Some underground workings have collapsed. A collapsed coal Adit at Millerton Block is shown in Figure 2.4.

2.1.3 Main environmental impacts

AMD describes the acidic, metalliferous or saline drainage from both mining and natural processes, both of which occur at Stockton. This report, however, is mostly focused on mining impacts, which are the main environmental impacts from Stockton (and adjacent mines).

AMD occurs when the sulfides, in this case pyrite, are exposed to water and air during historical and / or current mining activities and subsequently oxidise. The process generates sulfuric acid, a corrosive acid capable of breaking down surrounding rocks, which can mobilise metals, resulting in their dissolution and transport into surrounding groundwater and surface water (Alarcon, 1997).

[redacted]

[redacted]

Figure 2.4 Coal Adit collapse at Millerton (source: Bathurst)

2.2 Cypress

Open cast mining at Cypress (North Pit) started in late 2013, with pit dewatering commencing in July 2014. The North Pit has been excavated, via open cast mining, into the AMD-producing Kaiata Mudstone (KMS) and BCM (sandstone and coal). From the 1990s, various hydrogeological investigations, associated with the mine development, have been undertaken within and surrounding the Cypress area.

Cypress contains the Northern Engineered Landform (NELF). This temporary storage facility, containing potentially acid-forming (PAF) overburden waste rock, is sited on top of sandstone. Seepage from the storage, of up to 80 L/s is directed to the St Patrick Reservoir, along with dewatering from Cypress North Pit, for treatment at Stockton prior to discharge to the St Patrick Stream (GHD, 2024a).

2.3 Rockies Mine

The Rockies Coal Mine (Rockies Mine) is located on the crest of the Granity Escarpment (Millerton Block), south of Twins Stream headwaters (Figure 2.5). The mine was operated by the Westport Main Coal Company from 1924 – 1934, working coal outcrops at the edge of the plateau using opencast and underground mining techniques (RML, 2010). From 1935 – 2010 all mining stopped. [redacted] In 2014, active coal opencast mining operations stopped again and remains stopped to this day.

Although the mine is not in operation, water is still managed to some degree. Since 2014 (to present day), most AMD-impacted surface water and run-off from the mine has been diverted to Twins Stream. Some of this water is routed to a Mussel Shell Reactor (MSR) for treatment. Some remnant historical underground AMD continues to report to upper Rudolph Stream.

[redacted]

3. Environmental setting

3.1 Climate

The mean annual rainfall within the study area is topographically controlled and increases inland from approximately 3,000 mm at the coast to 6,000 mm at the top of the Stockton Plateau. The lowest rainfall months are generally January through to April. Rainfall greatly exceeds the mean annual evapotranspiration of approximately 1,350 mm (from Westport Township) (Macara, 2016).

3.2 Land use and topography

Outside the current mining areas, the dominant hill country land uses consist of native forest (indigenous forest and Manuka / Kanuka shrubland) and low producing grassland. The coastal plains are dominantly high-producing exotic grassland and coastal wetlands.

The area is characterised by a wedge-shaped, relatively flat plain near the coast, which pinches out near Hector Township. Stockton is at the western edge of a broad basement plateau (the 'Stockon Plateau'), approximately 300–1,000 m above sea level, on the flank of the main mountain range (Figure 3.1). From the higher elevations of the plateau at Stockton, the topography slopes slightly down towards Cypress, where the Waimangaroa River and St Patrick Stream flow in local depressions.

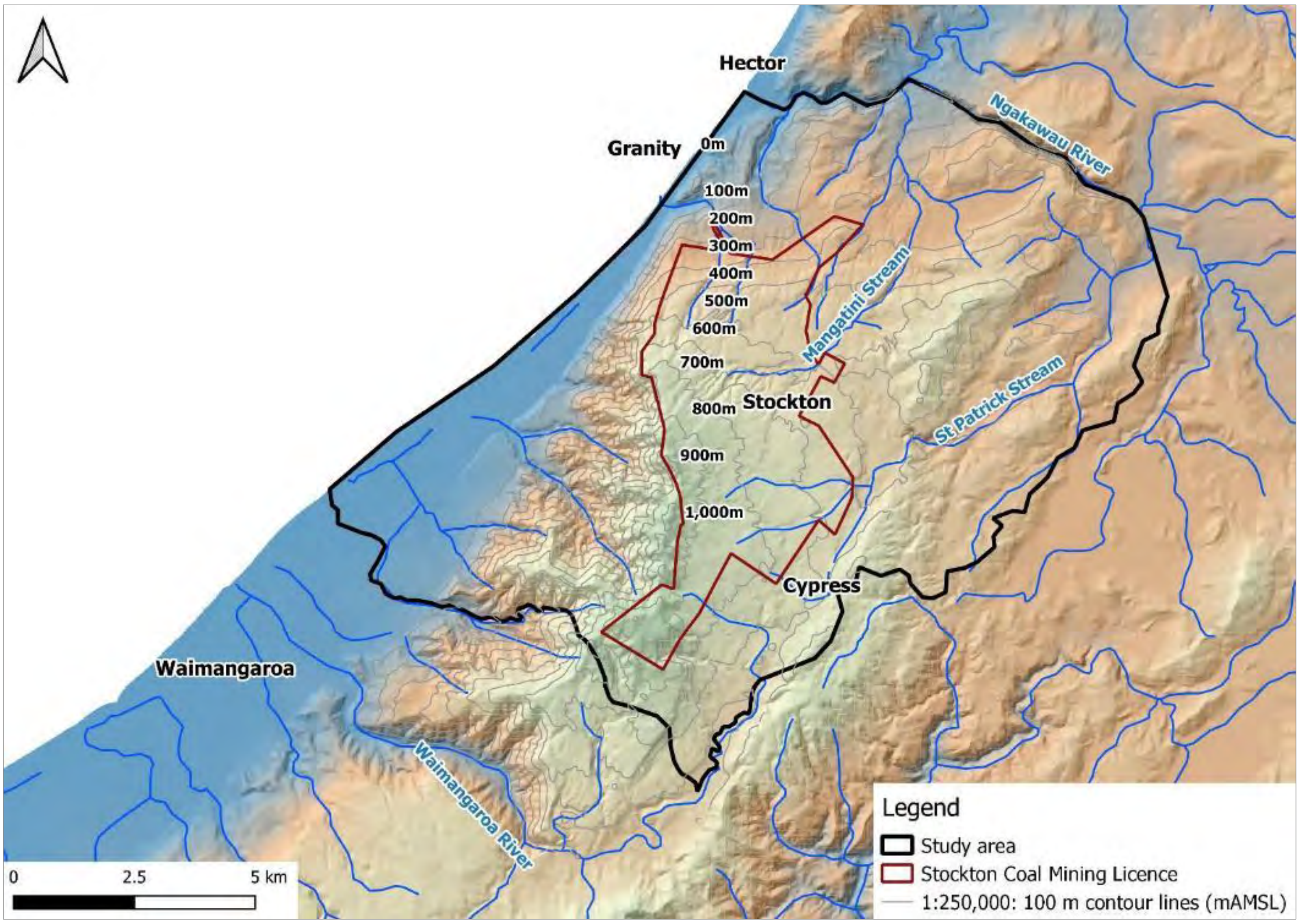

Figure 3.1 Topography (8 m DEM sourced from LINZ 2012)

3.3 Waterways

Stockton intercepts two large catchments – the Waimangaroa River to the south and Ngākawau River to the north, and smaller catchments draining to the coast (Figure 3.2). Cypress mine crosses the Cypress and St Patrick Streams and occupies a depression straddling the boundary between the Waimangaroa River and St Patrick Stream catchment.

For this report, waterways draining the Stockton Plateau are grouped into four main catchment areas shown in Figure 3.3, referred to as 1) Mangatini, 2) Millerton Block, 3) St Patrick and 4) Upper Waimangaroa. The waterways in these catchments drain into the following sources:

– Mangatini, St Patrick and Mine Creek (within the Millerton Block) catchments drain into the Ngakawau River.
– Upper Waimangaroa catchment drains into the Upper Waimangaroa River.
– Western Millerton Block catchments (Granity Stream, Twins Stream, Rudolph Stream, Hugh Stream) drain directly to the ocean or loss or all their flow into coastal groundwater.

Stockton is located on a topographic high, covered by numerous constructed sumps and remnant pits that have filled with water as well as natural and constructed tarns.

The flow regime of waterways draining the Stockton Plateau is dominated by rainfall-runoff over steeply sloping low permeability rock, and drainage from saturated shallow substrate. Hydrological data from Stockton show that rainfall-runoff accounts for approximately 75% - 95% the total flow. In contrast, groundwater (baseflow) inputs are relatively minor (Alarcon, 1997).

Over the last 130 years, Stockton mining operations have considerably altered the natural hydraulic regime of waterways. Remnant underground workings (some more than 100 years old) act as conduits of underground water between the defined surface water catchments, which are normally separated by natural factors such as topographic divides. In addition, there has been substantial modification of the ground surface by opencast mining methods, placement of waste rock, and pumping of water to different catchments for treatment, resulting in changes to overland / subsurface flow paths and flow regimes.

Historical underground mining has resulted in several waterway submergences (flow into) and resurgences (flow out of) to underground workings in the Millerton block (Solid Energy, 2010) (Figure 3.4). Mine Creek and Miller Stream lose all their water into the underground workings except in flood conditions when the capacity of the submergences is exceeded. Water quality in waterways flowing through the Millerton Block is currently affected by the passage through historic underground workings and underground fires (Solid Energy, 2010).

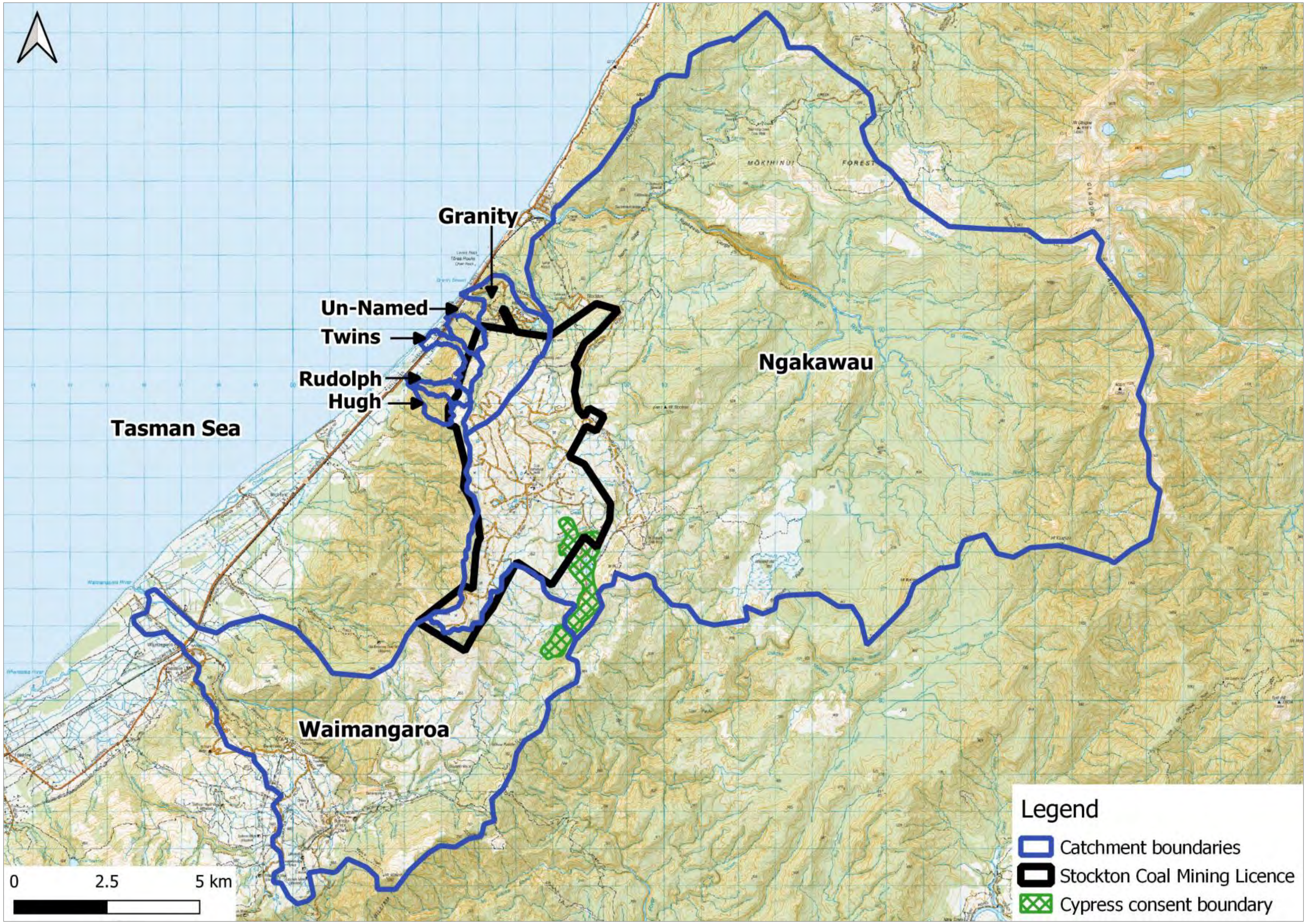

Figure 3.2 ***Major surface water catchments that intersect Stockton. Cypress consent boundary also shown***

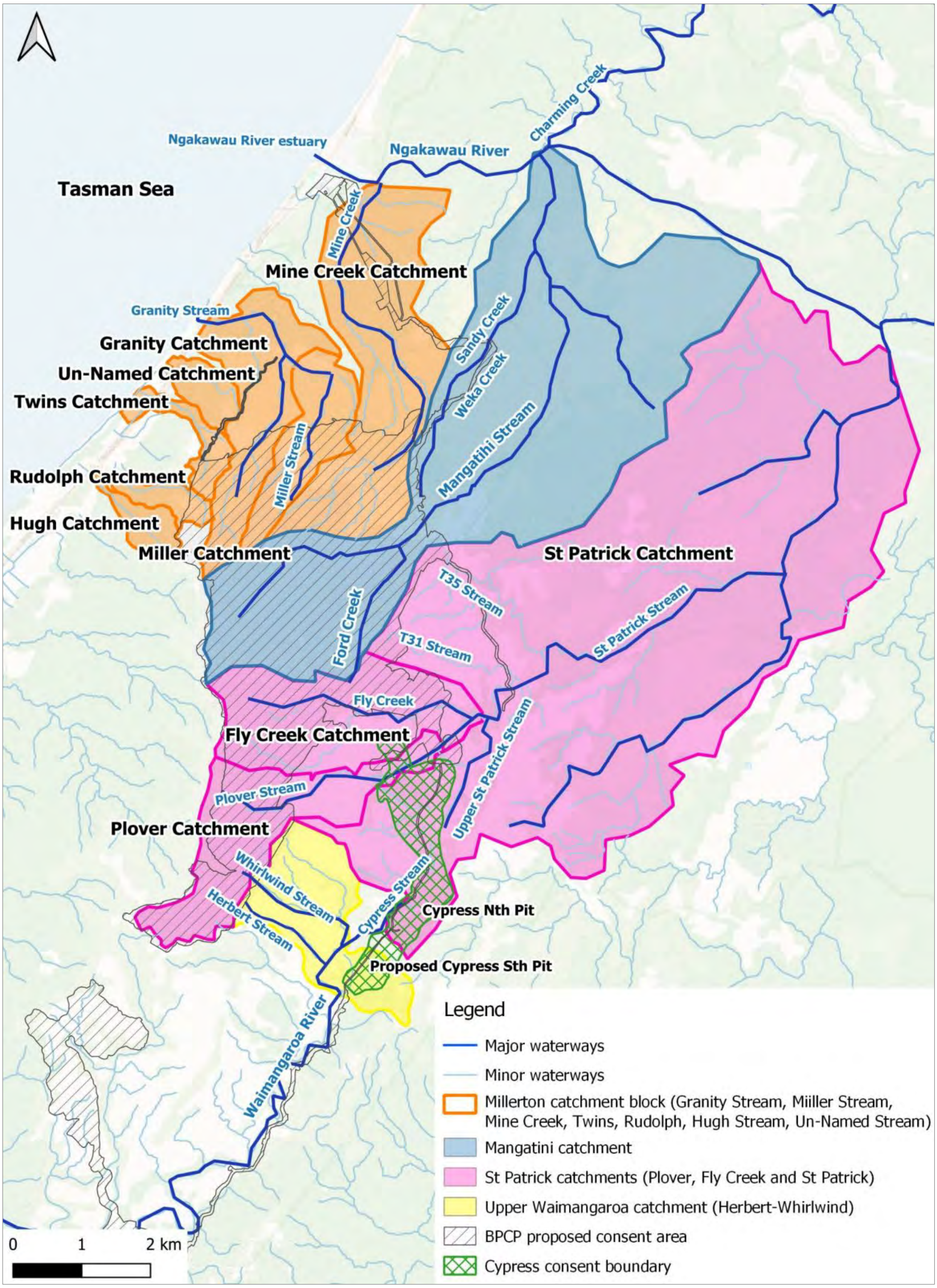

Figure 3.3 Key surface water catchments and waterways

[redacted]

3.4 Wetlands

The estimated wetland extents and type prior to European settlement, and the wetland extent in 2013, are shown in Figure 3.5 (LINZ, 2014b and c). Prior to European colonial settlement, Stockton was largely pakihi wetland, with further areas of this wetland type present along the base of the hills and north towards the Ngākawau River. By 2013, the wetland areas had reduced significantly, though some pākihi wetland was still present in the in the south-east corner and in other areas north and east of the mine.

The current (2025) distribution of wetlands within the BPCP, Disturbance Areas (areas of 'new' disturbance when applied to Stockton, for example: mining, mining infrastructure, roading, buildings) and Ecological Setbacks around the Disturbance Areas (10 m for Stockton) are shown in Figure 3.7. The wetland ecosystems represented within these areas at Stockton and their ecological values are summarised in Table 3.1.

Table 3.1 Current (2025) wetland ecosystems represented within the Disturbance Areas (and Ecological Setbacks) at Stockton and ecological values (source: Ecological Solutions, 2026)

Wetland type	Vegetation community	Overall ecological value
Shrubland	Mānuka-mountain beech-podocarp shrubland.	Very high
	Mānuka/Gahnia-wire rush shrubland.	Very high
	Mānuka-mountain flax/wire rush shrubland.	Very high
	Mānuka-tussock-wire rush shrubland.	High
Low vegetation	Low pākihi. *Characterised by a combination of flat topography, leached, very infertile soil, high rainfall and impeded drainage. Support sedgeland, rushland and fernland vegetation (Johnson & Gerbeaux 2004).*	Very high

Within the Millerton Block, some perched wetlands (Manuka, wire rush) on the Stockton Plateau are supported by a thin layer of soil on top of the rock, which is above the regional water table (Bioresearchers, 2024). In other areas, wetlands may be supported by regional groundwater seepages.

3.4.1 Coastal wetlands

Wetlands along the coast plains (Figure 3.5 and Figure 3.6), down-gradient of the Stockton Plateau, occupy low-lying depressions within coastal dune deposits and receive water from rainfall, groundwater, and surface water either as run-off, or where waterways lose some or all their flow into the ground.

The Granity Wetland Conservation Area (DoC, Unknown) (Figure 3.6) is located just south of Kerr Stream. This wetland is part of a larger wetland system that is likely to receive some water from the coastal waterways flowing from the Millerton Block at Stockton. Surface water and groundwater samples collected from this area are discussed later in the report.

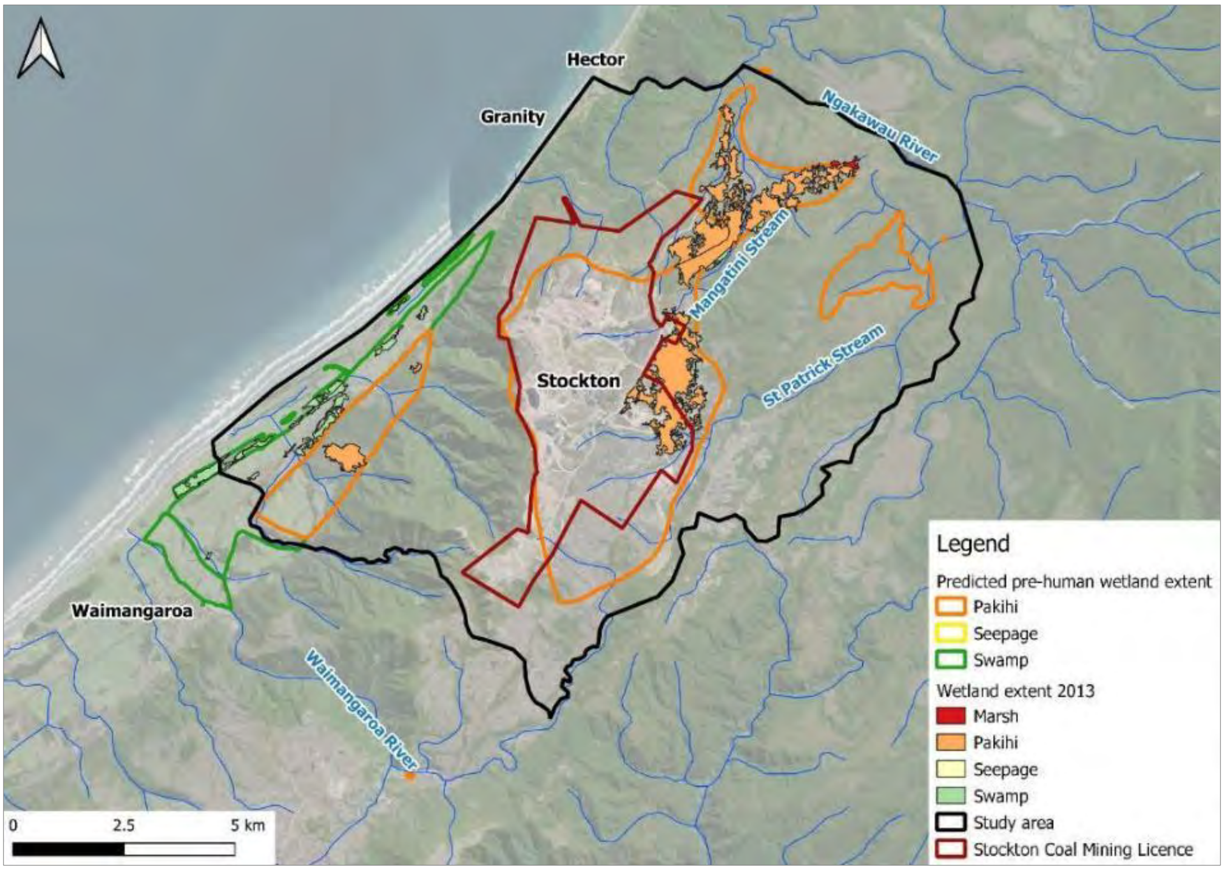

Figure 3.5 Wetlands pre and post human arrival (sourced from LINZ 2024b and 2024c)

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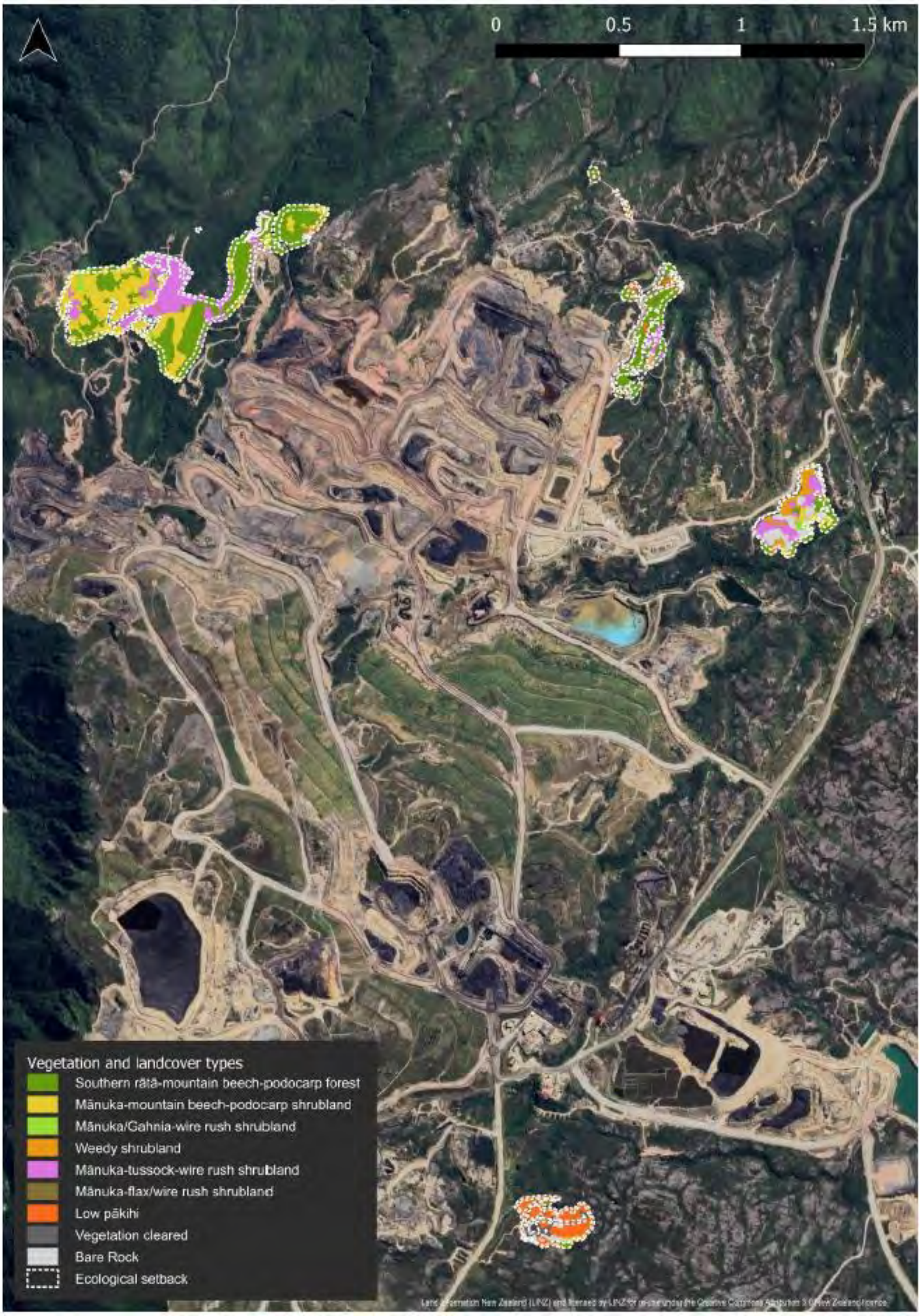

Figure 3.7 ***Vegetation types and wetlands within the Disturbance Area and Ecological Setback at Stockton (source: Ecological Solutions Ltd, 2026)***

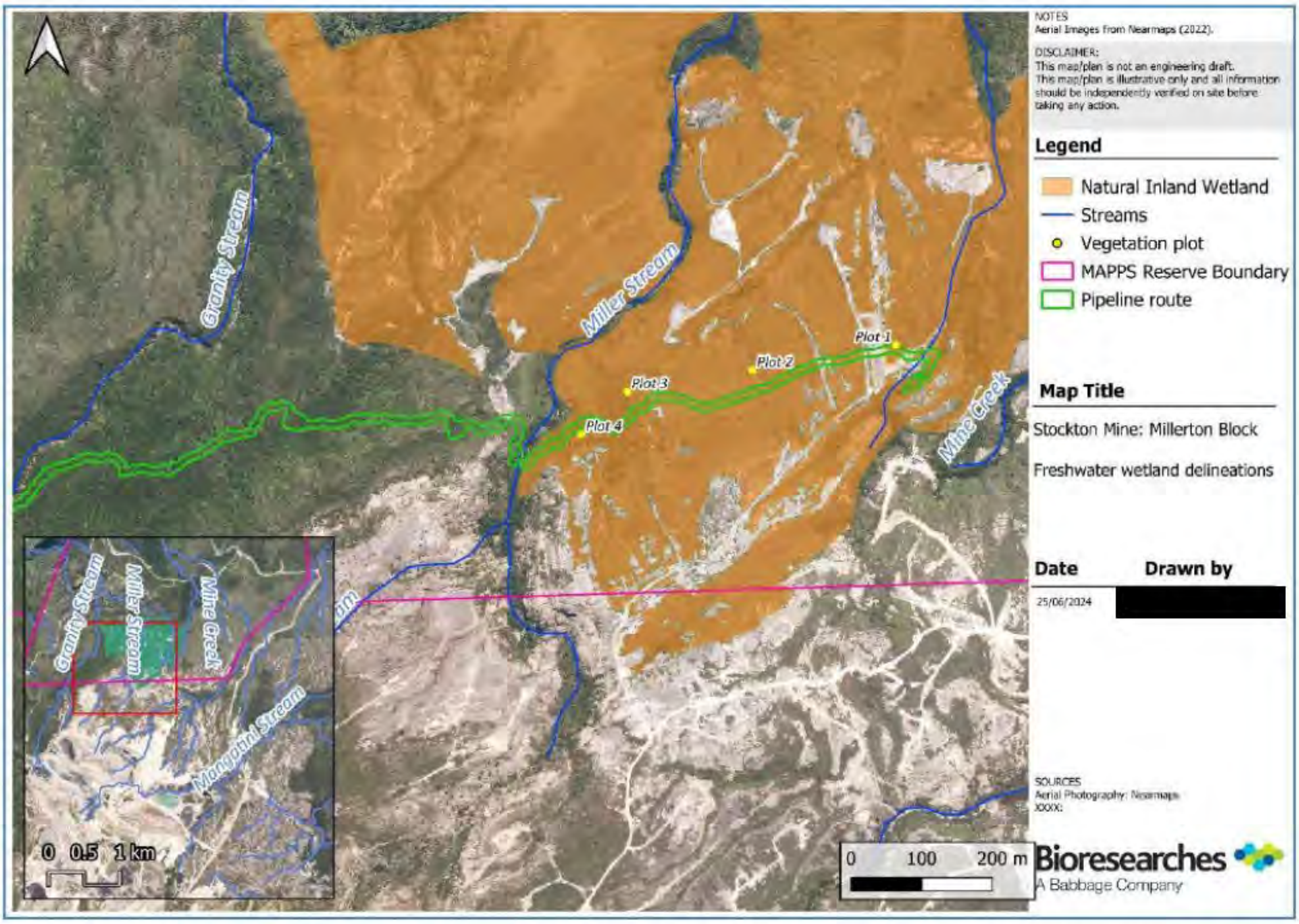

Figure 3.8 Current (as of 2024) wetlands identified within the MAPPS Reserve – Millerton Block (source: Bioresearchers, 2024)

The wetland at Plot 4 (Figure 3.8) is a large palustrine pākihi wetland predominantly fed by rainwater and surface water runoff from the higher topographical points (Bioresearchers, 2024). No pools, standing water or boggy ground was observed throughout the area. The underlying ground consists of impermeable material and it is likely the frequent and heavy rainfall (average about 6 m of rain annually) sits on the rock and trickles downslope providing a permanently damp surface to support the growth of hydrophytic herbaceous vegetation (Bioresearchers, 2024). It is likely the area does not contain enough soil material to support the growth of high tier shrub and canopy hydric vegetation (Bioresearchers, 2024).

3.5 Water monitoring

Surface water and groundwater monitoring is undertaken by BT Mining and began around the 1980s, by its predecessors Solid Energy and CoalCorp.

3.5.1 Surface water

Extensive surface water flow and water quality monitoring is conducted on waterways draining the Stockton Plateau. The sites provide data on impacts to waterways from both rainfall run-off and historical underground mining / groundwater sources. Monitoring focuses on active mining areas and AMD discharges. Figure 3.9 shows the locations of current and recent surface water monitoring sites.

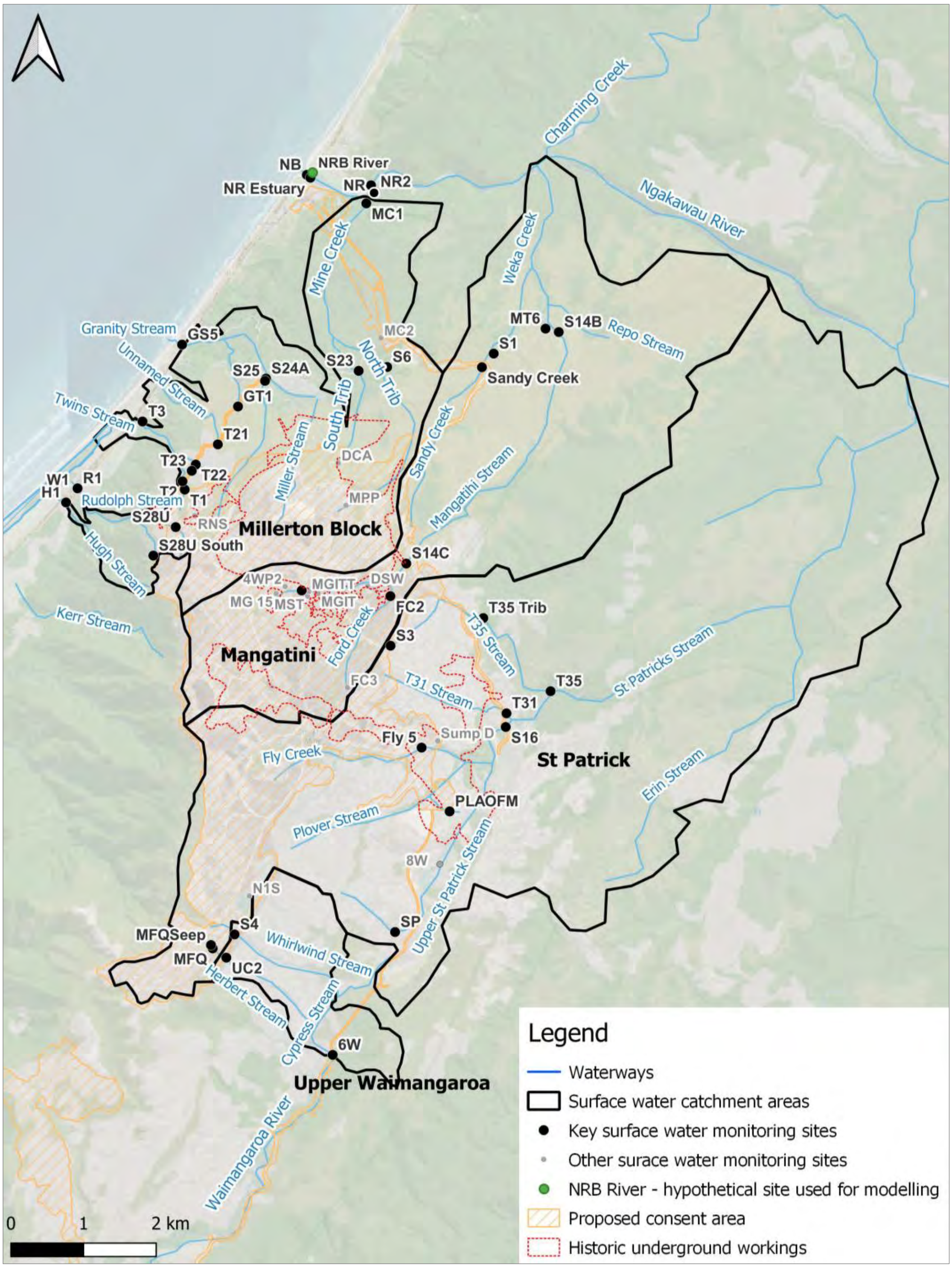

Figure 3.9 ***Current and recent historical surface water monitoring sites at Stockton***

3.5.2 Groundwater

Groundwater monitoring and data collection at Stockton mainly began in the early 2000s. Most recorded information includes groundwater levels used for environmental and geotechnical assessments. Waste rock seepages, including those from groundwater, are shown and discussed in Sections 4.5.3 and 5.3.3. The most comprehensive current groundwater monitoring occurs at Cypress, to assess the impacts of opencast pit dewatering and to inform the design of waste rock storage. Table 3.2 lists sources of groundwater information supplied by Bathurst for Stockton and surrounding areas. The groundwater information locations (excluding waste rock seepages) are shown in Figure 3.10.

[redacted]

Table 3.2 Current and historical groundwater information within and near the study area

Groundwater dataset name and description	Description	Location and catchment	Data types	Number of monitoring locations	Date range of groundwater measurements
Drillholes	Generally one-off groundwater level measurements at each	**Stockton** Millerton and Mangatini	Groundwater levels	419	May 2006 - February 2010
		Stockton St Patrick	Groundwater levels	16	February 2003 - March 2006
Millerton Bock Monitoring bores / Vibrating Wire Transducers	Continuous groundwater level monitoring using pressure transducers.	**Stockton** Millerton	Groundwater levels and potentially quality	~10	2009 – 2026 depending on the site
Coal Fines Storage Facilities	Vibrating Wire Piezometers (VWPs) - monitor groundwater levels within CFSFs	**Stockton** Mangatini and St Patrick	Groundwater levels	-	-
Mangatini Sump existing monitoring bores	Manual dipped groundwater levels	**Stockton** Mangatini	Groundwater levels and potentially quality	4 locations, 3 have shallow and deep piezometer, 7 piezo total	2013 - 2026
Mangatini Sump historical monitoring bores	Manual dipped groundwater levels	**Stockton** Mangatini	Groundwater levels and potentially quality	2 locations, each with a shallow and deep bore, hence 4 bores total	2007 - 2009
STK7163 monitoring bore	One manual dip water level reading - primarily for groundwater quality. Future monitoring of waste rock from Cypress to Webb area.	**Stockton** Mangatini – Webb area	Groundwater levels and potentially quality	1	2025
Drainage Control Adit	Underground working discharge to Mine Creek. Can be influenced by surface water at times.	**Stockton** Millerton Block	Water levels, flow and quality	1	-
Twins Stream T1	Groundwater seepage. Can be influenced by surface water at times.	**Stockton** Millerton Block	Flow and quality	1	-
Cypress BH1523	Series of manual dip readings taken during successive water quality sampling rounds	**Cypress** St Patrick	Groundwater levels and potentially quality	1	2019 - 2025
Cypress VWPs	Continuous groundwater level monitoring	**Cypress** St Patrick / Waimangaroa	Groundwater levels and potentially quality	94	2009 - 2025
Mount Frederick South monitoring bores	One manual dip measurement at each of the five bores, primarily used for water quality analysis.	**Mount Frederick South** ~ 500 to 1,500 m south-west of the study area	Groundwater levels quality and quality	5	Date of water level measurement unknown

3.6 Soils and geology

3.6.1 Soils

High rainfall has resulted in extensive podsolisation and acidification of soils across Stockton Plateau (Winterbourn and McDiffett, 1996), and soils retained on BCM and granitoid substrates are generally thin and lithic (Davies et al, 2011). This contributes to naturally acidic rainfall-derived surface water and shallow groundwater within the BCM.

3.6.2 Regional geology

Figure 3.11 shows the published 1:250,000 (surface) geology (Heron, 2014). Key units within the study area are summarised in Table 3.3. Information from the New Zealand Geotechnical Database within the study area is sparse with only one shallow hand auger hole located at the coast.

A generalised regional cross-section through Stockton to the coast is provided in Figure 3.12.

Basement rocks

The basement sequence is comprised of 1) Ordovician aged Greenland Group greywackes and argillites and 2) younger, locally intruded granitoids and minor diorite of Early Cretaceous Berlins Porphyry (Alarcon, 1997) which are commonly exposed in natural outcrops and excavations at Stockton and extensively intrude the Greenland Group. The basement rocks, with overlying remnants of the coal-bearing sedimentary veneer, have been uplifted to form a mountain range that rises from sea level to peaks up to 1,400 m above sea level a few kilometres to the east of Stockton (Davies et al, 2011). The uplifted basement rocks have been eroded overtime and are highly fractured, with joint spacing of 0.05 – 0.2 m. The weathering profile extends to about 20 m below ground level (Golder Associates, 2010).

Brunner Coal Measures (BCM)

Middle to Late Eocene-aged BCM unconformably overly the Greenland Group greywackes and argillites, and the Carboniferous to Cretaceous Karamea Batholith granitoids. The BCM is generally 30 – 100 m total thickness (Alarcon, 1997), and is composed of fine to coarse-grained sandstone, minor carbonaceous mudstone beds, and 10 – 20 m thick coal beds. The coal beds comprise coal 5 – 10m thick coal seams (Alarcon, 1997) that are separated by the non-coal lithologies.

Kaiata Formation Mudstone (KMS)

The Oligocene aged Kaiata Formation mudstone (KMS) sits stratigraphically above the BCM. It is 20 – 30 m thick and consists of massive silty mudstone grading to muddy sandstone near the base (Golder Associates, 2010).

Quaternary sediments

Quaternary sediments are found on the coastal plains and are dominated by gravel, with varying amounts of clay, silt, sand and peat. River deposits are dominant, with minor areas of Holocene wind-blown dune deposits near the coast. Outside of the coastal plains, areas of colluvium occur downslope from the areas of high relief.

SouthDrill (2016) drilled a 180 m deep hole (for potable water supply) intercepting quaternary sediments on the south bank of the Waimangaroa River - Waimangaroa township. The bore log describes a surface covering of tailings, clay from 9 – 15 m, then largely gravel from 15 – 67 m before intersecting mudstone (papa) to end of hole.

3.6.3 Faults and structures

There are no active faults, within the study area. The closest active fault is the Glasgow Fault, located approximately 10 km to the east. However, Stockton is dissected by numerous inactive faults, with over 20 shown by Alarcon (1997). The regionally uplifted and subsequently deeply incised BCM is locally controlled by faults that strike NE–SW and NW-SE. A major structural feature which strikes NE–SW along the Stockton Plateau escarpment is the Kongahu Fault (Figure 3.12). To the east, Stockton Plateau is bound by the low angle Mt. William thrust fault. The Stockton Plateau in this area generally slopes 8° - 12° to the north-east, but the dip varies between NE and SE from the influence of major faults in the vicinity. The general conjugate fracture pattern formed by closely spaced joints and faults evidently controls the surface water drainage system in the area, with deeply incised major waterways (Alarcon, 1997).

