Source Term Definition Report

Bendigo-Ophir Gold Project

5 August 2025

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MINE WASTE MANAGEMENT
GREENROAD GROUP

MATAKANUI
GOLD LIMITED

Source Term Definition Report

Bendigo-Ophir Gold Project

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EXECUTIVE SUMMARY

Mine Waste Management Limited (MWM) has developed this report to define the source terms for the water and load balance model (WLBM) for the Bendigo-Ophir Gold Project (BOGP) for Matakanui Gold Limited (MGL) to provide a summary of inputs that will be used during the modelling process. The model is discussed in MWM (2025c).

Objectives of this Study

The objectives of this report are to:

- Define the sources of data used for developing the water quality source terms.

- Define the rationale applied in deriving the source terms.

- Propose what performance monitoring is required to ensure potential effects are understood in advance.

Findings

The materials associated with the BOGP will generate neutral metalliferous drainage and may have elevated potential constituents of concern (PCOC) such as arsenic (As), sulfate, (SO_4), and trace metals. Nitrogenous compounds are also likely to be elevated. Collectively this is identified as mine impacted waters (MIW).

Water quality source terms were developed from a variety of sources including analogue data sources, baseline studies at the BOGP, and laboratory derived data from environmental geochemistry testing. This report provides an explanation of how the source terms for modelling were developed for the WLBM.

Management

Water management during the Operational Phase of the BOGP will involve discharge of only episodic runoff from haul roads and ELF surfaces. All other MIW (e.g., landform seepage) will be collected, used, and stored on site. In the Active Closure / Post Closure Phase, MIW will be treated and discharged to the receiving environment. Two models have been developed, that are reported elsewhere (MWM, 2025c) to reflect these phases:

- Operational Phase - Excel based models and calculations focussing on average annual water balance and runoff event discharge of MIW.

- Active Closure / Post Closure Phase - GoldSim based models and calculations, focussing on the evolution of instream water quality over time as a result of discharge of treated MIW.

Detailed stage models for years 1-13 of the BOGP will be developed using GoldSim[1] prior to mining commencing (i.e., during the project pre-startup phase). This will provide an operational tool for MGL to effectively manage water during operations.

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[1] https://www.goldsim.com

General Background

MGL is proposing to establish the BOGP, which comprises gold mining operations, processing operations, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell and will have a maximum disturbance footprint of 550 hectares.

The total Mineral Resource Estimate for the BOGP using a 0.5 g/t cut-off for open pit and 1.5 g/t for underground is 34.3 Mt at 2.1 g/t for 2.34 M oz (MGL, 2025). The Bendigo-Ophir resources occur in four deposits: Come in Time (CIT), Rise and Shine (RAS), Srex (SRX), Srex East (SRE). The majority of identified mineral resources are located within the RAS deposit. Three primary geological units are recognised at site:

- RSSZ – Rise and Shine Shear Zone

- TZ3 – Lower Greenschist facies Textural Zone 3 rocks of the Otago Schist

- TZ4 – Upper Greenschist facies Textural Zone 4 rocks of the Otago Schist

The resources will be mined by open pit methods at each deposit within the project site, with underground mining methods also proposed to be utilised at RAS to access the deeper gold deposits. The majority of the mining activities, ancillary facilities and associated infrastructure will be located in the Shepherds Valley with non-operational infrastructure located on the adjoining Ardgour Terrace. The BOGP also involves the taking of groundwater from the Bendigo Aquifer for use in mining-related activities and the realignment of Thomson Gorge Road via Ardgour Station.

There are numerous historic mine workings throughout the project area, which can impact baseline water quality. The archaeological survey completed by Lawrence et al. (2019) indicated 59 historic mine archaeological sites were identified within a 16 km^2 survey area. The majority of mine workings were pre-1900 mining activities and included the following key historic workings (Lawrence et al., 2019):

- Stamping batteries and processing areas.

- Underground mine adits.

- Mullock piles and tailings mounds.

- Sluicing areas.

These historical workings have affected the water quality in the area. For instance, arsenic is elevated in the Rise and Shine Creek, which is below these historic workings (MWM, 2025a).

Project Description

The proposed BOGP will include the following components:

- Open pits targeting the RAS, SRX, SRE, and CIT deposits.

- An underground mine targeting the RAS deposit.

- Three ex-pit engineered landforms (ELFs) – Shepherds ELF, SRX ELF, and West ELF (WELF).

- Two in-pit landforms (backfill) – CIT and SRE[2].

- Plant and processing area, where carbon-in-leach (CIL) extraction technologies will be used as part of the ore recovery process.

- A tailings storage facility (TSF) and TSF Embankment.

- Other ancillary support services / structures (e.g., roads, water management infrastructure, water treatment plants, etc).

Baseline Studies

The proposed BOGP water quality compliance limits (Ryder, 2025) are used as a screening tool to determine whether baseline water quality data are elevated.   The assessment (MWM, 2025a) indicated that:

- Shepherds Creek is elevated in copper (Cu).

- Bendigo Creek is elevated in arsenic (As), cobalt (Co), Cu, and iron (Fe).

- Groundwater is elevated in As, Cu, Fe, zinc (Zn), and on occasion strontium (Sr) within the project area. Thallium (Tl) was elevated on one occasion (although this appears anomalous).

Geoenvironmental Hazards

All BOGP materials are classified as non-acid forming (NAF), with circum-neutral pH drainage expected from mine domains that contain the materials. However, neutral metalliferous drainage is likely to occur with elevated levels of arsenic (As), sulfate (SO_4), trace metal, and nitrogenous compounds.

The most significant AMD source hazard for waste rock relates to the TZ4 and RSSZ materials, some of which will be waste rock, and some will be processed (to extract gold) producing tailings.