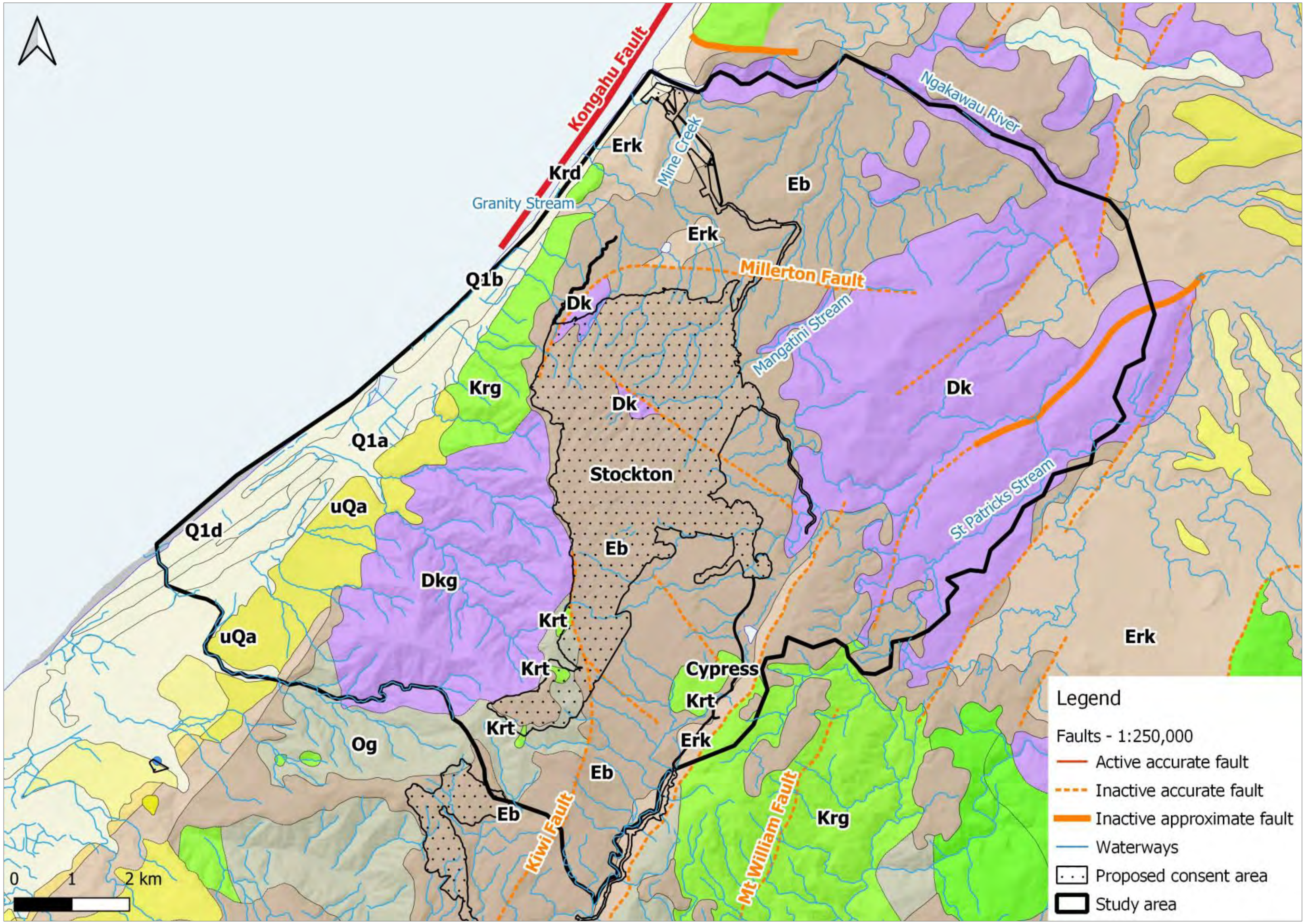

Figure 3.11 1:250,000 geology and faults (source: Heron 2014)

Table 3.3 Geological unit descriptions (source: Heron 2014)

Legend	Unit code	Age	Group	Key name	Main rock types	Minor rock types	Description
	Og	Ordovician	Buller Terrane	Greenland Group	Sandstone	Mudstone	Basement: Undifferentiated green-grey greywacke and argillite.
	Dk	Carboniferous	Karamea Batholith	Undifferentiated Karamea Suite	Granite	Granodiorite & diorite	Basement: Undifferentiated biotite, muscovite, porphyritic to equigranular, granodiorite and diorite.
	Dkg			Britannia Granite (Karamea Suite)	Granite	None	Basement: Light pink coarse grained biotite with potassium feldspar megacrysts.
	Krg	Cretaceous	Karamea Batholith	Rahu Suite	Granite	None	Basement: Biotite or muscovite biotite granite
	Krd			Rahu Suite	Quartz diorite	None	-
	Krt			Berlins Porphyry	Granite	None	Basement: Biotite or muscovite biotite granite
	Eb	Middle to Late Eocene	Mawheranui Group	Brunner Coal Measures (BCM)	Sandstone	Shale & coal measures	Quartz sandstone and conglomerate carbonaceous shale and coal seams
	Erk	Oligocene	Rapahoe Group	Kaiata Formation (KMS)	Mudstone	Sandstone	Massive silty mudstone and muddy sandstone
	uQa	Quaternary (Pleistocene to Holocene)	-	-	Gravel	Sand & silt	Undifferentiated older alluvial fans
	Q5a	Quaternary (Late Pleistocene)	-	-	Gravel	Sand & silt	River gravel and sand
	Q1a	Quaternary (Holocene)	-	-	Gravel	Sand, silt, mud, clay, boulders, peat	Well sorted river gravels forming moder flood plains and young fan deposits. Includes post glacial swamp deposits
	Q1d		-	-	Sand	None	Wind-blown dune deposits

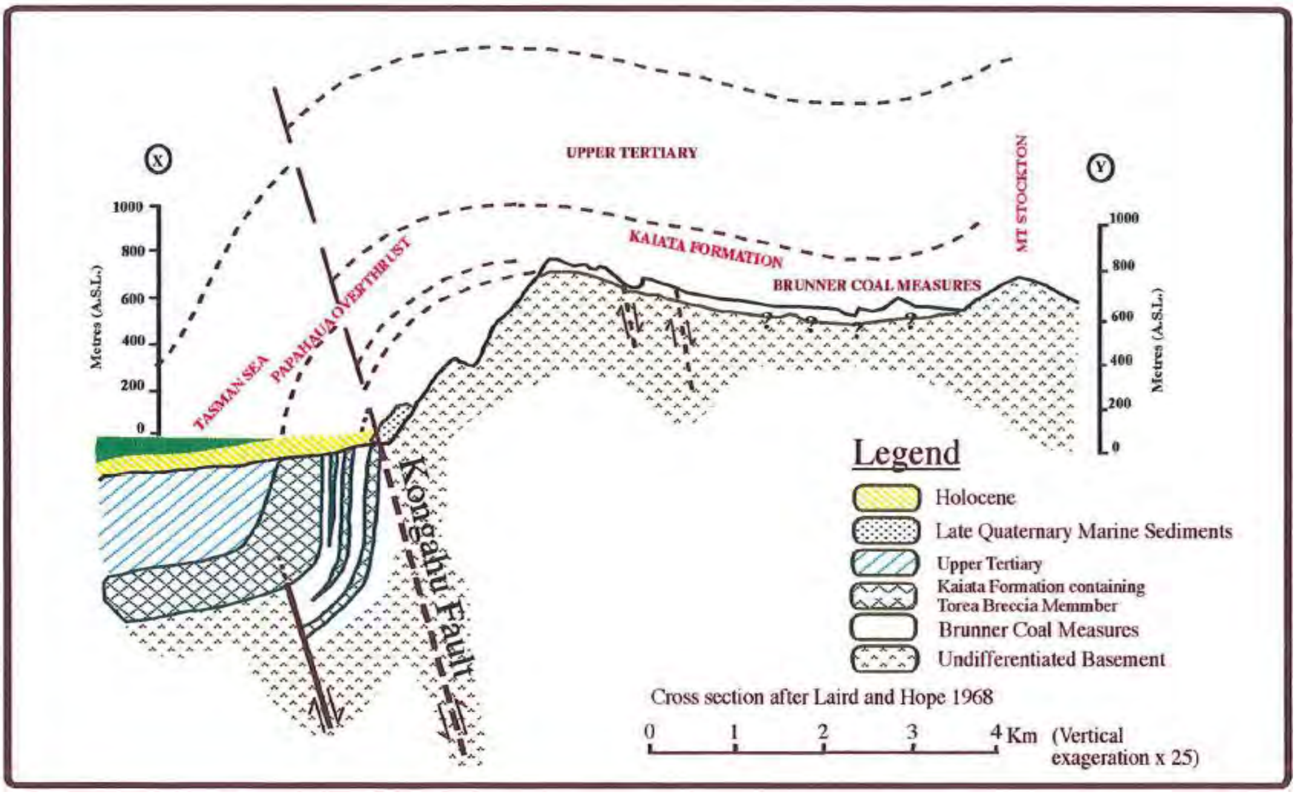

Figure 3.12 ***Generalised regional cross section through Stockton and the coast (source: Applied Geology Associates, cited in Alarcon, 1997)***

4. Hydrogeology

4.1 Current baseline

Groundwater within the Stockton Plateau, especially within the KMS and BCM, has been progressively altered over a period of 130 years due to mining, commencing with underground coal mining back in 1896, opencast mining from 1944, and disposal of PAF waste rock. The cumulative effects mean that the current baseline groundwater conditions over much of the Stockton Plateau, especially within the CML, represent a modified (non-natural) state. The following discussion of groundwater and hydraulically connected surface water (waterways) should be read in this context.

4.2 Hydrostratigraphy

Hydrostratigraphy is a term used to describe different groups of materials with similar hydraulic properties like permeability. Each distinct group is called a hydrostratigraphic unit (HSU).

4.2.1 Consolidated and unconsolidated materials

The study area is broadly broken into two major HSUs as identified by White et al (2019):

– Consolidated material (rock) which includes the Granite, Greenland Group, BCM and KMS that outcrop and underly the Stockton Plateau (purple in Figure 4.1). Each rock type having its own unique material properties.

– Unconsolidated material (sediments) which includes the Quaternary coastal sand, silt and gravel deposits overlying rock between the Plateau and Tasman Sea (brown in Figure 4.1).

Groundwater in the unconsolidated sediments flows through the primary, intergranular pores, whereas groundwater flow through the rock is largely driven by weathering and the degree of fracturing.

More detailed HSU information is provided in White et al (2019).

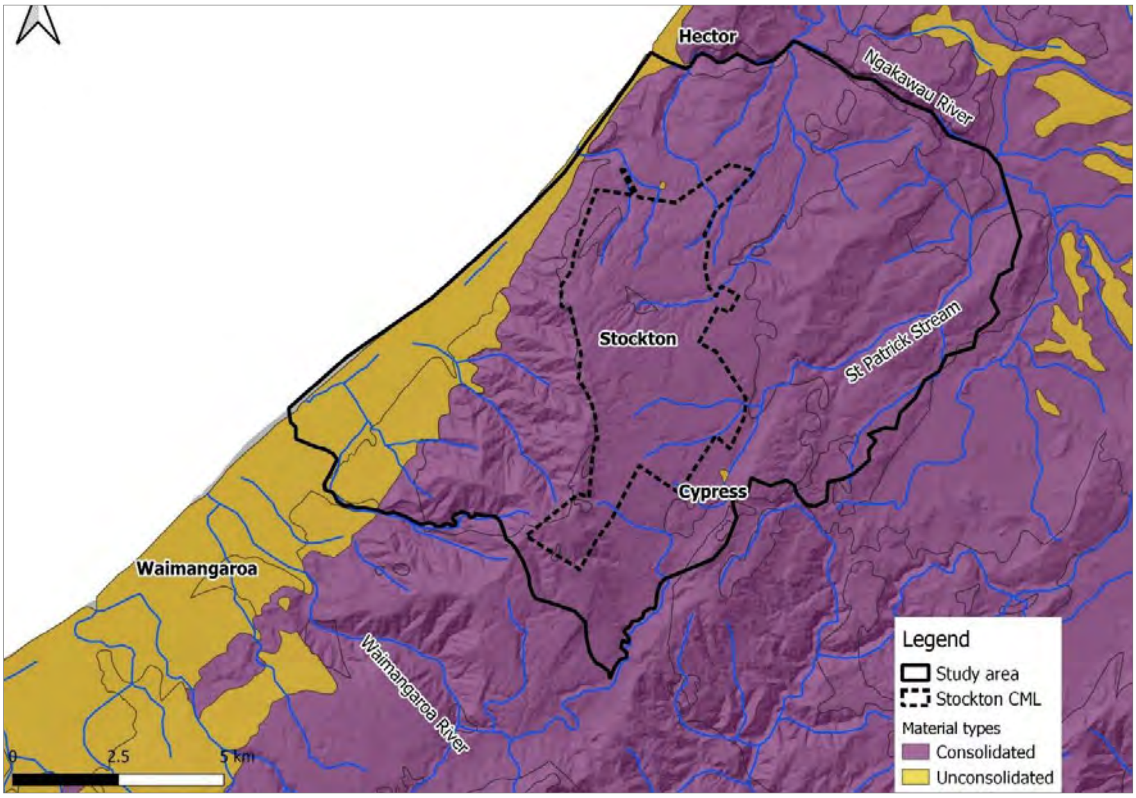

Figure 4.1 ***Surface distribution of consolidated (rock) and unconsolidated (sediments) (source: White et al, 2019)***

4.2.2 Basement

The Basement rocks (Greenland Group, granite and minor diorite) form the lower regional groundwater bearing unit and this is fundamentally different in character from the overlying BCM and KMS. The rock has low permeability, low groundwater storage, and flow occurring predominantly within fractures, stress-relief and cooling joints, faults, and weathered zones near the rock surface. As such, the basement material is best conceptualised as a fracture controlled system, with hydraulic conductivity varying spatially depending on fracture density, connectivity, and orientation. In the absence of mining influence, groundwater flow within the basement is typically subdued, with relatively low transmissivity and a strong dependence on topographic gradients and structural controls.

Hydraulic connectivity between the BCM and the Basement granite and Greenland Group (greywacke and argillite) rocks is inferred to occur locally via fracture networks, fault zones, and mining-induced stress-relief and fracturing. In areas where underground mine workings intersect or approach the Basement contact, a degree of vertical hydraulic connectivity between units may exist.

4.2.3 Brunner Coal Measures

The BCM constitute the upper and hydraulically complex unit across much of Stockton and have been extensively modified by a long history of underground and opencast coal mining. Lithologically, the BCM comprise interbedded coal seams, sandstones, conglomerates and carbonaceous shales, in a highly heterogeneous hydrogeological system. Groundwater flow within this unit is controlled by a combination of primary porosity within sandstones, secondary permeability associated with fractures, cleats, and bedding planes, and anthropogenic permeability introduced by mine workings, including roadways, panels, goaf zones, and shafts. As a result, groundwater flow paths within the BCM are often strongly anisotropic and spatially variable, with preferential flow along mine-induced conduits that may locally dominate over natural geological controls.

Mining activities have also significantly altered groundwater flow paths, recharge and discharge processes within the BCM. Opencast excavation, backfilling with waste rock, and surface changes have modified infiltration patterns, while underground mine dewatering and adit drainage have created artificial hydraulic sinks that locally depress groundwater levels and redirect flow towards mining infrastructure. In addition, subsidence from underground mining has created vertical fracturing that allows more rapid surface infiltration (rainfall recharge) and vertical flow.

Remnant tunnels that have not collapsed are considered to act as a preferential conduit type pathway for groundwater. Once in the tunnels, water may be typical of a surface water system, rather than flowing within natural fracture and fault dominant flow regime of unaltered BCM. In places, these features act as long-term drains on the system (akin to a subsurface drainage system), as evidenced by the inferred convergence of groundwater flow towards the Millerton Syncline and associated adit discharge points. Consequently, groundwater levels and flow directions within the BCM can vary both spatially and temporally in response to evolving mine geometry, dewatering practices, and rainfall.

4.2.4 Kaiata Mudstone

The KMS is a regionally extensive Oligocene marine mudstone which grades to sandstone near the base (GHD, 2024) and functions primarily as a low-permeability aquitard overlying the BCM. Matrix permeability is very low, and groundwater flow through the KMS is generally diffuse and slow. Vertical hydraulic conductivity is inferred to be low, making the unit an effective vertical flow barrier in many locations. As a result, the KMS commonly acts as a semi-confining layer over the BCM, particularly where it is intact and unweathered (GHD, 2025).

Although the KMS is largely massive, secondary permeability features can locally dominate groundwater flow. These features are spatially limited and should not be treated as representative of the formation as a whole, but they can be critical for seepage pathways, pit wall inflows, or backfill performance where intersected (GHD, 2025).

Conversely, compacted KMS has been demonstrated to achieve very low permeability ($<10^{-8}$ m/s), which underpins its use as backfill material and as low-permeability cores or liners in engineered landforms where geochemically suitable (GHD, 2026b).

4.2.5 Quaternary coastal sediments

Between Stockton Plateau and the coast, groundwater flow occurs within unconsolidated Quaternary coastal sediments composed of river gravels, sands and locally fine-grained estuarine deposits that overlay a mix of Basement, upper Tertiary and KMS (Figure 3.12). Coarser-grained sand and gravel material form highly permeable, unconfined aquifers with hydraulic conductivities typically several orders of magnitude greater than the underlying rock. Recharge is dominated by rainfall and river losses, with shallow groundwater flowing coastward and discharging to rivers, wetlands, estuaries and ultimately the Tasman Sea. Finer-grained silt layers at the base of the Plateau may act as aquitards, influencing water table elevations and discharge behaviour.

4.3 Hydraulic properties

The hydraulic properties of the subsurface material play an important part role in groundwater flow, recharge and discharge processes. Hydraulic conductivity normally increases significantly with increased weathering, amount of fracturing and sometimes at shallower depths. At Stockton, hydraulic conductivity is also likely influenced by mining, particularly underground workings and fracturing from subsidence. Hydraulic testing has indicated that fractures within the BCM and KMS are highly conductive (10^{-3} - 10^{-4} m/s), while the bulk hydraulic conductivities are much lower and in the order of 10^{-6} - 10^{-9} m/s (GHD, 2024a; GHD, 2025) (Table 4.1). Overall, the hydraulic conductivity of the Basement, BCM and KMS is generally low (10^{-7} – 10^{-6} m/s), but can vary by three to six orders of magnitude Table 4.1).

Table 4.1 Summary of hydraulic conductivity values

Geological unit, material or feature		Hydraulic conductivity (m/s)	Test method (s)	Reference
Basement: Greenland Group Sandstone at Mount Frederick South		2.3×10^{-6}	Slug testing	MWM, 2026
Basement: Metamorphosed greywacke and granite intrusions at Cypress.		10^{-9} - 10^{-6}	Pumping tests	GHD, 2024
Brunner Coal Measures	Highly fractured	10^{-4} - 10^{-3}	Not stated	GHD, 2024, GHD, 2025
	Non-fractured from testing at Cypress	10^{-9} - 10^{-6}	Packer testing Pump testing Numerical modelling	GHD, 2024, GHD, 2025
	Sandstone at Mount Frederick South	4×10^{-7}	Slug testing	MWM, 2026
	Main Coal Seam at Mount Frederick South	1.2×10^{-6}	Slug testing	MWM, 2026
	Pit coal floor at Mangatini Sump	3.3×10^{-7} - 2.3×10^{-6}	Packer testing	Bathurst, 2026
Kaiata Formation Mudstone bulk values at Cypress		10^{-9} - 10^{-6}	Constant head, Particle Size	GHD, 2024
Mount William Fault Zone at Cypress		10^{-10} - 10^{-8}	Not stated	GHD, 2024
Backfill and overburden (BCM and KMS) at Stockton		10^{-7} -10^{-6}	Infiltration testing Particle Size Numerical modelling	URS, 2005, GHD, 2026a

Though variable, site testing and modelling (at Cypress) show that the BCM has overall higher hydraulic conductivity than the Basement and KMS, which have similar, lower hydraulic conductivity (Table 4.2).

Table 4.2 Hydraulic conductivity estimates for Basement, BCM and KMS at Cypress (source: GHD, 2024, GHD, 2025, GHD 2026 unpublished model)

Geological unit	Geomean from site testing (m/s)	Numerical model calibration horizontal hydraulic conductivity (m/s)	Numerical model calibration vertical hydraulic conductivity (m/s)
Basement	8×10^{-8}	2×10^{-7} (2024 - 2026 models)	1.5×10^{-7} (2026 model)
BCM	6×10^{-7}	2×10^{-5} (2024 - 2025 models) 2×10^{-6} (2026 model)	1.1×10^{-6} (2026 model)
KMS	5×10^{-7}	1×10^{-6} (2025 - 2026 models)	5×10^{-7} (2026 model)

The hydraulic conductivity of coastal plains sediments will also show a large degree of variability depending on the amount of fine-grained material present. Hydraulic conductivity likely ranges from 10^{-7} m/s for silt dominated material to 10^{-2} m/s for well sorted clean river gravel deposits near the recent waterway channels.

A detailed summary of the hydraulic properties (hydraulic conductivity, specific storage and porosity) and testing undertaken at Cypress is provided in Appendix A.

It is recommended that further hydraulic testing be undertaken to provide site specific data for the various HSU's represented at Stockton (Section 9.1.2).

4.4 Groundwater recharge

4.4.1 Rainfall

Rainfall infiltration through the ground generally recharges groundwater. The Stockton Plateau has a low to moderate groundwater recharge from rainfall due to the generally low permeability rock and steep topography that promotes rainfall runoff into waterways. However, groundwater recharge from rainfall is enhanced in some areas from the presence of underground mining and fire-induced subsidence which result in cracks propagating to the surface as shown Figure 4.2.

Figure 4.2 Ground cracking of the BCM from underground mining and fire induced subsidence - Millerton Block (source: Bathurst)

Rainfall recharge rates based on the ranges used for model calibration at Cypress (GHD, 2024a) are presented below. Mean annal rainfall of 5,250 mm assumed.

- Basement: 0.1 - 260 mm/yr (0.003 - 5% of mean annual rainfall).
- BCM: 180 - 730 mm/yr (3 - 14 % of mean annual rainfall).
- KMS: 40 - 580 mm/yr (0.7 - 11 % of mean annual rainfall).
- Backfill (waste rock): 365 mm/yr (7% mean annual rainfall) (from GHD, 2026).

Similar rates are expected in the wider study area including Stockton.

Over the surface area of the BCM that outcrop within the study area, this equates to ~15,700,000 m^3/yr based on an average recharge rate 292 mm/yr (6% of mean annual rainfall using the latest Cypress groundwater model).

Greater rainfall infiltration into groundwater occurs in the more permeable and flatter areas in coastal sediments at the base of Stockton Plateau - with estimates of 700 - 2,000 mm/yr (assuming recharge equal to 20 - 50% of the mean annual rainfall).

4.4.2 Fire suppression water

Since 2012, water has been discharged (pumped using borehole infusion) into underground workings through numerous boreholes above and below the water table to control fires as needed to allow opencast mining within the Millerton Block to take place safely. The volumes, flow rates, water sources and acidity of the water (data from Bathurst) is summarised in Table 4.3.

Table 4.3 Volumes, flow rates, water sources and acidity of the water used for fire suppression at Millerton (source: adapted from Bathurst)

Year	Volume (m^3/yr)	Average continuous flow rate (L/s)	Water source	Water acidity
2012	2,308,608	73	Mangatini Sump (location shown on Figure 6.1)	Low
2013	2,522,880	80		
2014	2,522,880	80		
2015	2,522,880	80		
2016	2,522,880	80	Duncans Sump (location shown on Figure 6.1)	Medium
2017	2,522,880	80		
2018	2,522,880	80		
2019	2,522,880	80		
2020	2,522,880	80	Mangatini Sump	Low
2021	2,851,200	90	Millerton Pit	High (Median pH – 2.8)
2022	3,784,320	120		
2023	3,998,652	127		
2024	3,784,320	120		

The volumes of water (Table 4.3) were relatively consistent from 2012 – 2021 but rise from 2022 – 2024. This was due to increased opencast mining within the Millerton Block, meaning that more fires needed to be extinguished. Fire suppression discharge effects on water levels in some underground workings and waterways are discussed in Section 4.5.4.1 and 4.6.2.1. The fire suppression discharges (using Millerton Pit water) are expected to cease in 2028 – within two years of commencing the BPCP.

4.4.3 Surface water

4.4.3.1 Stockton Plateau

Some recharge to groundwater occurs on the upper Stockton Plateau where waterways lose flow into underground workings. One example is the Upper St Patrick Stream (St Patrick catchment) which loses all its flow into the historical Fly Creek underground workings (Figure 2.1) over an approximately 450 m length downstream of 8W. The flow then re-emerges upstream of site S16. Waterways may also lose flow to groundwater naturally, however, there are no documented cases of this occurring. Some Millerton Block waterways also lose flow into underground working – especially Mine Creek and Miller Stream. These are shown in Figure 3.4.

4.4.3.2 Coastal sediments

Groundwater recharge into the coastal sediments from surface water is expected to occur from Twins, Rudolph and Hugh Streams and other un-named smaller Millerton Block waterways, as they lose flow into the permeable alluvial sand and gravel deposits. Some waterways, like Rudolph Stream, lose all their flow before reaching the ocean. The flow losses to groundwater may also be an important source of water to some coastal wetlands (Figure 3.5, Figure 3.6).

An example from Rudolph Stream is shown in Figure 4.3.

Figure 4.3 Rudolph Stream – dry stream bed at the base of the escarpment where it typically losses all its flow into the ground (source: photo taken by Instream on 7 May 2026)

4.5 Groundwater discharge

Groundwater discharges occur in the form of seepages into waterways (especially at the base of deeply incised channels), underground working discharges that daylight at the surface, the ocean, and anthropogenic discharges where groundwater is abstracted for various purposes such as pit sump dewatering required for opencast mining and waste rock seepages. Some groundwater seepages into Mangatini and McCabes Sumps occur from pit faces above the pit operating water level. Water is also taken from pit sumps for dust suppression however these are smaller and shallower than the opencast pit sumps and generally do not intersect groundwater (Section 4.5.1).

4.5.1 Pit dewatering of groundwater

Opencast mining into the BCM occurs across multiple areas simultaneously. Pits that intercept groundwater require combined groundwater and surface water abstraction. A summary of the opencast pits that require groundwater abstractions are summarised in Table 4.4. The pit locations are shown in Figure 4.4.

Table 4.4 Current opencast pit dewatering at Stockton. All pits are constructed within the BCM

Catchment	Pit name	Adopted opencast pit area (m^2)	Groundwater abstractions from	Comment
Mangatini	WE07	12,900	In-pit sumps	Water pumped out goes to Mangatini Sump for treatment. Intercepts groundwater, including that in underground workings.
Millerton Block	Millerton	180,000	Highwall dewatering In-pit sumps	Of the total volume pumped out, currently 70% is used for fire suppression within underground workings. Intercepts groundwater, including that in underground workings. Opencast mining commenced in 2010.
	Hope Lyons (1 & 2)	44,900	In-pit sumps	Water pumped to Millerton Pit. Intercepts groundwater.
St Patrick	No.2 South / SN14 Backfill	42,000	In-pit sumps	Water pumped out goes to No.1 North dam and St Patrick Stream (via Plover Stream). Intercepts groundwater.

Pits (Figure 4.4) are filled with water when it rains, and then as much water as possible is pumped out. WE07 and SN14 constantly have a substantial amount of water in them but all pit sumps have some water in them most of the time (Bathurst).

Groundwater abstraction rates from the opencast coal mining pits constructed within the BCM were estimated using the Theim Dupuit equation for steady-state, unconfined and radial groundwater flow. Table 4.5 shows the estimated groundwater inflows based on hydraulic conductivity (K) ranges one order of magnitude higher and lower than the mean (adopted mean of 1×10^{-6} m/s from site testing and modelling at Cypress - Table 4.2), pit areas (Table 4.4), 20 m drawdown within the excavation footprint down to coal floor, and average drawdown-extent from the pit edge (radius of influence) calculated using the Sichardt equation (Kyrieleis & Sichardt, 1930) for steady-state radial drawdown and the Aravin & Numerov (1953) for transient drawdown after 5-years in unconfined groundwater, assuming a geometric mean specific yield of 0.28 for sandstone.

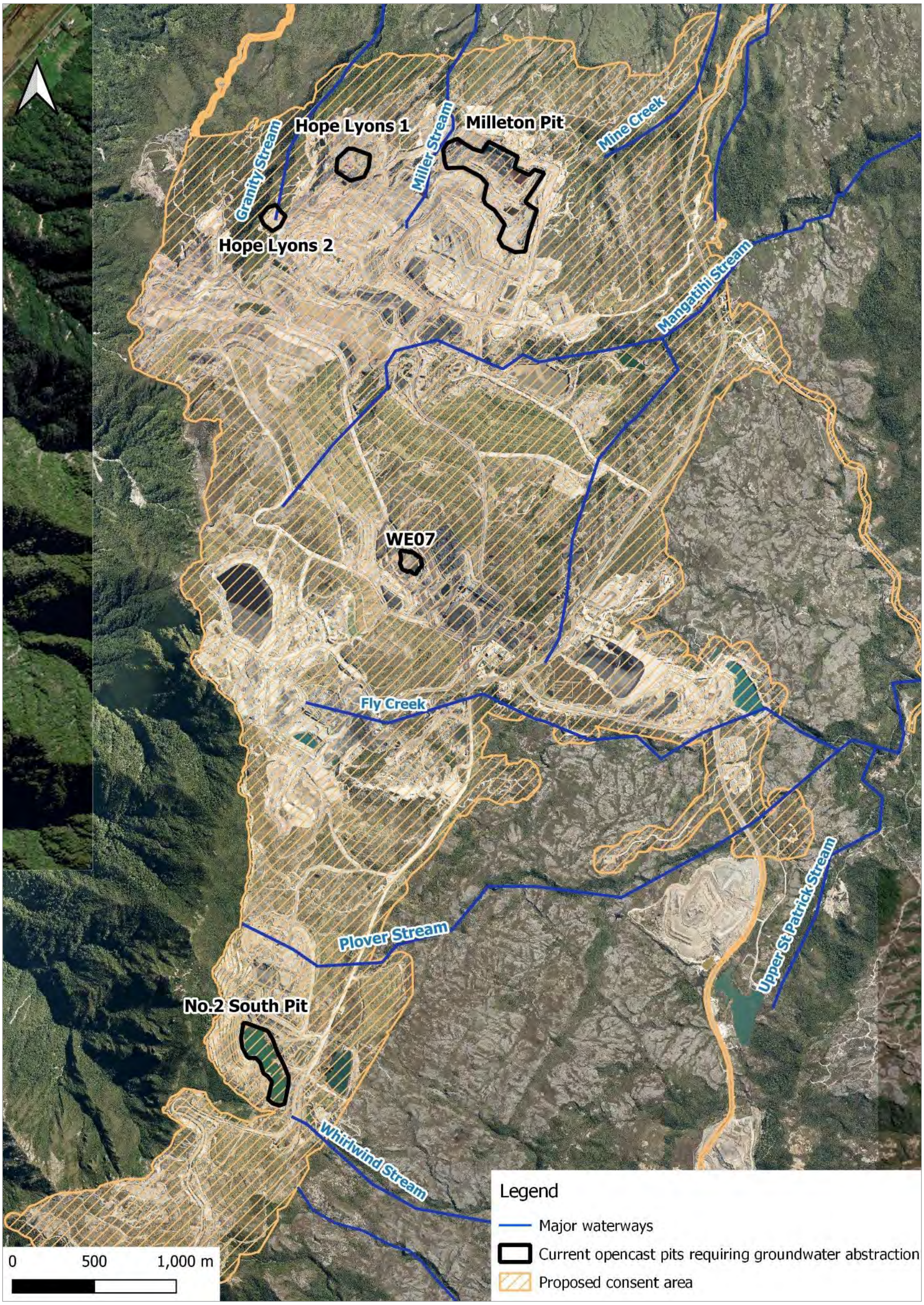

Figure 4.4 *Current opencast pits requiring groundwater dewatering*

Table 4.5 ***Modelled groundwater inflow rates into to current opencast pits***

Catchment	Pit name	Modelled groundwater inflow rate range in brackets and mean value (L/s)
Mangatini catchment	WE07	1 (0.3 – 6)
Millerton Block	Millerton	3 (0.8 – 13)
	Hope Lyons	2 (0.4 – 8)
St Patrick catchment	No.2 South	3 (0.8 – 17)

Table 4.5 shows low to moderate groundwater inflow rates in the order of 0.3 – 17 L/s, although localised areas of higher flow are likely where the pits intercept saturated underground workings and more permeable fractures. The modelled groundwater inflows to the Millerton Pit range from 0.8 – 13 L/s. In comparison, the median total pit pumping rate from surface water and groundwater from March 2024 to October 2025 was 142 L/s. This indicates that most of the pit water comes from rainfall and surface run-off, as might be expected with the other pits.

Pit dewatering also occurs at the adjacent Cypress Mine. The median pumping rate (surface water and groundwater) from the Cypress North pit from July 2020 to February 2024 was ~90 L/s (GHD, 2024a).

Figure 4.5 shows the modelled drawdown extent from the edges of the opencast pits, based on a range of hydraulic conductivity values for the BCM, and drawdown using the average value from the Sichardt equation for steady-state radial flow and Aravin & Numerov equation for transient drawdown after 5-years. The results suggest that the maximum drawdown extent ranges from ~50 – 425 m assuming 20 m drawdown within the pit. If the drawdown is less, for example 5 m within the pit, the maximum drawdown extent ranges from ~25 – 200 m.

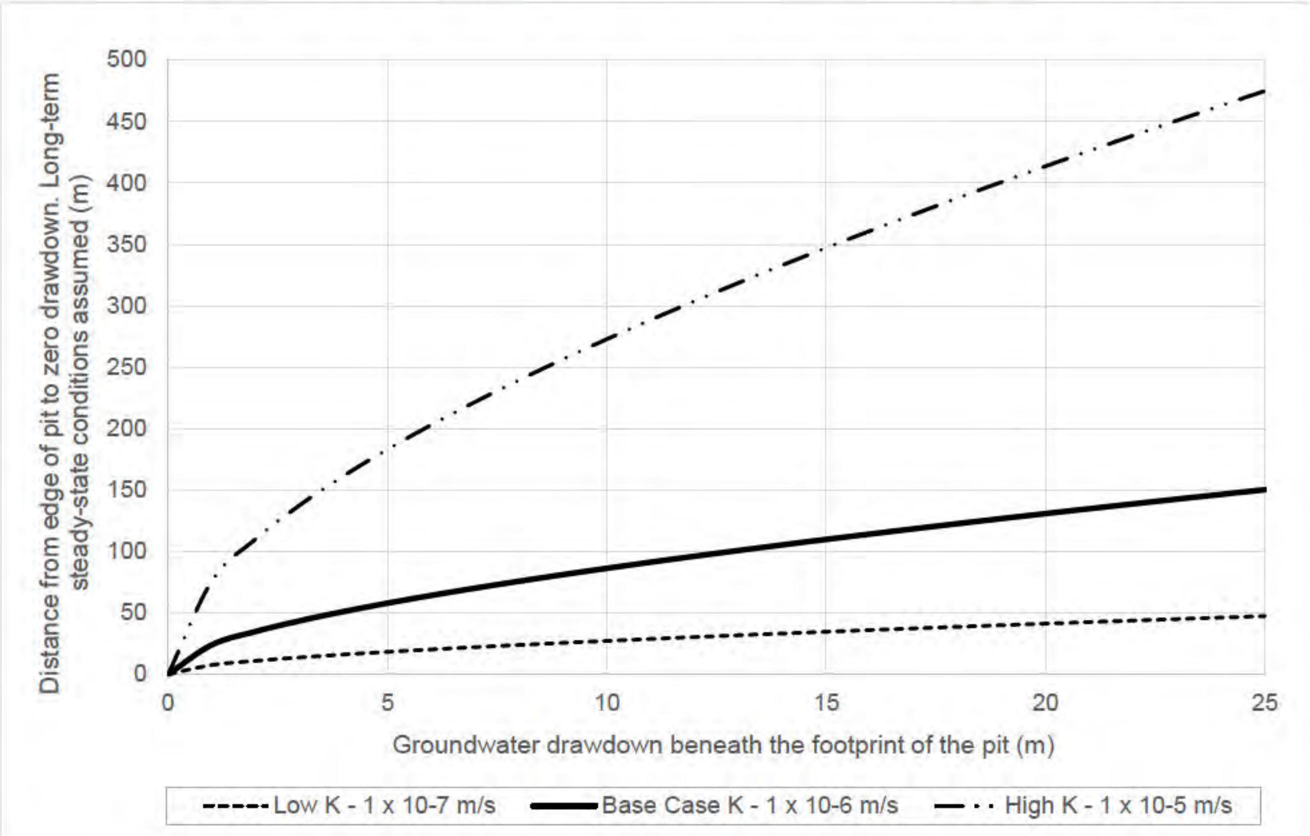

Figure 4.5 ***Modelled long-term steady-state distances to zero drawdown from the edge of the opencast pits excavated within the BCM for a range of drawdowns within the opencast footprints and varying hydraulic conductivity (K) of the BCM***

4.5.2 Consented groundwater takes and registered bores

Within the study area, groundwater abstractions from registered bores are small, with only one registered bore used for dairy use - presumably dairy shed washdown. The main consented groundwater take within the study area is for opencast dewatering at Cypress. The estimated groundwater abstraction for the actively mined North

Pit inflow is around 17 L/s (based on the May 2026 Cypress Groundwater model by GHD). Further information is provided in Section 6.1.

4.5.3 Waste rock seepages

Stockton is covered in PAF waste rock areas, composed of BCM and KMS overburden, mostly sourced from opencast mining. The waste rock generates AMD that can discharge as surface water run-off, underflow leachate at the base of the waste rock, seepages from isolated areas of saturated material, from perched groundwater, or in deeper groundwater where it may intersect the regional water table. The general processes are illustrated in Figure 5.1(Alarcon, 1997).

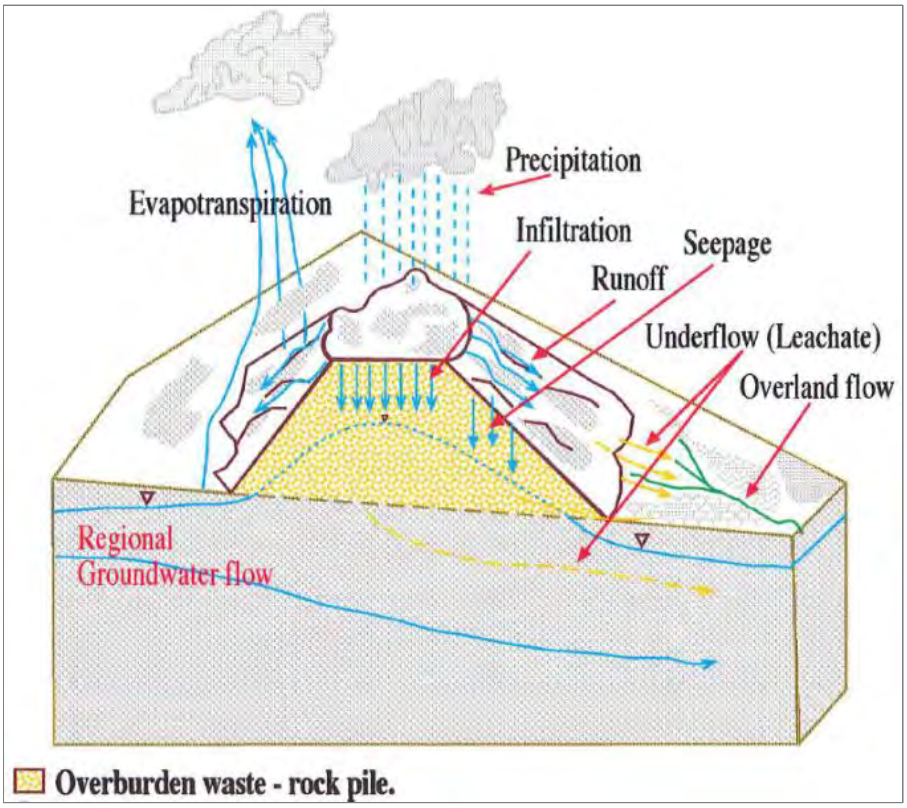

Figure 4.6 ***Conceptual water balance components for a waste rock storage area and potential interactions with groundwater (source: Alarcon, 1997)***

Within the Stockton CML, there are approximately 38 waste rock seepages that are measured for flow rate and water quality. The seepages are generally localised perched groundwater systems, and their connection to the underlying regional water table is unclear. For each seepage within the mine, water quality determines how the discharged water is managed (i.e. as minewater or cleanwater). Seepage locations are shown in Figure 4.7 and further described in Table 4.6.

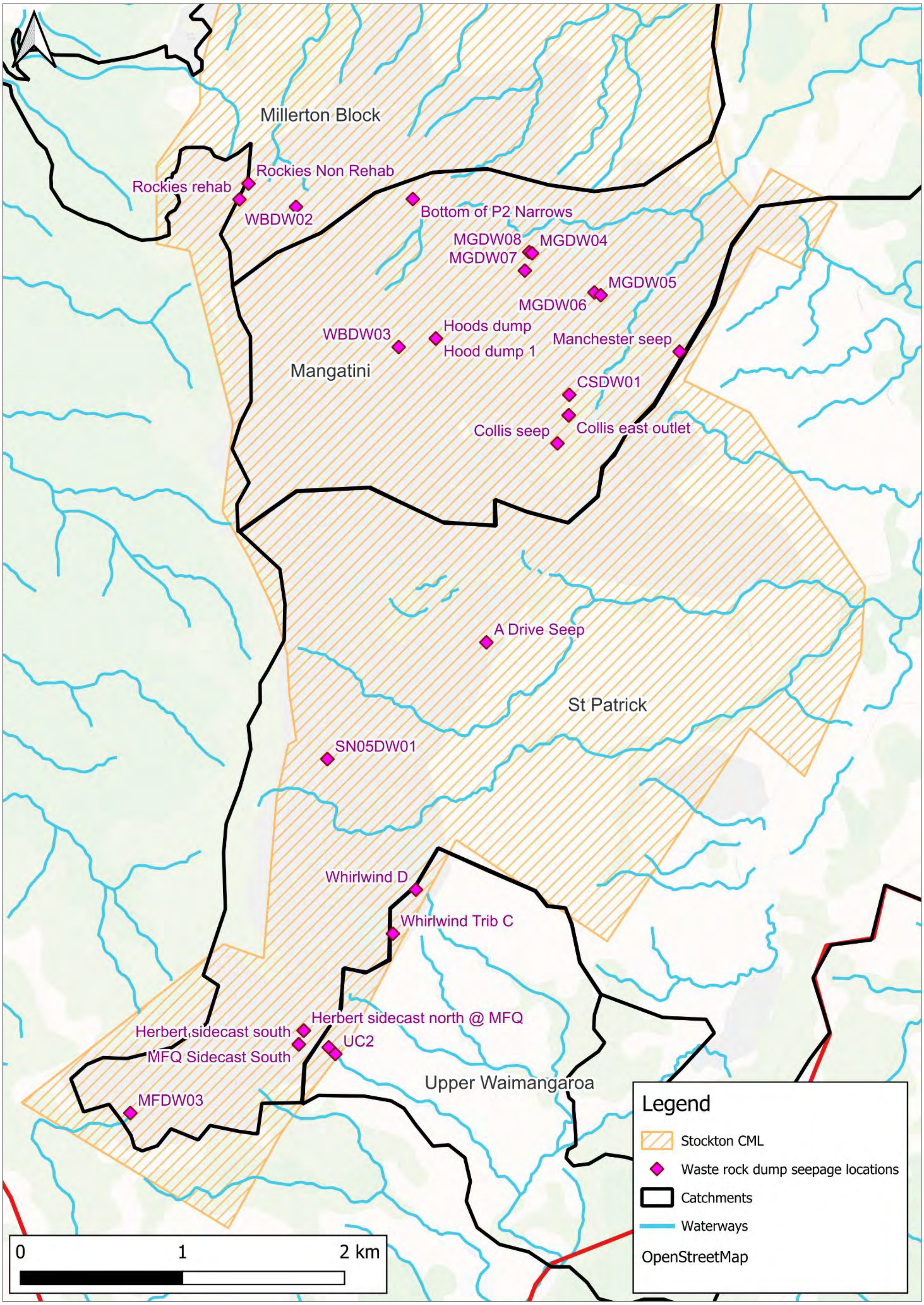

Figure 4.7 Waste rock seepages and current waterway AMD impacted states from Instream (2026)

Table 4.6 Description of known waste rock seepages, sampling rounds and flow rates

Site	Number of flow measurement rounds	Number of water quality sampling rounds	Location known	First round	Last round	Measured mean flow rate (L/s)	Site description *(notes from analysis results spreadsheet)*
A Drive Seep	2	4	Yes	2020-06-24	2024-05-17	3.3	Large flowing seep ~80 m from the haul road. Clear water. Rehabbed in tussock, grasses. Flaxes and manuka.
Collis seep	2	3	Yes	2020-06-25	2024-05-17	0.2	Two pipes connect to drain two big PVC tubes within waste rock area.
MFDW03	2	2	Yes	2020-06-24	2024-05-17	0.9	Seep emerges from waste rock then immediately runs under the road. Sampled uphill side, flow measured downhill side out of culvert.
MGDW06	1	3	Yes	2020-06-25	2023-08-09	0.9	Located ~40 m towards sump from MGDW05, low flow, clear water.
MGDW08	2	2	Yes	2020-06-25	2024-05-17	0.8	This is the furthest upstream major seep on the lower batter, with a smaller seep present slightly upslope. At the accessible upper section, extensive precipitate terraces are developed, with water discharging diffusely over a broad area. The majority of flow appears to be concentrated through an algae-filled opening. Total discharge was estimated at approximately 1–2 L/s; however, accurate flow measurement was not possible due to the wide distribution of flow across the terrace and multiple outlet points. Field measurements (YSI) were collected at the location of highest observable flow at the base of the cascade, where elevated dissolved oxygen and reduced pH and conductivity were recorded.
Manchester seep	1	3	Yes	2020-06-24	2023-08-09	0.2	Difficult to gauge seep catchment and rehab, seems to come from below road. Inlet to McCauley MSR.
Rockies Non-Rehab	1	3	Yes	2020-06-25	2022-08	0.01	Small seep, Mickey's lookout over Rockies ~50 m south, and seep is from waste rock below lookout.
Rockies rehab	1	4	Yes	2020-06-25	2023-08-10	0.06	Small seep from rehabbed waste rock onto road. Low flow, clear.
UC2	1	3	Yes	2020-06-24	2023-08-09	Unknown	No information.
Whirlwind Trib C	-	2	Yes	2020-06-24	2023-08-09	N/A	Below number 1 north dam, north side of sandstone bank below dam
Bottom of P2 Narrows	1	2	Yes	2020-06-25	2021-05-10	2	Located ~150m up from the roundabout at bottom of road. Took sample from near base of bank.
CSDW01	1	2	Yes	2020-06-24	2021-05-10	1.2	Waterway below access road, likely to contain some road drain water rather than a true seep
Herbert seep	1	2	Yes	2020-06-24	2021-05-10	6.2	Scrubby rehab, good flow, clear water.
MF sidecast drain @ MFQ	-	2	Yes	2021-05-10	2023-08-09	N/A	No information.
MGDW03	1	1	No	2023-08-10	2024-05-17	0.6	No information.
MGDW05	1	2	Yes	2020-06-25	2021-05-10	4.1	Mangatini seep near top of road opposite Manchester St coal stockpile. High flow, clear water, lot of algae, fully rehabbed.
SN05DW01	1	2	Yes	2020-06-24	2022-08	<0.1	Some water present and sampled, unsure if genuine seep water.
WBDW03	1	2	Yes	2020-06-25	2023-08-10	0.3	Small seep, several portions over a 10 m length of the batter drain, most upstream one sampled and flow measured ~half of total flow through measured portion.
Collis East - true left	1	-	Yes	2020-06-24	2020-06-24	< 0.1	Some gorse present in vegetation in this area, rehab looks great with near full vegetative cover.
Collis East - true right	1	1	Yes	2020-06-24	2020-06-24	0.03	Two seeps at the base of waste rock. Walked to east of access road and approximately at same batter level. True right seep sampled.
Collis east outlet	-	1	Yes	2021-05-10	2021-05-10	N/A	No information.
Collis east seep	-	1	Yes	2021-05-10	2021-05-10	N/A	No information.

Site	Number of flow measurement rounds	Number of water quality sampling rounds	Location known	First round	Last round	Measured mean flow rate (L/s)	Site description *(notes from analysis results spreadsheet)*
Herbert sidecast north @ MFQ	1	1	Yes	2020-06-24	2020-06-24	3.4	No information.
Herbert sidecast south	1	1	Yes	2020-06-24	2020-06-24	0.04	No information.
Hood waste rock 1	1	-	Yes	2020-06-24	2020-06-24	<0.1	Almost like rainwater. Not sampled.
Hood waste rock 2	1	1	Yes	2020-06-24	2020-06-24	4.3	Genuine seep, very clear water with low flow. Sits within a drainage channel, therefore may be difficult to sample in wet weather. Mostly fully rehabbed with some roading and some exposed rock.
Hoods waste rock	-	1	Yes	2021-05-10	2021-05-10	N/A	No information.
MF Sidecast seep south	-	1	Yes	2021-05-10	2021-05-10	N/A	Seep is gone, remove from list to look for/sample
MFQ Sidecast @MFQ	-	1	Yes	2022-08	2022-08	N/A	No information.
MFQ Sidecast South	-	1	Yes	2022-08	2022-08	N/A	No information.
MGD	-	1	No	2023-08-09	2023-08-09	N/A	No information.
MGDW04	1	1	Yes	2020-06-25	2020-06-25	10	Seep near base of Mangatini waste rock area, measurements taken at fall into Manchester St Drain - too steep to climb up to seep start. Flow estimated, to spread out over three waterfalls to measure, most upstream fall had highest flow and sampled here.
MGDW07	1	1	Yes	2020-06-25	2020-06-25	1.6	Several hundred meters from MGDW06. Some ppts in drain both up and downstream of seep, some rainwater dilution? Both orange and white.
Rockies Rehab	1	-	No	2022-08	2022-08		No information.
Top of CSDW01 above waste rock area	-	1	No	2020-06-24	2020-06-24	1.7	Drainage under road, field water quality parameters only, no sample collected
WBD	1	1	Yes	2023-08-10	2023-08-10	N/A	No information.
WBDW02	-	1	No	2020-06-25	2020-06-25	0.02	Non rehabbed area, ~20 mL/s flow estimate, 150 mL in 27 seconds = approximately 25% of flow
Whirlwind MCR IN	1	1	Yes	2022-08	2022-08	N/A	No information.
Whirlwind Trib D	2	4	Yes	2020-06-24	2020-06-24	N/A	Below number 2 north dam, slightly south of centre of sandstone bank below dam.

The seepage flow rates vary across the monitored sites, spanning three orders of magnitude. Recorded flows range from dry or undetectable to ~10 L/s at MGDW04 (Figure 4.7). Excluding sites recorded as zero, the lowest measured seepage rate is ~0.01 L/s, indicating very small, trickle type seeps.

Most sites fall within a low to moderate flow range, with the median flow approximately 0.7 L/s and most of the measured seeps discharging less than 2 L/s. These moderate flows are typical of persistent seepage from waste rock areas and batters, often emerging as discrete outlets or short channelised flows. In contrast, a small number of sites exhibit substantially higher discharges (>2 L/s), including MGDW05, Hood 2, A Drive Seep, MGDW04 and Herbert Seep shown in Figure 4.8.

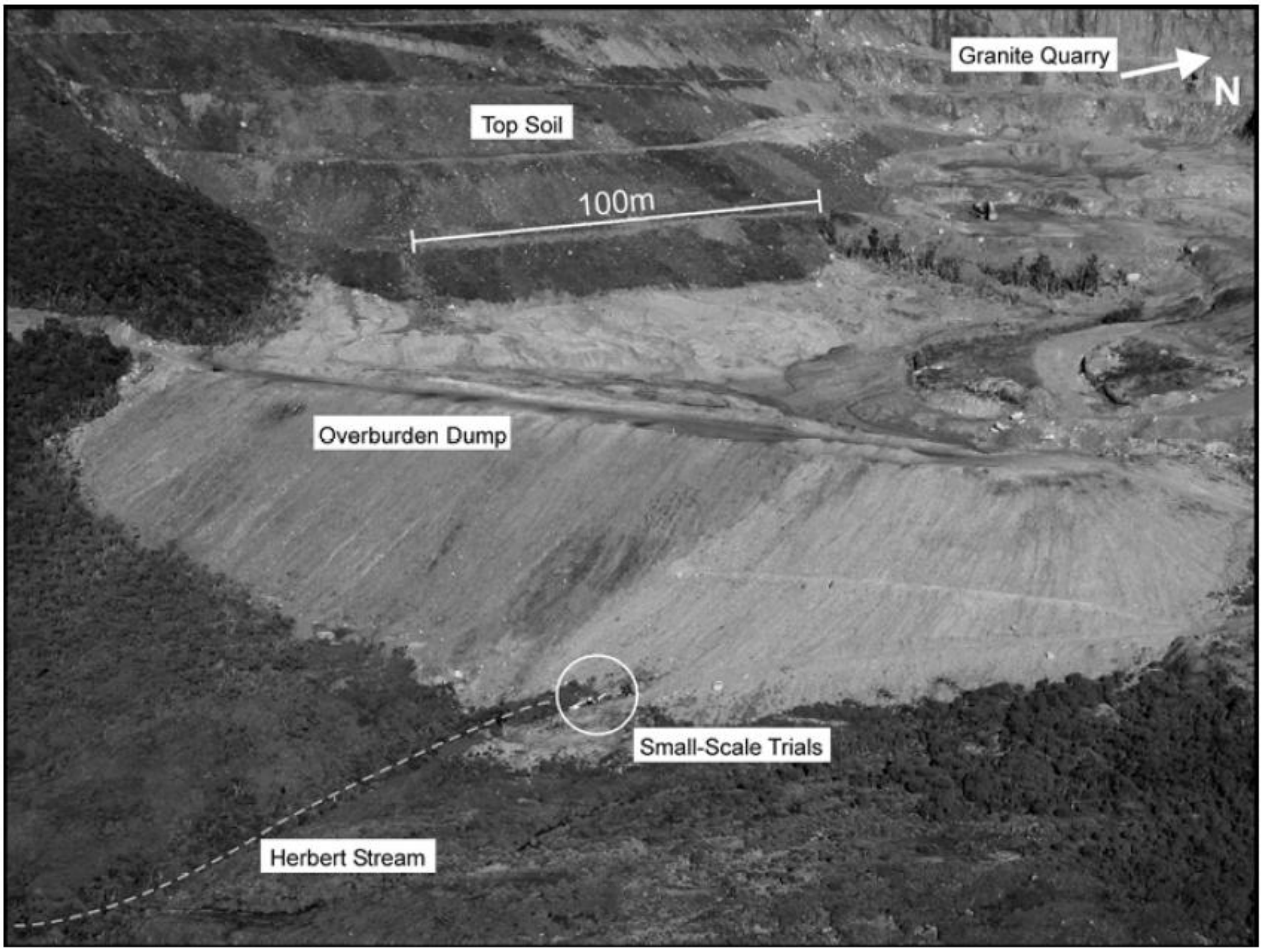

Figure 4.8 Seepage through waste rock at Herbert Seep an into Herbert Stream (Trumm et al, 2008)

Measurement uncertainty is greatest at the extremes of the range. Very low flows are close to practical measurement limits, while the highest flows are commonly described as estimated, diffuse, or difficult to measure accurately due to multiple outlets or broad discharge zones. Overall, the data indicate that seepage systems are dominated by numerous small to moderate seeps, with a limited number of high-flow sites that are hydrologically significant and warrant particular attention when considering cumulative discharge and load assessments. High flow, constant discharges suggest a connection between the seep and the regional watertable, while low flow to dry or ephemeral seeps are likely driven by rainfall recharge / discharge.

4.5.4 Groundwater discharges to waterways

Though dominantly rainfall-runoff fed, some Stockton waterways also receive groundwater. The groundwater generally comes from a combination of natural seepages where the water table intersects topographic low points within the incised beds (such as Twins Stream sites T1 and T3), and from historical underground workings that flow out of the ground.

4.5.4.1 Historical underground workings

Remnant underground tunnels within the historical underground workings that have not collapsed can act as a preferential pathway for water to flow below ground and into waterways. The underground tunnel network:

- Is unlined and pervious to water – meaning AMD-impacted water can flow in and out of the workings.
- Intersects groundwater (water table) in some areas. Historical mining records indicate that stopes were installed to divert groundwater, mostly toward the Drainage Control Adit (DCA) at the Millerton Syncline, a low point in the coal floor. Today water still discharges via this adit into Mine Creek.
- Receives AMD-impacted fire-suppression water in the Millerton Block.
- Discharges AMD-impacted water out of the ground at several locations within the Millerton Block, Mangatini and St Patrick catchments. These discharges predominantly flow into waterways, therefore, impacting surface water flows and quality.

The current main underground working discharges to waterways are summarised in Table 4.7.

Table 4.7 Stockton waterways receiving groundwater from historical underground workings. All within acid producing BCM

Catchment	Receiving waterway	Underground working discharge sources to waterway	Comment
Millerton Block	Mine Creek (S23)	DCA	Flow rate (2012 – 2026): • 50 L/s (min) • 115 L/s (median) • 1,960 L/s (max) Median (2024 – 2026): • pH – 2.5 • Dissolved aluminium – 180 mg/L Receives Millerton pit seepage, fire suppression water. Will be treated in the future as part of the BPCP.
	Mine Creek (S6)	B-Tunnel	-
	Miller Stream (S24A)	S24A	Receives Millerton pit seepage, fire suppression water
		S24A D/S	Receives Millerton pit seepage, fire suppression water
	Granity Stream (S25)	S25	-
	Twins Stream	Third west	3.4 ha of underground workings, which is considered the main source of AMD to headwaters of Twins Stream. Will remove 8% though open-cast ming as part of the BPCP. Other 92% will remain as AMD discharge.
	Rudolph	One underground working	Twins and Rudolph underground AMD sourced from within the Stockton the CML is covered in the 5-year LINZ/Crown liability plan. The combined acid load is <50 t/year (Bathurst).
St Patrick	St Patrick Stream	Fly Creek Mine	Historical mine - operated between 1913 and 1970, has remaining underground workings in the northern part of the catchment that continue to contribute AMD to St Patrick Stream.

Miller Stream

Figure 4.9 shows an underground working discharge into Miller Stream. Figure 4.10 shows the influence of fire suppression discharges on water levels within the Millerton Syncline, BCM, underground workings at DH2758 (red) and resultant effect on Miller Stream flows (blue) at monitoring site S24. The lobe of fire suppression water resulted in ~1 m water level rise (groundwater mounding) at DH2758 (on 30 December – two days after the rainfall event) and has an obvious effect on Miller Creek flows when compared to the assumed natural recession drawn in as dotted line. The rainfall responses ("RF") in this case are small in comparison.

[redacted]

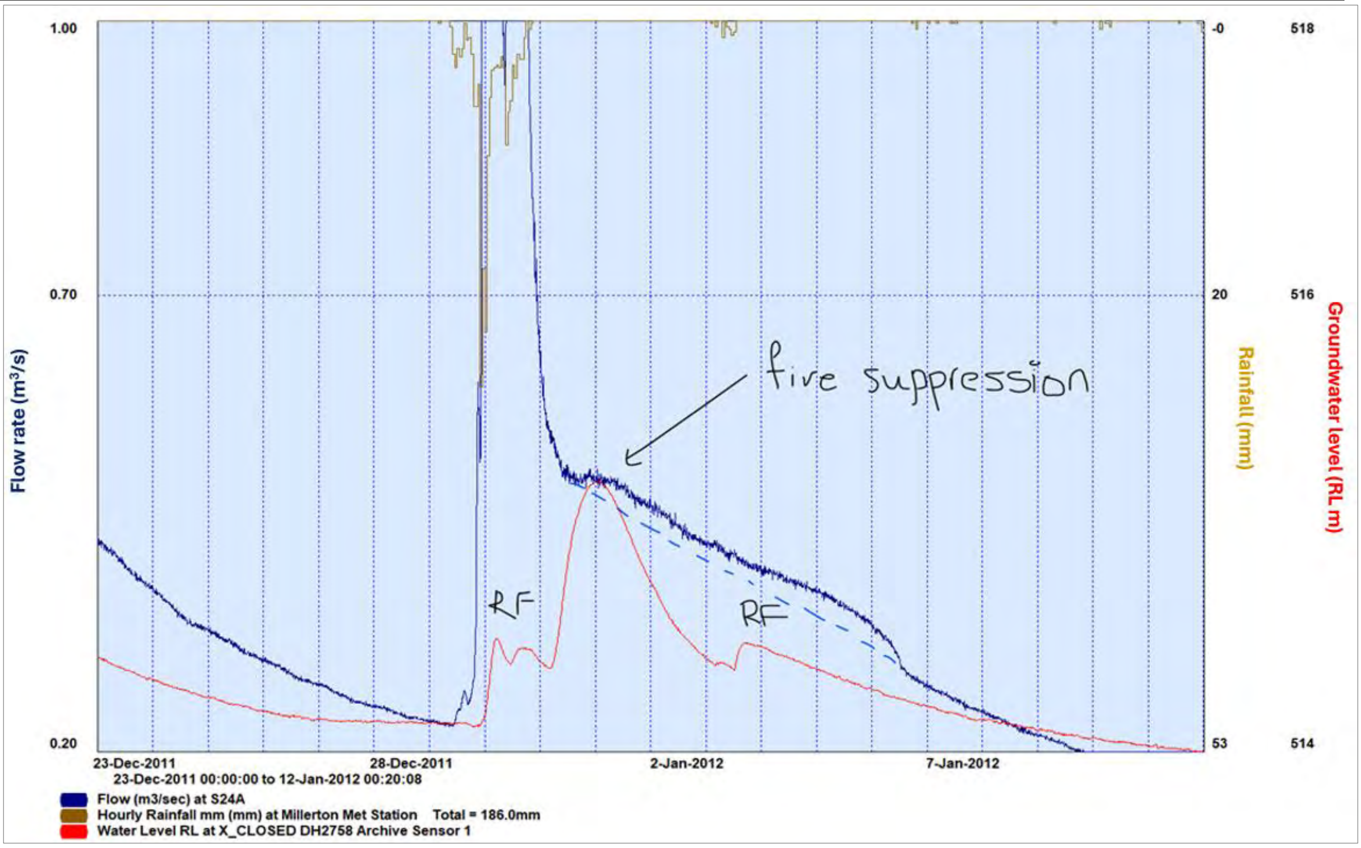

Figure 4.10 *Influence of fire suppression discharges (borehole water infusion) on Miller Stream S24A flow and underground workings water levels measured from VWT DH2758 within the Millerton Block (source: Bathurst)*

Mine Creek / Millerton Syncline

Figure 4.11 shows the relationship between flows from the Millerton Drainage Control Adit (DCA) which discharges from the Millerton Syncline underground workings into Mine Creek, to groundwater levels measured within the syncline itself at DH2758. The natural Millerton syncline contours of the coal seam in the southern and western parts of the Millerton block were historically used by the underground miners to provide a low point (c 505 m RL) to which water could be directed. The syncline adit allowed water to drain by gravity from the syncline area (Solid Energy, 2010).

The syncline adit is now partially blocked at the inlet by a rock fall which acts as an outlet throttle and ponds water at a fairly constant level of 513.6 to 514.2 m RL (95% of the time). When the outlet capacity is exceeded the syncline floods to approximately 520 m RL and water exits through the Mine Creek resurgence and other drives to the east and west (Solid Energy).

The close temporal correspondence between groundwater level increases within the syncline and elevated portal flows indicates a strong hydraulic connection between the syncline groundwater system and discharge at the DCA, with flow responses occurring over short timescales relative to groundwater recession. Both flows and water levels are likely highly influenced by rainfall, especially where rainfall has direct path into groundwater via surface cracks.

Water quality and flow data are available for the DCA. The DCA discharge has a median flow of 115 L/s (0.115 m^3/s), median pH of 2.5 and median dissolved aluminium concentration of 180 mg/L (source: Bathurst).

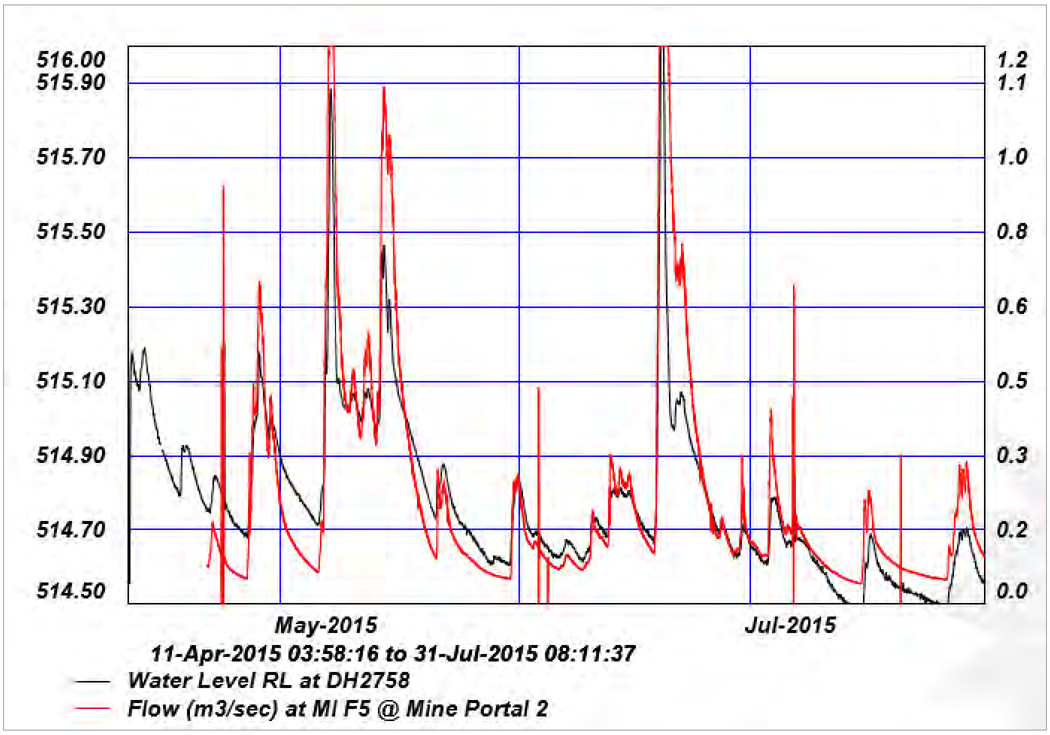

Figure 4.11 Water level (mRL, left axis) within historical underground workings in the Millerton Syncline and flow (m3/s, right axis) from the DCA portal into Mine Creek (source: Solid Energy, 2017)

4.5.4.2 Groundwater seepages

Deeply incised waterways may intercept the water table. Where they do, groundwater may enter as discrete seepages or larger areas of the stream channel. The most documented waterway intercepting groundwater is Twins Stream. Groundwater seepages have also been observed at Hugh Stream. For other waterways, there appears to be limited information on groundwater interception.

An older investigation by Alarcon (1997) notes groundwater discharges into Stockton waterways, stating that '*groundwater discharge* (in the BCM) *is restricted to areas where stream basins and groundwater are in contact, or in close proximity. Groundwater in such a case seems constantly and fast discharging and makes water table non-existent*.' The author may be suggesting that groundwater discharges lower groundwater levels near the waterways.

Twins Stream

Twins Stream gains flow from multiple groundwater discharges in its upper reaches, near the boundary of Stockton and Rockies Mine (RML, 2016). During low-flow conditions in the upper reaches, RML (2016) report that ~two-thirds of the flow measured at Twins Stream site T2 (Figure 2.5) is derived from a ~116 m length of stream immediately upstream. The largest groundwater seepage occurs at the proposed Twins Stream T1 compliance monitoring site (Table 9.1). During low-flow (base-flow) conditions which dominate the catchment, the median total flow at T1 is ~3.5 L/s, of which around ~0.7 L/s is derived from surface water draining the Twins catchment and ~2.8 L/s is supplied by groundwater seepages immediately upstream of the site (Bathurst comment). This seep likely represents a combination of regional groundwater flow and seepage from underground mine workings that has migrated into the groundwater system.

4.5.4.3 Waterway flows and baseflows from groundwater

Table 4.8 summaries the recent flow statistics for major surface water monitoring sites and estimated baseflow contributions from groundwater / underground water sources using available data and analysis undertaken to date. The total minimum groundwater input to the major waterway monitoring sites draining the Stockton Plateau is >~9,490,000 m^3/yr (based on Table 4.8).

Table 4.8 Summary of major surface water monitoring sites and estimated baseflow contributions from groundwater

Catchment	Major surface water monitoring sites	Median flows (L/s)	Lowest flows (L/s)	Max flows (L/s)	Baseflow from groundwater and or underground workings (L/s)	Receives flow from underground workings / groundwater seepages
St Patrick	St Patrick Stream (S16)	886	160	112,020	> 160 L/s - lowest flow	Goes underground through Fly Creek underground workings for 500 m then re-surfaces upstream of S16
Mangatini	Mangatini Stream (S14)	467	8	88,800	> 8 L/s - lowest flow	-
Millerton Block	Mine Creek Sth Tributary (S23)	152	15	9,270	115 L/s - median flow from DCA	DCA underground workings
	Mine Creek Nth Tributary (S6)	80	3	14,465	> 3 L/s - lowest flow	B-Tunnel underground workings
	Miller Stream (S24)	180	8	8,220	> 8 L/s - lowest flow	Minor fire suppression discharges from underground workings
	Granity Stream at Millerton (S25)	40	4	1,717	> 8 L/s - lowest flow	Higher baseflow from groundwater compared to Miller Stream, likely due to rainwater seeping through surface cracks caused by historical underground mining (Bathurst, 2026a)
	Twins Stream (T1)	3.5	-	5.3	2.8 L/s - median flow	Third West underground workings Groundwater seepages from BCM and granite
	Rudolph Stream	-	-	7.1*	Unknown	One underground working Groundwater seepages from granite
Upper Waimangaroa	Herbert Stream	-	-	-	Unknown	-
	Whirlwind Stream	-	-	-	Unknown	-
*Based on all available data between 2018 and 2025/26 from Bathurst. *Modelled data presented by Instream (2026)*						

Analysis of flow data has shown that flows from the underground workings can account for up to 30% of total Millerton Block (catchment near Stockton) and provide most of the base flow for Mine Creek and Miller Stream (Solid Energy, 2010).

4.5.5 Groundwater balance

Table 4.9 provides an estimate (high-level) of the annual groundwater recharge and discharge volumes based on existing data for the BCM.

Table 4.9 Approximate median annual groundwater recharge and discharge volumes for the BCM within the Stockton area

Water type	Study area source	Approximate volumes (m^3/yr)	Report section
Recharge	Rainfall study area Rainfall Millerton Block only	15,700,000 3,000,00	4.4.1
	Fire suppression at Millerton Block	4,000,000	4.4.2
	From waterways	*Unknown*	4.4.3
Discharges	Opencast dewatering of groundwater at Stockton	285,000	4.5.1
	Opencast dewatering at Cypress North Pit	536,000	4.5.2
	Consented takes and registered bores currently taking water	*Unknown – likely small*	4.5.2
	Waste rock seepages from groundwater	> 160,000	4.5.3
	St Patrick Stream, Mangatini Stream, Mine Creek, Granity Stream	> 9,490,000	4.5.4.3
	Ngākawau River	*Unknown*	-

Table 4.9 suggests that whilst rainfall is the dominant source of groundwater within the entire study area, fire suppression water is slightly higher than rainfall when rainfall recharge is calculated over the Millerton Block only.

The median pit dewatering (abstractions) of groundwater at Stockton may be in the order of 285,000 m^3/yr which is a small volume in comparison to possible groundwater discharges to waterways (~3%), sources of recharge from rainfall (~2%), and fire suppression water (~7%). The estimated dewatering flow rates are small due to the relatively low permeability of the BCM and suggest that most of the water abstracted from the pits comes from direct rainfall infiltration and surface water run-off.

4.6 Groundwater levels

4.6.1 Basement

At present, there are no available groundwater level data for the Basement material within the Stockton CML. Nevertheless, monitoring bores and VWPs located in the Cypress mining area (St Patrick catchment) track groundwater levels in Basement materials, including granite, to assess dewatering. Figure 4.12 shows the long-term groundwater level monitoring from the Basement at Cypress.

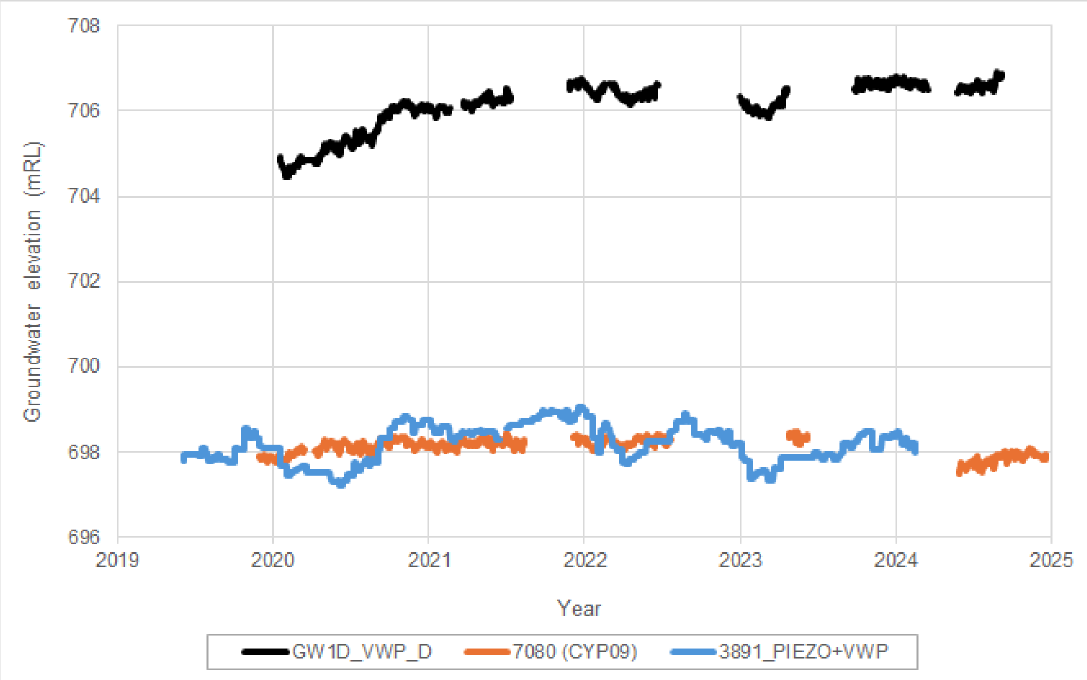

Figure 4.12 Long-term groundwater level data from the Basement material at Cypress (data sourced from Bathurst)

Compared to groundwater levels measured from underground workings in the BCM at Stockton, groundwater level fluctuations in the Basement at Cypress are smaller and water levels show a more subdued response to climatic changes such as rainfall. This would be expected given that the underground workings provide preferential pathways for rainfall and fire suppression water to rapidly enter the ground.

4.6.2 Brunner Coal Measures

4.6.2.1 Millerton Block underground workings

Groundwater levels in the Millerton Block are measured from monitoring from Vibrating Wire Transducers (VWTs) installed at depths of 33 m – 59 m below ground level into monitoring bores screening the BCM underground workings, downgradient of the current Millerton opencast mining areas. The VWTs and nearby surface water monitoring sites that receive some discharges from the underground workings monitored at the VWT locations are shown in Figure 4.13.

[redacted]

The transducers measure changes in groundwater levels (water pressure) within the historical underground tunnels (drives) in response to rainfall, opencast mining and the discharge of fire suppression water. Three VWTs are still in operation. Since the VWTs are installed within slotted pipe, groundwater samples can also be potentially taken of the underground water itself.

Groundwater level data from the VWTs from October 2009 – April 2012 and water level data from downstream surface water monitoring site S6 on Mine Creek are shown in Figure 4.14.

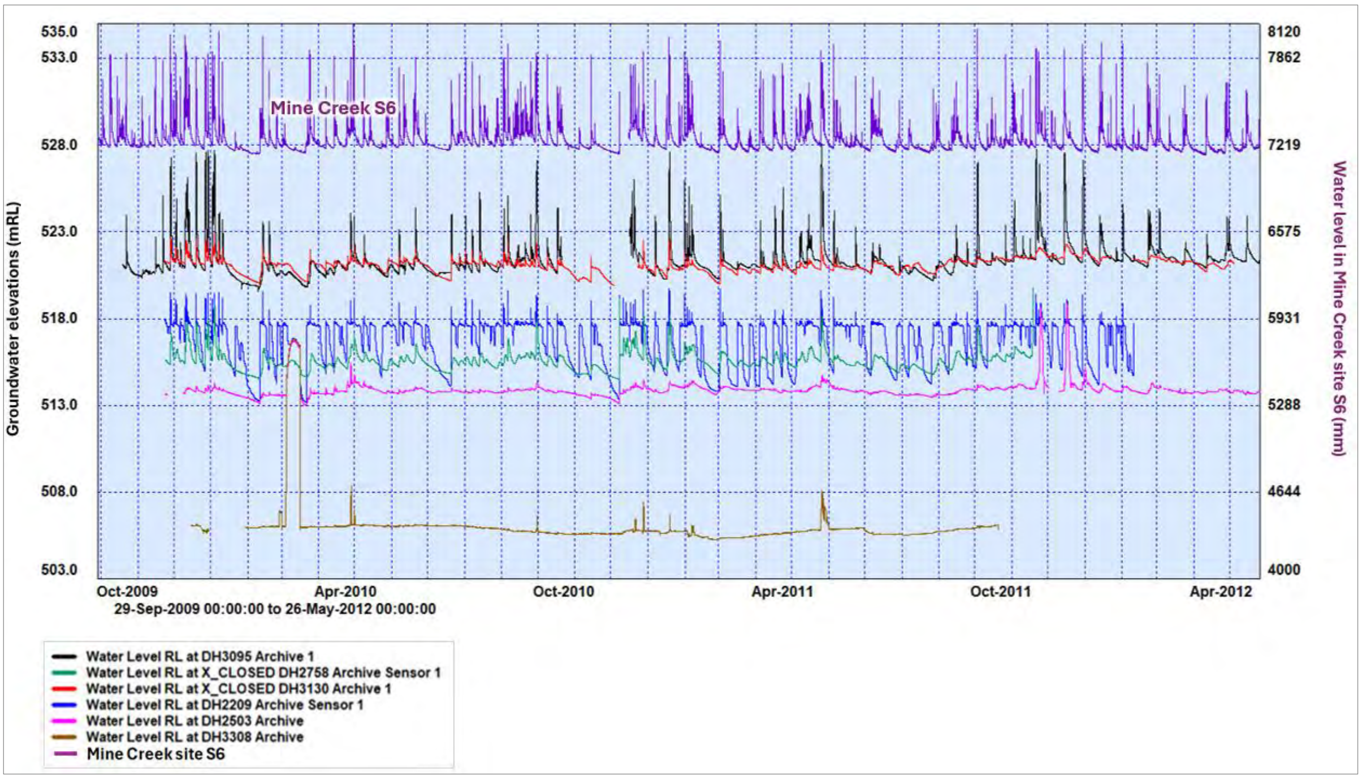

Figure 4.14 Groundwater level data (mRL) from the BCM downgradient of the Millerton opencast workings and water levels in Mine Creek monitoring site S6 (source: Bathurst)

Rainfall influences

Rainfall is the dominant influence on water levels within the underground workings, and all monitoring sites show rapid water levels rises in response rainfall events (Figure 4.14). Mine Creek (S6) shows rapid responses to rainfall, and hence, can be used as a proxy for rainfall.

Millerton Syncline influences

The water level fluctuations from rainfall differ between underground workings. Underground workings within the Millerton Syncline are less responsive to rainfall (moderating effect of large water body) than those that site outside of it.

Figure 4.15 shows that DH2758 located within the syncline, exhibits a muted response to rainfall. This subdued behaviour is consistent with storage and attenuation effects associated with the synclinal structure and reduced direct drainage compared with areas outside the syncline.

DH2209 and DH3130, show water levels within the underground tunnels that display responses that closely track rainfall without evidence of syncline influence. Their behaviour indicates that groundwater levels at these locations are primarily controlled by direct recharge and drainage within the underground workings, rather than by broader structural controls.

DH3130 and DH2503, positioned on the outskirts of the syncline, show a more complex response. Under normal conditions, their water levels respond predominantly to rainfall. However, during periods when the DCA is intentionally blocked and the syncline is backfilled, a distinct syncline-related response is observed. This indicates hydraulic connectivity between these monitoring points and the syncline structure, which becomes more apparent when preferential drainage pathways are restricted.

Fire suppression influences

Though rainfall is the dominant influence on water levels in the underground workings, fire suppression discharges can also have a pronounced effect, but are usually short lived. Figure 4.16 shows the groundwater elevation at DH2209 (blue), rainfall (red) and fire suppression discharge (black). The longer periods of fire suppression serve to hold up the groundwater recession in DH2209. Groundwater mounding of ~1 m was observed in at DH2758 (Figure 4.10) due to fire suppression discharges.

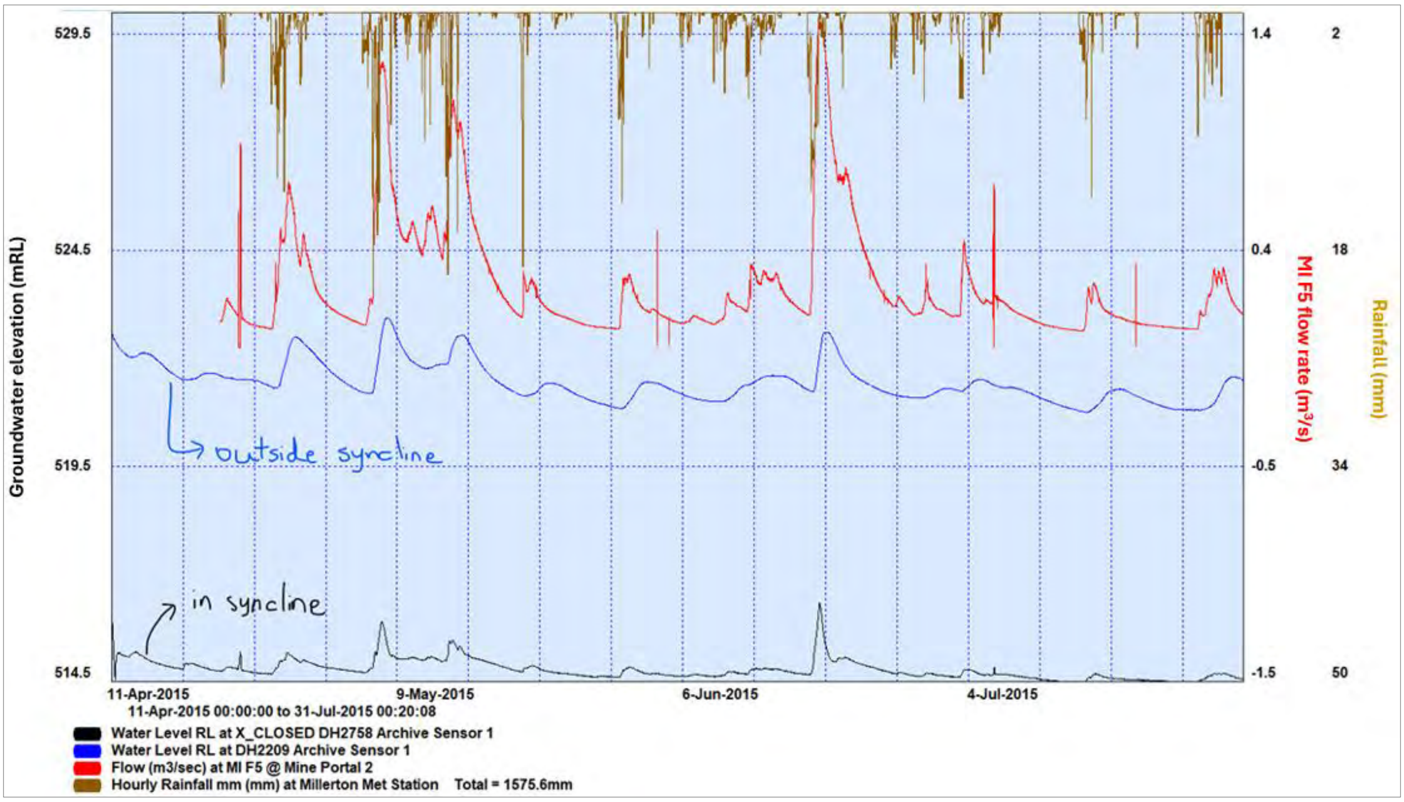

Figure 4.15 Millerton Syncline influence on water levels (source: Bathurst)

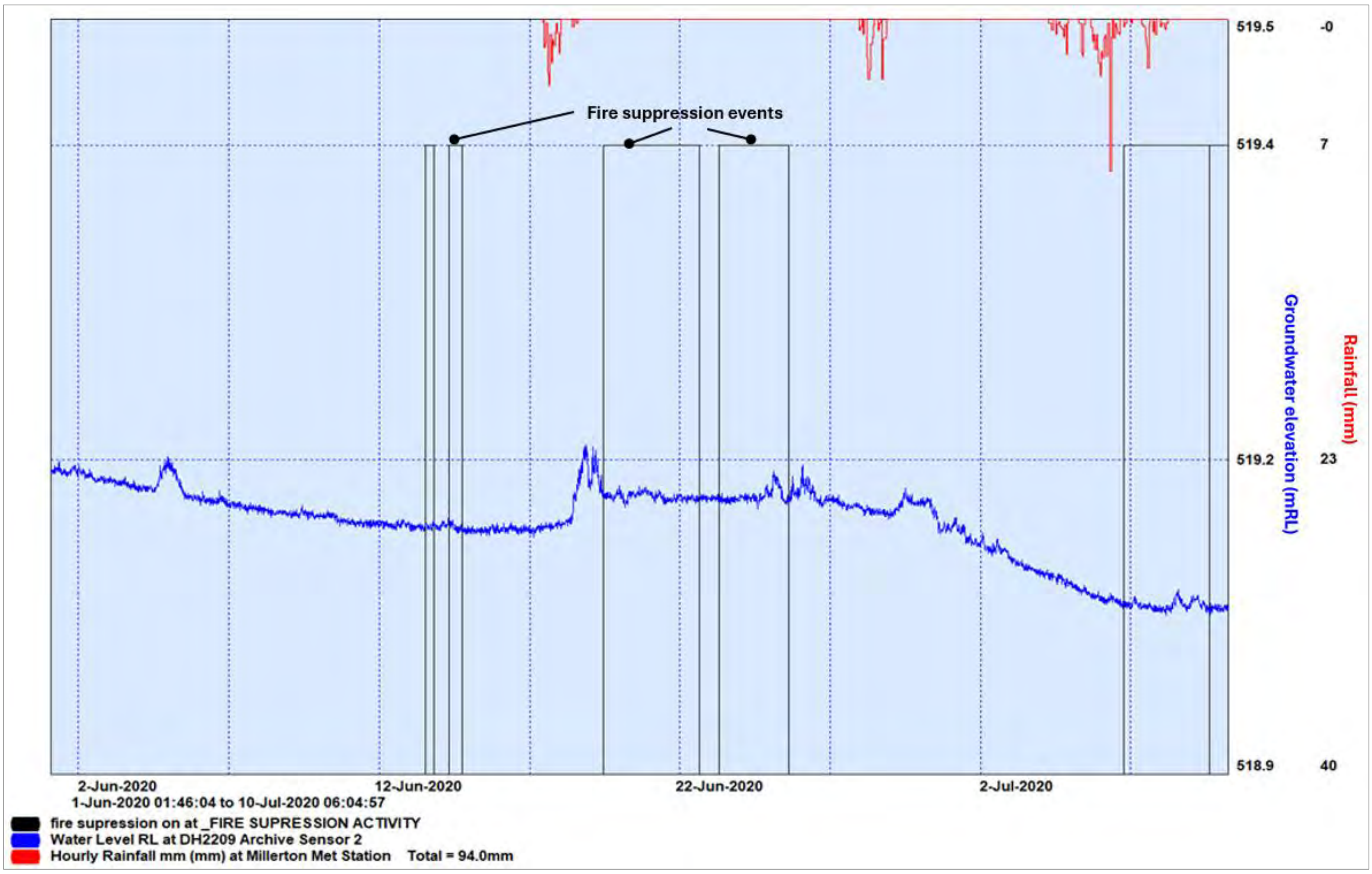

Figure 4.16 Effects of fire suppression discharges on underground workings water levels at DH2209 (source: Bathurst)

Influences on waterway flow / levels

Water levels in the Mine Creek north tributary monitoring site S6 (Figure 4.14) are dominantly influenced by rainfall and fluctuate in a very similar pattern to the water levels measured in the underground workings at DH3095 installed within the Drainage Control Adit (DCA) tunnel that currently discharges into the Mine Creek north tributary, upstream of S6.

4.6.2.2 Mangatini catchment

The Mangatini Sump monitoring bore locations are shown within the inset of Figure 3.10. The hydrographs from these bores, shown in Figure 4.17, indicate two distinct groundwater response behaviours down-gradient of the sump. The 3631 (shallow / deep (S/D)) and 3635 (S/D) nested bores show rapid, high-amplitude fluctuations and broadly synchronous rises and falls over the monitoring period (2009–2011). The timing and magnitude of these oscillations, together with several coherent step-changes, suggest these locations are hydraulically well connected to the sump perimeter and/or associated drainage pathways, so that changes in boundary conditions (sump stage and/or dewatering conditions) are quickly transmitted to groundwater levels. These bores commonly track within a few metres of the sump water level when it is elevated, consistent with a responsive, relatively transmissive zone near the sump edge.

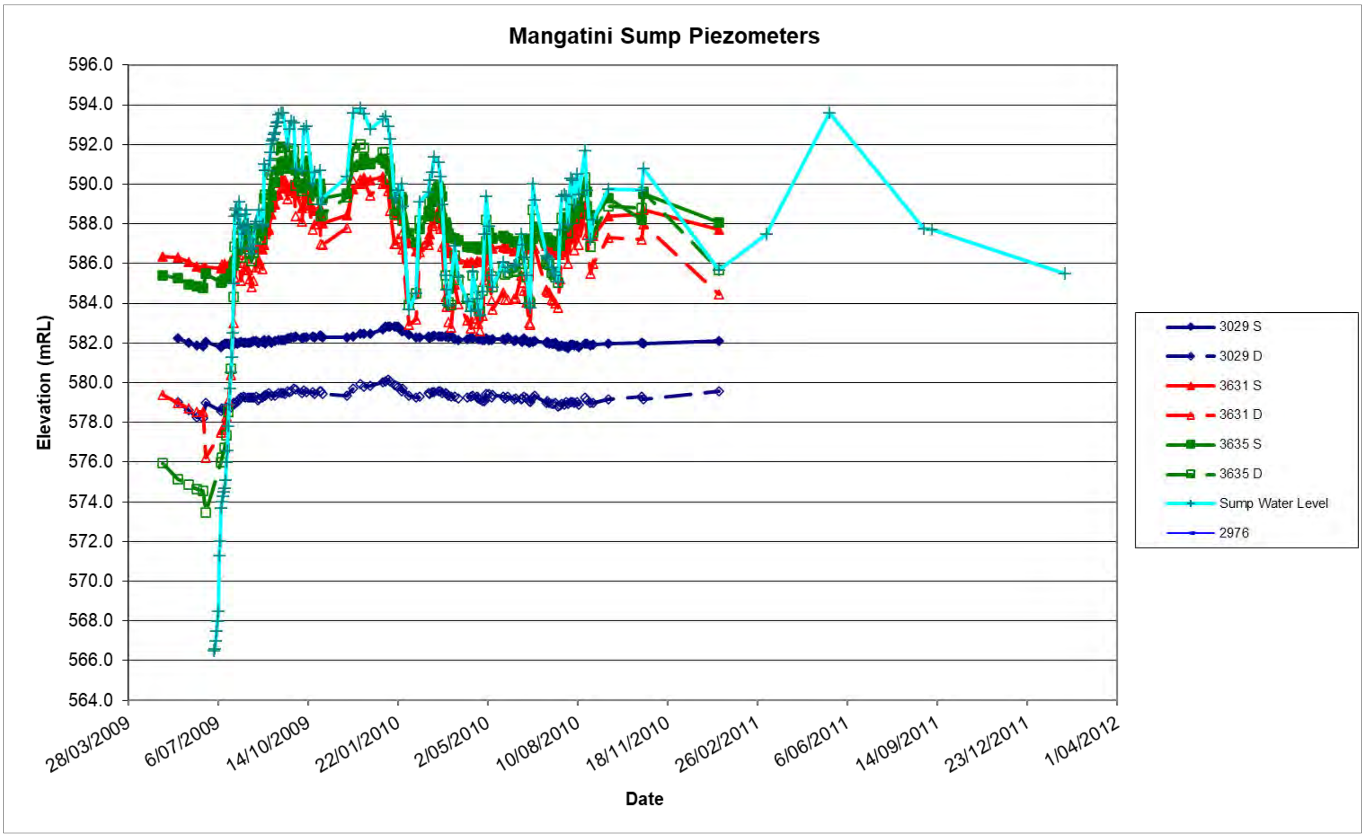

Figure 4.17 Groundwater level monitoring downgradient of Mangatini Sump

In contrast, the 3029 (S/D) bores exhibit comparatively stable groundwater levels with only minor variability through time, and at a consistently lower elevation than the more responsive monitoring bores. This muted behaviour indicates that groundwater at 3029 is hydraulically disconnected from the sump, either because it is within a less permeable unit, is separated by local heterogeneity/barriers, or is positioned outside the zone strongly influenced by sump stage changes (located ~170 m from sump).