Data for waste rock indicates that the TZ4 and RSSZ lithologies contain ~95.3% of arsenic and 21.9% of sulfur yet represents only 9.3% of the waste rock that will be disturbed. Hence, appropriate management of TZ4 and RSSZ materials to reduce sulfide mineral oxidation is a critical step to minimise deleterious effects, i.e., manage 9.3% of the waste rock well to mitigate 95.3% of the arsenic risk in the engineered landforms (ELFs) that will contain the waste rock.

The following potential constituents of concern (PCOC) are identified and are considered in this report:

- TZ3 materials are enriched As and cobalt (Co). Antimony (Sb) is possibly elevated.

- RZ4 and RSSZ materials are enriched in As, sulfur (S). Sb is possibly elevated.

- Geochemical testing indicates that BOGP materials could generate MIW that could be elevated in aluminium (Al), As, Co, copper (Cu), chromium (Cr), iron (Fe), and zinc (Zn).

- Process water quality data suggests that Al, As, Co, Cu, Cr, Fe, molybdenum (Mo), nickel (Ni), lead (Pb), Sb, strontium (Sr), Zn, cyanide (CN), and ammoniacal nitrogen (Amm-N) may be elevated. It is noted these data are limited.

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[2] *Note: SRE Pit is backfilled by the SRX ELF.*

- Based on analogue data and general geoenvironmental hazards:

  o Nitrogenous compounds (nitrate and ammoniacal nitrogen) are expected due to the use on ammonium-nitrate based explosives and cyanide.

  o Sulfate is considered a PCOC based on sulfate being elevated at the Macraes Gold Mine, which is considered a suitable analogue site due to its similar sulfur content.

Water and Load Balance Model

A WLBM that contains water flow and quality data is required for the BOGP to understand potential deleterious effects on the receiving environment associated with these MIW (noting the management of TSS is covered by the sediment and erosion management plan: EGL (2025a)). The WLBM has been developed using the GoldSim modelling platform[3]. Key water quality inputs (source terms) need to be defined for the WLBM and this includes the following key model components:

- Baseline streams within the BOGP area

- Groundwater

- Engineered Landform (ELF) seepage

- Pit voids

- Ore stockpile

- Tailings storage facility (TSF)

- Hardstand areas, ELF surfaces, and roads (e.g., mine impacted surfaces)

- Underground workings

- Rehabilitated surfaces

Derivation of Source Terms

Source terms were developed from a variety of sources including analogue data sources, baseline studies at the BOGP, and laboratory derived data from environmental geochemistry testing. This report provides an explanation of how the source terms for modelling were developed for the WLBM.

Source terms need to be validated through performance monitoring that should be ongoing through the operational and closure phases of the project.

[3] https://www.goldsim.com

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1   INTRODUCTION

Mine Waste Management Limited (MWM) has developed this report to define the source terms for the water and load balance model (WLBM) for the Bendigo-Ophir Gold Project (BOGP) for Matakanui Gold Limited (MGL) to provide a summary of inputs that will be used during the modelling process. The WLBM is discussed in MWM (2025c).

1.1   Background

MGL is proposing to establish the BOGP, which comprises a new gold mine, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell and will have a maximum disturbance footprint of 550 hectares.

As part of the assessment of environmental effects, the BOGP requires the development of a WLBM that will simulate flow and key water quality parameters associated with mine impacted waters (MIW) to support water management and treatment planning/design and forecast water quality at downstream compliance monitoring sites.

A key component of developing a WLBM is the development of appropriate source terms to define the water quality of each model domain. Some of these source terms will share commonality between model components, others will be unique to the model domain. Clarity on how these terms are derived is important to support the modelling process.

1.2   Project Description

MGL is proposing to establish the BOGP, which comprises gold mining operations, processing operations, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell and will have a maximum disturbance footprint of 550 hectares.

The total Mineral Resource Estimate for the BOGP using a 0.5 g/t cut-off for open pit and 1.5 g/t for underground is 34.3 Mt at 2.1 g/t for 2.34 M oz (MGL, 2025). The Bendigo-Ophir resources occur in four deposits: Come in Time (CIT), Rise and Shine (RAS), Srex (SRX), Srex East (SRE). The majority of identified mineral resources are located within the RAS deposit. Three primary geological units are recognised at site:

- RSSZ – Rise and Shine Shear Zone

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The resources will be mined by open pit methods at each deposit within the project site, with underground mining methods also proposed to be utilised at RAS to access the deeper gold deposits. The majority of the mining activities, ancillary facilities and associated infrastructure will be located in the Shepherds Valley – which includes a conventional carbon-in-leach (CIL) gold processing plant and water treatment plant, a tailing storage facility, three engineered landforms, internal haul roads, topsoil stockpiles, water pipelines, underground utilities and electrical supply - with non-operational infrastructure located on the adjoining Ardgour Terrace. The BOGP also involves the taking of

groundwater from the Bendigo Aquifer for use in mining-related activities and the realignment of Thomson Gorge Road via Ardgour Station.

There are numerous historic mine workings throughout the project area, which can impact baseline water quality. The archaeological survey completed by Lawrence et al. (2019) indicated 59 historic mine archaeological sites were identified within a 16 km^2 survey area. The majority of mine workings were pre-1900 mining activities and included the following key historic workings (Lawrence et al., 2019):

- Stamping batteries and processing areas.

- Underground mine adits.

- Mullock piles and tailings mounds.

- Sluicing areas.

These historical workings have affected the water quality in the area. For instance, arsenic (As) is elevated in the Rise and Shine Creek, a tributary of Bendigo Creek, which is below these historic workings (MWM, 2025a).