Across the nested installations, shallow and deep traces at each location generally move together, indicating that pressure changes propagate vertically at least to some degree (i.e., the screened intervals are not completely isolated). Higher groundwater elevations in the shallower (S) monitoring bores at times suggests a downward vertical hydraulic gradient. The water level difference might also suggest stratification and differences in permeability between shallow and deeper intervals. Overall, the dataset supports a conceptual model in which groundwater conditions around the Mangatini sump comprise a responsive, sump-influenced domain (3631/3635) and a more buffered, less connected domain (3029), with operational or stage-related controls superimposed on rainfall-driven variability.

The generally higher water level elevation in Mangatini Sump compared to the adjacent down-gradient monitoring bores (Figure 4.17) suggests the potential for seepage of AMD impacted water into groundwater. Any seepage from the base would probably be minimal due to the build-up of sludge, in combination with the low permeability BCM / Basement floor.

4.6.2.3 Depth to groundwater

The measured depth to groundwater from geological exploration drillholes within the BCM in the Millerton Block / north Mangatini catchment was generally 20 – 30 m over the 2006 / 07 period, with a full range of 0 – 50 m depth (Figure 4.28). Groundwater depths were shallowest near deeply incised waterways and mined out areas. Further information is provided in Section 4.7.2.

4.6.3 Coastal sediments

Groundwater level data on the Quaternary coastal plain sediments, downgradient of Stockton, are not available from the West Coast Regional Council (WCRC) online sources, however, one shallow monitoring bore (unknown m depth), previously installed by Solid Energy was identified in the wetland area associated with Kerr Stream (Figure 4.18). The WCRC database also lists 13 monitoring bores (unknown depth) within the coastal wetland areas (Figure 3.6) however, these could not be identified in the field and may no longer exist.

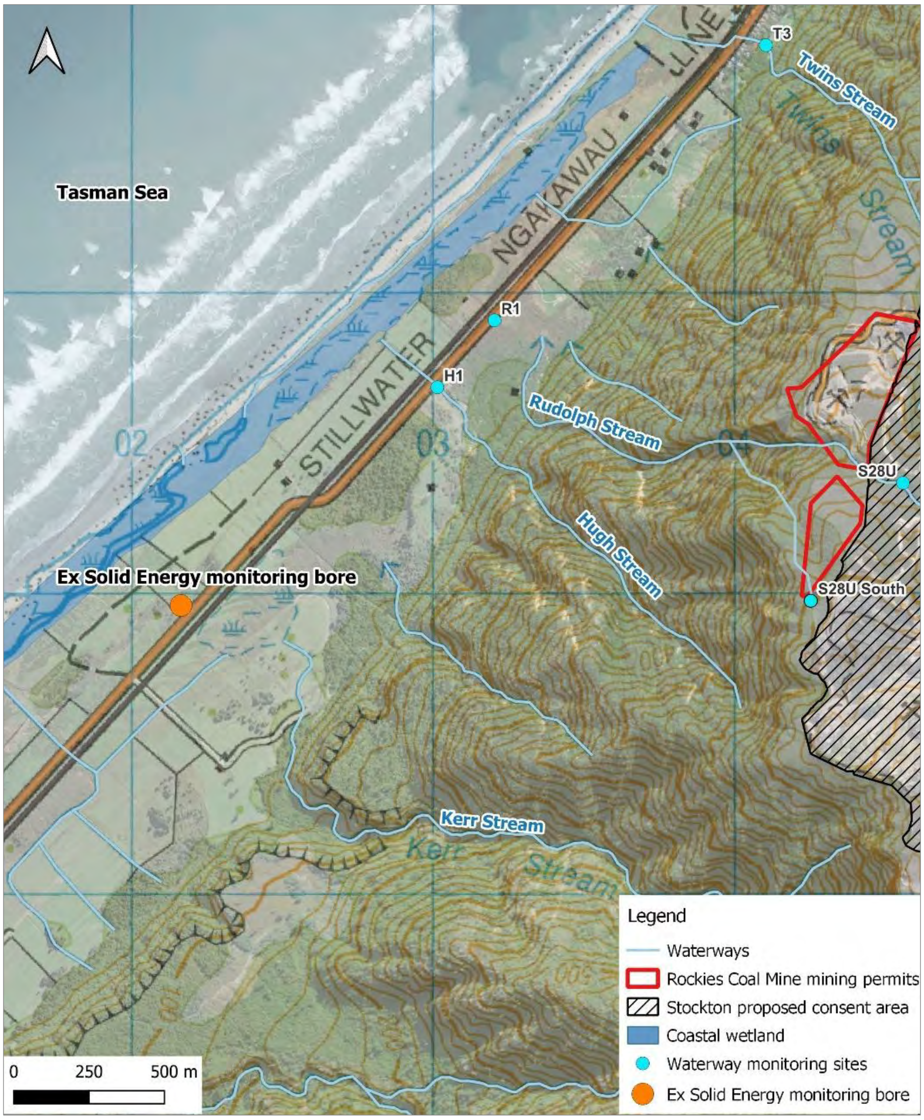

Figure 4.18 Coastal groundwater monitoring bore and nearby surface water monitoring sites

A site walkover by Bathurst staff in April 2026 identified significant areas of waterlogged soils between the state-highway and coast, downstream of Kerr Stream where the water table is at ground surface. During the walkover, a large un-named coastal wetland was also observed. This wetland extends from Twins Stream, to approximately 4 km south to Worley Stream, and occupies low-lying land between coastal sand dune deposits. Surface water in the wetland and the water table (upper surface of the zone of saturation in the ground) are likely to be at similar levels.

Further inland and adjacent to the highway, the groundwater level in the ex-Solid Energy monitoring bore (Figure 4.18) was measured at 0.7 m below ground on 20 April 2026. This suggests that depth to groundwater may increase with distance inland from the coast, though even still, the water levels are still relatively close to ground level.

Groundwater levels fluctuate in response to rainfall, waterway losses to groundwater and tidal fluctuations close to the coast. Coastal groundwater may be confined by overlying silt aquitard material, resulting in groundwater levels at depth which differ in elevation and fluctuations compared to the water table in overlying shallower groundwater.

4.6.4 Barometric pressure responses

Barometric pressure responses in groundwater level have been reported in the BCM and KMS (GHD, 2024a) which suggest these units are confined, at least in some locations and depths.

4.7 Groundwater flow direction

4.7.1 Regional groundwater flow direction

Figure 4.19 shows the inferred (not modelled) regional horizontal groundwater flow directions across the Stockton Plateau and wider study area.

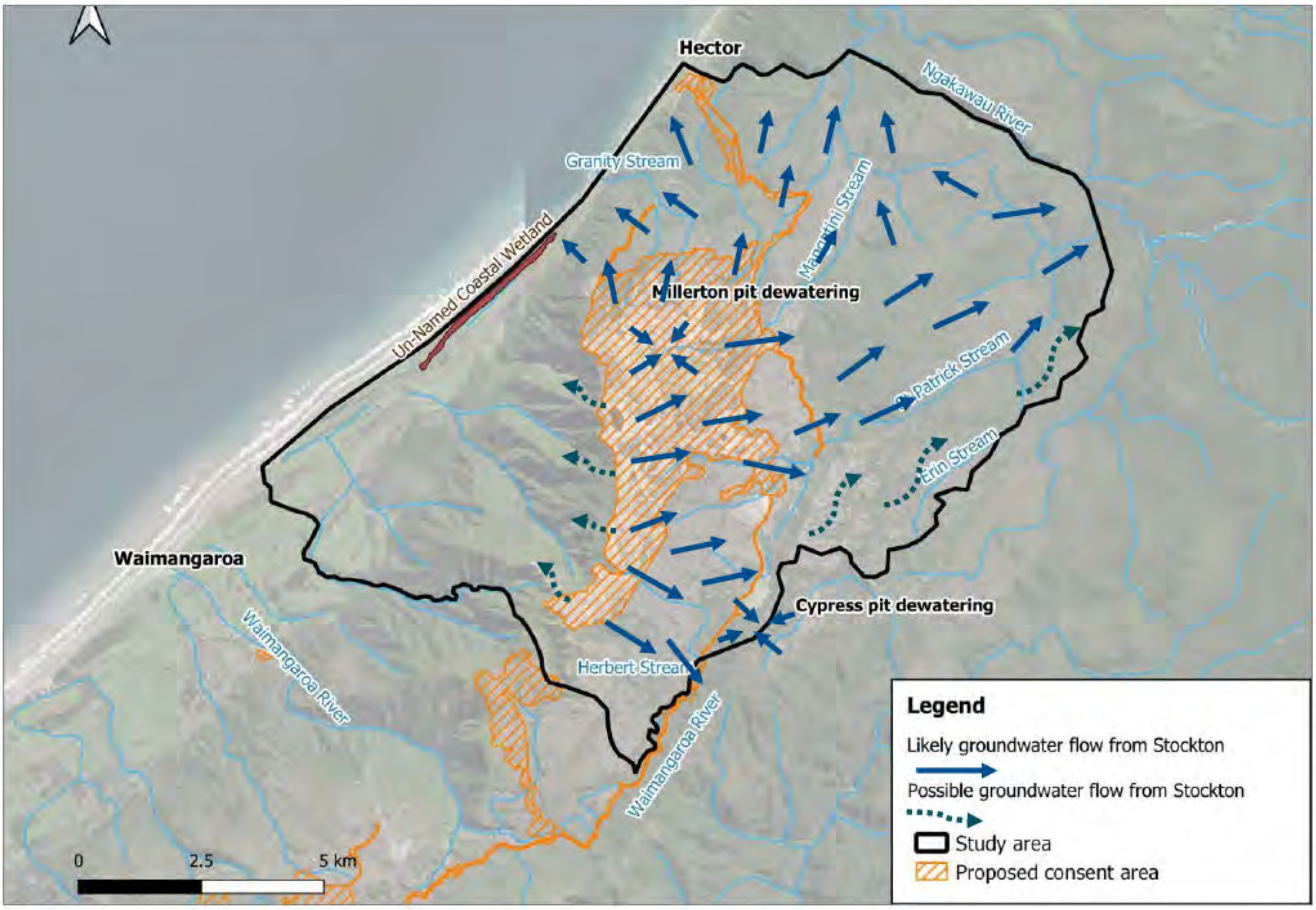

Figure 4.19 Inferred horizontal groundwater flow direction

The key assumption is that horizonal groundwater flow is topographically controlled, i.e. follows the topographic surface. This has been inferred for the BCM by contouring groundwater level measured within the Millerton Block and Mangatini catchment mining areas (Section 4.7.2.4).

Based on the topography, most groundwater from Stockton likely flows towards, and some may discharge into, the Ngākawau River. Some groundwater from Stockton is likely to discharge to the coast between the Ngākawau River and Rudolph Stream with a smaller amount flowing towards and possibly discharging into the Waimangaroa River as far south as Herbert Stream. It is possible that some limited groundwater from Stockton flows west towards the coast, south of Rudolph Stream, and northeast within the southern portion of the St Patrick Stream catchment (between St Patrick and Erin Stream) (Figure 4.19).

Groundwater flow from the south-eastern edge of Stockton is likely highly limited and extremely small in comparison to the total groundwater flow from non-mining areas downgradient. In addition, the headwaters of Hugh Stream, and Jones Stream and Kerr Stream south of Stockton are generally ephemeral (Bathurst comment), indicating a dominantly surface water rather than groundwater-driven flow.

Locally, groundwater flow is likely influenced from drawdown associated with dewatering of opencast pits at Stockton and Cypress.

Groundwater in the coastal plains sediments is likely to flow in a north-west direction towards the ocean and parallel to streams and rivers. Local variations may occur where groundwater discharges to or is recharged by an adjacent waterway.

4.7.2 Brunner Coal Measures at Millerton Block and Mangatini catchment

4.7.2.1 Methodology

Groundwater contour surfaces were interpolated from available monitoring data (see section 3.5.2) to provide an indicative representation of groundwater levels and assumed horizonal flow patterns across the Millerton Block and Mangatini catchment areas, during the period of available data from 2005-2010. This period is pre-Millerton opencast mining which commenced in ~2010.

The preferred approach for groundwater level assessment would ordinarily involve analysis of time-series data from a network of dedicated monitoring bores with either continuous logging or repeated manual measurements, allowing temporal trends and responses to external drivers to be robustly evaluated. However, the available dataset is dominated by drillholes with a single groundwater level measurement per location, which precludes conventional hydrograph analysis. In response, a pragmatic methodology was adopted whereby four dates with the highest number of drillholes completed on the same day were selected to generate “snapshot” groundwater contour maps. This approach maximises spatial coverage at a consistent point in time and allows first-order interpretation of regional groundwater gradients and potential flow directions.

To further assess seasonal variability, drillholes completed in each season (summer, autumn, winter, and spring) across the period of record (2005–2010) were grouped and used to interpolate seasonal groundwater contour surfaces, thereby increasing data density and enabling a broad assessment of seasonal groundwater levels.

4.7.2.2 Assumptions and limitations

This methodology is subject to several key assumptions and limitations that must be considered when interpreting the results, particularly given the Stockton Plateau’s long history of underground coal mining. The approach assumes that groundwater levels measured during or shortly after drilling are representative of formation hydraulic heads in the BCM, and that drilling-related impacts (e.g. incomplete equilibration, drilling fluids, temporary casing conditions, or short-term recharge influences) do not materially bias the measurements. It also assumes that groundwater levels from drillholes of varying depths and screened intervals are broadly comparable, notwithstanding the potential for vertical hydraulic gradients in fractured or stratified systems. In a hydrogeological setting altered by mining operations, these assumptions can be less robust because historical and ongoing mine workings (e.g. underground roadways, panels, goaf areas, dewatering infrastructure) can create preferential flow paths, localised hydraulic sinks/sources, and compartmentalisation that may decouple groundwater levels from a smoothly varying regional potentiometric surface.

In addition, the substantial modification of the ground surface by opencast mining in the Mangatini and St Patrick during the 2005-2010 period (e.g. excavation, backfilling, regrading, and changes to drainage networks) can alter recharge distribution, runoff–infiltration partitioning, and near-surface storage, resulting in spatially heterogeneous water-level responses that are difficult to capture using sparse, single-measurement drillhole data. The snapshot-day approach may therefore incorporate temporal and operational artefacts, as measurements taken on the same day can still reflect differences in antecedent rainfall, recent mining activity, and/or varying equilibration times between drillholes. Similarly, seasonal contouring aggregates data across multiple years (2005–2010), which can conflate seasonal variability with inter-annual changes and evolving mining conditions (e.g. progressive development of workings, changes in dewatering intensity, or backfill placement), potentially smoothing or obscuring true groundwater level patterns. Finally, interpolated surfaces remain sensitive to uneven drillhole distribution, particularly around mined areas where hydraulic gradients may be steep and structurally controlled, so contour geometry in data-sparse zones may be poorly constrained. Accordingly, the derived groundwater contours should be regarded as indicative and conceptual, useful for informing the Stockton conceptual model and identifying broad groundwater level patterns, rather than as a precise representation of the potentiometric surface in a complex, mining-modified system.

4.7.2.3 Results

Following interpolation of the groundwater contours for each scenario, the 2006-2007 LiDAR dataset was adopted to represent the ground surface conditions most closely aligned with the period of measurement. The interpolated groundwater surfaces were then analysed with LiDAR ground surface to derive depth-to-groundwater surfaces across the analysis area. Groundwater level contour maps for the snapshot dates are presented in:

– Groundwater levels on 05-07-2006 (Figure 4.20)
– Groundwater levels on 22-11-2006 (Figure 4.21)
– Groundwater levels on 05-07-2007 (Figure 4.22)
– Groundwater levels on 21-01-2008 (Figure 4.23)

Seasonal groundwater contour maps are provided in:

– Spring (Sep to Nov during the period from 2005 to 2010) (Figure 4.24)
– Summer (Dec to Feb during the period from 2005 to 2010) (Figure 4.25)
– Autumn (Mar to May during the period from 2005 to 2010) (Figure 4.26)
– Winter (Jun to Aug during the period from 2005 to 2010) (Figure 4.27)

Note that where groundwater is interpreted to be above ground level, the raster surface is coloured blue, indicating surface water ponding. A full discussion and interpretation of the groundwater contours and flow paths is presented in the *Hydrogeological Conceptual Model Summary* in Section 7.

4.7.2.4 Results discussion summary

A full discussion concerning the groundwater level surfaces and contours is presented in the hydrogeological conceptual model in Section 7. However, a summary of this discussion is presented as follows:

– Regional groundwater flow is predominantly towards the north-east. Groundwater elevations decrease from approximately 750 m RL in the south-west to around 515 m RL in the north-east, defining a clear regional hydraulic gradient.
– The contours and Figure 4.28 show that the horizontal groundwater flow in the BCM is highly correlated to surface topography.
– Groundwater in the BCM flows towards the Millerton Syncline, which is a structural low point in the geology that acts as a reservoir, and is historically where groundwater has been abstracted from to enable mining in water-free tunnels.
– Contoured groundwater levels are higher than the stream bed in some reaches of Miller Stream, Granity Stream and Mine Creek, suggesting areas of groundwater seepage from the BCM into these waterway reaches.
– The groundwater level data appear to show no major vertical gradients within the BCM (i.e. very different pressure head (water levels) at different depths).

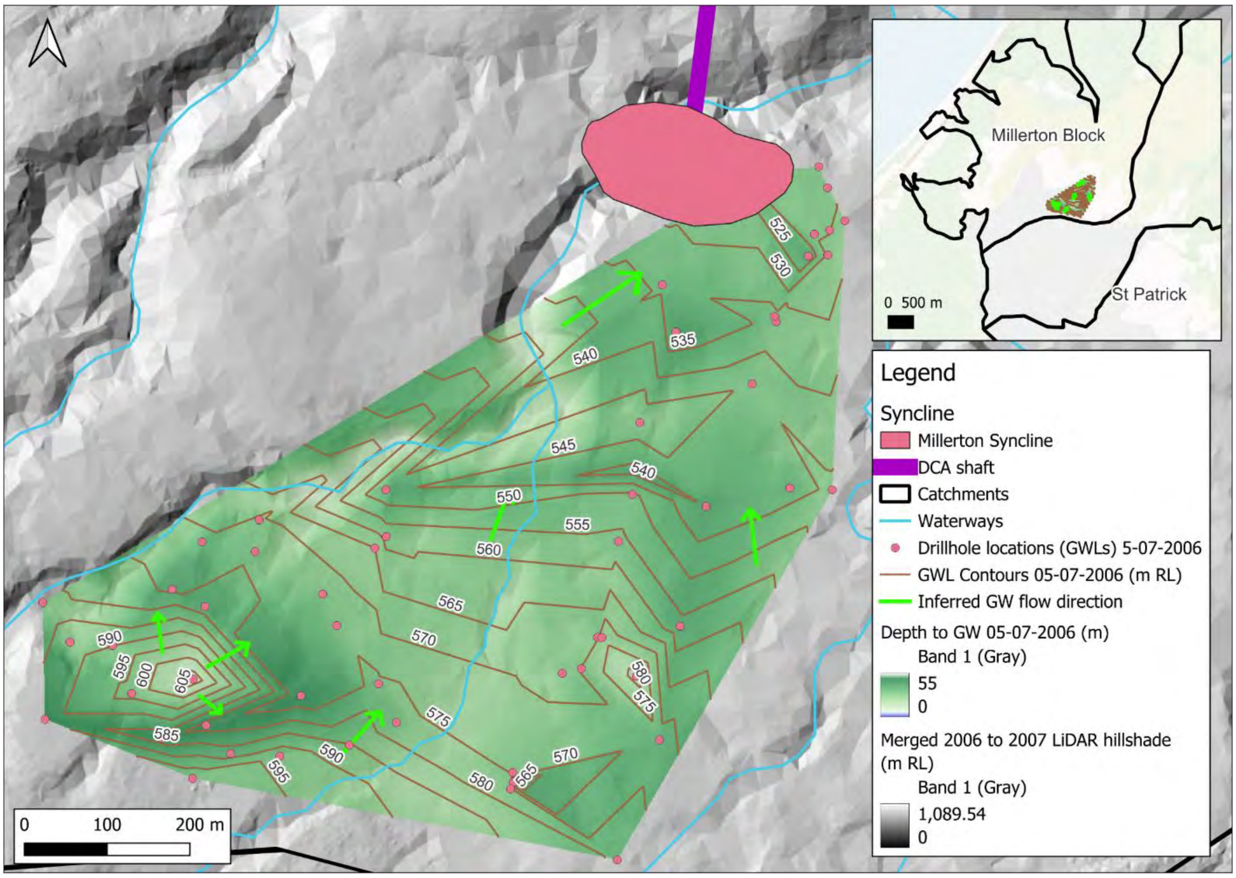

Figure 4.20 ***Groundwater elevation contours, inferred flow direction and depth to groundwater (05-07-2006)***

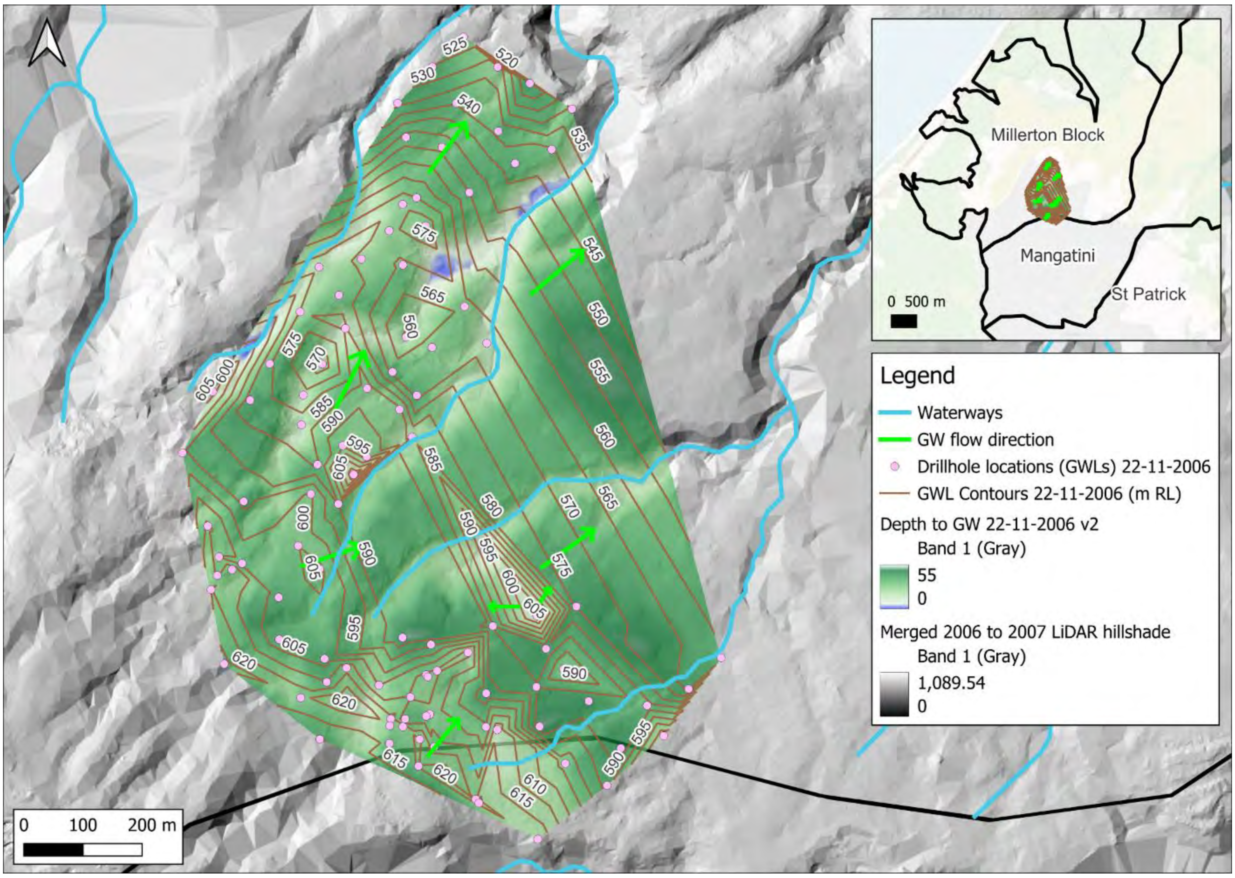

Figure 4.21 ***Groundwater elevation contours, inferred flow direction and depth to groundwater (22-11-2006)***

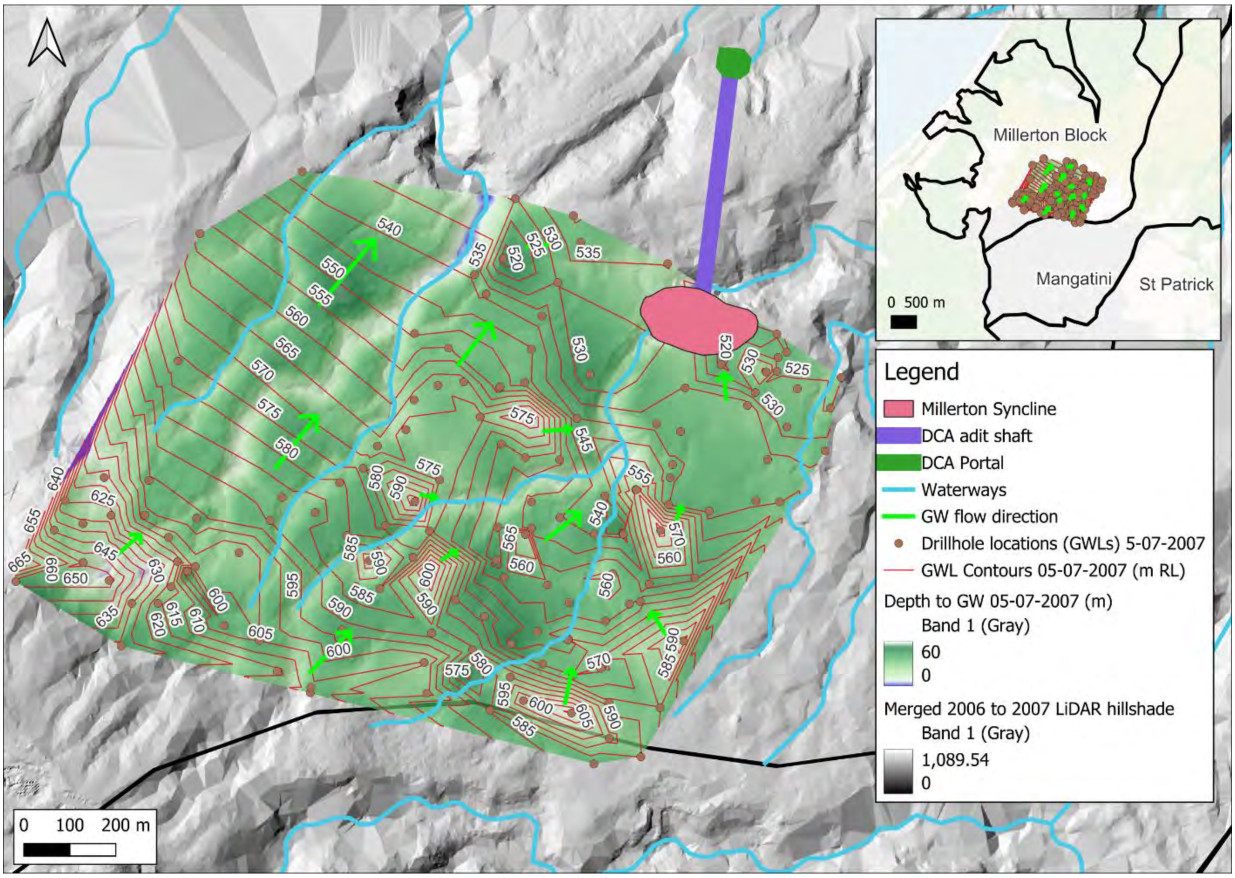

Figure 4.22 ***Groundwater elevation contours, inferred flow direction and depth to groundwater (05-07-2007)***

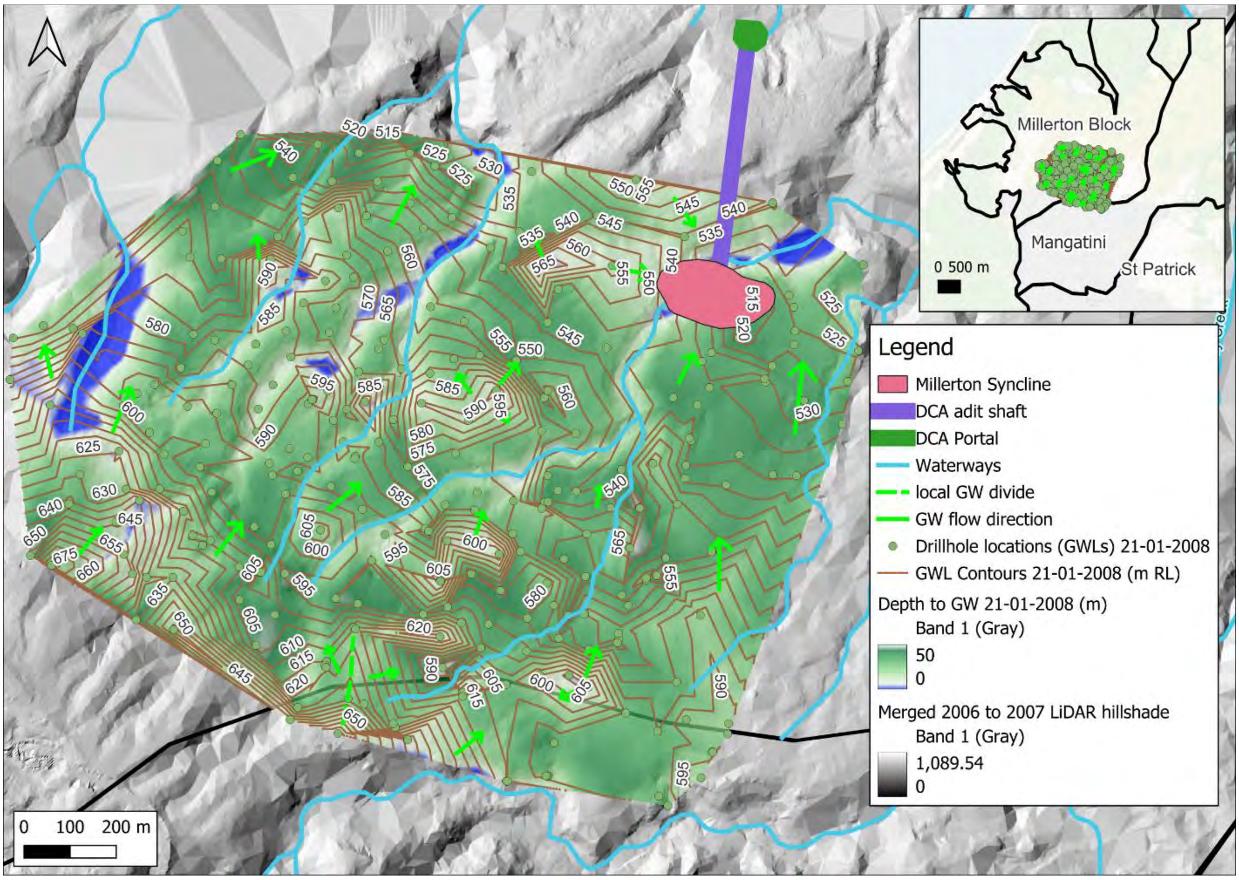

Figure 4.23 ***Groundwater elevation contours, inferred flow direction and depth to groundwater (21-01-2008)***

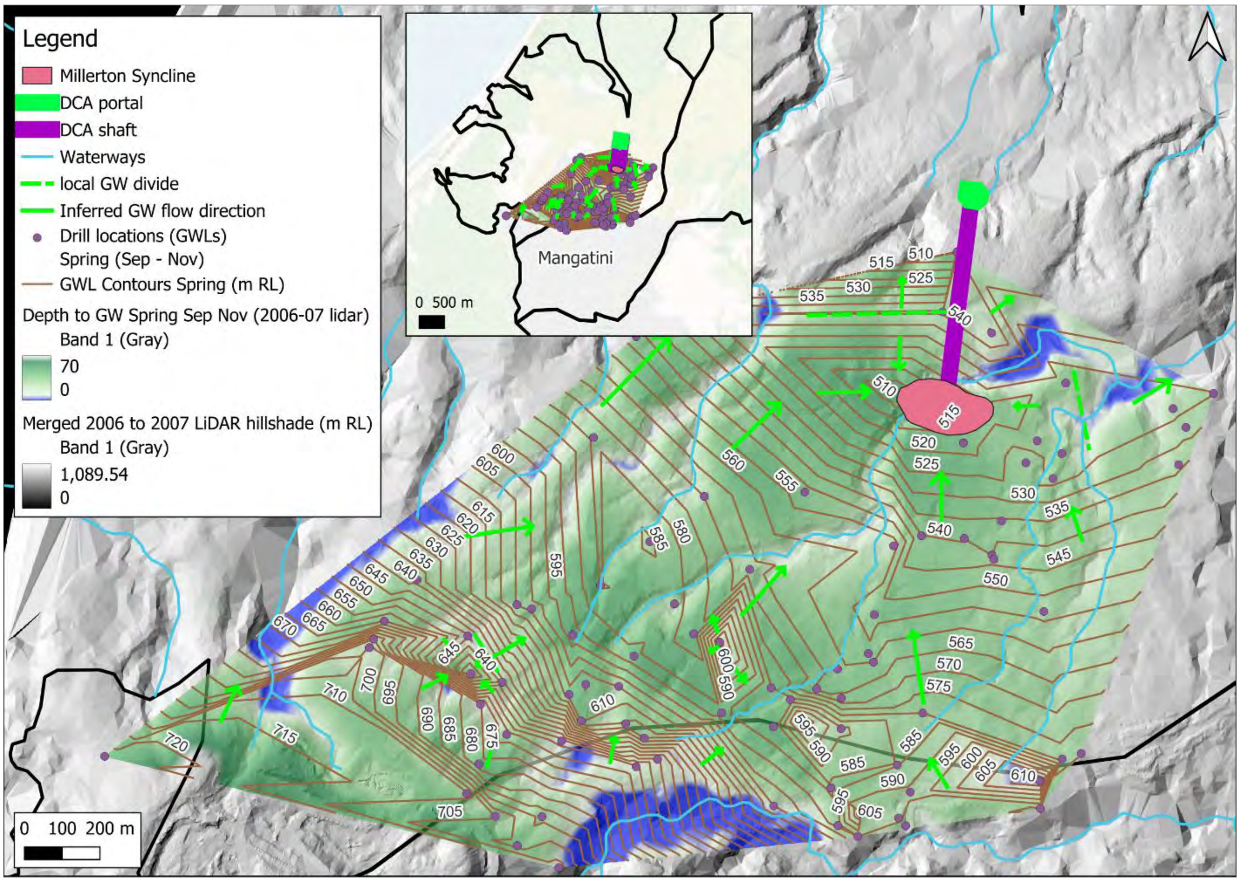

Figure 4.24 ***Groundwater elevation contours, inferred flow direction and depth to groundwater (Spring Sep-Nov, 2005-10)***

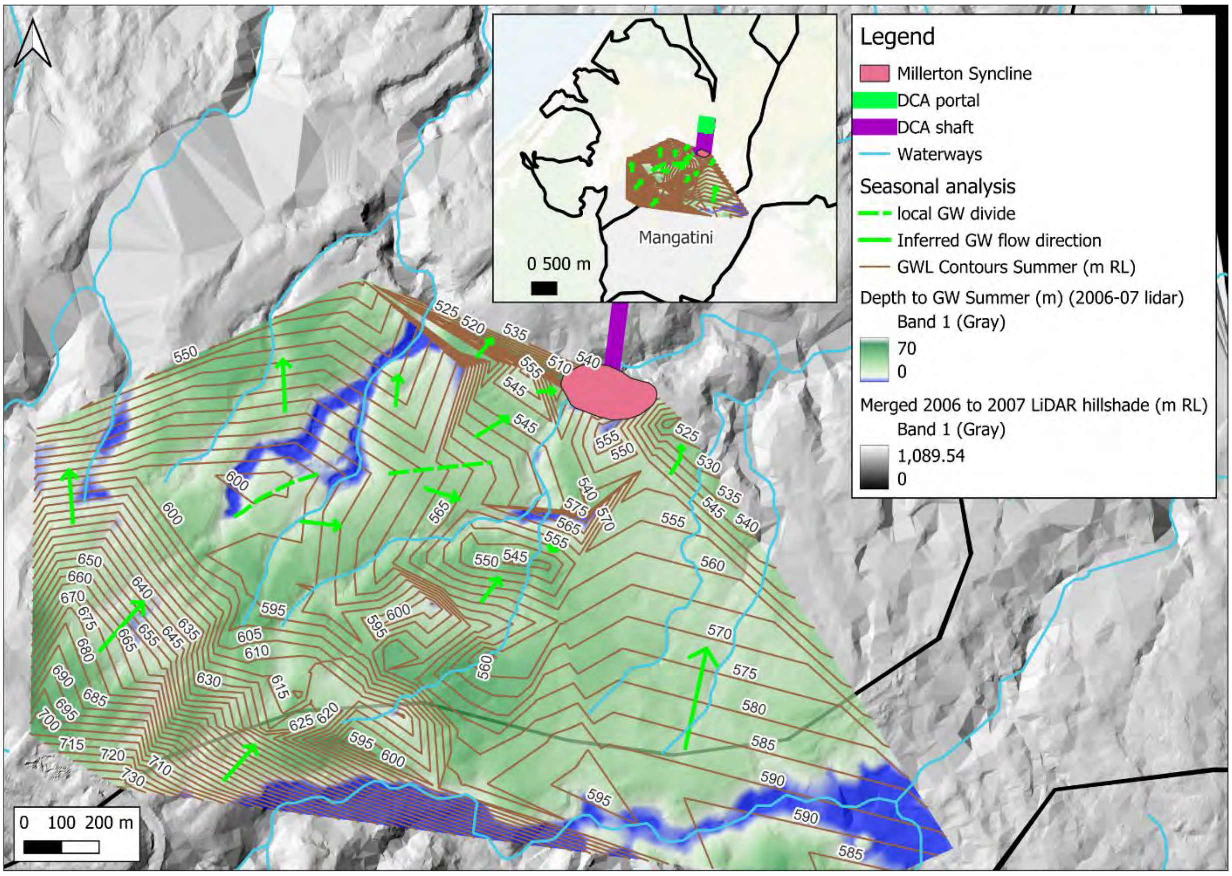

Figure 4.25 ***Groundwater elevation contours, inferred flow direction and depth to groundwater (Summer Dec-Feb, 2005-10)***

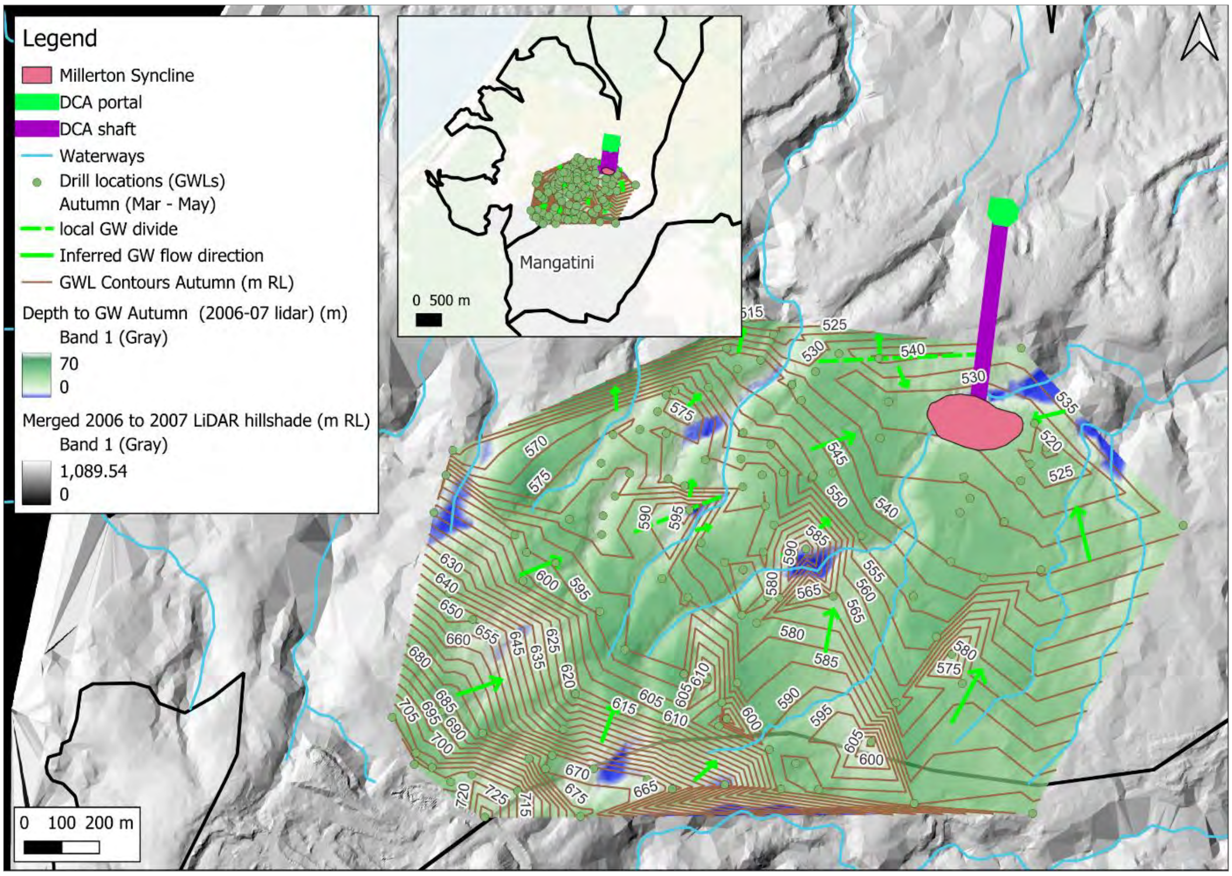

Figure 4.26 ***Groundwater elevation contours, inferred flow direction and depth to groundwater (Autumn Mar-May, 2005-10)***

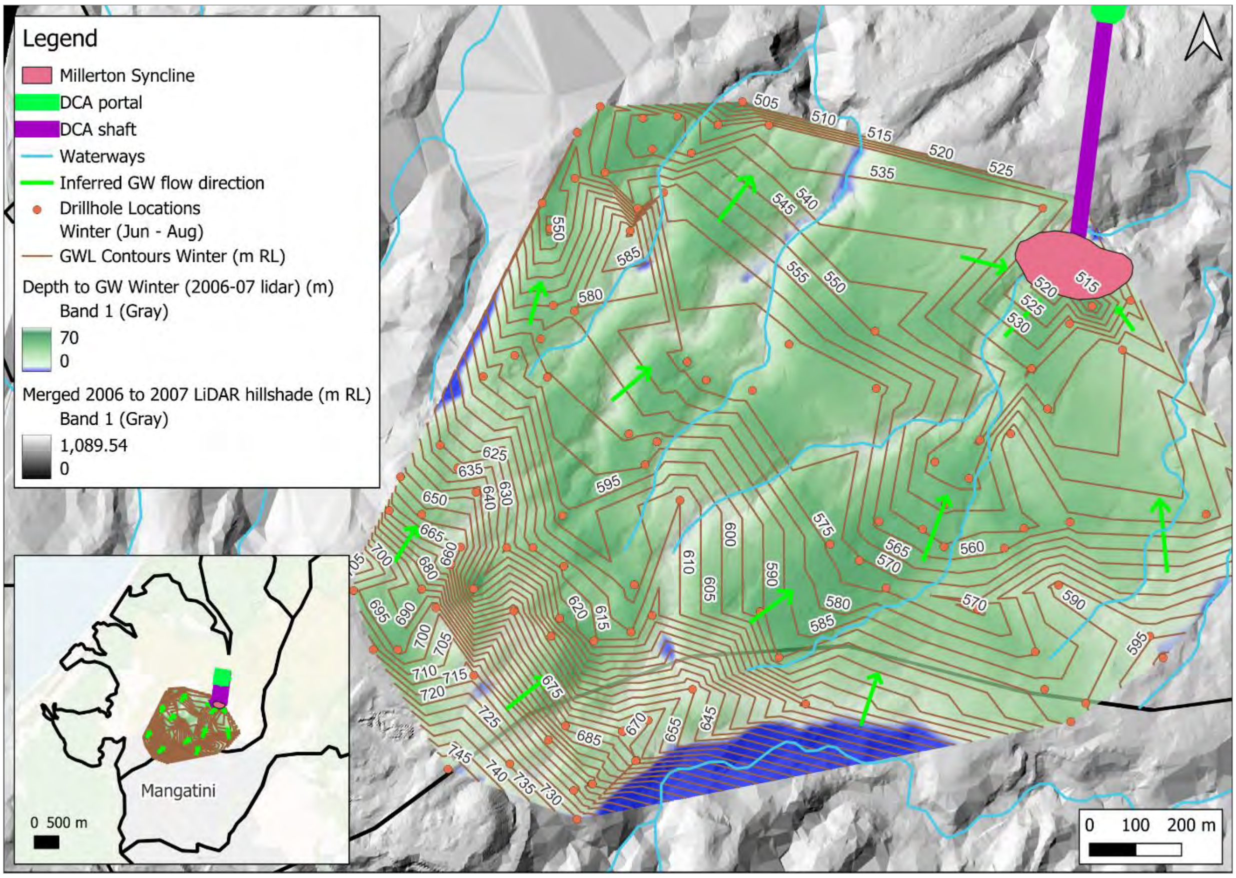

Figure 4.27 ***Groundwater elevation contours, inferred flow direction and depth to groundwater (Winter Jun-Aug, 2005-10***

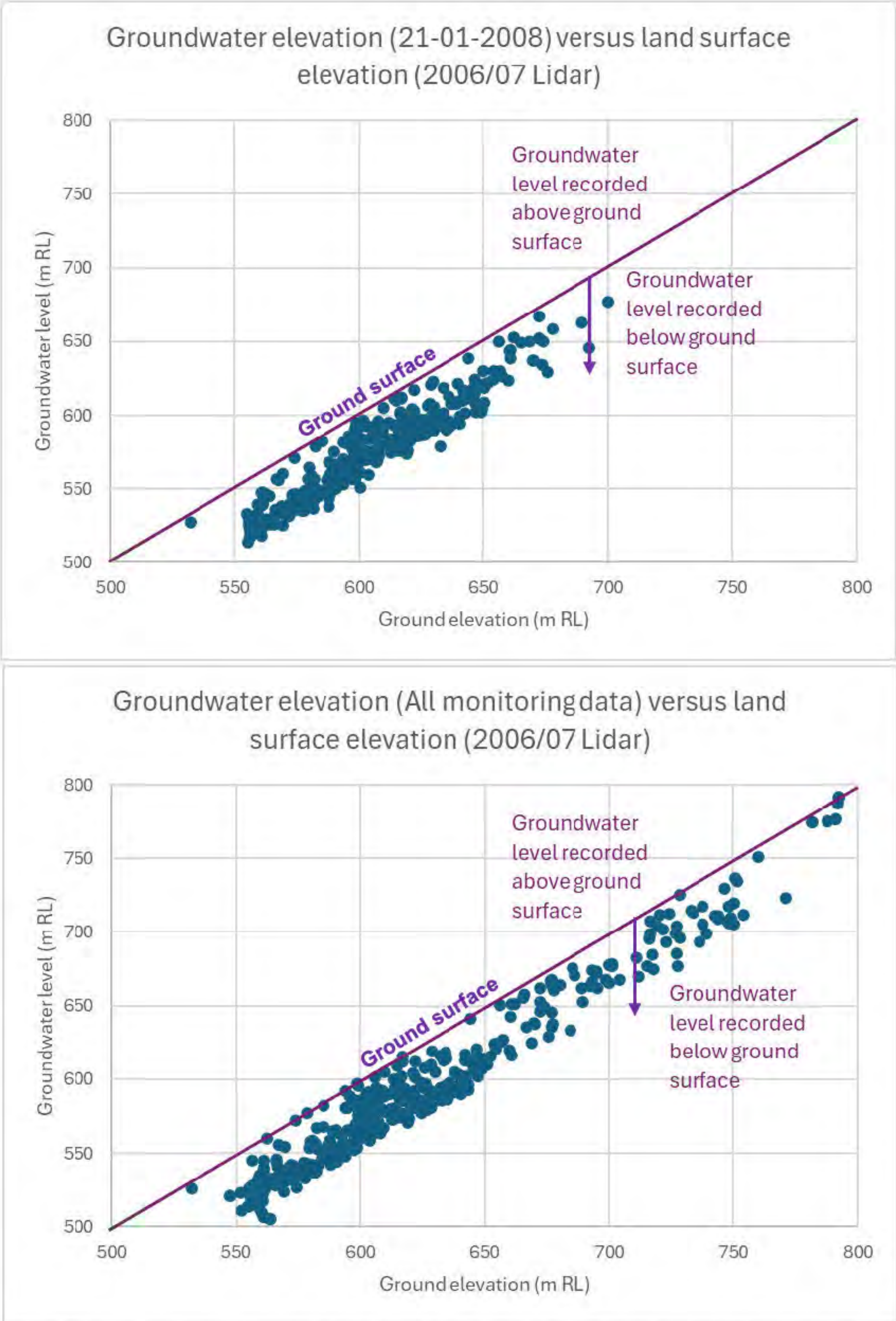

Figure 4.28 ***Groundwater elevation from drillhole data versus ground surface elevation within the BCM - Millerton Block and northern edge of the Mangatini catchment for selected scenarios over 2006 / 07***

5. Hydrogeochemistry

5.1 Groundwater quality and relationship to waterway quality

Groundwater monitoring throughout the study area, together with other available datasets, were assessed to understand groundwater quality, identify potential contaminant sources in groundwater (including waste rock areas, historical underground workings, coal fines storage and fire suppression activity), and assess the relationship between groundwater quality and receiving waterway quality. This interaction represents the main environmental impact arising from historical and current mining at Stockton).

Table 5.1 summarises three key AMD water quality indicator parameters - pH, aluminium and turbidity (where available) for various groundwater sources, rainfall, waterways and mining related contaminant sources. Broad observations are:

– Groundwater quality within the BCM / KMS and Basement, under both natural and AMD impacted conditions, is similar to the quality of waterways flowing over the same geological units.
– Acidity and dissolved metals are lower in groundwater within the Basement compared to the BCM / KMS.

5.2 Natural impacts on groundwater quality

5.2.1 Rainfall

Rainfall is the dominant source of groundwater recharge and therefore influences groundwater and surface water quality. In the absence of site-specific rainfall water-quality data for the study area, national-scale rainfall chemistry data were used to infer likely rainfall conditions at Stockton (Nichol et al., 1997). In New Zealand the rainfall typically has a pH of 5.7 – 6 (Holden and Clarkson, 1986, Jacobson et al., 2003) and total alkalinity (as $CaCO_3$) (based on calcium and magnesium concentrations) 0.1 – 2 mg/L (Nichol et al., 1997).

5.2.2 Soils and geology

Soils and geology play a key role in both AMD and the natural groundwater and waterway quality. Podsolisation and acidification of soils across the Stockton Plateau contributes to naturally acidic rainfall-derived surface water and shallow groundwater within the BCM.

Overburden at Stockton is a sequence of inter-layered sandstones, mudstones and intermediate units comprising the BCM and KMS. These units vary in their pyrite (sulphur) content and therefore acid-forming potential. Further secondary geochemical reactions lead to oxidation and dissolution of other sulphide and non-sulphide minerals resulting in additional acidity generation and dissolution of other elements and compounds (such as aluminium, nickel, zinc, sulphate, etc). Coarse white sandstones typical of the Mt Frederick area have lower concentrations of pyrite. Mudstone, bioturbated sandstones, laminated fine mudstones/sandstones and carbonaceous shales typical of the Webb, Mangatini, Rockies and Millerton areas have a higher pyrite content and are generally considered potentially acid forming (PAF). The dominant rock type that is currently being worked at Stockton Mine (excluding Cypress) is BCM (Bathurst, 2026c).

Naturally (without mining), the lowest pH groundwater and surface water occur in the silica-rich BCM and KMS sedimentary rocks, due to natural weathering of pyrite producing sulfuric acid and partial oxidisation of organic matter in the soils and within the coal seams producing organic acids, combined with limited calcium and magnesium content. Lower natural acidity occurs in groundwater and waterways draining areas containing the non-acid producing granites and Quaternary coastal sediments.

In surface water, the Stockton Plateau waterways are often naturally more acidic than rainfall because of abundant organic acids formed from decomposition of plant matter (Winterbourn and McDiffett, 1996).

Table 5.1 Typical median pH, dissolved aluminium and turbidity for groundwater and other sources within / near Stockton (data largely sourced from Bathurst)

Water type	Water source	Data Source	pH	Dissolved aluminium (mg/L)	Turbidity (NTU)
Rainfall **Section 5.2.1**	National scale literature values	(Nichol et al., 1997)	5.7 – 6	-	-
Fire suppression **Section 5.3.2**	Water from Millerton Pit AMD impacted	Millerton pipe (2024 – 2025)	2.8	235	13
Minewater **Section 5.3**	Coal fines storage surface water	A18 CFSF at Stockton.	4.3 – 4.4	0.06 – 0.1	-
	Coal fines storage pore water seepage		5.7	7.8	-
	BCM and KMS waste rock areas AMD impacted	2020 Stockton seepage sampling from 30 waste rock waste rock seepages.	2.3 – 4.2	1 – 220	-
Groundwater **Section 5.3**	BCM AMD impacted	Drainage Control Adit (DCA) – influenced by surface water at times (27 monitoring rounds between 2024 and 2026)	2.4 – 2.6	110 – 270	0.3 – 3.6
		AMD impacted Twins Stream Site T1 groundwater seepage (2024 – 2025)	3.7	7.1	9
	BCM Undisturbed material	Monitoring bore data from STK7163 (Mangatini block), BH1523 at Cypress, and Mount Frederick South monitoring bores (DC25, DC27, DC28 and DC41)	4.6 – 8	0.006 – 1.5	-
	Basement: Granite Undisturbed material	Cypress granite dewatering project (WP25-14970).	7.1 – 7.4	<0.006 – 0.04	-
	Basement: Greenland Group Greywacke and Argillite Natural water quality	Mount Frederick South monitoring bore (DC33) (average from four monitoring rounds) 2023 - 2025	5.4	0.07	-
	Coastal sediments	Monitoring bore next to Kerr Stream, Granity Wetland Conservation Area	6.1	0.08	-
Surface water - waterways draining to the coast and Ngākawau River and coastal wetlands. **Section 5.8**	Largely BCM and KMS AMD-impacted	Median ranges for AMD impacted waterways from 2024 - 2025 (GHD, 2026b)	2.5 – 4.9	1 – 200	0.2 – 20
	BCM Natural water quality	Weka Creek S1, Granity Stream GT1, Twins Stream T21 and T35 Stream range of median values over 12 months from 2024 - 2025	4.3 – 4.4	0.3 – 0.4	0.6 – 1.1
	Basement: Granite Undisturbed material	St Patrick Stream SP median value (2024 – 2025), Rudolph Stream R1 and Hugh Stream H1 at the state highway.	5.7 – 7.2	0.005 – 0.07	0.7
	Coastal sediments	Coastal wetland intercepting Twins Stream	6.3	0.034	99

AMD impacted water quality in the BCM, KMS and fire suppression water	Natural water quality or undisturbed material in the BCM and KMS	Water quality in the Basement granite

5.3 Potential contaminant sources

5.3.1 Acid & Metalliferous Mine Drainage

The principal AMD sources from Stockton in order of largest to smallest are listed below.

– Historical underground, opencast coal workings (within the BCM) and uncapped (BCM) waste rock areas prior to 2017 are by far the largest source (~80%). Significant areas of underground workings extend beyond the Stockton CML – the majority of which is addressed in the Crown Liability Deed of Commitment (further discussed in Section 8.2).
– Current waste rock areas and open cast mining.
– Underground coal fires within the Millerton Block and Mangatini catchment that started in the early 1900s.
– Current fire suppression works within the Millerton Block that create secondary AMD.
– Coal fine storage areas. Minor AMD sources because most of the acid-producing pyrite has been leached out.

Operationally, all BCM at Stockton is classified as PAF and managed as a homogenous unit from an AMD perspective (Bathurst, 2026c).

In the absence of treatment, a timeframe of 100 years is commonly applied to the natural decay processes where PAF waste rock material is left exposed (Bathurst, 2026a). The primary acidity decay rates used for long term modelling were sourced from studies using Stockton waste rock carried out by Gandy and Younger (2007) and followed by O'Kane Consultants (2015). This identifies two phases of acidity decay, being:

– An initial rapid phase of acidity decay equivalent to a 50% decrease in acidity in the first 10 years after completion of final landform rehabilitation (typically applied as a linear 7% decrease in acidity per year over 10 years for modelling purposes).
– A constant long term decay equivalent to 0.62% per year thereafter.

High decay rates are notably common for exposed coal floor / highwall, particularly early in the decay sequence when concentrations decrease by orders of magnitude over short periods. Historical and current AMD from mining related sources will continue to be produced until the process is complete or the rock material is encapsulated in such a way that oxygen and/or water is excluded or reduced to very minimal levels.

5.3.2 Fire suppression water

The sources of water used to supress fires within the historical underground workings at Millerton have become more acidic overtime. Since 2021, fire suppression water has been sourced from the Millerton Pit with a low median pH of 2.5. This water likely mixes with groundwater within the historical underground workings, and some probably discharges into waterways. Fire suppression water sources since 2012 and key water quality attributes are summarised in Table 5.2.

Table 5.2 Quality of fire suppression water (median values) sources since 2012

Fire suppression water - source	Period sourced	AMD treatment	Acidity (mg/L)	pH	Calcium (mg/L)
Mangatini Sump	2012 – 2015 and 2020	Treated	19	4.8	250
Duncans Sump	2016 – 2019	Untreated	221	3.3	41
Millerton Pit sump	2021 – present	Untreated	1,960	2.7	15

5.3.3 Waste rock

Background

Stockton is covered in waste rock areas composed of BCM and KMS overburden, mostly sourced from opencast mining. The waste rock generates AMD when sulfide minerals are exposed to water and oxygen. The AMD can move into the surrounding surface water and groundwater, causing environmental impacts. The key processes are illustrated in Figure 5.1.

At Stockton, a purpose of rehabilitation is to minimise AMD impacts – especially from waste rock areas. The AMD generation from waste rock occurs at varying rates across Stockton, depending on the age and standard of rehabilitation that has been applied. Historical uncapped waste rock produces higher rates of AMD compared to the current capped waste rock areas that reduce exposure to water and oxygen.

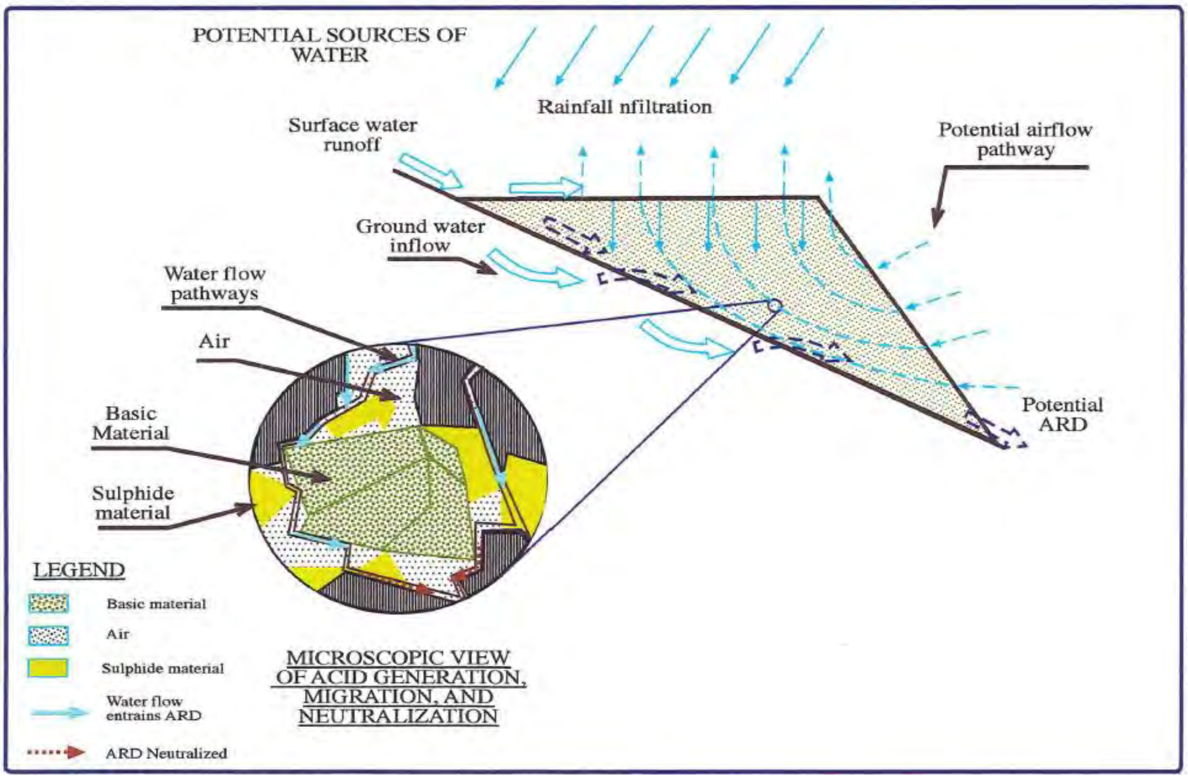

Figure 5.1 *Conceptual illustration AMD processes in waste rock areas (source: Alarcon, 1997)*

Historic and current / future waste rock storage

Historical waste rock areas inherited by BT Mining and dating back to opencast mining commencing in the 1950s, generally lacked engineered underdrains, were uncapped, had 15 m tipheads, experienced material segregation and channelling, and had relatively high permeability and seepage flows.

The encapsulated waste rock areas approach that commenced in 2006 by Solid Energy that is currently applied at Stockton is a significant improvement. This approach includes improved water management, 2 - 5 m lift heights, compaction and recontouring to form final landform gradients that are stable and mimic the natural topography, a 400 mm layer of weathered granite to cap and seal the waste rock (reduce oxygen and water) and a 200 mm layer of soil / fertiliser for vegetation re-establishment. Not all AMD seepages are captured and treated. However, AMD seepages captured by the Mangatini and McCabes Treatment Systems are dosed with CaO to neutralise acidity before being discharged into downstream waterways

In the future, waste rock areas designed as Engineered Landforms (ELFs) are being proposed under the BPCP at Millerton Block (discussed in the *Millerton Block AMD Water Management Plan*. STO-ENV-PLN-027), and in the ESE and MFS BPCP sub areas. This will result in result in further improvements to minimise AMD generation.

Storage below the water table

A key aspect related to groundwater is the ability to reduce AMD generation by storing waste rock below the water table which reduce the amount of oxygen. Due to the nature of the dipping stratigraphy, shallow coal seams, and low water table at Stockton, there is limited capacity for permanent waste rock storage in a saturated state in backfilled pits or sumps (which is a key component of AMD management at existing Cypress North Pit) (Bathurst, 2026c). Additional groundwater level data collected as part of the proposed groundwater monitoring (Section 9.1.2) could assist decision making for waste rock storage.

Seepage water quality

Water quality of AMD waste rock seepages is summarised in Table 5.3. The monitoring was undertaken over multiple sampling rounds from June 2020 to May 2024. Eighteen sites were sampled in two or more different monitoring rounds, allowing temporal comparison of water quality, while 21 sites were sampled once, reflecting opportunistic sampling of ephemeral seeps. Laboratory testing shows a wide range of water quality conditions, spanning from moderately acidic to strongly acidic, metal-rich drainage. pH values range from 2.3 to 5.9, indicating substantial variability in acidity between seepage locations and reflecting differing degrees of sulfide oxidation, buffering capacity, and dilution. This pH range corresponds to several orders of magnitude variation in hydrogen ion activity, demonstrating that some seepages represent highly aggressive acidic flows while others are partially neutralised or mixed with less impacted groundwater.

Table 5.3 Water quality summary from waste rock seepages

Analyte	Minimum	Maximum
pH (lab)	2.3	5.9
Acidity pH 4 (mg/L)	10	1,100
Acidity pH 5 (mg/L)	8	2,400
Acidity pH 7 (mg/L)	20	2,800
Dissolved aluminium (mg/L)	0.25	280
Dissolved iron (mg/L)	0.072	388
Sulfate (mg/L)	39	1,200

Acidity and dissolved metal concentrations are correspondingly elevated and highly variable. Acidity to pH 7 ranges from 20 – 2,800 mg/L (as $CaCO_3$). Dissolved aluminium and iron concentrations reach up to 280 mg/L and 388 mg/L, respectively, consistent with acidic conditions that promote metal mobilisation. Sulfate concentrations (39 – 1,200 mg/L) indicate variable sulfide oxidation intensity and dilution across the Stockton. Overall, the data indicate water quality ranging from strongly acid-forming drainage to more moderately impacted discharges.

As mentioned in Section 5.3.1, the acidity in the waste rock will generally decay rapidly in the first 10 years, followed by a constant long-term slower decay equivalent thereafter.

5.3.4 Coal fines storage

The Stockton Coal Handling and Processing Plant (CHPP) generate coal fines rejects that are currently stored at the A18 (Mangatini catchment) and McCabes (St Patrick catchment) CFSFs (Figure 5.2). The CFSFs are engineered to reduce seepage into groundwater. For example, A18 includes a low permeability compacted earth liner along the eastern side, and McCabes CFSF includes an impermeable geomembrane on the upstream shoulder and spillway to discharge water into the McCabes Sump for treatment. Three additional CFSFs, A-Drive Quarry #1, #2, and #3 (Figure 5.2) are being proposed under the BPCP in the St Patrick catchment.

A18 Coal Fines Storage Facility

A review of water chemistry from A18 CFSF showed that rainfall run-off samples were consistently acidic (pH 4.3 – 4.4) but relatively dilute with low levels of sulfates and dissolved metals, suggesting that the acidity is mainly from rainfall or organic acids (which have low metal concentrations) rather than significant amounts of AMD.

In contrast, pore water seepage samples from A18 seep showed higher pH (5.7) but markedly elevated sulfate and metal concentrations, indicating a strong AMD signature linked to groundwater pathways with greater water–rock interaction. This contrast highlights that while surface waters are acidic yet dilute, the seep is a concentrated, AMD-impacted source with substantially higher sulfate, metals, and acidity.

5.3.5 Water treatment sumps

The water level elevation in Mangatini Sump is higher than the groundwater elevation in down-gradient monitoring bores (Figure 4.17) suggesting the potential for seepage of AMD impacted water into groundwater. These monitoring bores are recommended to be included in the future groundwater monitoring plan.

Figure 5.2 ***Stockton Coal Fines Storage Facility locations, current (A18 and McCabes) and proposed (A-Drive, A-Drive#2 and A-Drive#3)***

5.3.6 Nutrients

5.3.6.1 Non-mining sources

Agriculture is the dominant land use across the unconsolidated coastal plains sediments, primarily comprising dairy farming. Contaminants typically associated with this dairy effluent discharge include nutrients and pathogens from organic waste. Near Hector Township, additional inputs occur from small local towns where limited human effluent discharges are present.

5.3.6.2 Mining-related sources

Nitrogen in nitrate and ammoniacal form is the primary nutrient entering groundwater and the receiving waters from Stockton mining activities. Elevated concentrations are attributed to three primary sources (Bathurst, 2026d) listed in order of largest to smallest:

- Nitrogen-based explosives (Ammonium Nitrate Fuel Oil (ANFO)) used in mining operations - 2.4 – 3.5 tonnes/yr currently.
- Fertiliser applied during remediation and revegetation works (Bathurst, 2026d). Groundwater would be expected to contain these contaminants where leaching occurs - < 400 kg/yr of total nitrogen currently.
- Treated sewage effluent - < 70 kg/yr of total nitrogen currently.

Nutrient leaching of undetonated ANFO to groundwater may occur in wet conditions between loading and detonation if the explosive is not contained within a water-resistant casing, or within an emulsion or slurry (Bathurst, 2026d).

For fertiliser, approximately 30% of applied nitrogen is assimilated by vegetation. Of the remaining ~70%, an estimated 42% – 63% is expected to be mobilised via rainfall runoff to surface waters and 7% – 28% leaches to groundwater (Bathurst, 2026d).

5.3.6.3 Current potential impacts

To date, nitrogen species in groundwater have not been sampled. However, surface water monitoring results (2021 – 2025) show that the National Policy Statement for Freshwater Management (NPS-FM) “bottom line” standards for Nitrate-N and Ammonium-N for the annual median and annual 95th percentile concentrations are being achieved in all of the major catchments (Millerton Block, Mangatini and St Patrick) (Bathurst, 2026d). The median concentrations of Nitrate-N and Ammonium-N in St Patrick / Mangatini Streams and Mine Creek are 0.1 mg/L and 0.08 mg/L, respectively. Since the surface water results include upstream discharges of groundwater, this would suggest that any impacts from groundwater to waterways are minimal. In addition, nutrient leaching to groundwater from fertiliser application is smaller than the estimated load being delivered waterways in the through run-off.

5.4 Acid neutralising capacity

The acid neutralisation capacity of the subsurface material is important for understanding the extent of water quality impacts to groundwater at Stockton. Table 5.4 compares the total alkalinity in the BCM and Basement granite – an important measure of acid neutralisation. As expected, the PAF BCM total alkalinity is generally much less than the granite, and in some cases, the same as rainfall. In contrast, the non-PAF granite, which underlies much of Stockton to significant depths, has slightly higher total alkalinity, suggesting that it may contribute a small amount of acid neutralisation.

Table 5.4 Alkalinity from groundwater and surface water sources

Geology	Water source	Sites	Total alkalinity $CaCO_3$ (mg/L)	
			Median	Range
Basement: Granite	Groundwater	Cypress dewatering bores	71	36 - 110
	Groundwater & surface water	Hugh Stream H1	42	39 - 44
BCM	Groundwater	Stockton monitoring bore STK7163	7	-

Geology	Water source	Sites	Total alkalinity $CaCO_3$ (mg/L)	
			Median	Range
		MFS monitoring bores	8	4 - 79

Groundwater pH (Table 5.1) in the granite (7.1 – 7.4) and in some undisturbed BCM groundwater (4.6 – 8) is also higher than rainfall. The granite shows more elevated pH and total alkalinity compared to rainfall than the BCM which appears to be very similar in some cases. This suggests greater natural buffering from carbonates or some silicates that provide acid neutralisation in the granite in comparison to the BCM.

Though it provides more buffering than the BCM, typical granite minerology does not result in significant acid neutralisation. Davies et al, (2011) states that '*Granitoids commonly exposed in natural outcrops and excavations beneath the BCM at Stockton contribute negligible neutralisation capacity to AMD*'.

Confirmation of in-situ buffering from the granite would require mineralogical characterisation and AMD testing. Effective buffering typically relies on the presence of carbonate minerals, which rapidly consume acidity and must occur at relatively high abundances. These minerals are generally absent or present only in trace quantities in granite, meaning carbonate buffering cannot be assumed. Although silicate minerals can contribute to acid neutralisation, this process is slow and generally requires prolonged contact times (years to decades) under low-recharge conditions, rather than sustained inputs of acidic recharge from surface sources.

5.5 Basement

Groundwater chemistry and minerology data for the Basement material is limited. Within the granite, Hugh Stream (Figure 3.9) which flows to the coast from the south of the Millerton Block is fed by granite groundwater seepages and is circumneutral (median pH of 7.2), with low dissolved aluminium (median concentration of 0.04 mg/L) and moderate alkalinity (median of 44 mg/L as CaCO3) at the state-highway.

Groundwater samples from the from the Cypress North Pit, highwall granite dewatering bores (Table 5.5) indicate the granite is not susceptible to AMD, showing a circum-neutral pH (7.1 – 7.4), very low dissolved aluminium concentrations (<0.0006 – 0.04 mg/L) and alkalinity (as $CaCO_3$) ranging from approximately 36 - 110 mg/L. The granite groundwater chemistry is also very similar to that of Hugh Stream.

The substantial thickness (> 300 m) and volume of the Basement, together with the likely presence of calcium-and magnesium-bearing minerals contributing to background hardness (which is elevated compared to the BCM), are likely to provide some degree of geochemical buffering. As a result, AMD percolating through the granite would be attenuated through neutralisation and dilution processes, further reducing the potential for acidic conditions to be transmitted beyond the granite. Where carbonate minerals may be absent, the acid-buffering capacity of common granite minerals (including feldspar and micas) is limited and generally insufficient to counter sulfide oxidation, except under very low acid loads over long timeframes and attenuation would be largely dominated by dilution.

5.6 Brunner Coal Measures

Groundwater quality data from the BCM is available from monitoring bore sites at Stockton (Mangatini catchment), Cypress and Mount Frederick South, historical underground workings, and groundwater seepages from the waste rock.

5.6.1 Undisturbed material

Groundwater quality data has been collected from undisturbed BCM material within the following areas:

- Monitoring bore STK7163 within active mining areas of the Mangatini catchment (Webb Block) at Stockton.
- Monitoring bore BH1523 within active mining areas of the St Patrick catchment at Cypress.
- Four monitoring bores at Mount Frederick South, located ~1 km south of Stockton.

The monitoring bore locations are shown in Figure 3.10. The water quality data is shown in Table 5.5.

Table 5.5 ***Brunner Coal Measures groundwater quality at measured at Stockton, Cypress and Mount Frederick South***

Analyte	Stockton		Cypress		Mount Frederick South	
	Monitoring from October 2025 to February 2026 (2 rounds) from monitoring bore STK7163		Monitoring from May 2019 to June 2024 from monitoring bore BH1523		Monitoring from 2023 to 2026 (average of 4 rounds) across 4 monitoring bores (DC25, DC27, DC28 and DC41)	
	Min	**Max**	**Min**	**Max**	**Min**	**Max**
pH	5.7	6.9	5.6	7.1	4.6	8
EC (µS/cm at 25°C)	130	130	130	425	3	24
Dissolved aluminium (mg/L)	0.061	0.17	0.0059	1.5	0.016	0.18
Dissolved iron (mg/L)	<0.071	<0.071	0.088	0.77	0.024	0.99
Dissolved lead (mg/L)	<0.0050	<0.0050	0.0076	0.0076	<0.0005	<0.0005
Dissolved nickel (mg/L)	0.006	0.006	0.0017	0.032	0.0005	0.03
Dissolved cadmium (mg/L)	0.0001	0.001	0.0001	0.0002	<0.0002	<0.0002
Dissolved zinc (mg/L)	0.01	0.02	0.0084	0.06	0.005	0.12
Total Alkalinity ($CaCO_3$) (mg/L)	7	7	-	-	3	79
Sulfate (mg/L)	34	34	-	-	0.8	27

Groundwater from the BCM generally exhibits moderately low to moderately high pH and low total alkalinity. Across the three areas sampled, pH ranges from moderately acidic (5.7) to slightly alkaline (8), indicating spatial variability in groundwater geochemistry. The lower pH values coincide with conditions under which some metals may become more soluble and mobile. Where reported, total alkalinity (as $CaCO_3$) is very low, which is consistent with limited carbonate buffering; however, the implications for acidity generation and metal mobility are dependent on local hydrogeochemical conditions and the presence of acid-generating processes.

Regarding the main indicators of AMD, sulfate is present but not elevated in the locations where it was analysed. This pattern of low pH with only modest sulfate suggests that the sections of BCM screened by the monitoring bores may be experiencing mild acidification and metal mobilisation rather than strong, sulfate-rich AMD conditions. Alternative causes may include mixing/dilution and/or lower sulfate concentrations in groundwater due to sulfate reduction.

The clearest AMD signal is the mobilisation of aluminium and iron under acidic conditions. Dissolved aluminium reaches 0.17 mg/L at STK7163, 1.5 mg/L at BH1523 and 0.18 mg/L at Mount Frederick South. The BH1523 maximum (1.5 mg/L) exceeds the NZ drinking-water Maximum Acceptable Value (MAV) for aluminium (1 mg/L), which, while a potable standard, highlights that aluminium is being strongly mobilised naturally in groundwater at this site and should be treated as an AMD risk indicator. Dissolved iron at BH1523 reaches 0.77 mg/L, exceeding the 0.3 mg/L aesthetic drinking water value (Taumata Arowai, 20222) (benchmark rather than an AMD standard), consistent with either acidic mobilisation and/or redox-controlled iron solubility.

Overall, the BCM groundwater chemistry indicates a system naturally prone to acidification (as evident from Mount Frederick South) with demonstrable metal mobilisation (aluminium and iron), but with no strong sulfate signal in the data available, suggesting incipient or moderated AMD influence rather than fully developed AMD, pending supporting redox/major-ion evidence.

5.6.2 Historical underground workings

Water quality data has also been collected from BCM material disturbed from historical underground mining activities at Millerton. Underground water flowing through the BCM and out of the DCA shaft and currently into Mine Creek has been sampled from 2005 to 2010, and from 2023 to 2024. At times, the underground workings receive fire suppression discharges using AMD-influenced water taken from Millerton Pit. The results presented in Table 5.6 show highly acidic water and elevated dissolved aluminium and iron. This major difference compared to the undisturbed material is the significantly higher levels of oxygen which is needed to produce AMD.

Table 5.6 Monthly DCA water quality data

Parameter	Median value from 2005 to 2011	Mean value from August 2023 to June 2024	Median value from August 2023 to June 2024
Acidity 40 (mg/L)	-	680	649
Acidity 70 (mg/L)	-	1,705	1,567
EC (µS/cm at 25°C)	1,259	3,993	3,785
pH	2.8	2.5	2.5
TSS (mg/L)	1.7	1.5	1.5
Turbidity (NTU)	0.6	0.4	0.4
Dissolved aluminium (mg/L)	32	180	180
Dissolved iron (mg/L)	-	163	150
Sulfate (mg/L)	470	3,073	3,038

5.6.3 Groundwater seepage

Twins Stream Site T1 (described in Section 4.5.4.2) is a groundwater seepage from the BCM into the head of the Twins Stream south branch in an area of active mining and historical underground workings. The seepage originates from underground workings that converge along the Millerton Fault, with the point of emergence and mixing occurring at, or immediately upstream of water monitoring site T1. As a result, water quality at T1 during low-flow periods is dominated by groundwater, with a strong influence from AMD associated with the historical underground workings.

The water quality characteristics at T1 during low flow periods are dominantly groundwater sourced with dissolved aluminium concentrations exceeding 10 mg/L and a median pH of 3.7 (2024-2025).

5.7 Coastal sediments

5.7.1 Influences on groundwater quality

The potential influences on groundwater quality in the coastal sediments include:

– Waterway seepage losses to groundwater from AMD and non-AMD impacted waterways.
– Rainfall and seawater.
– Agricultural land uses and wastewater discharges from septic tanks associated with the small towns along the coast and associated nutrient and pathogens.
– Upward leakage from the granite Basement.

Waterway seepage losses to ground / groundwater

Millerton Block waterways that flow towards the coast appear to lose flow to ground (gravel, sand and silt material) and into the underlying and likely more permeable coastal sediments. A summary of the coastal waterways downstream of Stockton and potential interaction with groundwater summarised as follows:

– **Currently AMD-impacted:**
  - Granity Stream is highly impacted from AMD (red - Figure 5.3). No investigations have been undertaken to determine flow losses to groundwater. However, the stream has a relatively short reach across the coastal plain of approximately 200 m from the base of the escarpment to the coast.
  - Rudolph Stream is highly / moderately impacted by AMD in its upper and middle reaches (red - Figure 5.3). The stream typically losses all its flow from these reaches into the coastal sediments at the base of the escarpment, most of which would enter groundwater, and some of which may enter the coastal wetlands.
  - Lower Twins Stream is moderately impacted by AMD (orange - Figure 5.3). The stream appears to lose some of its flow into ground, some of which might enter the coastal wetlands.

– **Currently not AMD-impacted:**

- Rudolph Stream re-surfaces near the State-Highway (Instream, 2026). As such the water sample at the State-Highway site R1 is likely to represent significant shallow groundwater input. The water at R1 is circumneutral with low dissolved aluminium (green - Figure 5.3), suggesting no evidence of AMD impacts on shallow groundwater / surface water at this location, or any impacts from losses into groundwater from AMD impacted water sourced in its upper and middle reaches.
- Hugh Stream and several unnamed smaller waterways located north and south, flow across and source some groundwater from the non-acid forming granite Basement and are not impacted by AMD (blue - Figure 5.3). Most of these streams appear to lose flow to groundwater, which is likely to discharge to the coastal wetlands and ocean.

Rainfall and seawater

Coastal rainfall is expected to have a higher salt content than up on the Stockton Plateau, and in combination with marine aerosols, this would be expected to increase the salinity of the shallow groundwater slightly. Groundwater salinity may be slightly elevated at depth, closer to the seawater interface adjacent to the coast

Agricultural land uses and wastewater discharges from septic tanks

Given the coastal areas agricultural land uses and small towns, nutrient and pathogen contamination from effluent / septic tank discharges and grazing stock are likely.

Upward leakage from the granite Basement

Any upward seepage from the low permeability underlying Basement and KMS would be relatively minor compared to the groundwater throughflow within the more permeable coastal sediments, of which a significant amount of the water would be derived from rainfall recharge and waterway losses to groundwater. Available data from Stockton, Cypress and MFS show the granite Basement is circumneutral with low dissolved trace elements. On this basis, it is considered highly unlikely that groundwater within the coastal sediments is influenced by groundwater in the granite.

5.7.2 Observed groundwater quality

Groundwater quality data from the coastal sediments was obtained by Bathurst in April 2026 from the ex-Solid Energy monitoring bore located in the north-eastern corner of the Granity Wetland Conservation Area (DoC, Unknown) close to Kerr Stream, where it losses flow to groundwater (Figure 4.18).

The results (Appendix B) show weakly acidic water (pH 6.1 median) typical of rainfall and low metals concentrations. Concentrations of dissolved nickel, zinc and sulfate are all low, showing no indication of AMD. The Nitrate-N concentration of 1.6 mg/L suggests minor nutrient contamination from surrounding rural land uses. The maximum dissolved aluminium concentration of 0.13 mg/L, slightly exceeds the New Zealand Drinking water guideline value (GV) (Taumata Araowai, 2022a) of 0.1 mg/L for scale deposits, but are well below the maximum acceptable value (MAV) of 1 mg/L. All other parameters measured, apart from the GV for turbidity (which may have been function of the bore development and condition) and the pH (considered to be naturally low), were below the drinking water GV and MAV, suggesting no impacts to potable groundwater supplies in this part of the coastal plains.

There is no water quality data to assess the potential impacts on groundwater further north near AMD influenced Granity and Twins Stream. An assessment of groundwater in this area is proposed as part of the future monitoring (Table 9.1).

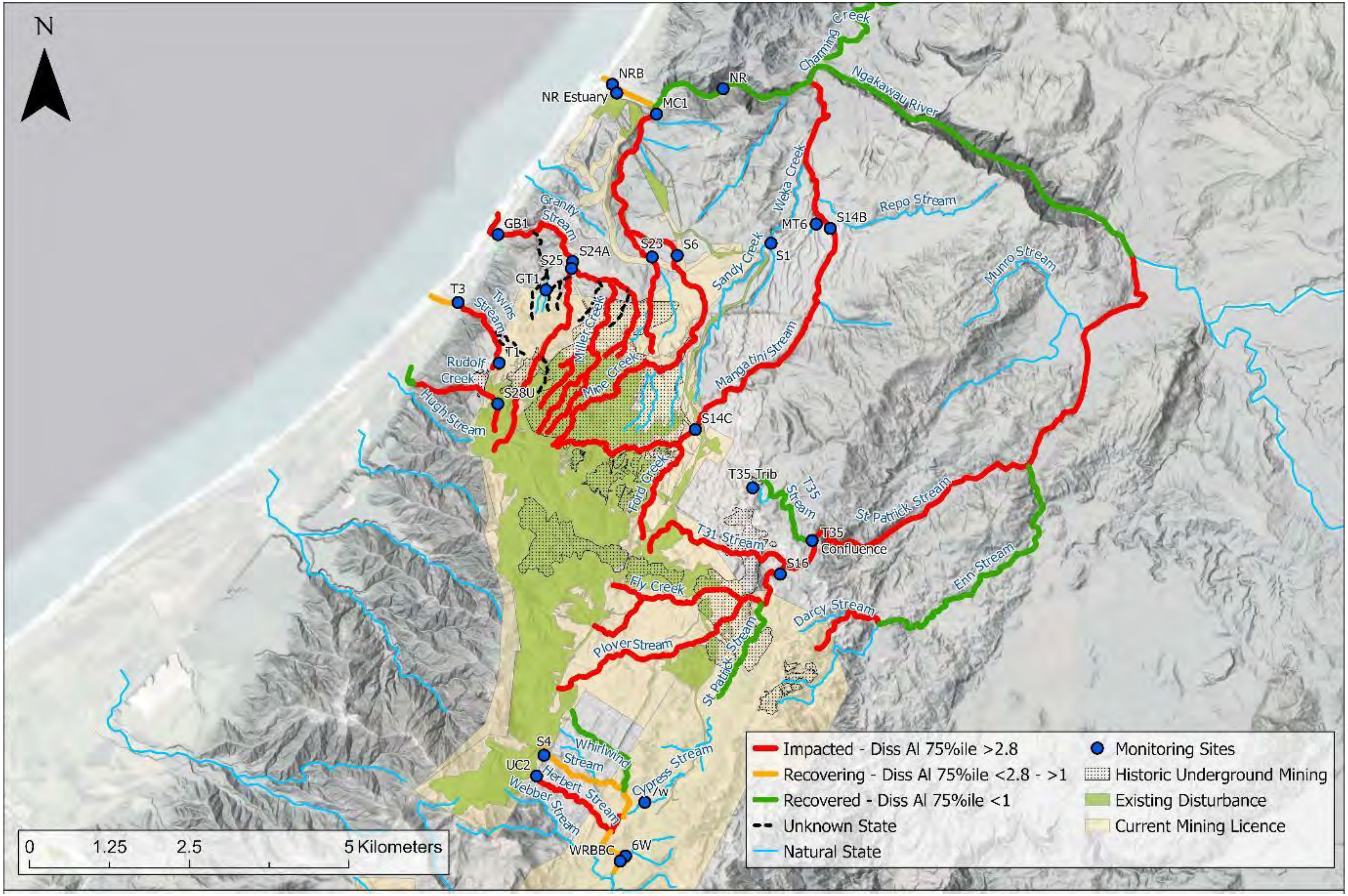

Figure 5.3 ***Current aquatic ecosystem state of Stockton waterways based on key AMD indicator water quality parameters (source: Instream, 2026)***

5.8 Waterways and coastal wetlands

Groundwater could affect waterway quality where it discharges into waterways, and waterways can affect groundwater quality where they lose flow to ground. On the Stockton Plateau, some waterways receive groundwater from underground workings and groundwater seepages whilst some lose to groundwater in places. Along the coast, waterways generally lose flow to ground (coastal sediments), some of which probably discharges into coastal wetlands.

Table 5.7 shows that for each geological material and AMD impact; groundwater is generally similar to surface water for key AMD indicators pH and dissolved aluminium. One slight difference is the pH, which is slightly lower in the surface waters. This may in part be due to a greater influence from rainfall which generally has a pH of 5.7 – 6, run-off from soils producing organic acids from decomposing plant matter and / or a pH drop as the dissolved ferrous iron in groundwater oxidises to form ferric iron when it discharges to surface, releasing H+ ions.

Table 5.7 Comparison of AMD indicators in groundwater and surface water (summarised from Table 5.1)

Geological material	Source	Median pH	Median dissolved aluminium (mg/L)
BCM AMD impacted	Groundwater – DCA	2.4 – 2.6	110 – 270
	Waterways	2.5 – 4.9	1 – 200
BCM undisturbed material	Groundwater	4.6 – 8	0.006 – 1.5
	Waterways	4.3 – 4.4	0.3 – 0.4
Basement: Granite Undisturbed material	Groundwater	7.1 – 7.4	<0.006 – 0.04
	Waterways	5.7 – 5.2	0.005 – 0.07
Coastal sediments	Groundwater	6.1	0.08
	Coastal wetlands	6.3	0.03

Figure 5.3 is interpreted to show the current combined AMD impacts from groundwater and surface water (rainfall run-off and shallow substrate) on Stockton waterway quality and aquatic ecosystems. A discussion of these impacts and surface water influences on waterway quality is provided in the *Stockton Plateau Aquatic Ecology: history, thresholds and long-term management* by Instream (2026).