The proposed BOGP will include the following components:

- Open pits targeting the RAS, SRX, SRE, and CIT deposits.

- An underground mine targeting the RAS deposit.

- Three ex-pit engineered landforms (ELFs) – Shepherds ELF, SRX ELF, and West ELF (WELF).

- Two in-pit landforms (backfill) – CIT and SRE[4].

- Plant and processing area, where CIL extraction technologies will be used as part of the ore recovery process.

- A tailings storage facility (TSF) and TSF Embankment.

- Other ancillary support services / structures (e.g., roads, water management infrastructure, water treatment plants, etc).

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[4] Note: SRE Pit is backfilled by the SRX ELF.

1.3   Mine Plan

The proposed mine plan is shown in Table 1 as a schedule of activities.

Table 1. BOGP Mine Plan

MONTH	YEAR	MINING PHASE	DESCRIPTION OF PHASE
		Pre-startup	Detailed design phase
0 to 6	0 to 0.5	**Startup**	Pioneering / RAS Pre-Strip, Initial Jean Creek Silt Pond, earthworks at process plant.
6 to 24	0.5 to 2	**Project Development**	Construction of process plant, TSF, Shepherds Creek Silt Pond, North Diversion Channel, Commissioning, mining RAS pre-strip (Pre-strip ends month 19).
Operations			
25 to 54	3 to 4.5	RAS pit mining on its own	Operations (Pit ore production in month 20. UG Development begins month 54)
54 to 72	4.5 to 5	RAS pit with UG development	Operations (UG Ore production begins month 70 -)
72 to 132	6 to 11	RAS pit plus RAS UG	Operations (UG Ore production months 70 to 150)
		RAS Pit plus RAS UG plus CIT Pit	Operations (CIT Pit mined months 102 to 114)
		RAS Pit plus RAS UG, plus CIT backfilled, plus Srex	Operations (Srex Pit mined months 145 onwards)
120 - 160	10 to 13.3	RAS UG continues on its own with CIT and Srex open pit feeds	Operations (all mining halted month 160)
Closure			
160 - 372	11 to 31	**Active Closure**	All mining halted. Active closure of pits, TSF, and wider site, plus setup of active water treatment plant (option).
372 -	31 onwards	**Post-Closure**	Passive treatment and maintenance

TSF = Tailings Storage Facility; UG = Underground

1.4   Objectives

The purpose of this report is to define and present the relevant data that have been used to derive the key source terms to be used in the WLBM for the BOGP. The objectives of this report are to:

- Define the sources of data used for developing the water quality source terms.

- Define the rationale applied in deriving the source terms.

- Propose what performance monitoring is required to ensure potential effects are understood in advance.

1.5   Source Term Components

Models that assess the effects on water quality generally require flow rates and water quality estimates. Source terms are created to represent the water quality of each component of the model. Source terms are derived from empirical site data and analogue data, which may be from the compilation of data (mean, 95th percentile, etc) or from geochemical relationships (e.g., sulfate versus potential constituents of concern (PCOC)). Source terms that require definition for BOGP include:

- The composition of rainfall water, for understanding its interaction with project materials.

- Baseline surface water quality.

- Groundwater inflow quality (e.g., to the RAS Pit void).

- ELF seepage.

- Process water quality associated with the tailings (assumed to be representative of TSF decant water quality).

- Pit water quality.

- TSF decant water.

- TSF seepage water quality.

- MIW quality associated with ELF runoff, haul roads, and hardstand areas.

- Underground workings (operational and closure).

- Rehabilitated surfaces.

1.6   Modelling Approach

Water management during the Operational Phase of the BOGP will involve discharge of only episodic runoff from haul roads and ELF surfaces. All other MIW (e.g., landform seepage) will be collected, used, and stored on site. In the Active Closure / Post Closure Phase, MIW will be treated and discharged to the receiving environment. Two models have been developed (MWM, 2025c) to reflect these phases:

- Operational Phase - Excel based models and calculations focussing on average annual water balance and runoff event discharge of MIW.

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Detailed stage models for years 1-13 of the BOGP (Table 1) will be developed using GoldSim[5] prior to mining commencing (i.e., during the project pre-startup phase). This will provide an operational tool for MGL to effectively manage water during operations.

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[5] https://www.goldsim.com

2   PROJECT AREA DESCRIPTION

The following section summarises the relevant background information for the BOGP.

2.1   Introduction

MGL is proposing to establish the BOGP, which comprises gold mining operations, processing operations, ancillary facilities and environmental mitigation measures on Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell and will have a maximum disturbance footprint of 550 hectares.

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The proposed BOGP will include the following components as shown in Figure 1:

- Open pits targeting the RAS, SRX, SRE, and CIT deposits.

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- Plant and processing area, where CIL extraction technologies will be used as part of the ore recovery process.

- A tailings storage facility (TSF) and TSF Embankment.

- Other ancillary support services / structures (e.g., roads, water management infrastructure, water treatment plants, etc).
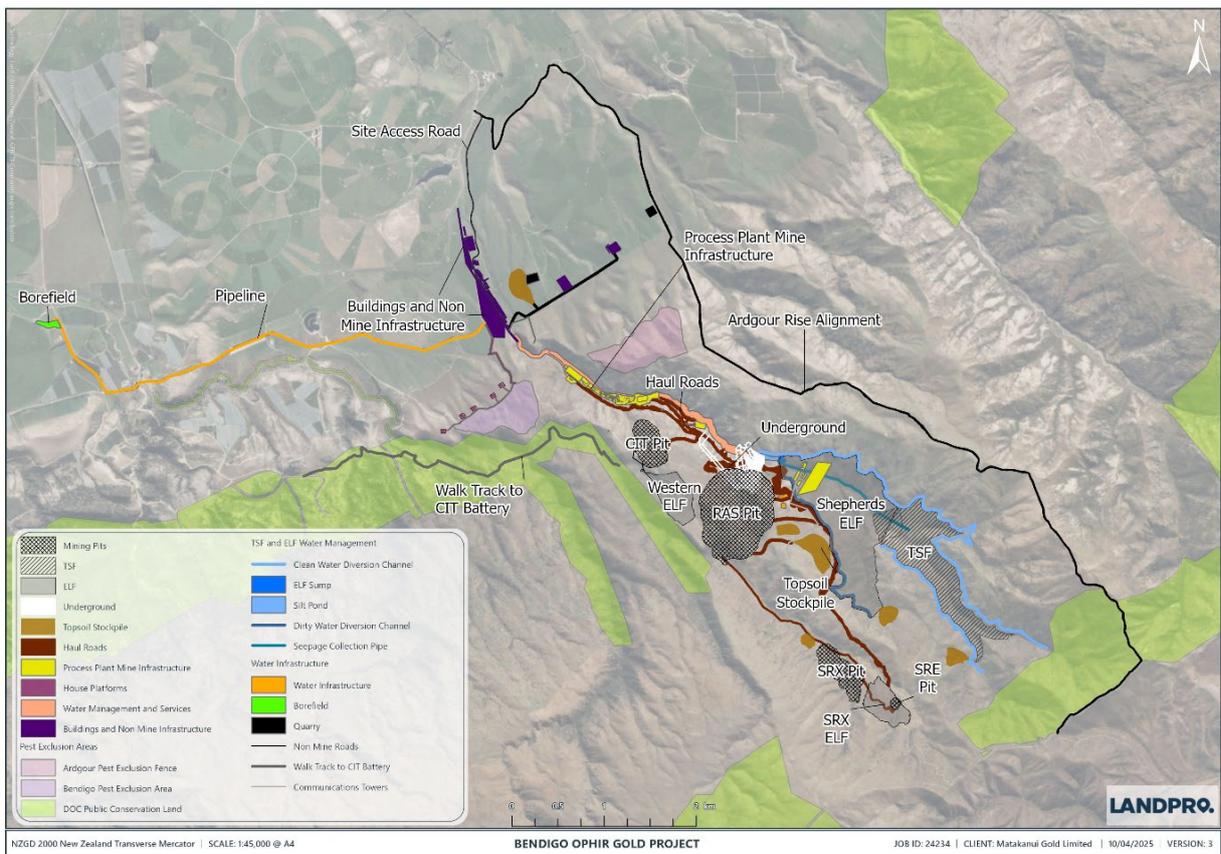
Figure 1. Bendigo-Ophir Gold Project Infrastructure

2.2   Surface Water

The project area covers several catchments and sub-catchments (Figure 2), including:

- Shepherds Creek: This creek runs through the project area and runs intermittently towards the Lindis River. An irrigation water-take on Shepherds Creek (RM17.301.15) downstream of SC1 monitoring site takes all available surface water in normal flow conditions, which is supplied to an irrigation dam, so the creek does not flow past this point. There is potential for groundwater to flow past this point via a thin layer of alluvial gravels along the creek bed.

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[6] Note: SRE Pit is backfilled by the SRX ELF.

- Jean Creek: This creek is an intermittent tributary to Shepherds Creek.

- Rise and Shine Creek: This creek reek joins Clearwater Creek south-east of the Come in Time Battery and flows into Bendigo Creek.

- Clearwater Creek: Flows into Bendigo Creek.

- Bendigo Creek: Several irrigation water-takes are in place on this creek (RM20.079.01 and RM20.079.02).

Figure 2. Bendigo-Ophir Gold Project area and water quality monitoring sites.

The proposed BOGP water quality compliance limits (Ryder, 2025) are used as a screening tool to determine whether baseline water quality data are elevated. The assessment (MWM, 2025a) indicated that:

- <u>Shepherds Creek</u> is elevated in copper (Cu).

- <u>Bendigo Creek</u> is elevated in arsenic (As), cobalt (Co), Cu, and iron (Fe).

- <u>Groundwater</u> is elevated in As, Cu, Fe, zinc (Zn), and on occasion strontium (Sr) within the project area. Thallium (Tl) was elevated on one occasion (although this appears anomalous).

Further details are provided in MWM (2025a).

2.3   Soils

MGL has conducted a soil study within the Rise and Shine Creek to map the distribution of As in the soils. This study utilised portable X-ray fluorescence (pXRF) and the results are presented in Figure 3.

The average crustal abundance of As is approximately 1.5 ppm (AusIMM, 2011), while the As concentrations observed in the soil within the Rise and Shine Creek valley ranged from 20 - >500 ppm. These anomalous As concentrations are likely to be associated with mineralisation that created the gold deposit.