5.8.1 Brunner Coal Measures groundwater

Historical underground workings

Historical underground working discharges from the BCM impact waterway quality, especially within the Millerton Block (like the DCA discharge into Mine Creek) and Fly Creek underground working discharges into upper St Patrick Stream.

Groundwater seepages – Twins Stream

AMD impacted groundwater seepages from the BCM originating from Stockton effect the quality of water in the upper reaches of Twins Stream at site T1 (Figure 2.5) monitored by Bathurst. Downstream of T1, further groundwater seepages occur, some of which originate from within the Rockies Mine (RML, 2016). Sampling from RML (2016) shows a progressive decline in water quality, characterised by generally decreasing pH and increasing metal and sulfate loadings from T1 to TC1 (prior to any Rockies Mine discharges) and from TC1 to T2 (Figure 2.5). These trends are evident under both low and high-flow conditions, indicating that the groundwater entering Twins Stream is of poor quality, consistent with AMD impacted groundwater. Rockies Mine discharges at TD1 and TD2 (Figure 2.5) are assessed by RML as also impacting metal loads, particularly during higher flow conditions.

5.8.2 Basement granite groundwater

Downstream from Twins Stream T1 to T3 at the state-highway, the water quality improves, going from an AMD Impacted State (red -Figure 5.3) at the upstream monitoring site to a Recovering State, likely as a result of dilution from inputs of alkalinity from granite groundwater seepages and runoff. These processes act to partially neutralise acidity and reduce contaminant concentrations relative to upstream AMD-impacted baseflow conditions. Further south, Hugh Stream (Figure 3.9) is not AMD-impacted flowing from the BCM with naturally low pH, but by the time it gets to the coastal plains, the water is circumneutral (median pH of 7.2), with low dissolved aluminium (median concentration of 0.04 mg/L) due to the influence from granite groundwater seepages.

5.8.3 Coastal wetlands

The wetlands occupying low-lying depressions within coastal dune deposits receive inputs from rainfall, groundwater, and surface water, including runoff and locations where waterways partially or fully lose flow to groundwater.

A water quality sample from the coastal wetland (W1) that extends from Twins Stream south to almost Worley Stream was obtained by Bathurst in April 2026. The wetland was sampled roughly halfway between Rudolph Stream and Hugh Stream (Figure 4.18) where they lose flow to groundwater. The results (Appendix B) show weakly acidic water (pH 5.7) typical of rainfall, with low metals concentrations and chemical composition that is very similar to the coastal groundwater sampled from the ex-Solid Energy bore (Section 5.7.2). The results show no indication of AMD or exceedances of the New Zealand Drinking water MAV, or GV (based on the analytes sampled for) at this location, apart from pH which is considered to be naturally low. The results also indicate no AMD impacts from Rudolph Stream.

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6. Groundwater users

6.1 Groundwater consents

The current (non-expired) consents to take (Table 6.1), divert (Table 6.2) and discharge to (Table 6.3) groundwater within the study area are summarised below. These groundwater consents, registered and non-registered bore locations, are shown in Figure 6.1. Some consents have multiple locations. The consents and registered bore information was sourced from the WCRC Online Maps (West Coast Regional Council, 2026).

[redacted]

[redacted] [redacted]

Table 6.1 Summary of existing groundwater take consents within the study area (source: West Coast Regional Council, 2026)

Primary purpose / Held by	Consent number	Duration	Catchment	WCRC consents database description
Stockton Mining / BT Mining	RC07007-2	2007 - 2028	Mangatini	To take ground water associated with the construction of "Duncan's Sump", Stockton Coal Mine.
	RC07229-4	2008 - 2028	Mangatini	To take ground water associated with the construction and operation of the "Mangatini Sump", Stockton Coal Mine.
	RC10256-3	2010 - 2027	St Patrick	To take groundwater (seepage) from the mine pit, McCabes Block, Stockton.
Mining outside Stockton /	RC03175-7	2004 - 2039	St Patrick	To take groundwater seepage and stormwater runoff from within the Cypress opencast working for dewatering purposes, at a rate of up to 600 litres per second.

Primary purpose / Held by	Consent number	Duration	Catchment	WCRC consents database description
BT Mining	RC11181-4	2014 - 2049	St Patrick	To take and divert groundwater seepage and stormwater runoff from within the opencast pit at the Mt William North mining area for dewatering purposes.
	RC11012-4	2011 - 2046	St Patrick	To take, divert and use groundwater (including seepage) within the scheme area defined in Figure A associated with the construction, use, operation, repair, and maintenance of the St Pats 2 Water Treatment Scheme.
	RC11237-4	2012 - 2047	St Patrick	To take, divert and use groundwater (including seepage) within the scheme area associated with the construction, use, operation, repair, and maintenance of the Lower St Pat's Reservoir Water Treatment Scheme.
	RC12073-2	2012 - 2047	St Patrick	To take and use groundwater from seepage, Lower St Pat's Quarry.

[redacted]

Table 6.2 Summary of existing diversion consents that include groundwater within the study area (source: West Coast Regional Council, 2026)

Primary purpose / Held by	Consent number	Duration	Catchment	WCRC consents database description
Cypress Stockton / BT Mining	RC03175-7	2004 - 2039	St Patrick	To divert minewater (operational stormwater runoff and **groundwater seepage**) from within opencast workings, haul road, Cypress overburden placement area, soil stockpiles, and other ancillary mining activities, to St Pat's Dam water impoundment via drainage.
Mining outside Stockton / BT Mining	RC09028/5	2009 – 2044	Mangatini	To divert minewater, stormwater, surface water and **groundwater** to the syncline within the underground workings, the "North-East Sump" and the "Millerton Water Treatment Plant".
	RC11181/5	2014 – 2049	St Patrick	To dam and divert the headwaters of streams and minewater (stormwater runoff and **groundwater seepage**) from within opencast workings, haul road, overburden

Primary purpose / Held by	Consent number	Duration	Catchment	WCRC consents database description
				placement area, soil stockpiles, and other ancillary mining activities, to Lower St Pats Reservoir
	RC12073/3	2012 - 2047	St Patrick	To divert surface and **groundwater**, including runoff, Lower St Pat's Quarry.

Table 6.3 Summary of existing discharge consents that include groundwater within the study area (source: West Coast Regional Council, 2026)

Primary purpose / Held by	Consent number	Duration	Catchment	WCRC consents database description
Cypress Stockton / BT Mining	RC03175/14	2004 - 2039	St Patrick	To discharge minewater (stormwater runoff and **groundwater seepage**) from within opencast workings, haul road, Cypress overburden placement area, soil stockpiles, and other ancillary mining activities, to St Pat's Dam water impoundment.
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]

BT Mining consents

BT Mining currently hold three groundwater take consents at Stockton which are due to expire in 2027/28. They are related to the construction of Duncans Sump (RC07007-2), construction of Mangatini Sump (RC07229-4) (sump locations shown in Figure 6.1) and abstraction of groundwater seepage from McCabes Block (RC10256-3). The consents for sump construction have been exercised. The McCabes Block groundwater consent was for mining the McCabes Block and granted in 2010. BT Mining has advised that McCabes mining has been completed and the area rehabilitated, with ongoing use for CFSF and the McCabes Treatment System. As such, this consent related to groundwater abstraction from the McCabes pit is not considered further in this assessment.

BT Mining also hold groundwater consents for the following activities outside the Stockton CML:

- RC03175-7: current consent for opencast pit dewatering at the adjacent Cypress mine.
- RC11181-4: separate permitted mine area just to north northeast of Cypress called Mount William North to take and divert groundwater seepage and stormwater runoff from within the opencast pit at the Mt William North mining area for dewatering purposes.
- RC11012-4, RC11237-4, RC12073-2: related to consents for a lower St Patrick reservoir/sump on the Cypress Mine Permit area, which was to be part of the Solid Energy Stockton hydroelectric scheme water collection and would also supply granite to Stockton from digging out the sump for roading and waste rock capping. BT Mining have advised that this project has not proceeded.
- RC03175-7, RC09028/5, RC11181/5 and RC12073/3 to divert groundwater and groundwater seepages.
- RC03175/14 to discharge minewater that incudes groundwater seepage.

Other consent holders

All other current groundwater consents within the Stockton Plateau held by third parties are located outside the BPCP and Stockton sub-area. These include:

- [redacted]

[redacted]

- [redacted]
  - [redacted]

Since all other consent holder consents are currently not being exercised, there is currently no impact. The potential impacts, from the BPCP, should these consents be exercised in the future, are discussed in Section 8.11.1.

6.2 Registered bores

All 14 bores registered with the West Coast Regional Council (Table 6.4) occur outside the Stockton CML and within the Quaternary coastal sediments (Figure 6.1). There are no registered bores used for domestic or community potable supplies.

Table 6.4 Groundwater bore records within the study area from (source: West Coast Regional Council, 2026)

Bore ID	Use	Bore diameter (mm)	Status on council database
0387 – 0399 (13 bores)	Monitoring	100	Current
0347	Dairy	125	Current

[redacted]

[redacted]
The consent application proposed 20 m deep boreholes, so presumably any monitoring bores were installed to this depth or shallower. It is thought that the bores were constructed, however, a site investigation by Bathurst in April 2026 did not identify or locate them. As such, bores appear to be no longer present.

Dairy supply bore

The one registered bore (unknown depth) used for dairying is located along the coast and is more than 3 km south of the AMD impacted Twins Stream discharge into coastal groundwater and 2.5 km south of the probable AMD impacted Rudolph Stream discharge into coastal groundwater. At this distance away from the Twins and Rudolph Stream, and based on the lack of any AMD impacts in groundwater as measured from the ex-Solid Energy monitoring bore located 1.1 km south of Rudolph Stream, and in the groundwater / surface water sample taken from Rudolph Stream (R1) near the coast, any potential impacts from Stockton on the groundwater quality or quantity is considered extremely unlikely.

6.3 Non-Registered bores

One monitoring bore not registered with the WCRC was identified by Bathurst (in April 2026) located in the north-eastern corner of the Granity Wetland Conservation Area (DoC, Unknown) close to Kerr Stream. The monitoring bore was installed by Solid Energy Limited in the early 2000s for the purpose of monitoring water levels in relation to an infill planting program that Solid Energy agreed with DoC as an offset for Stockton Ridgeline mining in the 2000s (Bathurst). The Birchfield and Kerr Swamp / wetlands were weed-controlled and intensively planted and maintained by Solid Energy for 8 years. The monitoring bore is 150 mm diameter, had a groundwater level of 0.7-m depth below ground measured in April 2026 and is likely shallow (< 10 m deep). The bore is now owned by Bathurst, who purchased Solid Energy in 2017. A water sample was taken in April 2026 (Section 5.7.2).

7. Hydrogeological conceptual model

Hydrogeological conceptual models were developed along two cross-sections (Figure 7.1). Section A–A′ extends south–north from the Mangatini catchment through the Millerton Block and Mine Creek and towards the Ngākawau River (Figure 7.2). Section B–B′ extends northwest–southeast from the coastal margin, through the Millerton Block, to the Mangatini catchment (Figure 7.3).

The cross sections represent pre-opencast mining conditions at the Millerton Block from 2006–2008 and contemporary operational conditions from 2010 to 2026, noting opencast mining had already occurred in other areas of dating back as far 1944. The models illustrate how the ground surface, subsurface geology and extent of historical underground workings have changed over time in response to mining activities, as well as changes over time in groundwater levels, flow paths and water quality.

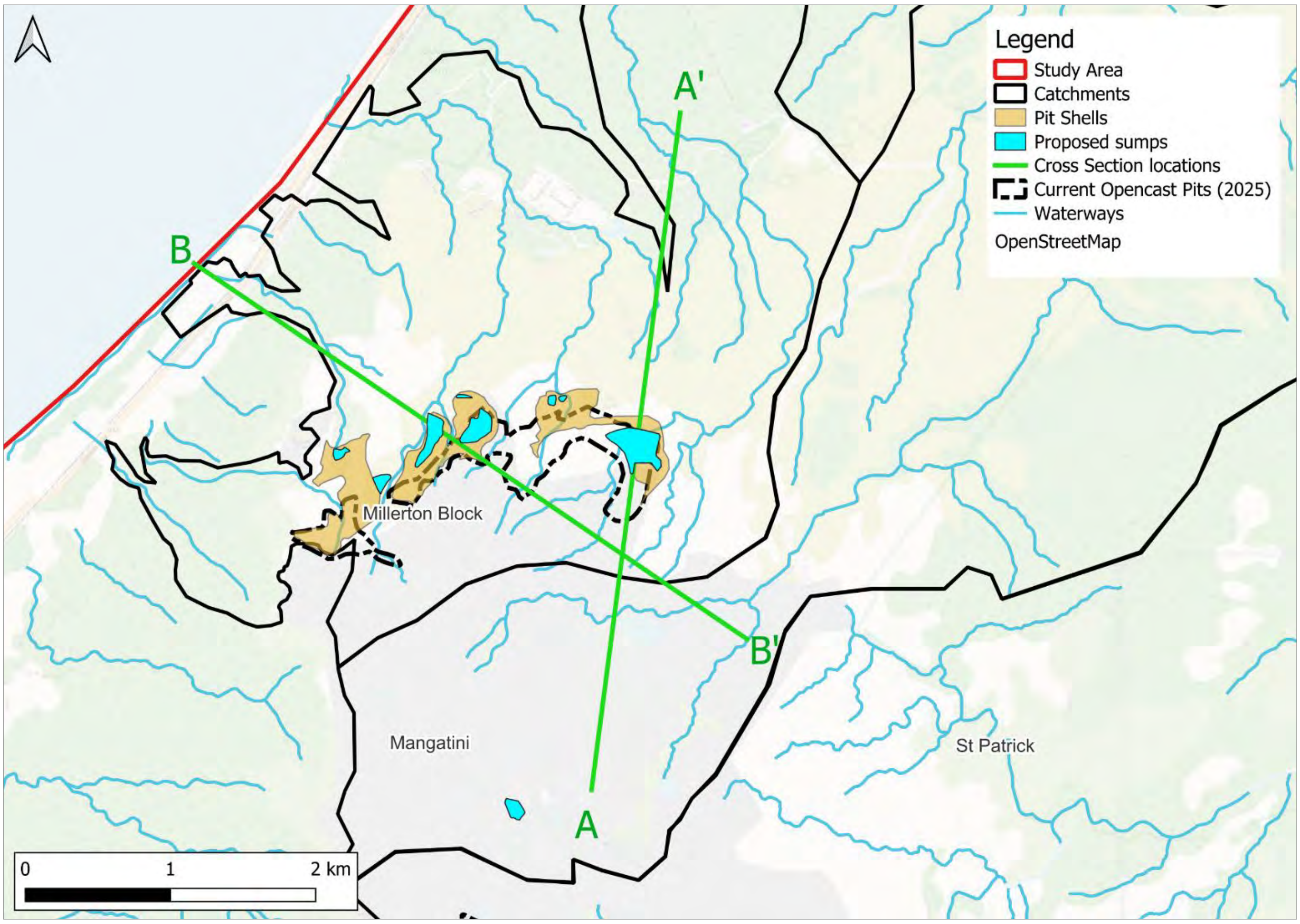

Figure 7.1 Hydrogeological cross section locations

7.1 Pre-mining

Pre-mining (before 1896), shallow (unconfined) groundwater on the Stockton Plateau would have generally flowed in the direction of the natural topographic surface, with some discharges to waterways and wetlands in natural topographic low points. Structural features such as faults, folding, fracturing and weathering would also have played a significant role in groundwater flow direction, especially in the deeper consolidated rock material. Some wetlands were, and still are, supported by a thin layer of soil on top of the rock which is perched well above the regional water table.

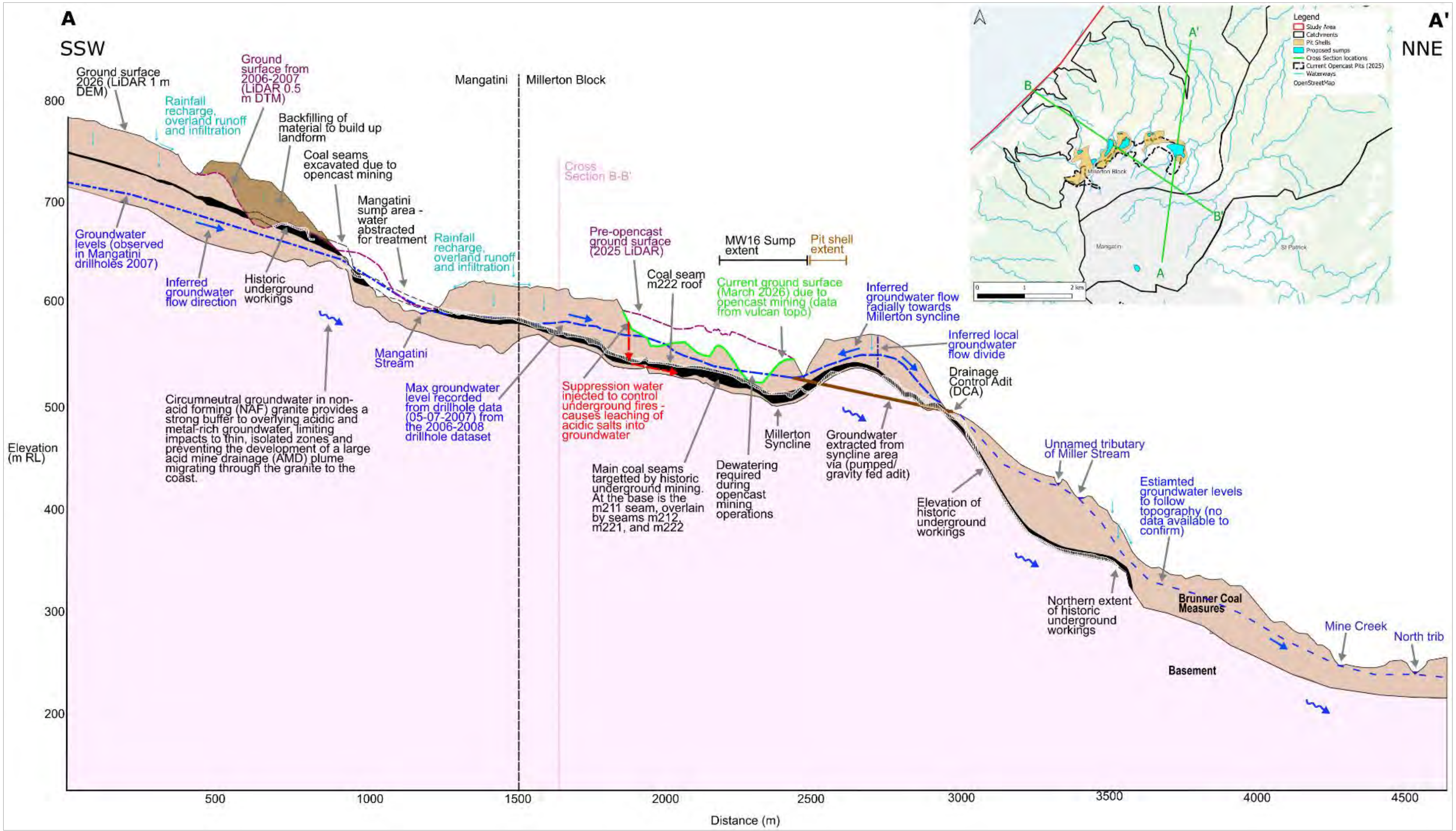

Figure 7.2 *Active mining (2006 – 2026) hydrogeological conceptual model cross section A - A' towards the Ngakawau River*

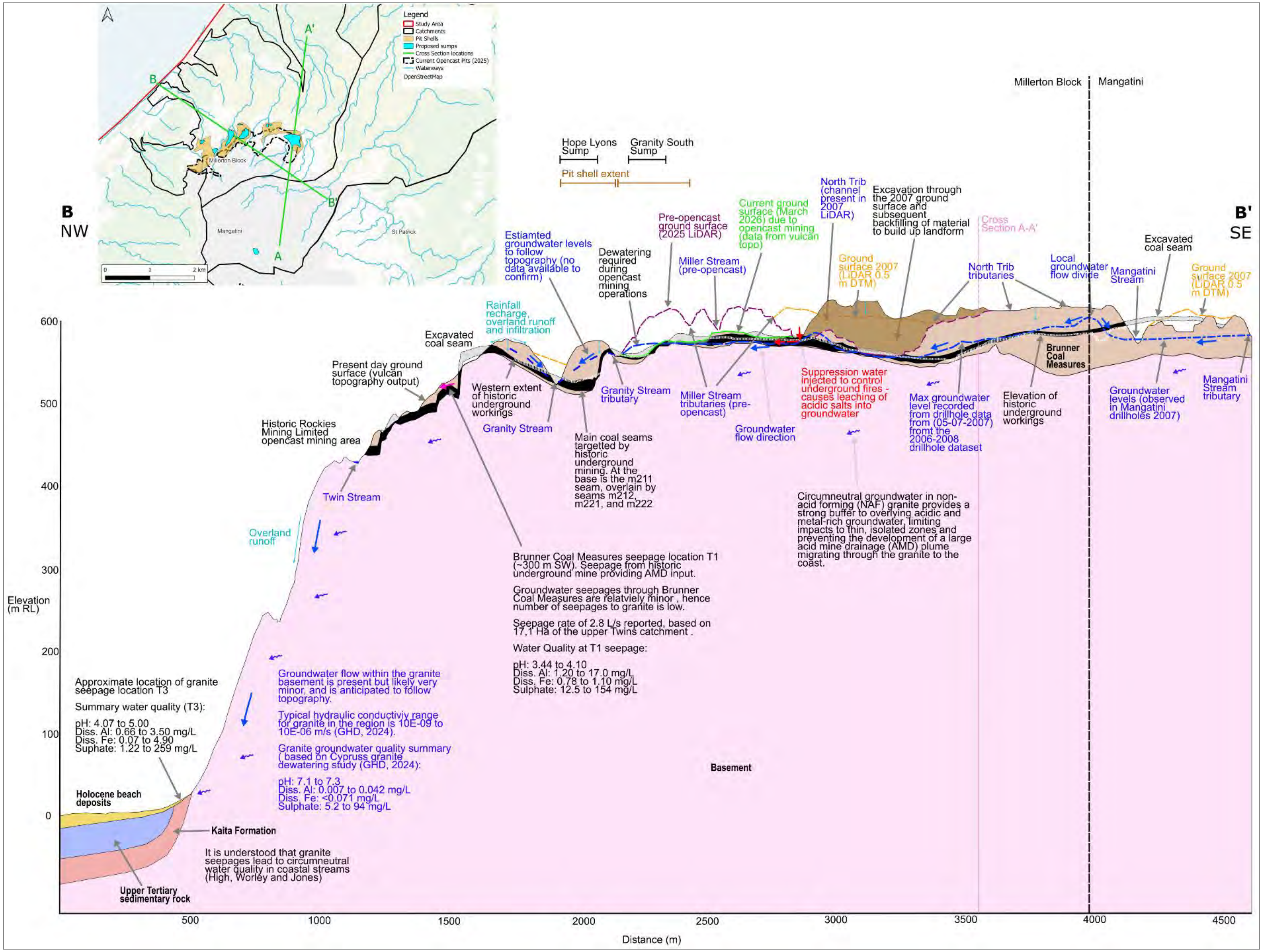

Figure 7.3 ***Active mining (2006 – 2026) hydrogeological conceptual model cross section B - B' towards the coast***

Given its generally low permeability, natural discharges from the consolidated rock were more likely present as seepages rather than large flowing discharges, apart from possible shallow fractures that intercepted the ground surface. Along with deeper groundwater, the ultimate discharge point for groundwater was, and likely still is, the ocean either directly or via the major rivers (Ngākawau and Waimangaroa).

Both shallow and deeper groundwater in the coastal sediments would have flowed towards the coast with discharges likely into coastal dune system wetlands, like the Granity Wetland Conservation Area, which is often where the water table is highest. In general, it is expected that the waterways would have lost flow to coastal sediment groundwater as they exited the steeper Stockton Plateau BCM and granite.

Rainfall in the area is high and would have been the dominant source of diffuse recharge, followed by surface water (waterway) losses to groundwater. These two sources of water will have been the two main factors driving groundwater levels to rise and fall pre-mining. Rainfall recharge to groundwater would have been highest on the flatter and more permeable alluvial and marine sediments near the coast, and lowest on the low permeability and topographically steeper outcropping basement and younger rocks.

Shallow groundwater on the Stockton Plateau was likely slightly acidic naturally within the KMS and BCM, due to land surface recharge from the low pH rainfall, acid leaching from soils, and low buffering capacity of the rock material. Groundwater in the granite Basement would have had a higher, near circumneutral pH, like that observed to date.

7.2 Contemporary mining

The contemporary impacts of mining on groundwater are shown in Figure 7.2 (cross-section A-A') between Stockton Plateau north towards the Ngākawau River and in Figure 7.3 (cross-section B-B') between Stockton Plateau and the coast.

The hydrogeology of the Stockton Plateau has been influenced by historical (commencing in 1896) and current mining activities throughout the area. In areas that are influenced by these mining activities, the mining operations and the subsequent handling of waste materials have induced changes in the hydrological system. These changes have included alterations to land surface configurations (i.e. open pits and highwall cuts) and water flow patterns (both groundwater and surface water), which have impacted the overall hydrological balance of the area.

7.2.1 Section A-A' – Stockton Plateau towards the Ngākawau River

The interpolated groundwater elevation contours and derived depth-to-groundwater (below ground) surfaces from 2006–2008 indicate a regional north-east groundwater flow towards, and possibly into the Ngākawau River (cross-section A-A') from the south and north-eastern parts of the Millerton Block. This broadly aligns with regional topography and the dominant surface water flow directions within the local stream catchments, supporting a conceptual model in which groundwater flow is largely topographically driven at the regional scale. Depth to groundwater varies from above the stream beds in some locations, to below the stream bed in others, suggesting, that the waterways have a mixture of gaining and losing reaches. At the Millerton Block, the maximum interpolated groundwater elevations of approximately 750 mRL occur in the south-western part of the study area, decreasing to minimum elevations of approximately 515 mRL in the north-eastern part, defining a relatively steep regional horizontal hydraulic gradient towards the northwest and Ngākawau River.

The seasonal interpolation maps suggest groundwater flow towards a convergence zone associated with the Millerton Syncline (low point in the BCM historically used for dewatering the underground tunnels). At this location, water under the ground is (and was historically) intercepted and pumped via an adit to the north. This water is currently treated at the DCA portal, before being discharged into Mine Creek. This indicates mine infrastructure exerts some control on local groundwater flow patterns. Underground water discharges from the DCA confirms the syncline's role as a point of AMD impacted groundwater discharge. Similar groundwater AMD discharges from historical underground workings into waterways occur at other locations within and downgradient of Stockton, demonstrating the effect historical workings have as a conduit for groundwater discharge preferentially to typical groundwater flow (i.e. perpendicular to topography, surface waterways).

In addition to the 2007 ground surface, cross-section A-A' also features the current ground surface, which shows the topographic changes that have occurred due to contemporary opencast mining, waste rock / backfill placement and rehabilitation in the Millerton Block.

7.2.2 Section B-B' – Stockton Plateau to the coast

In the north-western portion of the Millerton Block, groundwater is inferred to flow in a northwest direction towards the coast, aligning with local topographic gradients associated with the Granity/Miller, Twins, and Rudolph Stream catchments. Depth to groundwater ranges from near-surface to approximately 70 m below ground level, reflecting the combined influence of topography, geological structure, historical and current mining activities.

Opencast mining at Millerton Pit is likely to be resulting in some drawdown of the water table, however, drawdown extent from the edge of the pit, and other opencast pits at Stockton, is unlikely to extend more than 250 m based on the low permeability BCM and KMS. Groundwater inflows to dewatered opencast pits at Millerton and through out Stockton, is expected to range from approximately 0.5 – 6 L/s at each pit, though higher inflows may occur where fractures and historical underground workings are intercepted. Overall, the groundwater component of dewatering is much less than that derived from rainfall and run-off.

Localised groundwater highs and lows are evident, with associated small-scale changes in inferred groundwater flow direction. These features may reflect hydrogeological controls, such as structural complexity, variable permeability associated with fractured rock and mine workings, or localised recharge and discharge zones. However, they may also, in part, be artefacts of the interpolation process and data limitations, including reliance on single water-level measurements.

Overall, while the groundwater contour and depth-to-groundwater surfaces provide a high level conceptualisation of regional groundwater flow, they should be interpreted with caution at local scales. The long history of underground and opencast mining has significantly altered both surface and subsurface conditions, introducing preferential flow paths, artificial hydraulic sinks, and spatially variable recharge that are not fully captured by the available dataset.

7.2.3 Hydrogeochemistry

The land surface recharge into groundwater from rainfall is naturally acidic due to the low pH of rainfall which is further reduced (made more acidic) by organic material in the soils. For the BCM and KMS, which have little buffering capacity, this generally results in naturally acidic shallow groundwater and surface waters. This naturally acidic water is made more acidic from the mining. Within the historical underground workings located within, and which in places extend beyond, the Stockon CML, increased oxygen levels in combination with underground fires result in further increases in acidity and metal concentrations within the BCM and KMS underground waters. In some places, this water discharges to waterways. Current opencast mining removes some underground workings, and hence, this source of AMD, but at the same time is a source of AMD as well.

Both KMS and BCM overburden waste rock from the opencast mining results in AMD discharges from seepages. At Stockton, these seepages are currently captured and diverted to the Mangatini and McCabes systems for AMD treatment prior to being discharged into waterways. The waste rock areas are also being rehabilitated to reduce AMD. This involves a general three step-process of 1) landform reshaping and benching, followed by 2) granite capping and finally 3) either topsoil and replanting or Vegetation Direct Transfer.

The BCM and KMS are PAF rock materials that do not provide acid neutralisation, whilst the granite Basement which outcrops and underlies much of the Stockton opencast excavations is non-PAF but still provides negligible AMD neutralisation capacity due to its mineralogy. Overall, both groundwater and waterways flowing through the granite have higher pH (often circumneutral) and low concentrations of dissolved metals. This may in part be the result of the granite having slightly higher alkalinity compared to the KMS and BCM, and also appears to be largely hydraulically separate from the more acidic BCM groundwater. As a result, groundwater quality impacts from mining are probably localised to the BCM / KMS, rather than showing a laterally extensive and vertically deep AMD plume migrating through the granite toward the coast and Ngākawau River.

7.2.4 Groundwater interaction with surface water

Groundwater can affect waterway quality where it discharges into waterways, and waterways can affect groundwater quality where they lose flow to ground. On the Stockton Plateau, some waterways receive groundwater from underground workings and groundwater seepages whilst some lose to groundwater in places.

Along the coast, waterways generally lose flow to ground (coastal sediments) at the base of the escarpment, some of which probably discharges into coastal wetlands.

Groundwater discharges into waterways

Groundwater discharges into waterways from areas of AMD-impacted KMS / BCM with historical underground workings and from stream bed seepages as is the case at Twins Stream. High quality non-AMD-impacted groundwater seepages also occur into waterways, particularly from the granite and probably non-impacted BCM / KMS, resulting in dilution and significant water quality improvements.

Recent opencast mining at Millerton Block may have reduced the baseflow flow from groundwater slightly in some waterways, possibly from the capture and dewatering of groundwater upgradient.

Waterway discharges into the ground / groundwater

Some waterways and specific waterway reaches on the Stockton Plateau are likely to lose flow to ground and potentially into groundwater. The headwaters of Hugh Stream, as well as Jones Stream and Kerr Stream south of Stockton are generally ephemeral (Bathurst comment) indicating flow losses to ground / groundwater. Another good example is the Upper St Patrick Stream, which loses all its flow into the historical Fly Creek underground workings, between monitoring points 8W and S16. The flow then re-emerges upstream of site S16.

Millerton Block waterways that flow towards the coast also appear to lose flow to ground (gravel, sand and silt material) and into the underlying and likely more permeable coastal sediment groundwater. The coastal groundwater is likely to support the many coastal wetlands. Some waterways, like Rudolph Stream, lose all their flow before reaching the ocean. Of these waterways flowing from Stockton, Granity Stream and Twins Stream are AMD impacted at the coast.

Groundwater within the Granity Wetland Conservation Area, where Kerr Stream loses flow to groundwater, has a pH typical of rainfall, low metals concentrations and no evidence of AMD impacts.

8. Proposed works and potential impacts on groundwater

8.1 Overview

Bathurst seeks a 35-year term covering a period from 2027 – 2062 for the proposed BPCP. An overview of the BPCP is provided with the FTAA application. Table 8.1 lists the BPCP reports prepared to assess the water-related impacts from Stockton.

Table 8.1 BPCP reports prepared to assess the water related impacts from Stockton

Impacts on	Report	Stockton catchment areas
Groundwater and hydraulically connected waterway quantity / quality	This assessment.	All
Waterway hydrology	*Hydrological assessment. Buller Plateaux Continuation Project Mine Waste Management (MWM, 2026c).*	Millerton Block, Mangatini, St Patrick
Waterway quality	*Millerton Water and AMD Management Report'* (Bathurst, 2026a)	Millerton Block
	Stockton Mine 80-year Water Quality Forecast (Bathurst, 2026c)	Millerton Block, Mangatini, St Patrick
	Stockton Water Management and Waterway Impacts Assessment (GHD, 2026)	All
Waterway aquatic ecosystems	*Buller Plateaux Aquatic Ecology: history, thresholds and long-term management'* (Instream, 2026)	All

This assessment addresses the potential impacts on groundwater and hydraulically connected waterway quality / quantity over the 35-year term. This covers operation through to post-closure stages of mining at Stockton and the cumulative impacts from adjacent mining areas. The two main environmental receptors are 1) waterways fed by groundwater and 2) groundwater users. An assessment of the impacts to waterway aquatic ecosystems (current and future) is provided in the '*Buller Plateaux Aquatic Ecology: history, thresholds and long-term managemen*t' report prepared by Instream (2026). The assessment of impacts to groundwater users – both current consented and registered / non-registered bores is provided in this report.

8.2 Impacts outside the scope of the BPCP

The BPCP involves further, although not complete, removal of underground fires and historic underground workings. This will reduce AMD contribution to waterways, however, AMD from remaining underground workings within and outside the FTAA proposed consent area (Section 2.1.2), including the exclusion of mining within the Millerton and Plateau Protection Society Incorporated (MaPPs) area in the Millerton Block (Figure 8.4), will prevent aquatic ecosystem recovery within the next 80-years in most waterways (Bathurst, 2026a, Instream, 2026).

Acid loads from most remaining underground workings are addressed in the Crown Liability Deed of Commitment picked at nodal points S24a, S25, S23 and S6 in Millerton Block; S14c in Mangatini and S16 in St Patrick catchments. No significant remaining underground workings produce acid in these major catchments downstream of these sites. The only other underground workings outside the CML are in are T31 and T35 streams.

Twins and Rudolph underground workings AMD are captured in the CML and in the 5-year Crown Liability Plan.

8.3 Impacts summary

The BPCP has potential to impact groundwater and hydraulically connected surface waters in the following ways:

- Groundwater quantity:
  - Groundwater lowering and possible reduction in waterway base flow in areas near opencast mining (especially below the water table) and removal of historical underground workings.
  - Increased groundwater levels and waterway baseflow from fire suppression discharges into the ground at the Millerton Block which is a current impact. When this ceases, groundwater levels and baseflows are expected to drop in some waterways.
  - Land rehabilitation changes to land surface recharge of groundwater from rainfall and waterways.
- Groundwater quality:
  - AMD seepage from PAF waste rock / ELF areas (shown in Figure 8.1 and Figure 8.2), CFSF areas, opencast mining (especially pit floor seepages) and water treatment sumps that impact groundwater and hydraulically connected surface water.
  - Nutrients from explosive operations, treated effluent discharges and revegetation.

8.4 Proposed works minimising groundwater impacts

The BPCP will involve various works designed to minimise impacts to groundwater. In general, these include:

- Using compacted fill liners at the base of backfill material to minimise contaminant losses to groundwater.
- Scraping of PAF waste rock to leave a clean coal floor that has minimal AMD.
- Rehabilitation that involves the emplacement of PAF waste rock in dedicated, large ELFs in specific catchments (Mine Creek north branch) and compacted with underdrains to channel all AMD from waste rock area seepages to the MW16 water treatment sump.
- Waste rock placement below the water table (into groundwater) where possible to obtain permanent waste rock saturation and reduce / prevent AMD. However, this is likely to be limited as depth to groundwater is relatively deep (in comparison to Cypress for example).
- Reinstating the topographic surface to pre-mining levels where possible and to divert runoff from AMD impacted areas to sumps for treatment (for example the Millerton Block MW16 Sump).
- Removal of historical underground and opencast coal mine workings and extinguishing underground fires.
- Diversions around work areas to separate cleanwater.

Hydrogeological conceptual models showing operation, EOML and post closure phase features of the BPCP within the Millerton Block and parts of the Mangatini catchment are shown in Figure 8.1 and Figure 8.2.

8.5 Millerton Block

The Millerton Block is currently the most AMD-impacted catchment at Stockton. Most of area is disturbed due to underground workings, ongoing opencast mining and disposal of waste rock. Most waterways flowing from their upper reaches of the Millerton Block are in an AMD-impacted state (Figure 5.3). Groundwater quality and quantity in this catchment have been significantly impacted from mining since 1896, especially from the extensive underground workings that originally covered ~80% of Stockton CML within this catchment by 1969 (Figure 2.1).

8.5.1 Historical underground workings

Table 8.2 lists the sites where water from historical underground workings emerges from the ground and into waterways upstream of the major monitoring sites. The table also shows the reduction in underground workings' catchment areas, and consequent reduction in AMD loads from these workings from 2010-pre opencast conditions, through to the end of Stockton EOML in 2033. The future impacts from reducing the amount of underground workings and sealing underground tunnels are discussed within the report sections on waterway baseflows (Section 8.5.2.2) and quality (Section 8.5.3.4).

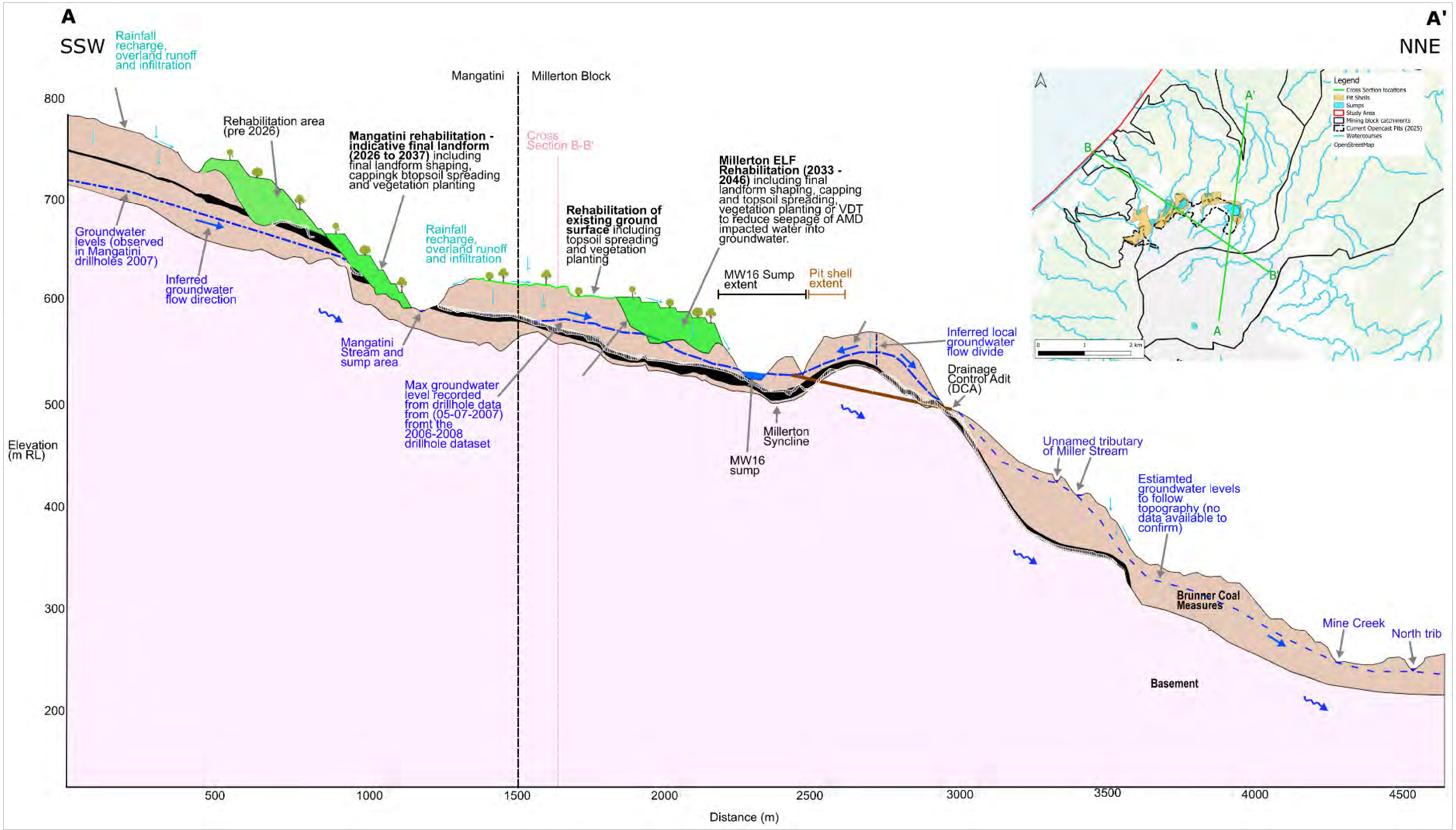

Figure 8.1 Future hydrogeological conceptual model cross section A - A' towards the Ngakawau River within the Millerton Block and Mangatini catchment. Various operation, EOML and post-closure phase features are shown.

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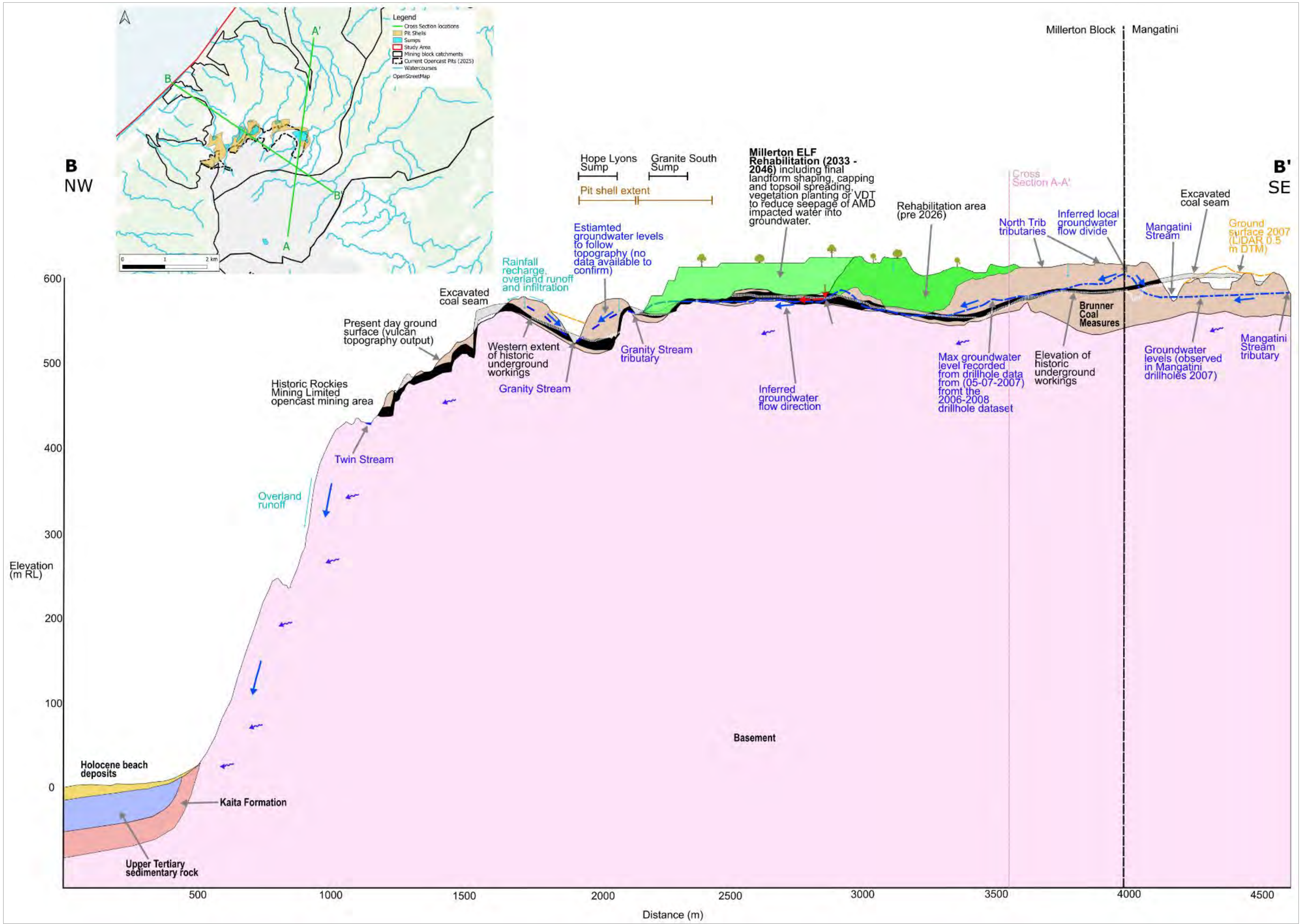

Figure 8.2 *Future hydrogeological conceptual model cross section B - B' to the coast largely within the Millerton Block. Various operation, EOML and post-closure phase features are shown.*

Table 8.2 Millerton Block underground workings discharges and catchment area reduction to EOML (2033) (sources: Bathurst, 2026a and Bathurst staff)

Catchment	Impacted waterway monitoring site	Historical underground working discharge points that daylight upstream of the impacted waterway monitoring sites. Current and remaining to at least EOML	Area of underground workings assumed to contribute flow and AMD at the impacted waterway monitoring sites (ha)		
			Pre-opencast (2010)	Recent (2025)	EOML (2033)
Mine Creek	S23	[redacted]	152	92	33*
	S6	[redacted]	67	67	67
Miller Stream	S24A	[redacted]	125	96	68
		[redacted]			
Granity Stream	S25	[redacted]	22	13	12
Twins Stream	T1	[redacted]	3.6	3.6	3.3
Rudolph Stream	S28U	[redacted]	No change in area		
* During the operation phase (2027 – 2033) there will be increased AMD recovery (including fire suppression water) and transfer to Mangatini Treatment System from ~2026 – 2028. The DCA portal intercepting the opencast pit will be sealed from ~2029.					