Further studies have been completed on these As-rich soils (GRM, 2025).
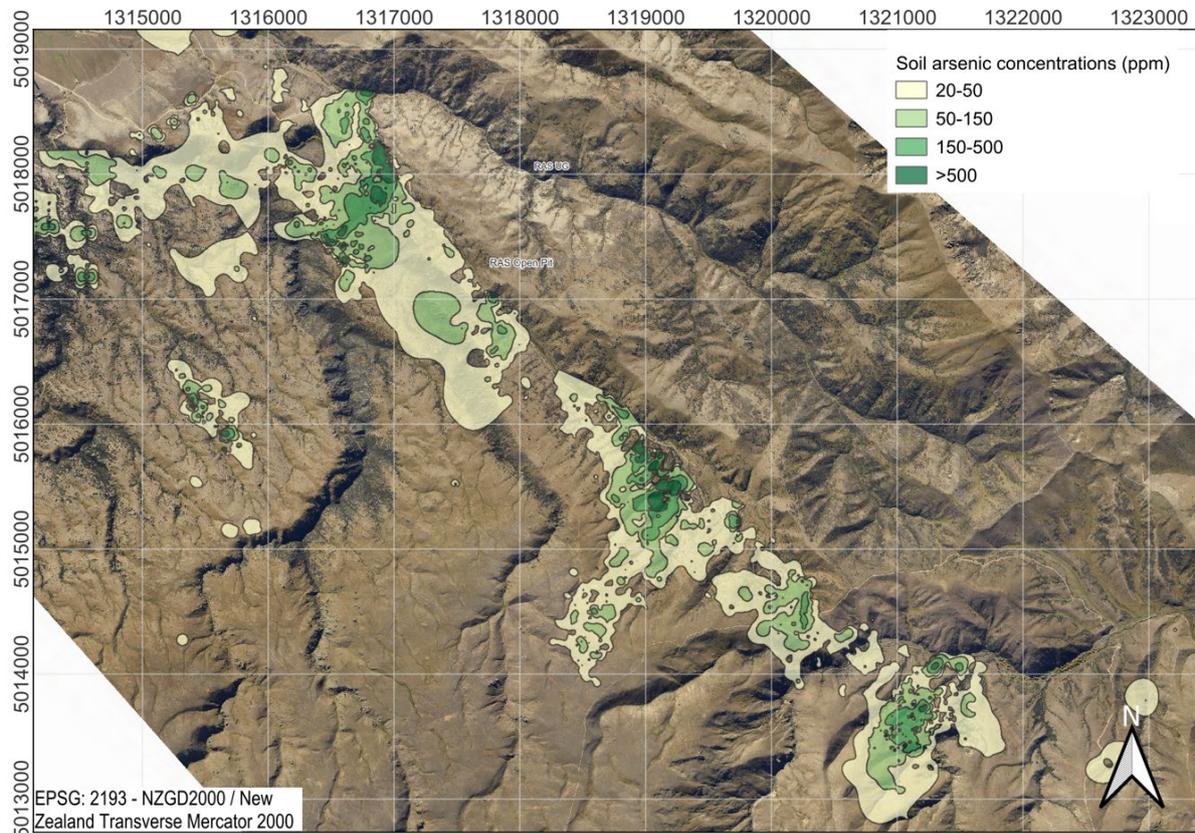
Figure 3. Arsenic concentration in soils in the study area.

Data source: Santana (2024) – GIS Shape Files

2.4   Geology

2.4.1   Regional Geology

The Dunstan Mountains are an uplifted block of the Otago Schist tilted to the northwest with remnants of a Cretaceous peneplain well preserved on its northern slopes. The Otago Schist is formed from sedimentary and minor intermediate volcanics and volcaniclastics of the Caples and Torlesse tectono-stratigraphic terranes. Greenschist facies rocks of the Otago schist are sub-divided into four textural zones based on mineralogy and mineral textures. Peak metamorphic grades in the Otago Schist occurred during the Jurassic when the Zealandia micro continent formed the outboard subduction complex of the Gondwana continental margin.

The regional geology of the Central Otago goldfields surrounding the BOGP consists of chlorite and biotite schists. The Rise & Shine Shear Zone (RSSZ), a late metamorphic deformation zone (Cox et al., 2006), runs through the project area dipping at 20-30 degrees northeast. The RSSZ occurs only in the footwall Textural Zone 4 (TZ4) schist in close association with the Thomsons Gorge Fault, which cuts and truncates the RSSZ against the unmineralised TZ3 schist (Cox et al., 2006). There is no

mineralisation associated with the Thomsons Gorge Fault itself, and Au mineralisation had ceased by the time of formation of the Thomsons Gorge Fault (c. 100 Ma) (Cox et al., 2006).

2.4.2   Project Geology

The project area contains four discrete mineral occurrences:

- Rise and Shine (RAS) deposit

- Come in Time (CIT) deposit

- Srex (SRX) deposit

- Srex East (SRE) deposit

The main mineralisation at RAS is associated with silica-siderite/ankerite alteration with minor arsenopyrite sulfides associated with the gold. In some areas a cataclastite (brecciated) network of anastomosing, post-metamorphic quartz, occur with minor sulfide veins in a halo of the core mineralisation. Allibone (2023) also identified the presence of sphalerite ((Zn,Fe)S) and galena (PbS) at the BOGP.

Locally, a number of splay faults are interpreted coming off the main structure which give a sense of structural control. These are also mineralised and are traceable for 10s to 100s of metres. Gold occurs as free gold particles, typically up to 400 µm but with some coarser visible gold. A minor gold component occurs associated with the arsenopyrite grains, but it is typically not in solid solution, giving rise to the free milling and highly gravity recoverable components expressed by metallurgical testing.

2.5   Geochemistry

All BOGP materials are classified as non-acid forming, with circum-neutral pH drainage expected from mine domains that contain the materials. However, neutral metalliferous drainage is likely to occur with elevated levels of As, sulfate (SO_4), trace metal, and nitrogenous compounds.

The most significant AMD source hazard for waste rock relates to the TZ4 and RSSZ materials, some of which will be waste rock, and some will be processed (to extract gold) producing tailings.

Data for waste rock indicates that the TZ4 and RSSZ lithologies contain ~95.3% of arsenic and 21.9% of sulfur yet represents only 9.3% of the waste rock that will be disturbed. Hence, appropriate management of TZ4 and RSSZ materials to reduce sulfide mineral oxidation is a critical step to minimise deleterious effects, i.e., manage 9.3% of the waste rock well to mitigate 95.3% of the arsenic risk in the engineered landforms (ELFs) that will contain the waste rock.

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- Geochemical testing indicates that BOGP materials could generate MIW that could be elevated in aluminium (Al), As, Co, copper (Cu), chromium (Cr), iron (Fe), and zinc (Zn).

- Process water quality data suggests that Al, As, Co, Cu, Cr, Fe, molybdenum (Mo), nickel (Ni), lead (Pb), Sb, strontium (Sr), Zn, cyanide (CN), and ammoniacal nitrogen (Amm-N) may be elevated. It is noted these data are limited.

- Based on analogue data and general geoenvironmental hazards:

  o Nitrogenous compounds (nitrate and ammoniacal nitrogen) are expected due to the use on ammonium-nitrate based explosives and cyanide.

  o Sulfate is considered a PCOC based on sulfate being elevated at the Macraes Gold Mine, which is considered a suitable analogue site due to its similar sulfur content.

Further details are provided in MWM (2024b).

3   SOURCE TERMS – RAINFALL WATER QUALITY

This section summarises the rainfall water quality data used for the project area.

3.1   Data Source

Rainfall water quality is required as an input to the WLBM (MWM, 2024c). Further climatic information is available in Rekker (2025).

3.1.1   Rainfall Water Quality Source Term

The source term for average rainfall water quality is obtained from Nichol et al. (1997) using the Lauder collection site, which includes rainfall water quality data from 1983 to 1994. The Lauder site is located to the west of BOGP with an annual rainfall of 530 mm/year (Nichol et al., 1997) and therefore presents a reasonable dataset for rainfall water quality.

The rainfall quality data is provided in Table 2. The rainfall is slightly acidic with a pH value of 5.2 and with a low alkalinity (0.8 mg/L as $CaCO_3$).

<p align="center">Table 2. Rainfall Quality Source Term Data</p>

PARAMETERS	UNITS	VALUE
pH	pH unit	5.2
Acidity	mg/L as $CaCO_3$	2.28
Alkalinity Total	mg/L as $CaCO_3$	0.81
Ca	mg/L	0.11
Cl	mg/L	0.31
K	mg/L	0.88
Mg	mg/L	0.09
Na	mg/L	0.32
NO_3-N	mg/L	0.06
SO_4	mg/L	0.18

Source: Nichol et al., 1997: Table 5 (Lauder M8391) for the period 1983 – 1991 (monthly data).

These data are used as the source term for rainfall in the WLBM.

3.1.2   Assumptions

- It is assumed these data represent the reasonable concentrations of rainfall and that the average data provided are suitable.

4   SOURCE TERMS - BASELINE WATER QUALITY

This section reviews baseline water quality for the BOGP area.

4.1   Surface Water Quality

Source terms for baseline water quality have been derived from surface water quality data from the Shepherds Creek and Bendigo Creek (e.g., Rise and Shine Creek) areas, with monitoring data covering multiple locations from 2022 to 2024. The complete presentation and analysis of data, including discussion of monitoring data limitations is provided in the baseline water quality report (MWM, 2025a).

4.1.1   Shepherds Creek Catchment Source Term

Surface water quality data for Shepherds Catchment are provided in Table 3. The following observations are provided:

- Concentrations of dissolved parameters are generally lower in the upper catchment (e.g., SC03 and JC01) and are likely to be unaffected by mineralisation, which could influence SC01.

- In the upper catchment, SC03 has a larger dataset, which provides more confidence in the data.

- Data lower than the limit of reporting (LOR) are presented in Table 3 in green text as half the LOR. For the source term they are treated as a value of 0 in the WLBM.

- Average data for SC03 (as shown in Figure 2) were selected as the source term for water quality in the WLBM for the Shepherds Creek Catchment and is assumed to be reflective of water quality in the catchment (as shown by yellow data in Table 3).

Table 3. Surface water quality source terms for Shepherds Creek.

PARAMETERS	SC01 (n=25) AVE (mg/L)	SC03 (n=21) AVE (mg/L)	JC01 (n=6) AVE (mg/L)
Alkalinity (mg CaCO$_3$/L)	216.0	136.2	246.3
pH (pH units)	8.11	7.88	8.30
EC (µS/cm)	488.9	319.1	498.0
Ca	60.8	40.9	53.3
Cl	6.08	2.74	5.55
F	0.103	0.119	0.076
Mg	21.3	10.2	20.1
Na	20.3	36.2	59.0
K	2.01	1.43	1.98
TOC	2.08	2.01	4.40
Al	0.00454	0.00640	0.0070
As	0.00239	0.00079	0.00085
B	0.03304	0.0280	0.0337
Cd	0.00010	0.00011	0.00011
Co	0.00026	0.00029	0.00031
Cr	0.00056	0.00062	0.00060
Cu	0.00055	0.00055	0.00143

PARAMETERS	SC01 (n=25) AVE (mg/L)	SC03 (n=21) AVE (mg/L)	JC01 (n=6) AVE (mg/L)
Fe	0.01135	0.0215	0.00750
Hg	0.00026	0.00030	0.00029
Mn	0.00265	0.00357	0.00104
Mo	0.00051	0.00044	0.00114
Ni	0.00035	0.00036	0.00039
Pb	0.00025	0.00029	0.00034
Sb	0.00053	0.00058	0.00073
Se	0.0025	0.0029	0.0028
Sr	0.947	0.675	0.718
Tl	0.00023	0.00027	0.00026
U	0.0051	0.0022	0.006
V	0.0005	0.0005	0.0005
Zn	0.0017	0.0015	0.0025
Sulfate	40.5	14.4	18.5
Ammoniacal nitrogen	0.0103	0.0117	0.0075
Nitrate-N	0.083	0.139	0.062
TCN	0.0028	0.0032	0.0026

Note: Green data are ½ LOR and are included in the source term as '0'

4.1.2 Bendigo Creek Catchment Source Term

Surface water quality source terms for the Bendigo Creek Catchment are provided in Table 4. The following observations are provided:

- Water quality in the Rise and Shine Creek is generally poorer than the water quality in Shepherds Creek due to the historic mining activities and natural mineralisation (e.g., refer to MWM, 2025a).