8.5.2 Groundwater quantity

8.5.2.1 Groundwater levels, recharge and abstractions

Dewatering from opencast mining

Future opencast will continue within the north of the Millerton Block until 2033. The opencast disturbance footprint and future water treatment pit sumps are shown in Figure 8.3. A portion of the footprint will have pits down to coal floor that are progressively backfilled with overburden waste rock. Some pits sumps will be left for future water treatment. Both rainfall run-off and any groundwater will be collected in the pit / pit sumps, with a portion used for fire suppression and the rest sent to the Mangatini Treatment System.

The maximum groundwater abstraction rates from the opencast areas and pit sumps were based on the modelling approach outlined in Section 4.5.1. The required drawdown, which varied between pits depending on the depth, was based on an assumed average depth to groundwater of 20 m. The maximum pit abstraction rates from groundwater and rainfall / surface water inputs are shown in Table 8.3. Groundwater on average accounts for ~12% of the total flow rate taken, but could vary anywhere from 6 – >35% depending on the amount of rainfall.

Table 8.3 Millerton Block operation phase (2027 – 2033) maximum pumped water takes by sump / catchment (source: Bathurst, 2026c)

Catchment (taken from)	Pit sump (taken from)	Max surface water abstraction rate (L/s)	Max groundwater abstraction rate (L/s)	Total max abstraction rate (L/s)
Twins Stream (T1)	Twins	72	5	77
Granity Stream (S25)	Rockies	68	6	74
	Hope Lyons	35	19	54
	Granity North	13	1	14
	Granity South	30	7	37
Miller Stream (S24a)	Miller	32	11	43
Mine Creek (S6)	Mine Pit / MW16 (Figure 8.1)	319	30	349
Total		**568**	**79**	**647**

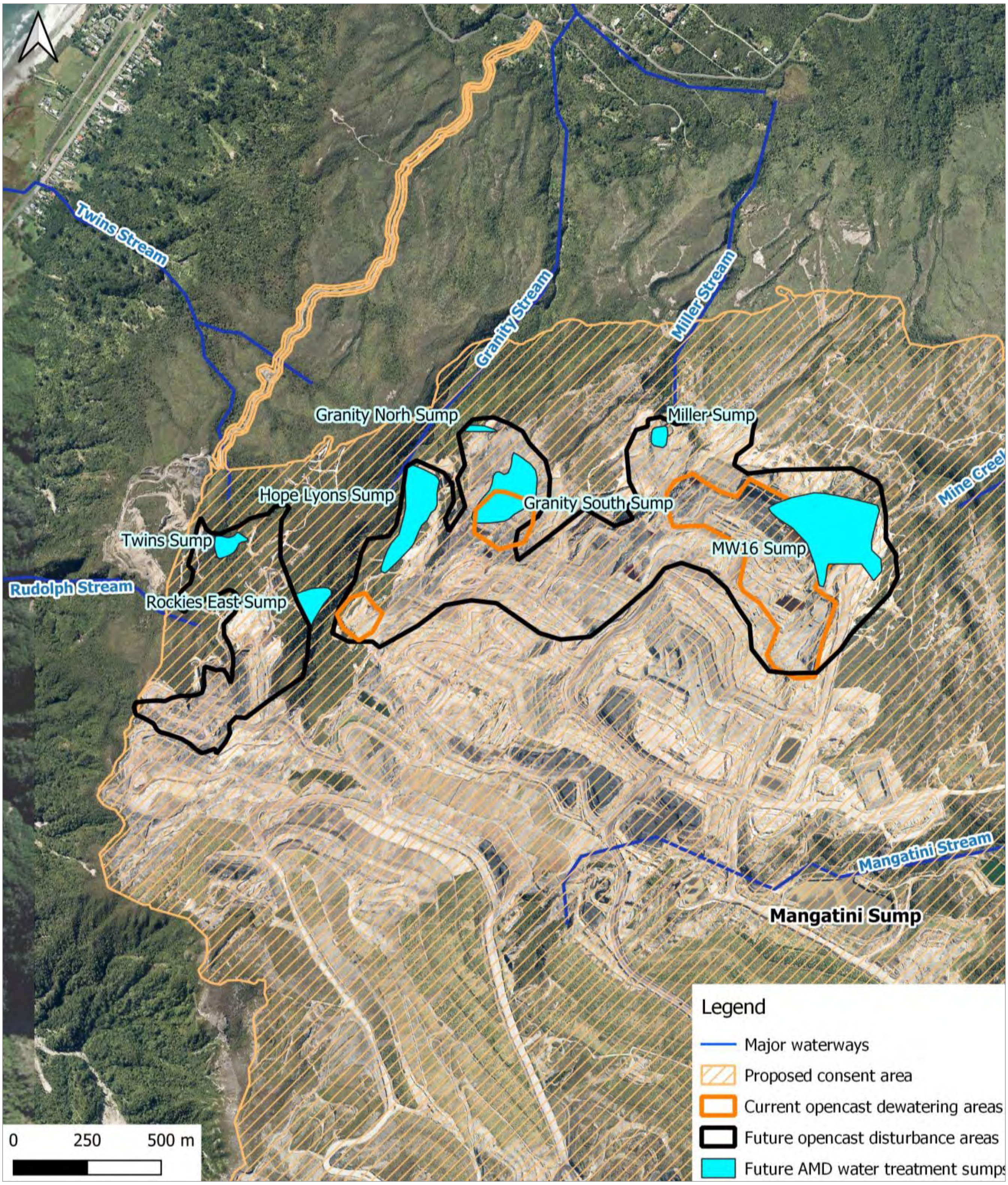

Figure 8.3 ***Current and proposed Millerton Block future opencast disturbance areas (2027 – 2033) and proposed water treatment pit sumps (2027 – post closure)***

Additional dewatering from opencast areas outside the pit sumps would be expected to result in groundwater abstraction rates in the range of 1 – 20 L/s, depending on the pit depth, area and depth to groundwater. Higher groundwater abstraction rates may occur where the pits intercept large fractures and open underground workings below the water table. However, direct rainfall and run-off are still considered to be the dominant sources of water required to be pumped from the pits.

Figure 4.5 shows drawdown extents from the edge of pits (constructed within the BCM) for a range of drawdown at the base of the pit and BCM hydraulic conductivity values. The results suggest drawdown extending up to 50 – 475 m from the pit edges for 25 m drawdown at the pits.

When groundwater abstractions cease, water levels in the BCM are expected to recover (rise). Given the long history of mining in Millerton Block (since 1896) before environmental monitoring was undertaken, there is no record of the natural pre-mining groundwater levels. Post-closure phase groundwater levels and flow direction will reflect past mining and the final changes in material hydraulic properties from backfill, sumps, hill side cuts, and left-over underground tunnels and adits. The time required for groundwater levels to recover to a new post-mining level is expected to be in the order of 1 – 7 years based on groundwater modelling for the Cypress opencast mining area (GHD, 2024a).

Outside the active mining areas, groundwater levels will remain generally unaltered due to the low permeability of the BCM / KMS, and resultant limited extent of drawdown (up to ~475 m) away from the active ground water abstraction areas.

Fire suppression discharges

Water will continue to be taken from Millerton (opencast) Pit and directed into the underground workings to extinguish fires until ~2028. In some locations, this may offset some / all drawdown resulting from the opencast mining, or result in locally higher water levels (groundwater mounding) in the workings and groundwater.

Land surface recharge

Capping (using low permeability compacted granite) of historic, current and future waste rock areas associated with land rehabilitation will likely result in less land surface recharge from rainfall. Much of the rainfall that reports as run-off will be diverted to the new water treatment sumps in the Millerton Block. These sumps will collect water, then spill into the waterways during periods of high rainfall. The effect of this on groundwater levels may be smaller than the changes resulting from removal of underground workings, and replacement material with waste rock. The combined influences of these all changes would be identified as part of the proposed groundwater level monitoring (Section 9.1.2)

Closure phase

Post-closure, the pit sumps (Figure 8.3) will not be pumped, and are expected to be full of water most of the time. As a result, there may be some seepage of sump water into groundwater.

8.5.2.2 Waterway baseflows

The Millerton Block includes the Granity Stream, Miller Stream, Mine Creek, Twins Stream and Rudolph Stream sub-catchments (Figure 3.3). The flow regime changes at monitoring sites on Granity Stream (S25), Miller Stream (S24a), Mine Creek (S23, S6), and Twins Stream (T1, T2 and T3) through, operation, EOML and closure is provided in the '*Hydrology Assessment*' by MWM (2026c) and summarised in Table 8.4. Water Balance Models (WBM) have not been developed – hence the following is a qualitative discussion of potential groundwater related impacts.

Table 8.4 Millerton Block waterway flow changes. Changes from post-opencast in red (lower), same (green), higher, (blue). Twins Stream expressed as percentage change in the absence of flow records. Adapted from MWM (2026c)

Waterway	90th percentile flow rate (L/s)			Median flow rate (L/s)		
	Current (2025)	Forecast operation and EOML phase with sump pumping	Closure phase no sump pumping	Current (2025)	Forecast operation and EOML phase with sump pumping	Closure phase no sump pumping
Granity Stream (S25)	225	136	423	39	24	39
Miller Stream (S24A)	466	322	312	178	123	127
Granity Stream (S25+S24)	691	458	735	217	147	166

Waterway	90th percentile flow rate (L/s)			Median flow rate (L/s)		
	Current (2025)	Forecast operation and EOML phase with sump pumping	Closure phase no sump pumping	Current (2025)	Forecast operation and EOML phase with sump pumping	Closure phase no sump pumping
Mine Creek (S23)	464	464	68	151	151	27
Mine Creek (S6)	473	316	898	78	52	203
Mine Creek (S23+S6)	937	780	966	229	203	230
Twins Stream T1	n/a	-67%	-1%	n/a	-67%	-1%
Twins Stream T2	n/a	-67%	-4%	n/a	-67%	-4%
Twins Stream T3	n/a	-67%	-2%	n/a	-67%	-2%

The forecast effect of the BPCP on Rudolph Stream is a reduction in flow from the additional ~1 ha of catchment diverted by construction of Twins Sump, resulting in a 7-day MALF at the base of the catchment dropping from 5 – 4.9 L/s (Instream, 2026).

Activities likely to contribute more groundwater / underground water to waterways

Continued fire suppression discharges of ~120 L/s (similar to current) using AMD impacted water to ~2028. This provides additional flows to Mine Creek (S23) from the DCA and Miller Stream (tributary of Granity Stream) (see Section 4.5.4.1). There is limited information to determine the effects on other waterways.

Post closure, MWM (2026c) forecasted flow changes in Mine Creek (S6) (Table 8.4) by including the effect of increased underground workings flow paths reporting to MW16 Sump by adding DCA flows. Overall, post-closure-waterway baseflows may drop slightly in response to further opencast mining, capture potential AMD impacted groundwater recharge from the Millerton ELF underdrainage system and other diversions to the sumps.

– **Activities likely to contribute less groundwater / underground water to waterways**

Temporary groundwater abstractions required for opencast mining and the pit sumps are a relatively small (~14%) component of the total pit sump water takes and other water diversions that would impact waterway flows. The actual 'stream-depletion' effect will also likely be a portion of the total groundwater abstraction rate, meaning not all the groundwater abstracted is likely to discharge into the waterways. Reasons include, the fractured and conduit flow nature of underground water within the BCM, the limited drawdown extents of ~475 m (see Section 8.5.2.1) from the edge of the pits due to the low permeability BCM material, and the location of the opencast pits at the upgradient end of the waterways rather than long the length.

Fire suppression discharges of up to ~120 L/s (similar to the current) from Millerton Pit into underground workings will cease from ~2028. It is currently unknown how much of this water passes through and then discharges into the waterways versus recharge into groundwater that does not feed the waterways. Since Miller Stream and Mine Creek flows are currently influenced by fire suppression, the discharges are expected to reduce the flows in these two waterways. The influence on other waterways is unknown. The effect on waterway flow may be more pronounced during periods of low flow.

In-pit / near pit sealing of underground workings which are conduits of underground water into waterways. This includes the DCA portal from ~2029 which discharges into Mine Creek (S23) from the DCA. However, these underground working tunnels will still capture any groundwater present between the in-pit portal seals, down-gradient to the point of discharge into waterways.

The expected waterway flow changes due to changes in underground workings areas (Table 8.2) are as follows:

- No flow reduction at Mine Creek (S6) since the underground workings area will remain the same.
- Small flow reduction at Rudolph Stream (S28U), Granity Stream (S25) and Twins Stream is expected from a relatively small reduction in underground workings from 2025 onwards. For Twins Stream, MWM (2026c) concluded that the closure phase flow rate changes (Table 8.4) are minor, due to the small changes in catchment area and historical underground working discharges remaining largely unchanged.

– Moderate flow reduction at Miller Stream (S24) and Mine Creek (S23) from removal of underground workings reporting to these sites. Of these, the largest will occur to Mine Creek (S23) which received water from the DCA. The closure phase flow rate for Mine Creek (S23) shown in Table 8.4 was estimated by MWM (2026c) by subtracting the operational phase DCA flow which includes the effect of fire suppression.

8.5.3 Groundwater quality

8.5.3.1 Operation phase (2027 – 2033)

Impacts to groundwater

Operation phase impacts on groundwater quality are:

- Ongoing fire suppression discharges to underground workings to ~2028 using untreated AMD impacted water from Millerton opencast pit.
- Highwall and coal floor exposure, and the construction of ELFs during continued opencast mining at the Millerton Block till 2033.
- AMD-producing underground workings are removed from opencast mining, and pit voids filled with PAF waste rock in ELFs. Future groundwater monitoring of waste rock impacts on groundwater quality is proposed (Section 9.1.2).

Activities that reduce groundwater impacts

Operation phase activities that reduce the long-term and offset some of the short-term impacts:

- Ceasing fire suppression from ~2028 will significantly reduce the AMD load into the ground (Bathurst, 2026a).
- Removal of fires that increase AMD to water within the underground workings.
- Removal of an additional ~88 ha of historical underground workings (relative to the 2025 disturbance) through continued opencast mining. These workings are a large source of AMD.
- Cutoff, capture and treatment of AMD impacted water from ~42 ha of historical underground workings in the MW16 Sump east of Millerton ELF (Figure 8.4).
- Increased AMD recovery (including fire suppression water) from the DCA stopping and transfer to the Mangatini Treatment System from ~2026 – 2028.
- Portal sealing within and near-pit sumps to prevent AMD drainage into groundwater via underground workings. This includes the DCA portal (Figure 8.1) sealing from ~2029, a large historical underground working that currently discharges AMD-impacted underground water into Mine Creek. Continued monitoring of water quality and flow from the DCA is proposed until this time (Section 9.1).
- Ongoing rehabilitation of future and historical PAF waste rock areas using modern ELFS, to reduce oxygen and water ingress, thereby reducing AMD production and seepage into groundwater. This includes ~125 ha granite (NAF material) capping. The process involves 1) backfilling pits / voids with waste rock, 2) compaction and recontouring to form gentle gradients that mimic the natural topography, 3) 400 mm of weathered granite to cap seal the waste rock, 4) soil / fertiliser for vegetation re-establishment.
- PAF waste rock (overburden) material from Twins, Granity, Miller and Mine Creek south catchments removed during opencast mining will be placed in a single ELF (Millerton ELF) designed to high modern-day standards. The remaining pit voids will be used as sumps (Figure 8.4) to capture and treat AMD impacted water, including influent groundwater
- Millerton ELF (Figure 8.1) construction with underdrains on low permeability coal floors will capture AMD leachate and seepage from the base of the waste rock that might otherwise migrate into groundwater and surface water. This will be sent to MW16 Sump (Figure 8.1), then pumped to the Mangatini Treatment System.
- The potential impacts to future coastal groundwater users are discussed in Section 8.11.4.

8.5.3.2 EOML phase (2033 – 2046)

The ceasing of operation-phase opencast mining and expected ceasing of fire suppression discharges will reduce impacts to groundwater during the EOML phase. Runoff and seepage from the Millerton ELF will continue to be directed to MW16 Sump and then pumped to the Mangatini Treatment System.

If continued fire suppression is needed, water would be sourced from the Mangatini Treatment System or MW16 Sump treated water through the EOML phase to minimise acid load addition to the underground workings (Bathurst, 2026d).

Underground workings within the mined out pits will have been removed by EOML. Exposed portals will be sealed with an earth bund where there is a risk of pit water being released into them. The Syncline area will be mined out to create MW16 Sump during the Operational phase. This will utilise the naturally formed low in the coal floor. The portal to the DCA will be sealed to prevent further water flows into the remnant underground workings (via the DCA) during the EOML phase (Bathurst, 2026d).

Beyond the active mining phase, ANFO use will cease and will therefore no longer contribute as a potential nitrogen source to groundwater, and an anticipated reduction in full-time employees will see treated sewage effluent as a source significantly reduce.

The Millerton ELF and final landform shaping and capping outside the Millerton ELF will reduce the long-term potential impacts on groundwater quality. Capping along with sympathetic shaping of the local topography to restore the local drainage systems and the establishment of vegetation will help reduce water ingress and AMD loads into groundwater.

8.5.3.3 Closure phase (2047 onwards)

The final landform design involves minimising the Millerton ELF footprint to reduce AMD seepage into groundwater and leaving the coal floor and highwall areas with low AMD-generating capacity permanently exposed. The closure phase water management is shown in Figure 8.4.

Historical underground workings within and outside the Stockton CML will remain, contributing untreated AMD to groundwater and waterways. Figure 2.1 shows the remaining areas post-closure. An agreement between Bathurst and the MaPPs means that opencast mining and subsequent removal of additional underground workings north towards Millerton Township, in the MaPPS area shown in Figure 8.4, cannot occur.

AMD from waste rock ELFs have potential to enter to groundwater. The low hydraulic conductivity ELF basal rock will result in preferential seepage along the coal or pit floor and into the underdrainage system for collection and treatment at the sumps. This will limit potential impacts. In addition, monitoring of seepages and groundwater down-gradient of the Millerton ELF are proposed (Table 9.1).

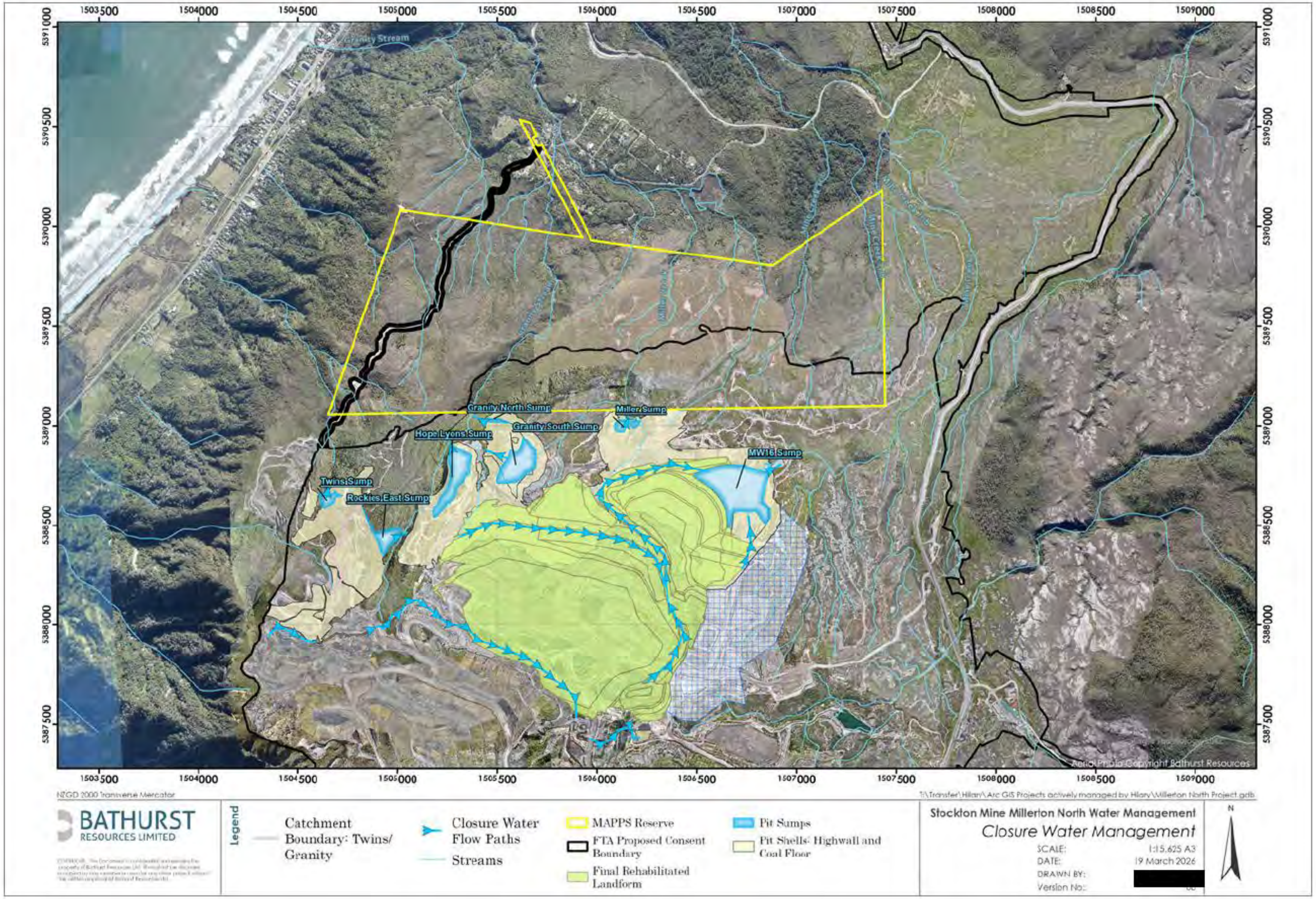

Figure 8.4 *Millerton Block closure phase water management (source: Bathurst, 2026a)*

AMD-impacted runoff from highwall / pit (coal) floors (shaded yellow in Figure 8.4) that remain post-closure is a potential risk to groundwater quality, should a portion infiltrate into the ground. However, impacts to groundwater are probably minimal, with coal floor runoff being diverted to pit sumps and captured for treatment or controlled discharge (Bathurst, 2026a). The low hydraulic conductivity (Table 4.1) pit flow is expected to result in most of the rainfall being transmitted as surface runoff, similar to the exposed granite. Infiltration would, therefore, be a small proportion, potentially 5 - 7% of the annual rainfall based on regional rainfall recharge rates to groundwater estimated from modelling at Cypress (GHD, 2021). In addition, AMD from highwall / pit floors decreases rapidly over the short-term, the pit floors will be sealed to prevent flow into groundwater via underground workings.

Post-closure, the pit sumps (Figure 8.3) will not be pumped. When full of water, there is potential for seepage of AMD-impacted water into groundwater. This will be minimised by sealing underground working / portals within and near the sumps.

8.5.3.4 Waterway quality

AMD-impacted underground workings within KMS and BCM occur within, and at places discharge into the headwaters of waterways draining the Millerton Block. AMD-impacted underground water discharges to waterways will decrease as some of these workings are mined out and blocked. However, those remaining will continue adding acid load to waterways post-closure.

Fire suppression discharges into historical underground workings using AMD impacted water is expected to temporarily increase the acidity in Miller Stream at monitoring site S24A until 2028, after which time fire suppression discharges are expected to cease and the acidity will reduce. At Mine Creek monitoring site S23, additional treatment will reduce the acidity despite impacts of fire suppression discharges occurring to 2028. Blocking the DCA in 2029 will result in further reduction in acidity and metals concentrations.

Twins Stream and Rudolph Stream receive groundwater seepage from the granite, which improves the waterway quality. These granite seepages do not appear to show any impacts from the long history of mining at the Millerton Block. As such, the relatively short period of future mining is considered unlikely to cause any impacts to the quality of the granite groundwater seepages.

8.6 Mangatini

The Mangatini catchment currently consists of largely rehabilitated historical waste rock and opencast mining areas, groundwater dewatering at WE07 opencast pit and the A18 CFSF (Figure 5 2). Runoff and waste rock / CFSF seepages from disturbed and rehabilitated areas report to the Mangatini Treatment System.

Transfer of excess PAF waste rock from Cypress and UWHR construction to the Webb South ELF (WE07) is the main mining activity anticipated post April 2027 other than a small amount of groundwater dewatering at WE07 opencast pit.

8.6.1 Historical underground workings

A limited area containing historical underground workings drain AMD impacted water into Mine Creek North Tributary (S6) below the Mangatini Sump. These underground workings will remain post-closure as the workings extend beyond the planned BPCP consent area, across Crown Land.

8.6.2 Groundwater quantity

There will be no opencast pit dewatering in the Mangatini catchment and no changes to underground mining areas. Localised groundwater levels changes may occur during rehabilitation and backfill activities, especially as waste rock areas are capped, promoting more run-off to surface water. Any changes in waterway baseflows are therefore expected to be minor.

8.6.3 Groundwater quality

The PAF waste rock storage at Webb South ELF (WE07) shown in Figure 9.1, is the main future activity that could impact groundwater quality. The waste rock will be stored on top of a compacted liner to minimise AMD seepage into groundwater. Groundwater monitoring is proposed within the BCM and granite Basement downgradient of the ELF (Section 9.1.2).

The existing A18 CFSF is a comparably smaller potential contaminant source to groundwater, compared to the Webb South ELF, because much of the pyrite (key acid forming mineral) is leached out during processing at the CHPP. The coal fines have a higher pH (4.3 – 5.7) compared to waste rock (2.3 – 4.2), and significantly lower dissolved metals concentrations (0.01 – 8 mg/L for aluminium) compared to waste rock (1 – 200 mg/L for aluminium) – see Table 5.1.

The A18 CFSF is at full capacity and studies have been undertaken to develop a closure plan and final rehabilitation. The CFSF will be progressively capped with locally sourced overburden material, from operating mine areas and the A Drive quarry. Long-term closure design incorporates a drainage channel across the surface of the impoundment. The impoundment is currently monitored by an array of vibrating wire piezometers and other seepages. This monitoring is proposed to be continued. Groundwater from the A18 CFSF is likely to flow east to north-east, controlled by the backfilled pit mined-out surface, ultimately collected and managed within the Mangatini Sump.

Seepages from the Webb South ELF and A18 CFSF will be captured and diverted to the Mangatini Treatment System to reduce potential impacts on groundwater.

As of 2025, 38% of landforms assumed to contribute acidity in Mangatini Catchment are not yet rehabilitated. Final landform rehabilitation of these areas will contribute ~19% acidity concentration reduction across the catchment compared to 2025 (Bathurst, 2026b). After final landform rehabilitation and all mining is completed in ~2037, AMD sources will continue to decline because of acidity decay, further reducing potential impacts on groundwater quality.

8.6.3.1 Waterway quality

A limited area of historical underground workings will remain, contributing untreated AMD to Mine Creek North Tributary (S6). Any impacts from groundwater reporting to Mangatini catchment waterways will be captured from downstream surface water monitoring sites. A full description of the proposed monitoring is provided in the waterway aquatic ecosystems impacts report by Instream (2026).

8.7 St Patrick

The St Patrick catchment currently consists of rehabilitated mining areas, small portion of active opencast, and the McCabes CFSF. Future activities in this catchment that could impact groundwater include 1) water abstractions from No.2 South / SN14 Backfill pit, any groundwater dewatering at Peninsula opencast (Figure 8.5), 2) three additional CFSFs located in the upper catchment at A Drive and 3) ongoing AMD discharges from the historical Fly Creek underground workings.

8.7.1 Historical underground workings

The St Patrick contains a small area of historical underground workings within the proposed FTAA consent area (Figure 2.1). The majority occurs down-gradient of it. The area of historical underground workings within the consent area will remain the same as current.

8.7.2 Groundwater quantity

Some water abstractions may be required from the No.2 South / SN14 Backfill pit for backup supply. The mean groundwater inflows are ~3 L/s (Table 4.5). Opencast mining at the proposed Peninsula area (Figure 8.5) may also result in groundwater abductions for dewatering. The pit is relatively shallow < 20 m depth below ground and hence may not intercept groundwater. Assuming groundwater levels were very high (5 m depth below ground) the maximum groundwater abstraction rate would be ~3 L/s (using the models discussed in Section 4.5.1).

Given the relatively small potential groundwater abstraction rates, limited drawdown extents (< 250 m due to the expected shallow depth below the water table) and rainfall runoff-dominated flow in the adjacent waterways, any impacts on the waterway flows are considered negligible. Other proposed activities such as ongoing rehabilitation and further CFSFs are not expected to significantly change groundwater levels and flow directions, and therefore not impact waterway base flows.

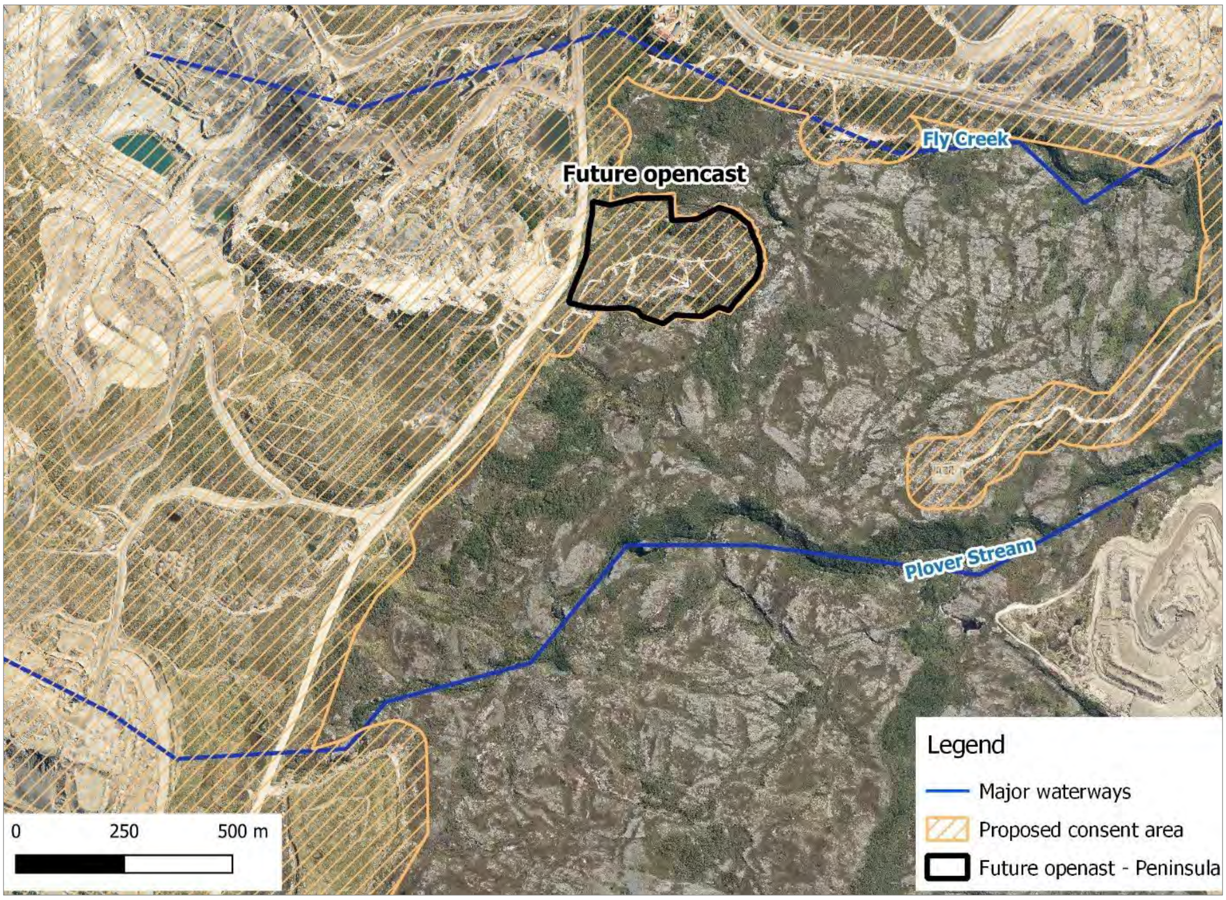

Figure 8.5 Peninsula opencast mining area – St Patrick catchment

Localised groundwater levels changes may occur during rehabilitation and backfill activities, especially as waste rock areas are capped, promoting more run-off to surface water.

8.7.3 Groundwater quality

Water and contaminants (specifically coal fines) from the CHPP will be discharged to land at the existing McCabes CFS and three new CFSFs located at A-Drive, A-Drive#2 and A-Drive#3 (Figure 5.2). As discussed in Section 8.6.3, the water quality from the CFSFs is comparably much better, and a lower risk to groundwater than the waste rock areas.

The McCabes CFSF is an engineered, purpose-built, partially lined structure. The impoundment is monitored by an array of vibrating wire piezometers which are proposed for future groundwater monitoring. Significant leakage is expected through the facility floor and unlined bulk fill, based on pumping only required to prevent overspilling when it is consistently raining. Future rehabilitation will utilise capping materials sourced locally. Groundwater flow is dominantly to the east, primarily discharging to the McCabes Sump. Any leakage and contaminants in groundwater that bypass the McCabes Sump would likely report to the Fly Creek underground workings.

At the A-Drive Quarry (proposed locations for the new CFSFs) significant leakage has been noted. For example, a dewatering pump was removed by December 2024, and no spilling was observed as of December 2025, despite high rainfall. Groundwater flow from the A-Drive Quarry #1, #2, and #3 is eastward. Any contaminants reaching groundwater would therefore likely discharge into either Fly Creek itself or the Fly Creek underground workings.

The proposed groundwater monitoring of the CFSFs is discussed in Section 9.1.2.

Ongoing rehabilitation to be completed by 2037 will result in less AMD seepage into groundwater. Long-term, groundwater quality will improve from acidity decay in AMD sources.

8.7.3.1 Waterway quality

The Upper St Patrick Stream will continue to flow into, then emerge out of, the historical Fly Creek underground workings above the St Patrick Stream S16 monitoring site. This will continue to result in AMD being discharged into this waterway from this location. The forecast 75th percentile dissolved aluminium concentration at St Patrick Stream S16 does not fall below 1 mg/L (recovered aquatic ecosystem) within the 80-year timeframe due to the substantial historical Fly Creek underground workings, which contribute almost half the total acidity load upstream of this monitoring site (Bathurst, 2026b). The AMD underground water discharges into St Patrick Stream are located downstream of the current AMD treatment infrastructure (McCabes Sump) and will therefore remain untreated. At this stage, there are no AMD management options developed for the historical Fly Creek workings (Bathurst, 2026b). St Patrick Stream site S16 captures AMD impacts from the underground water discharges. The site is proposed as a compliance monitoring site with daily (weekday) water sampling (Instream, 2026).

The remaining St Patrick catchment waterways are dominantly rainfall-runoff fed, and in the absence of any major impacts on groundwater quality, there is unlikely to be any impacts from groundwater.

8.8 Upper Waimangaroa

This catchment has no AMD sources from further proposed opencast mining, nor any historical underground workings, and there are no changes to water management in this catchment proposed under the BPCP other than final landform construction and rehabilitation which includes granite capping of waste rock and minor addition of nutrients from revegetation. In addition to ongoing acidity decay, the groundwater quality in this catchment is expected to improve with time.

Provided that the passive Whirlwind MSR treatment system, designed to intercept and treat acidic seepage water that emerges from acid-forming overburden and waste rock within the Whirlwind catchment, continues to operate with periodic maintenance, surface water quality in the is also expected to gradually improve.

The impacts of final landform construction and rehabilitation on groundwater baseflow in the Herbert and Whirlwind Streams has not been modelled. However, any impacts are likely to be small given there is no future dewatering proposed or underground workings.

8.9 Nutrients

There are no significant changes in nitrogen inputs expected from ANFO use or treated sewage effluent during the remaining active mining phase (2027 – 2033). Inputs are comparable to recent years (Bathurst, 2026d). Contrastingly, land rehabilitation rates are planned to increase from ~23 ha/year (previous 5 years) to 43 ha/year from 2027 up until 2034 (~90% increase), increasing the potential release of nitrogen into groundwater and waterways (Bathurst, 2026d). Any increase in nitrogen from extra fertiliser use will be assessed by monitoring in groundwater (Section 9.1.2) and surface water, and reduced use will be implemented if required.

8.10 Groundwater dependent ecosystems

Operation phase (2027 – 2033) opencast mining within the Millerton Block and St Patrick catchment and groundwater takes from the pit sumps are likely to result in temporary drawdown in the range of 250 – 475 m from the edge of the pits and opencast workings (Figure 8.6). This has potential to impact any groundwater dependents ecosystems in any waterways and wetlands located within the radius of drawdown that rely on groundwater.

The potential impacts of dewatering on waterways aquatic ecosystems is discussed in the *'Buller Plateaux Aquatic Ecology: history, thresholds and long-term management'* (Instream, 2026)

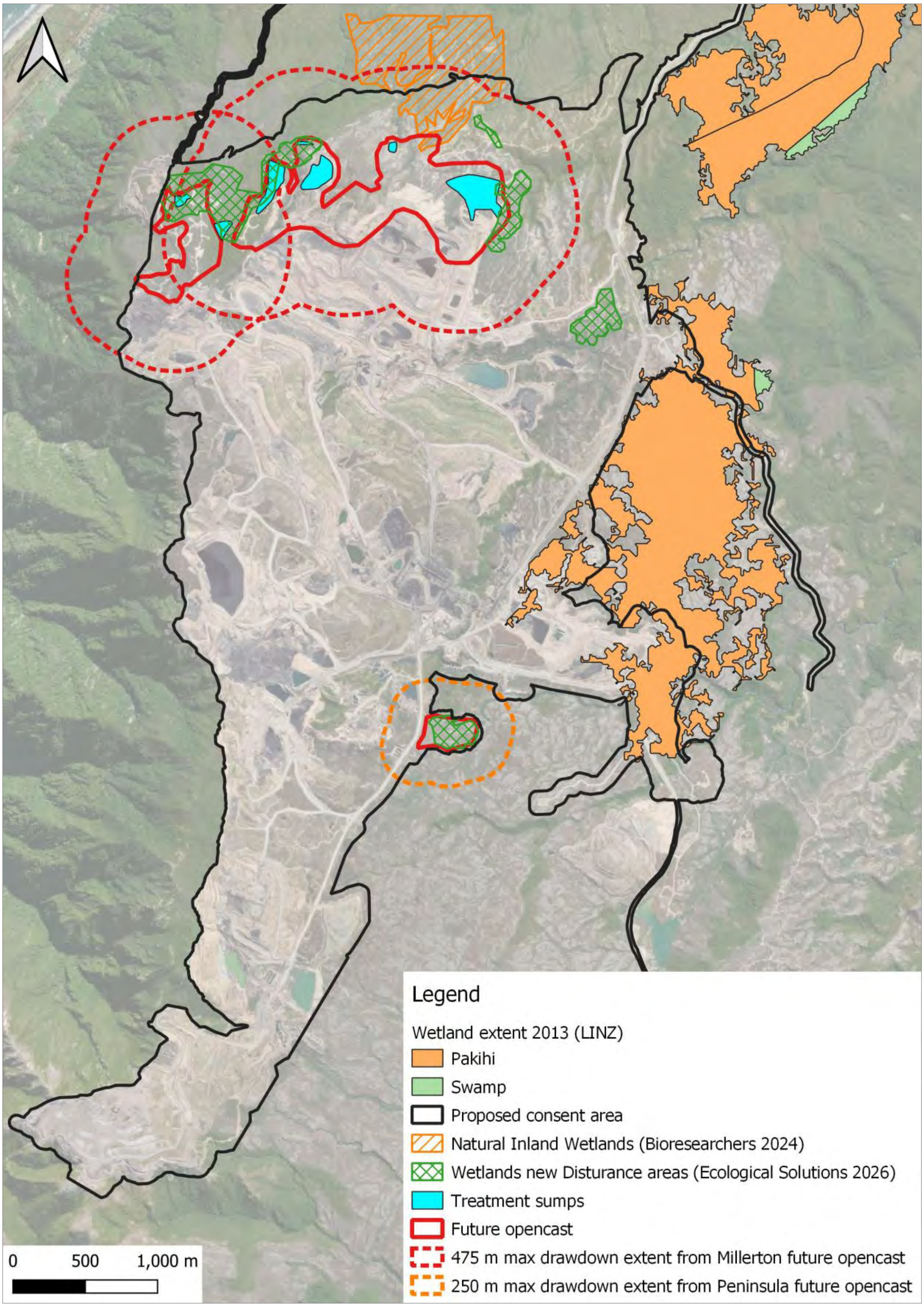

Figure 8.6 ***Reported wetlands, future water treatment sumps and maximum estimated future drawdown extents from opencast mining***

8.10.1 Wetlands

8.10.1.1 Stockton Plateau

Wetlands are ubiquitous across the Stockton Plateau and are assumed to be presented within the potential zone of drawdown. These wetland types and dominant water sources are discussed below:

– Pakahi wetlands are rainfall fed and exist on a thin soil over rock which is perched above the regional water table.
– The Manuka shrub land and associated wetland vegetation would be shallow rooted (generally < 1 m deep) and source the majority of its water from the thin soil overlying rock – meaning this vegetation to is also unlikely to intercept groundwater which is generally more than 5 m deep.

The exceptions to both points above would be at groundwater seepages, topographic low points and deeply incised waterways outside of the current and New Disturbance areas. However, these areas are likely to be a very small portion of the total area, and the topographic low points and incised waterways would be significantly influenced by rainfall run-off. As such, any groundwater related impacts on wetlands are considered are considered unlikely.

8.10.1.2 Coastal

Extensive wetlands occur along the coast downstream of AMD impacted Millerton Block waterways Granity Stream, Twins Stream and Rudolph Stream that flow from the Stockton Plateau. These wetlands are likely to receive some groundwater. The coastal wetland sampled at W1 half-way between Rudolph and Hugh Stream, shows no AMD impacts from the current mining operations (Section 5.8.3). The future water quality at Rudolph Stream is expected to improve (Instream 2026; Table 18) and Hugh Stream is not AMD impacted. Therefore, there is expected to be no negative impacts on the quality of water within this section of the wetland from the BPCP.

Wetland sampling next to Twins Stream and groundwater monitoring next to the more AMD impacted Granity and Twins stream further north is proposed to assess any potential future impacts (Section 9.1.2).

8.11 Groundwater users

Details of the current groundwater consents and registered / non-registered bores are discussed in Section 5.8.

8.11.1 Groundwater consents

Third party groundwater consents are held by:

– [redacted]
[redacted]
– None of the consents are used for potable supply.

Rockies Mine

[redacted]

[redacted]

[redacted]

[redacted]. The most likely (Base Case) drawdown extent from the edge of Twins Sump is ~130 m for the 20 m drawdown scenario shown in Figure 4.5. As such, any waterway flow losses from dewatering are expected to be negligible, but certainly possible.

Rudolph Stream water quality changes are not expected from the BPCP (Instream, 2026). A reduction in flow from the additional ~1 ha of the catchment being diverted from the construction of Twins Sump, is forecast to result in a 7-day MALF at the base of the catchment declining from 5 – 4.9 L/s (Instream, 2026). Rudolph Stream is located far enough away from Twins and Rockies East Sumps that any drawdown effects from temporary dewatering are also considered unlikely to reduce the flow.