- RS04 was selected (Figure 2) to represent water quality within the catchment upstream of the Rise and Shine historic mine workings (as shown by yellow data in Table 4). Average water quality data are provided Table 4.

- Data lower than the LOR are presented in Table 4 in green text as half the LOR. For the source term they are treated as a value of 0 in the WLBM.

- Average data for CC01 was selected (as shown by green data in Table 4) as the source term for water quality in the WLBM for the Clearwater Creek Catchment and is assumed to be reflective of water quality in the catchment.

Table 4. Surface water quality source terms for Bendigo Creek.

PARAMETERS	RSA1 (n=25) AVE (mg/L)	RS01 (n=26) AVE (mg/L)	RS02 (n=26) AVE (mg/L)	RS03 (n=25) AVE (mg/L)	RS04 (n=14) AVE (mg/L)	CC01 (n=16) AVE (mg/L)
Alkalinity (mg CaCO$_3$/L	107.8	87.5	65.8	39.1	72.8	14.7
pH (pH units)	7.32	7.61	7.57	7.42	7.51	7.03

PARAMETERS	RSA1 (n=25) AVE (mg/L)	RS01 (n=26) AVE (mg/L)	RS02 (n=26) AVE (mg/L)	RS03 (n=25) AVE (mg/L)	RS04 (n=14) AVE (mg/L)	CC01 (n=16) AVE (mg/L)
EC (µS/cm)	211.7	181.8	151.4	86.4	165.0	34.0
Ca	28.7	26.3	19.7	11.1	23.3	3.88
Cl	2.55	2.38	2.07	1.33	1.96	0.794
F	0.096	0.086	0.082	0.057	0.059	0.055
Mg	5.22	4.82	3.61	1.99	3.74	0.844
Na	52.5	10.4	6.87	39.5	5.15	2.35
K	1.04	1.14	1.07	0.578	1.18	0.335
TOC	4.04	2.77	2.09	1.75	2.75	1.23
Al	0.00288	0.00421	0.00820	0.00756	0.00686	0.01231
As	0.0386	0.0193	0.0049	0.0085	0.001	0.0010
B	0.0188	0.0185	0.0185	0.0188	0.011	0.0175
Cd	0.00010	0.00010	0.00010	0.00010	0.00003	0.00009
Co	0.00053	0.00026	0.00025	0.00025	0.00013	0.00021
Cr	0.00058	0.00054	0.00054	0.00059	0.00026	0.00056
Cu	0.00185	0.00057	0.00063	0.00046	0.00083	0.00043
Fe	0.2048	0.0614	0.0245	0.0375	0.068	0.0293
Hg	0.00026	0.00026	0.00026	0.00026	0.00011	0.00024
Mn	0.1614	0.0211	0.0011	0.0095	0.006	0.0009
Mo	0.00034	0.00034	0.00033	0.00033	0.00022	0.00033
Ni	0.00049	0.00044	0.00041	0.00035	0.00049	0.00056
Pb	0.00025	0.00025	0.00025	0.00025	0.00008	0.00022
Sb	0.00050	0.00048	0.00048	0.00050	0.00017	0.00044
Se	0.0025	0.0024	0.0024	0.0025	0.0008	0.0022
Sr	0.381	0.358	0.266	0.136	0.315	0.042
Tl	0.00023	0.00022	0.00022	0.00023	0.00005	0.00019
U	0.00025	0.00015	0.00026	0.00012	0.00030	0.00009
V	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050
Zn	0.00466	0.00175	0.00204	0.00229	0.00142	0.00161
Sulfate	4.52	5.13	2.72	1.57	2.80	0.843
Ammoniacal nitrogen	0.0222	0.0098	0.0121	0.0092	0.013	0.0086
Nitrate-N	0.0153	0.0171	0.0308	0.0088	0.0033	0.0096
TCN	0.0028	0.0028	0.0028	0.0028	0.0013	0.0026

Note: Green data are ½ LOR and are included in the source term as '0'

Average data for RS04 (see Figure 2) was selected as the source term for water quality in the WLBM for the Rise and Shine Creek Catchment and is assumed to be reflective of water quality in the catchment.

4.1.3 Temperature Effects

The temperature of the streams at the proposed compliance monitoring sites (SC01 and RS03) were assessed to derive average summer and winter stream water temperature. These average data are used to modify toxicity for cyanide and sulfide (e.g., Ryder, 2025). These data are presented in Table 5

The WLBM does not consider temperature effects given that cyanide is not modelled, and sulfide will be a function of passive treatment in the post closure phase when further empirical data will be available ot understand effects.

Table 5: Average seasonal water temperature at proposed compliance monitoring sites SC01 and RS03.

SITE ID	SEASON	AVERAGE TEMPERATURE (°C)
RS03	Summer (November – April)	10.7
	Winter (May – October)	4.4
SC01	Summer (November – April)	14.2
	Winter (May – October)	7.2

Note: Calculated from data obtained over the period 2023-2025.

4.1.4   Assumptions

The following assumptions are presented for the source term for the baseline streams:

- It is assumed that the average water quality provides a reasonable dataset to create a source term for the project area for non-impacted catchments.

- It is assumed that water quality data upstream of mineralisation is suitable as the baseline water quality with the expectation that mineralised areas will be mined.