[redacted]

Hydropower

[redacted]

[redacted]

[redacted]

- [redacted]
- [redacted]

[redacted]. Stockton BPCP activities are not expected to increase groundwater levels that might cause issues for construction dewatering and tunnelling, as such, any impacts are considered extremely unlikely.

[redacted]

[redacted]

[redacted] Under the BPCP, future groundwater abstractions from dewatering in this catchment are small ~5 L/s and temporary. The new CFSFs are not expected to significantly change groundwater levels and flow directions, and leachate will be captured and treated. Therefore, impacts on groundwater levels, quality are considered negligible.

8.11.2 Registered bores

The WCRC database lists 14 registered bores along the coastal sediments downgradient of, and well outside the Stockton CML.

[redacted] At this distance, impacts from Stockton on the groundwater quality or quantity is considered extremely unlikely.

Sampling by Bathurst in April and May 2026 showed no evidence of AMD impacts from Stockton mining on coastal groundwater and wetlands. In addition, the proposed BPCP will significantly improve the water quality in Twins Stream beyond 2028 (Instream, 2026), a waterway that loses flow to groundwater in its coastal reaches. As such, there are not considered to be any negative impacts from the BPCP.

8.11.3 Non-registered bores

[redacted] Water samples taken from this bore by Bathurst in April 2026 also show no evidence of AMD impacts from Stockton at this location.

8.11.4 Future consents and registered bores

Stockton Plateau

On the Stockton Plateau downgradient of the mining disturbance areas, future groundwater takes for sensitive uses such as potable supplies are considered much less likely due to the isolated nature of the area, and the potential constraints from lower yields in comparison to the more productive coastal alluvial aquifers. The overall waterway quality improvements downgradient of Stockton may reflect an improvement in groundwater quality as well.

Coastal groundwater

Recent (April 2026) water quality monitoring data (Section 5.7.2) indicates no AMD impacts on shallow coastal groundwater near Kerr Stream (Figure 3.9 and Figure 4.18). There is no groundwater quality data available to assess the potential impacts on groundwater further north near AMD influenced Granity and Twins Stream. Both waterways show a long-term water quality improvement (Instream, 2026 and Bathurst 2026a). Therefore, any potential impacts on groundwater quality assuming that both waterways losing flow to groundwater and future groundwater users would be expected to reduce with time. To assess, this area more fully, future groundwater monitoring (quality and levels) in this area is proposed (Table 9.1).

8.12 Cumulative impacts from outside Stockton

8.12.1 Cypress Mine

The Cypress Mine (Cypress) is located east of Stockton and lies partially within the St Patrick catchment and partially within the upper catchment of the Waimangaroa River. Key features at Cypress are the existing PAF waste rock stored within the Northern Engineered Landform (NELF) (ex-pit), existing dewatered North Pit, and the proposed to be dewatered South Pit.

The Cypress (three-dimensional numerical) groundwater flow modelling shows that the current drawdown from dewatering of the North Pit and proposed future South Pit does not extend into the Stockton proposed consent area (GHD, 2024, GHD, 2025). Hence, there is expected to be no cumulative impacts associated with opencast dewatering of pits at Stockton.

Currently, all dewatered groundwater and surface runoff from the Cypress North Pit is pumped to the St Patrick catchment at Stockton, where it is managed and treated, prior to discharge into St Patrick Stream. Existing cleanwater diversions ensure no AMD impacted Cypress water enters the Upper Waimangaroa River, thereby minimising any impacts associated with the AMD discharges from Stockton to the Upper Waimangaroa River via Whirlwind and Herbert Streams.

The AMD impacts on the Upper Waimangaroa River from Cypress and Stockton via the Herbert and Whirlwind streams is undertaken at surface water monitoring site 6W. The site is currently monitored as part of the Cypress consents (Instream, 2026) and is proposed to be included as part of the groundwater monitoring plan to assess any cumulative impacts associated with the proposed BPCP (Section 9.1.2).

8.12.2 Rockies Mine

The Rockies Mine (Figure 2.5) has potential for cumulative impacts on groundwater in the future, as the historical underground mine workings and associated AMD sources remain in place if mine remains closed, allowing groundwater impacts to persist without the benefit of remediation or removal. The mine is currently in care and maintenance, and there has been limited public information about its future, however the operation is consented until 2047. If mining does not recommence, the influence on the highly groundwater-dependent Twins Stream and Rudolph Stream is expected to remain broadly consistent with current conditions. Recommencement of mining could lead to changes in groundwater quality and potential effects on Twins Stream water quality, although the magnitude and extent of these changes remain uncertain.

Should mining re-commence, operations would include land rehabilitation, water treatment and removal of historical underground workings (REM, 2010a). This would be expected to reduce the long-term AMD impacts on these waterways. However, to manage this uncertainty, Bathurst is proposing that the Twins Stream groundwater seepage site T1 located upstream of Rockies Mine influence become a consent compliance site for managing the impacts on Twins Stream. This site provides Bathurst with a reference location for assessing water quality in the absence of influence from the Rockies Mine and is included as part of the proposed groundwater monitoring plan (Section 9.1). Further details are provided in Instream (2026).

8.12.3 Proposed Mount Fredrick South

The Mount Fredrick South (MFS) opencast coal mine is being proposed under the BPCP. The mine is located in the upper Waimangaroa catchment, ~1 km south of Stockton. Stockton and MFS are separated by Deep Creek which flows into the Upper Waimangaroa River. The creek receives groundwater inflows and is situated within a deep, highly incised valley rising 150 m to Stockton (MWM, 2026).

A groundwater impact assessment of the MFS as part of the BPCP was undertaken by MWM (2026). Opencast mining is expected to lower the water table by up to 30 m in some areas. However, the drawdown is not expected to reach as far as Stockton due to the relatively low permeability of the BCM, large elevation difference between the two mine sites, and the presence of Deep Creek probably acting as groundwater divide.

Potential cumulative impacts from groundwater are therefore considered to be limited to the Upper Waimangaroa River via inflows from Deep Creek and in-pit dewatering at MFS, and via inflows from Whirlwind and Herbert Streams at Stockton. Under the BPCP, the water quality in both Whirlwind and Herbert Streams is expected to improve (Instream, 2026), hence impacts from Stockton are expected to reduce.

Impacts from the MFS on the Waimangaroa River include discharges of treated in-pit dewatering directly to the river and changes in tributary flows (MWM, 2026). Overall, the modelling suggests an increase in lower flow conditions post-closure compared to baseline (MWM, 2026).

Over the course of the BPCP, the cumulative impacts on the Waimangaroa River downstream of MFS, Stockton and Cypress will be assessed at site 17W (compliance monitoring) downstream of Deep Creek confluence, and sites 2W (compliance monitoring) and 16W (performance monitoring) upstream of MFS (MWM, 2026). In addition, Whirlwind Stream site S4 and Herbert Stream site UC2 are proposed as performance monitoring sites downstream of Stockton (Instream, 2026).

8.13 Impacts without the BPCP

If the BPCP is not granted, upon closure of the Stockton, BT Mining is contractually obligated to return the land to the Crown. At that point, the Crown will take direct responsibility for treatment of all AMD sources (GHD, 2026b).

8.13.1 Groundwater impacts on waterways

Without the BPCP and associated water treatment, a significant regression in waterway quality is expected, unless the Crown undertakes ongoing water quality management equivalent to that currently in place. The impacts related to groundwater are discussed below.

Millerton Block

The closure of Stockton would cause AMD impacted fire suppression discharges and opencast mining to cease. This would result in an immediate improvement in the down-gradient groundwater and receiving waterway quality in the Millerton Block.

However, the long-term waterway quality without the BPCP would not improve to the extent that it would under the BPCP without 1) further open-cast mining to remove additional historical underground workings and underground fires that discharge AMD impacted water, 2) sump cut-off of historical workings and 3) sealing of the DCA portal and other underground working portals near pit sumps.

Both the forecasted waterway quality and proposed water treatment for the Millerton Block are covered in *'Millerton Water and AMD Management Report'* (Bathurst, 2026a).

Mangatini, St Patrick and Upper Waimangaroa catchments

Compared to the Millerton Block, the closure of Stockton would likely result in minimal changes to groundwater in the Mangatini, St Patrick and Upper Waimangaroa catchments apart from potential impacts to groundwater quality from PAF waste rock stored in the Webb ELF (Mangatini catchment). This reflects the extent of existing rehabilitation and the relatively limited intensity and duration of groundwater disturbance from mining activities in these areas. The ceasing of small areas of pit sump groundwater dewatering would result in isolated areas of groundwater levels rising to a new post-mining water level.

8.13.2 Groundwater user impacts

The ceasing of mining at Stockton is considered unlikely to impact existing groundwater users based on their distances from the active mining areas, and the generally low permeability rock hosting groundwater on the Stockton Plateau which limits the extent of any impacts. Potential impacts on coastal groundwater around AMD influenced Twins and Granity Stream would remain the same and reduce overtime from acid decay.

9. Recommendations

9.1 Proposed groundwater monitoring

9.1.1 Background

The existing groundwater monitoring data and current sites provide useful information on the current state of groundwater in some areas of Stockton. Future activities under the proposed BPCP will result in further changes to groundwater and hydraulically connected waterways.

It is recommended that the current hydrogeological monitoring be expanded to confirm the current predictions and to monitor the potential changes on groundwater from the BPCP and particularly hydraulically connected surface water. The Millerton Block is considered as the focus area where ongoing opencast mining and potential groundwater impacts on waterways are likely to be greatest.

9.1.2 Proposed monitoring and investigations

Details of the proposed groundwater monitoring investigations consistent with MFS and ESE (MWM, 20206a & b) are provided Table 9.1. The current water monitoring sites across the Stockton area are summarised in Table 9.2. The justification for the proposed groundwater monitoring sites is presented in Figure 9.1, and location information is summarised in Table 9.3. The proposed groundwater sampling details are provided Table 9.4.

Final details of the groundwater monitoring (sampling, location etc) will be confirmed as a condition of the granting of the BPCP. Most groundwater monitoring will be used to assess AMD management performance as opposed to measurement against specific compliance criteria.

As part of finalising the groundwater monitoring plan, a bore condition assessment and assessment of other groundwater monitoring sites will be undertaken to assess the status, condition and suitability for future monitoring. The final monitoring locations will also prioritise areas that will allow continued monitoring over the long-term, and minimise the number of sites being removed through operational activities.

The groundwater monitoring strategy for BPCP will focus on groundwater interaction with waterways and AMD impacts from the BCM (main acid-forming material) at / or near key discharges into waterways from seepages or historical underground workings and downgradient of potential contaminant sources in PAF waste rock, coal fines storage, water treatment sumps and pit floor run-off sites.

Slug testing of each new monitoring bore is proposed on completion (after development) to obtain site-specific hydraulic conductivity data for the Brunner Coal Measures / Kaita Mudstone and Basement. Slug testing is also proposed on existing monitoring bores that are assessed to be in reasonable condition. The extra hydraulic conductivity data will be important for any future groundwater modelling (analytical or numerical).

The final monitoring plan will also include flow and quality of key existing and future waste rock seepages.

Table 9.1 Proposed groundwater monitoring and investigations

Catchments	Monitoring site description	Groundwater monitoring type and analysis	Formation monitored	Reporting type	Monitored impacts from	Monitored impacts on	'Current' monitored or proposed 'new'
Millerton Block	Continue measurements from current monitoring bores with VWTs installed within historical underground workings down-gradient and within the Millerton opencast pit areas that still exist and are of suitable condition. Noting that some of these sites will likely be removed through future opencast mining.	Levels / possibly quality	BCM	Performance	Fire suppression discharges, pit dewatering, climatic influences, especially rainfall.	Groundwater interaction with Mine Creek, Miller Stream and Granity Stream.	Current
	T1 groundwater seepage into Twins Stream. Sampling as per proposed consent compliance limits under the BPCP for dissolved aluminium and turbidity (Instream, 2026).	Flow and quality	BCM	**Compliance**	AMD treatment activities and separation of potential impacts on Twins Stream from Rockies Mine.	Groundwater interaction with Twins Stream	Current
	Monitoring bore	Levels and quality	BCM	Performance	Dewatering associated with opencast mining, pit sumps and changes due to removal of underground workings.	Groundwater with a focus on potential impacts to Rockies Coal Mine	New
	Historical underground workings - DCA portal	Flow and quality	BCM	Performance	Fire suppression discharges, opencast mining and the underground workings	Mine Creek – receiving waterway	Current
	Paired monitoring bores located up-gradient and down-gradient of the proposed MW16 (AMD water treatment) Sump and Millerton ELF and in undisturbed material and providing background (reference) data up-gradient of historic workings and waste rock. The paired monitoring bores include one bore screened into the BCM and one into the Basement to monitor hydraulic connection and potential contaminant pathways between the two HSUs.	Levels and quality	Basement / BCM	Performance	MW16 Sump AMD seepage, Millerton ELF, groundwater flow, and underground workings cutoff, waste rock, underground workings and dewatering activities	Groundwater interaction with waterways including Mine Creek.	New
	Two monitoring bores located between Granity and Twins Streams. Quarterly monitoring for two years – followed by a review to assess the results and whether further monitoring is required. Note that the proposed location of these new bores is outside the Stockton mining area, so will be subject to landowner approval.	Levels and quality	Coastal sediments	Performance	Potential AMD seepage into groundwater from Twins ad Granity Streams.	Shallow (unconfined) groundwater	New
Mangatini	Bores adjacent and downgradient of Mangatini Sump.	Levels and quality	BCM	Performance	Seepage of AMD and LDS from the sump.	Groundwater	Current
	Existing bore STK7163 used to monitor groundwater impacts down-gradient of the proposed Webb ELF (used for disposal of Cypress PAF waste rock). This bore has been installed as part of Cypress consent RC03175, which requires that a sampling and monitoring programme be established. Additional monitoring downgradient of the Webb ELF using. paired monitoring bores; one to target the BCM and one to target Basement. Paired monitoring bores screening undisturbed material and providing background (reference) data up-gradient of historic workings and waste rock.	Levels and quality	Basement / BCM	**Compliance**	AMD from Cypress PAF waste rock material.	Groundwater	Current and New
	Monitoring bores and seepages.	Levels and quality	BCM	Performance	Current A18 CFSF.	Groundwater down-gradient of CFSFs and upgradient of Ford Creek	New
	Coal fines pore water, seepage quality and levels measured in VWPS.	Levels and quality	Coal Fines	Performance	CFSFs.	Groundwater	Current
St Patrick	Monitoring bores screened into to BCM and Basement to monitor hydraulic connection and potential contamination pathways. Paired monitoring bores screening undisturbed material and providing background (reference) data up-gradient of historic workings and waste rock.	Levels and quality	Basement / BCM	Performance	CFSFs.	Groundwater down-gradient of CFSFs and upgradient Fly Creek and T31 Stream	New
	Monitoring bores and seepages.	Levels and quality	BCM	Performance	New CFSFs	Groundwater up-gradient and down-gradient of CFSFs	New
	Coal fines pore water, seepage quality and levels measured in VWPS.	Levels and quality	Coal Fines	Performance	CFSFs.	Groundwater	Current
Upper Waimangaro a	Combined groundwater and surface water impacts at monitored at Upper Waimangaroa River monitoring site 6W.	Quality	-	Performance	Cumulative impacts from the Cypress and Stockon mining.	Upper Waimangaroa River	Current

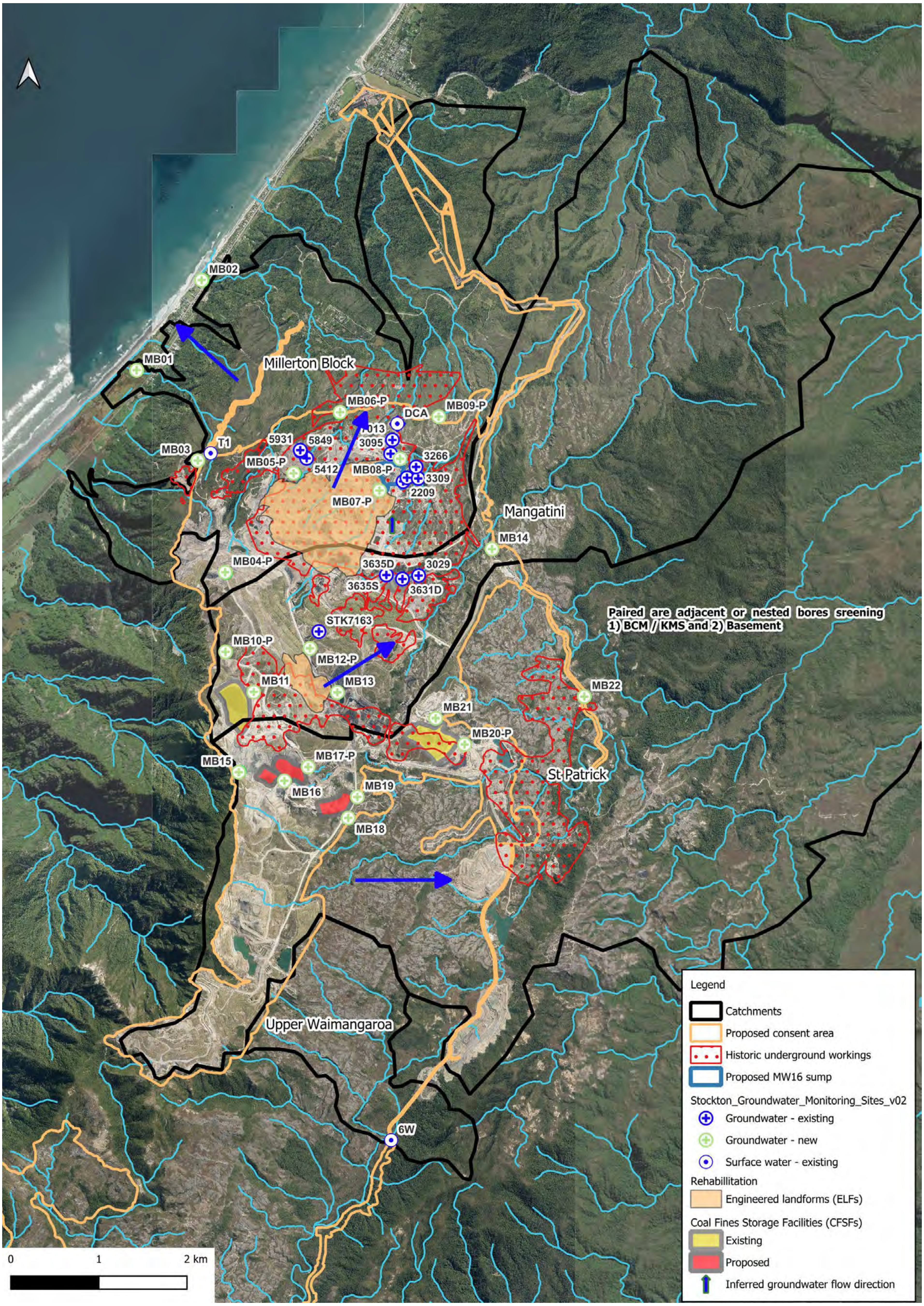

Figure 9.1 Proposed groundwater monitoring locations on the Stockton Plateau. New monitoring locations are indicative and some existing sites will be removed as a result of continued opencast mining

Table 9.2 Current water monitoring location summary

ID	xNZTM	yNZTM	Source	Catchment	Monitoring type	Target Unit(s)
T1	1504670	5388917	Surface water	Millerton Block	Water course	Groundwater discharge
6W	1506719	5381113	Surface water	Upper Waimangaroa	Water course	Groundwater discharge
DCA	1506789	5389252	Surface water	Millerton Block	Water course	Groundwater discharge
STK7163	1505899	5386890	Groundwater	Mangatini	Single bore	BCM
3029	1507031	5387526	Groundwater	Mangatini	Single bore	Mangatini Sump
3631S	1506848	5387487	Groundwater	Mangatini	Single piezometer	Mangatini Sump
3631D	1506848	5387487	Groundwater	Mangatini	Single piezometer	Mangatini Sump
3635S	1506665	5387533	Groundwater	Mangatini	Single piezometer	Mangatini Sump
3635D	1506665	5387533	Groundwater	Mangatini	Single piezometer	Mangatini Sump
2209	1506855	5388595	Groundwater	Millerton Block	Single bore	Millerton Pit
2503	1506899	5388638	Groundwater	Millerton Block	Single bore	Millerton Pit
3309	1507027	5388630	Groundwater	Millerton Block	Single bore	Millerton Pit
3266	1507002	5388761	Groundwater	Millerton Block	Single bore	Millerton Pit
3095	1506713	5388910	Groundwater	Millerton Block	Single bore	Millerton Pit
7013	1506734	5389068	Groundwater	Millerton Block	Single bore	Millerton Pit
5412	1505760	5388859	Groundwater	Millerton Block	Single bore	Millerton Pit
5849	1505693	5388937	Groundwater	Millerton Block	Single bore	Millerton Pit
5931	1505687	5388951	Groundwater	Millerton Block	Single bore	Millerton Pit

Table 9.3 Proposed groundwater monitoring location summary

ID	xNZTM	yNZTM	Source	Catchment	Monitoring type	Target Unit(s)
MB01	1503830	5389860	Groundwater	Millerton Block	Single bore	Unconsolidated sediments[1]
MB02	1504567	5390882	Groundwater	Millerton Block	Single bore	Unconsolidated sediments[1]
MB03	1504524	5388833	Groundwater	Millerton Block	Single bore	BCM/KMS[2]
MB04	1504835	5387564	Groundwater	Millerton Block	Paired	BCM/KMS & Basement
MB05	1505611	5388688	Groundwater	Millerton Block	Paired	BCM/KMS & Basement
MB06	1506139	5389383	Groundwater	Millerton Block	Paired	BCM/KMS & Basement
MB07	1506586	5388492	Groundwater	Millerton Block	Paired	BCM/KMS & Basement
MB08	1506820	5388854	Groundwater	Millerton Block	Paired	BCM/KMS & Basement
MB09	1507259	5389332	Groundwater	Millerton Block	Paired	BCM/KMS & Basement
MB10	1504839	5386660	Groundwater	Mangatini	Paired	BCM/KMS & Basement
MB11	1505159	5386205	Groundwater	Mangatini	Single bore	BCM/KMS
MB12	1505798	5386699	Groundwater	Mangatini	Paired	BCM/KMS & Basement
MB13	1506109	5386200	Groundwater	Mangatini	Single bore	BCM/KMS
MB14	1507864	5387828	Groundwater	Mangatini	Single bore	BCM/KMS
MB15	1504989	5385293	Groundwater	St Patrick	Single bore	BCM/KMS
MB16	1505508	5385195	Groundwater	St Patrick	Single bore	BCM/KMS
MB17	1505777	5385353	Groundwater	St Patrick	Single bore	BCM/KMS
MB18	1506232	5384773	Groundwater	St Patrick	Single bore	BCM/KMS
MB19	1506335	5385012	Groundwater	St Patrick	Single bore	BCM/KMS
MB20	1507553	5385608	Groundwater	St Patrick	Paired	BCM/KMS & Basement
MB21	1507225	5385906	Groundwater	St Patrick	Single bore	BCM/KMS
MB22	1508912	5386153	Groundwater	St Patrick	Single bore	BCM/KMS

<u>Notes</u>:
1- Coastal groundwater
2- Rockies Coal Mine Bore

Table 9.4 Proposed groundwater monitoring details

Details	Description
Number of monitoring sites	As shown in Figure 9.1 and discussed in Table 9.1.
Screen targets	Screens will target intercepted structures (e.g., fracture zones) and/or bedding contacts (e.g., BCM and Basement contact).
Sampling frequency	Sampling frequency will be quarterly and full major ions suites annually.
Sampling methodology	Manual and automated (with pressure transducers) groundwater level measurement. Low flow sampling methodology is the preferred method to obtain a representative sample where possible.
Sampling parameters	Field: Groundwater level (manual and from pressure transducers). pH, temperature, electrical conductivity, oxidation reduction potential, dissolved oxygen. Laboratory: Laboratory: pH Electrical Conductivity Alkalinity Acidity (to pH 8.3) Bicarbonate Chloride Sulphate Nitrate-nitrogen Total nitrogen Dissolved Calcium Dissolved Magnesium Dissolved Potassium Dissolved Sodium Dissolved Aluminium Dissolved Arsenic Dissolved Cadmium Dissolved Chromium Dissolved Copper Dissolved Iron Dissolved Manganese Dissolved Nickel Dissolved Selenium Dissolved Zinc Dissolved Organic Carbon Total Suspended Solids Turbidity
Quality Control sampling	One trip blank per sampling event. One duplicate sample per every 10-20 primary samples. One field blank per sampling event
Reporting requirements	Groundwater monitoring data collected will be reported in an annual water report alongside surface water monitoring.

10. References

Alarcon , 1997. Long-term mine site rehabilitation studies at Stockton open cast coal-mine. Master's thesis, University of Canterbury, Christchurch, New Zealand. **https://ir.canterbury.ac.nz/handle/10092/1679**

Applied Geology Associates, 1984. Coal Quality Investigations Stockton No 2 Block. Vol. 1. New Zealand Coal Resources Survey. 24 pp.

Aravin, V.I., & Numerov, S.V. 1953. Theory of Groundwater Flow. State Technical Publishing House for Literature on Geology and Conservation of Mineral Resources. Moscow.

Bathurst 2026a. Millerton Water and AMD Management Report. Stockton Mine. February 2026.

Bathurst 2026b. Stockton Mine 80-year water quality forecast. Version 4. 7 January 2026. Internal memorandum. Prepared by Bathurst Resources Limited.

Bathurst 2026c. Stockton Mine Acid and Metalliferous Drainage (AMD) Environment Management Plan STO-ENV-PLN-016. May 2026.

Bathurst 2026d. Stockton. Water quality nitrates. Reviewed by Dr Chris Hickey, May 2026.

Bioresearchers, 2024. Stockton Mine. Millerton Wetland Assessment. for: BT Mining. Draft A. 8 July 2024.

CoalCorp 1995. Resource consent application for Buller Bay Jetty feasibility study. Reference TCH 8/11. December 1995.

Davies, H., Weber, P., Lindsay, P., Craw, D. & Pope, J. (2011). Characterisation of acid mine drainage in a high rainfall mountain environment, New Zealand. Science of the Total Environment, 409(15), 2971–2980. **https://doi.org/10.1016/j.scitotenv.2011.04.034**

Department of Conservation (Doc) Unknown. KAW _12 - Birchfield, Birchfield East Wetland, Granity Wetland. **https://ftp.doc.govt.nz/public/file/Byw-pBP5MU632BcFq39GyQ/SLR%20-%20WSI%20-%20KAW_12%20-%20Birchfield%2C%20Birchfield%20East%20Wetland%2C%20Granity%20Wetland%20-%20Technical%20Report%20-%20DOC-6865335.pdf**

Dudding, M.W.G., 1988; Hydrogeological investigation of the Marshall Block, Upper Waimangaroa Sector, Buller Coalfield. Unpublished thesis. University of Canterbury, New Zealand. 178 pp.

Gandy and Younger 2007. Predictive Modelling of Waste Rock Leaching at Stockton Mine. Hydrogeochemical Engineering Research and Outreach Institute for Research on Environment and Sustainability Newcastle University, UK issued July 2007.

GHD 2020. Pit Bund Liner. Memorandum prepared for BT Mining Limited.

GHD 2021. Cypress Mine groundwater and water balance model – Groundwater Assessment.

GHD 2024a. Cypress Mine Groundwater and Water Balance Model. Groundwater Assessment – Updated South Pit GHD Limited (NZ). Prepared for BT Mining.

GHD 2024b. Stockton Hydrogeological Desktop Assessment. Prepared for Bathurst Resources Limited. 16 October 2024.

GHD 2025. Cypress Mine Groundwater. Groundwater Assessment - Updated North Pit. GHD Limited (NZ). 29 August 2025

GHD. 2026a. High-level assessment of changes in groundwater and geotechnical site conditions relating to proposed placement of SN14 Backfill. Letter report. Prepared for Bathurst Resources Limited. 26 February 2026.

GHD. 2026b. Stockton water management and assessment of effects on waterways and water users from the BPCP Stockton mining activities. Bathurst Resources Limited (including its subsidiary companies BT Mining Ltd, Bathurst Coal Ltd, and Buller Coal Ltd).

Golder Associates 2010. Cypress Mining Project Post-Mining Groundwater Recovery Assessment. Prepared for Solid Energy (NZL).

Heron, D. W. (custodian). 2014. Geological map of New Zealand 1:250,000: Digital vector data 2014 (2nd ed.; GNS Science Geological Map 1). GNS Science.

Instream 2026. Stockton Plateau aquatic ecology: history, thresholds and long-term management. Client report prepared by D. P. Gray, L. Hore, T. Green for BT Mining. 145p.

Kingett Mitchell Limited 2005. Hydrogeological Review for Highwall. R_JR250705.

Kyrieleis, W., & Sichardt, W. 1930. Grundwasserabsenkung bei Fundierungsarbeiten. Springer, Berlin.

Land Information New Zealand 2011. NZ River Centrelines (Topo, 1:50k) **https://data.linz.govt.nz/layer/50327-nz-river-centrelines-topo-150k/** (Accessed 23/7/24)

Land Information New Zealand 2012a. NZ Pond Polygons (Topo, 1:50k) **https://data.linz.govt.nz/layer/50310-nz-pond-polygons-topo-150k/** (Accessed 23/7/2024)

Land Information New Zealand 2012b. NZ Lake Polygons (Topo, 1:50k) **https://data.linz.govt.nz/layer/50293-nz-lake-polygons-topo-150k/**

Land Information New Zealand 2012c. NZ 8m Digital Elevation Model (2012). **https://data.linz.govt.nz/layer/51768-nz-8m-digital-elevation-model-2012/** (Accessed 23/7/2024)

Land Information New Zealand 2024a. NZ Contours (Topo, 1:250k) **https://data.linz.govt.nz/layer/50159-nz-contours-topo-1250k/** (Accessed 23/7/2024)

Land Information New Zealand 2024b. Prediction of wetlands before humans arrived **https://data.mfe.govt.nz/layer/52677-prediction-of-wetlands-before-humans-arrived/** (Accessed 23/7/2024)

Land Information New Zealand 2024c. Current wetland extent, 2013. **https://data.mfe.govt.nz/layer/52676-current-wetland-extent-2013/** (Accessed 23/7/2024)

Macara, G.R. 2016. The Climate and Weather of West Coast. 2nd edition. ISSN 1173-0382. **https://niwa.co.nz/sites/default/files/West_Coast_Climatology_NIWA_web.pdf**

Manaaki Whenua – Landcare Research 2021. LRIS Portal. LCDB v5.0 - Land Cover Database version 5.0, Mainland, New Zealand. **https://lris.scinfo.org.nz/layer/104400-lcdb-v50-land-cover-database-version-50-mainland-new-zealand/** (Accessed 20/8/2024)

MWH 2003. Cypress Mine Pre-Feasibility Assessment of the North Pit Embankment.

Mine Waste Management (MWM) 2026a. Mt Frederick South. Groundwater Technical Report. 3 February 2026. J-NZ0377-004-R-Rev0.

Mine Waste Management (MWM) 2026b. Escarpment Extended Mine Project. 3 February 2026. J-NZ0433-002-R-Rev0.

Mine Waste Management (MWM) 2026c. Hydrological assessment. Buller Plateaux Continuation Project. J-NZ0494-001-R-RevB.

Ministry for the Environment (2010). River Environment Classification Catchment Order 3.

https://data.mfe.govt.nz/layer/52370-river-environment-classification-catchment-order-3-2010/

O'Kane Consultants 2015. Acid Mine Drainage Liabilities. Stockton and Cypress Operations. Report No. 949/01-01 issued July 2015.

Pope, J., Christenson, H., Gordon, K., Newman, N., Trumm, D., 2018a. Decrease in acid mine drainage release rate from mine pit walls in Brunner Coal Measures. New Zealand Journal of Geology and Geophysics, Vol. 61, No. 2, 195–206.

Resource and Environmental Management Limited (REM), 2010. Rockies Mine Project. West Coast Regional Council Resource Consent Application and Assessment of Effects on the Environment. ROC01. V2. 15 March 2010.

West Coast Regional Council (WCRC) 2010. Resource Consent for [redacted]. V3. May 2010.

[redacted]

Solid Energy. 2010. Millerton Mining Area. Revised Water Management Strategy. Resource Consent Application and Assessment of Environmental Effects. November 2010.

Solid Energy. 2017. Millerton Syncline and Drainage Control Adit. Summary of Interaction with Coal. 21 April 2017. By [redacted].

SouthDrill. 2016. Bore Log Data Sheet. 180.5 m deep borehole. [redacted]. RC-2016-0066-01. 15 November 2016.

Taumata Araowai, 2022a. Aesthetic Values for Drinking Water. Notice 2022. **https://www.taumataarowai.govt.nz/assets/Uploads/Rules-and-standards/Taumata-Arowai-Aesthetic-Values-for-Drinking-Water-2022.pdf**

Taumata Araowai, 2022b. Water Services (Drinking Water Standards for New Zealand) Regulations 2022. **https://www.legislation.govt.nz/secondary-legislation/pco-drafted/2022/168/en/latest/#LMS698021**

Trewick, S.A., Walker, K.J., Jordan, C.J. 2008. Taxonomic and conservation status of a newly discovered giant landsnail from Mount Augustus, New Zealand. Conservation Genetics, December 2008. **https://www.researchgate.net/publication/225314419_Taxonomic_and_conservation_status_of_a_newly_discovered_giant_landsnail_from_Mount_Augustus_New_Zealand**

Tregaskis Brown and Tonkin + Taylor 2023. Stockton Mine AMD Management Project. Prepared for Te Tai Ōhanga – The Treasury, Version 2.1, dated 19 December 2023. Business Case Appendices.

Tregaskis Brown and Tonkin + Taylor 2024. Stockton Mine AMD Management Project. Prepared for Te Tai Ōhanga – The Treasury, Version 2.2, dated 6 March 2024. **https://www.treasury.govt.nz/sites/default/files/2025-12/stockton-mine-drainage-business-case.pdf**

Trumm, D., Watts, M., Pope, J. & Lindsay, P., 2008. Using pilot trials to test geochemical treatment of acid mine drainage on Stockton Plateau. New Zealand Journal of Geology and Geophysics, 51(3), pp.175–186. **https://doi.org/10.1080/00288300809509858**

URS 2005. Technical Memorandum. Dam Construction Material Characterisation. Stockton Opencast Mine. Prepared for, Solid Energy NZ Ltd. 19 August 2005.

URS 2008. Millerton Syncline Trial Update. Memorandum. 15 August 2008.

URS 2010. Cypress Mine South Pit Packer Testing.

Westerhoff et al., 2018. Application of an improved global-scale groundwater model for water table estimation across New Zealand, Hydrol. Earth Syst. Sci., 22, 6449–6472, doi:10.5194/hess-22-6449-2018. **https://hess.copernicus.org/preprints/hess-2018-235/hess-2018-235.pdf**

WestMaps 2014a. West coast water bores. **https://gis.westcoast.govt.nz/WestMapsViewer/?map=f00edc0d875f4508b76c89e321c64f1a** (Accessed 23/8/24)

WestMaps 2014b. West coast consents. **https://gis.westcoast.govt.nz/WestMapsViewer/?map=a167d549ecf04e58b6404e1c45afb305** Accessed 23/8/24)

White PA, Moreau M, Mourot F, Rawlinson ZJ. 2019 (Revised 2022). New Zealand groundwater atlas:hydrogeological-unit map of New Zealand. Lower Hutt (NZ): GNS Science. [86] p. Consultancy Report 2019/144. **https://environment.govt.nz/assets/Publications/Files/New-Zealand-Groundwater-Atlas-Hydrogeological-Unit-Map-of-New-Zealand.pdf**

Winterbourn MJ and McDiffett WF, 1996. Benthic faunas of streams of low pH but contrasting water chemistry in New Zealand. Hydrobiologia 341:101–11.

Appendices

Appendix A

Hydraulic properties (source: GHD, 2024)

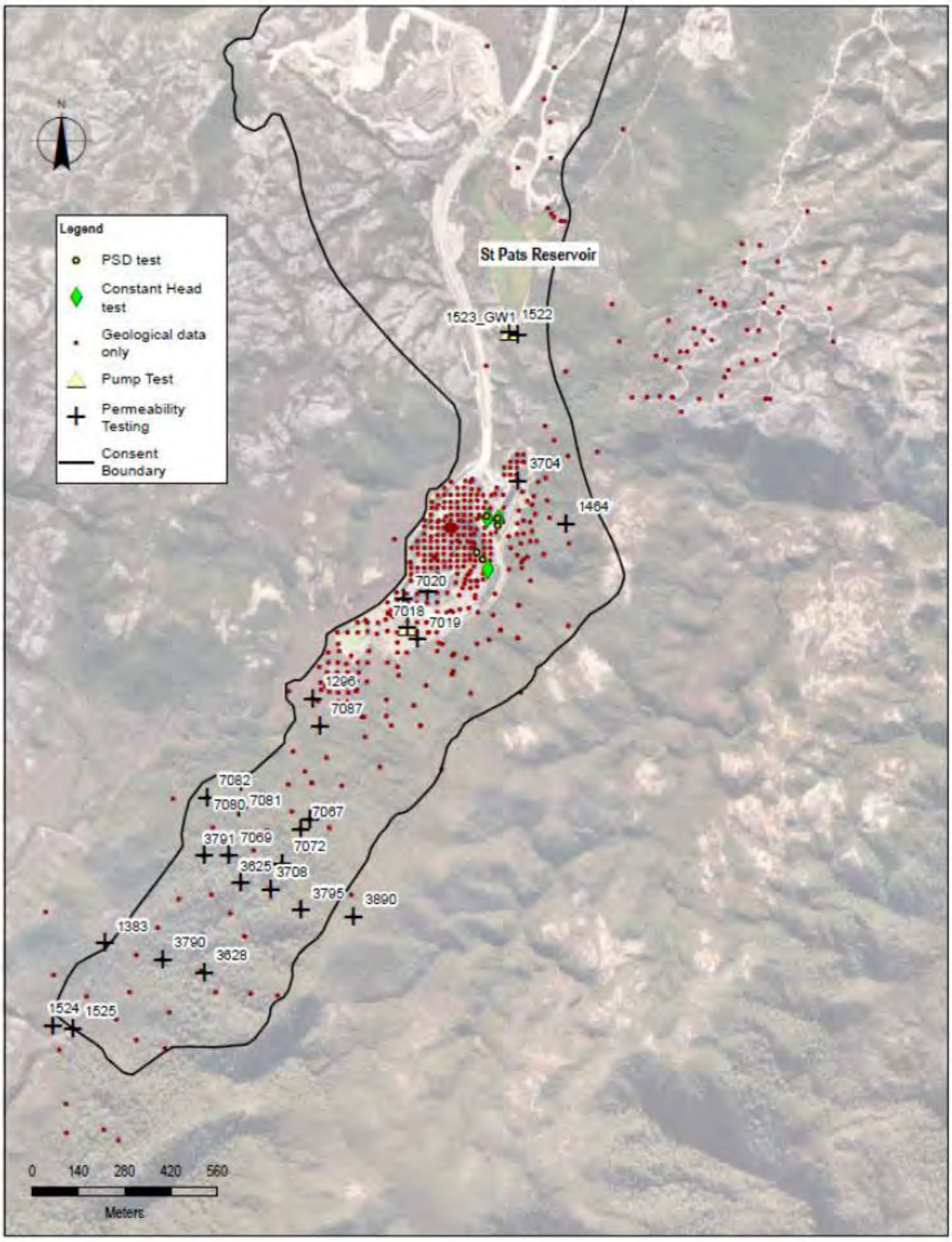

Figure A.1 ***Hydraulic property test locations and geological boreholes at Cypress (source: GHD, 2024)***

Table A.1 ***Hydrogeological properties from previous reports and data (source: GHD, 2024)***

Report / Source	Unit	Conductivity (m/s)		Specific Storage	Porosity	Notes
		Range	Reported Mean			
MWH (2003)	BCM	9.6×10^{-6} to 2.3×10^{-7}	2.0×10^{-6}	-	-	Values from Rekker, (for MWH) 2001
	Basement	1.5×10^{-6} to 2.9×10^{-7}	2.3×10^{-7}	-	-	
Kingett Mitchell Ltd (2005)	BCM Fracture zones	-	6×10^{-5}	-	-	-
	BCM	-	2.0×10^{-6}	7×10^{-7} *	*	*associated with confined zones, may decrease to 10-

Report / Source	Unit	Conductivity (m/s)		Specific Storage	Porosity	Notes
		Range	Reported Mean			
						[3] or 10^{-4} where depressurised
	Basement	2.9×10^{-7} to 1.5×10^{-6}	-	-	-	-
	Mudstone	1.3×10^{-5} to 7×10^{-6}	-	-	-	-
Golder Associates (2010)	Mudstone	-	2.9×10^{-7}	0.03	6×10^{-5}	Applied in model after data review and calibration
	BCM	-	3.75×10^{-6}	0.15	6×10^{-5}	
	Basement	-	1.9×10^{-7}	0.01	1×10^{-5}	
	Fault Zone	-	3.8×10^{-9}	0.04	0.0001	
	Fill	-	5.0×10^{-5}	0.25	0.0001	
URS (2010)	Mudstone	3.5×10^{-6} to 3.9×10^{-8}	1.3×10^{-6}	-	-	Packer tests discounted in average if screened across significant portions of two units
	BCM	4.0×10^{-6} to 2.6×10^{-8}	1.1×10^{-6}	-	-	
	Basement	2.8×10^{-6} to 8.6×10^{-10}	4.7×10^{-7}	-	-	
Stockton Alliance Testing 2014 – 2019	Mudstone	-	1.4×10^{-6}	-	-	Tests undertaken for the Stockton Alliance / BT Mining (Cypress South Packer Tests excel documents provided by BT Mining and Stockton Alliance, 2014 report *Storativity values from DH7018 pump test
	BCM	-	8.9×10^{-8}	1×10^{-5} to 4×10^{-6} *(Storativity values from DH7018 pump test)	-	
GHD (2020 2021) Pit Bund Liner	Pit Liner - Kaiata	-	<1×10^{-8}	-	-	Well compacted and consistent liner (target compaction)
	Pit Liner - granite	1×10^{-6} to 5×10^{-7}	-	-	-	Average from field testing
	Basement rock	1×10^{-9}	-	-	-	Low permeability applied, considered representative
	Fracture zone	1×10^{-3}	-	-	-	-
	BCM	3.8×10^{-6}	-	-	-	-
	Kaiata	2.9×10^{-7}	-	-	-	-
GHD (2023) Constant Head and Particle Size Distribution	Kaiata	4.1×10^{-8} to 4.5×10^{-10}	1.5×10^{-8}	-	-	-

Appendix B

Water quality results (source: Bathurst)

Parameter	New Zaland drinking water standards		ex-Solid Energy monitoring bore		Wetland (W1)
	Guideline Value (GV)[1]	Maximum Acceptable Value (MAV)[2]	17 April 2026	29 April 2026	29 April 2026
Turbidity (NTU)	≤ 5 appearance		169	130	99
pH	7.0 – 8.5		5.9	6.3	5.7
Total Acidity (pH 8.3) mg/L ($CaCO_3$)			27	70	60
Electrical Conductivity (mS/m)			10.4	12.7	8.4
Total Suspended Solids (mg/L)			320	320	156
Dissolved Aluminium (mg/L)	≤ 0.1 deposits	≤ 1	0.128	0.034	0.31
Dissolved Cadmium (mg/L)		≤ 0.004	< 0.00005	< 0.00005	< 0.00005
Dissolved Calcium (mg/L)			6.2	9.0	4.9
Dissolved Chromium (mg/L)		≤ 0.05	0.0019	< 0.0005	0.0018
Dissolved Cobalt (mg/L)			< 0.0002	0.0003	0.0002
Dissolved Copper (mg/L)	≤ 1 staining	≤ 2	0.001	< 0.0005	0.0012
Dissolved Iron (mg/L)	≤ 0.3 staining		0.02	0.14	< 0.02
Dissolved Magnesium (mg/L)			1.54	1.86	1.04
Dissolved Manganese (mg/L)	≤ 0.04 staining ≤ 0.10 taste	≤ 0.4	0.0045	0.0193	0.032
Dissolved Nickel (mg/L)		≤ 0.08	0.0014	0.0051	0.0021
Dissolved Thallium (mg/L)			-	< 0.00005	< 0.00005
Dissolved Zinc (mg/L)	≤ 1.5 taste		0.0062	0.0166	0.31
Total Ammoniacal-N (mg/L)			< 0.010	-	-
Nitrite-N (mg/L)		≤ 0.9	< 0.002	-	-
Nitrate-N (mg/L)		≤ 11.3	1.6	-	-
Nitrate-N + Nitrite-N (mg/L)			1.6	-	-
Dissolved Reactive Phosphorus (mg/L)			< 0.004	-	-
Sulphate (mg/L)	≤ 250 taste		2	1.9	2.0
[1] Taumata Araowai, 2022a, [2] Taumata Araowai, 2022b					
Exceeds GV					
Exceeds MAV					
Water samples taken by BT Mining					