4.1.5   Performance Monitoring

The following performance monitoring is recommended for the baseline stream water quality:

- Ongoing monitoring of water monitoring sites SC01 and RS03 including continuous flow, EC, temperature, and pH; and monthly grab samples for water quality and compliance monitoring.

- Ongoing performance monitoring of RS01 for water quality effects associated with the project and historic mining activities / natural mineralisation.

- Ongoing performance monitoring of Clearwater Creek as a control site (monthly samples for water quality).

- Comparison of water quality data and trends against agreed BOGP water quality compliance limits as proposed by Ryder (2025).

4.2   Groundwater Quality

Groundwater is implicitly included within the WLBM through the use of baseline groundwater quality data for the BOGP. However, a source term is required for inflow to the pit voids.

4.2.1   Groundwater Source Term

The source terms for groundwater are provided in Table 6. The following observations are provided:

- MDD015 (Figure 2) is located with the proposed RAS Pit shell. It also has the greatest number of samples.

- Water quality data suggests that As and Sr can be elevated in groundwater associated with the BOGP.

- Data lower than the LOR are presented in Table 4 in green text as half the LOR. For the source term they are treated as a value of 0 in the WLBM.

- Data for MDD015 (see Figure 2) was selected as the source term for groundwater quality (data shown in yellow in Table 6) and is assumed to be reflective of water quality in the catchment.

Table 6. Water quality source terms for groundwater.

PARAMETERS	MDD015 (n=18)	MRC002 (n=1)	MDD302 (n=12)
	AVE	AVE	AVE
Alkalinity (mg $CaCO_3$/L	201.6	110.0	237.0
pH (pH units)	8.10	8.00	7.78
EC (µS/cm)	446.5	250.0	493.3
Ca	38.9	14.8	63.3
Cl	9.42	3.50	2.96
F	0.162	-	0.137
Mg	16.2	6.61	21.6
Na	43.6	27.0	7.98
K	1.44	1.88	1.42
TOC	0.300	-	0.500
Al	0.0061	0.0060	0.0038
As	0.024	0.011	0.052
B	0.0331	-	0.01
Cd	0.00008	0.0002	0.00002
Co	0.00019	0.0005	0.00001
Cr	0.0005	0.001	0.0002
Cu	0.0003	0.002	0.0002
Fe	0.0147	0.090	0.005
Hg	0.0002	0.0005	0.00008
Mn	0.0068	0.0034	0.0045
Mo	0.0004	0.0009	0.0003
Ni	0.0003	0.0005	0.0002
Pb	0.0002	0.0005	0.00005
Sb	0.0004	-	0.00018
Se	0.0018	-	0.0005
Sr	9.76	3.57	1.13
Tl	0.0003	0.0005	0.00001
U	0.0010	-	0.004815
V	0.0005	0.0005	0.0005
Zn	0.0015	0.094	0.001
Sulfate	10.3	5.40	9.59
Ammoniacal nitrogen	0.109	-	0.050
Nitrate-N	0.0051	-	0.0033
TCN	0.0023	-	0.0011

Note: Green data are ½ LOR and are included in the source term as '0'. Data in mg/L unless stated outherwise.

4.2.2   Assumptions

The following assumptions are presented for the source term for groundwater:

- It is assumed that the average water quality provides a reasonable dataset to create a source term for the project area.

- It is assumed the source term derived is appropriate for all pits within the proposed BOGP area.

4.2.3   Performance Monitoring

The following performance monitoring is recommended for the groundwater quality:

- Continue monitoring of groundwater for the project at MDD015 until mining commences to confirm baseline conditions.

- Commence monitoring of the Ardgour Aquifer groundwater quality once the monitoring bores (e.g., MWM101 – MWM 103: Figure 2) have been installed. These bores will be installed for compliance monitoring purposes, and a baseline is required to determine any effects.

5   ENGINEERED LANDFORMS

This section discusses the source term for the engineered landform (ELF) seepage at the BOGP.

5.1   Background

During the operational phase of the BOGP, surface water from the surface of the Shepherds ELF will be directed to the Shepherds Silt Pond. Water sheeted off the ELF will be diluted by high rainfall events. The water will report to the Shepherds Silt Pond for sediment retention and will then be discharged to Shepherds Creek.   EGL (2025b) note that the Shepherds Silt Pond will be a large dam with a decant tower. The silt pond will have a total capacity of around 100,000 m³ (some of which will be dead storage for sediment capture).

In closure, Shepherds ELF will be capped in brown rock and topsoils. Once vegetation establishes, the risk of sediment laden water is mitigated. Shepherds Silt Pond can then be decommissioned, although it may also be used for passive treatment during the active- and post-closure phases. The decision to use this sediment pond as a passive treatment system will be subject to further studies, completed during the operational phase of the BOGP.

5.2   Literature Review - Macraes

Analysis indicates that Macraes and the BOGP have similar sulfur content and similar geology (MWM, 2025b).   Sulfur content is a key consideration as to whether an analogue site is suitable as this represents the potential source hazard for AMD. Analysis of total sulfur data for tailings and waste rock at Macraes is comparable to BOGP with average waste rock being ~ 0.13 wt% S at Macraes and ~ 0.094 wt% S at BOGP (MWM, 2024b). Hence, the source hazard for sulfate in waste rock is similar for both Macraes and BOGP and is therefore a suitable analogue site.

Data provided by Golder (2011b) for silt ponds, located at the toe of waste rock stacks (WRSs) at Macraes, indicates elevated sulfate in seepage waters (Table 7). Such data provides an indication of the risks to surface waters associated with this mine domain at the BOGP.

Table 7. WRS silt pond seepage water quality from Macraes. From Golder (2011b).

PARAMETER	DEEPDELL NORTH	DEEPDELL SOUTH	BATTERY CREEK	NORTHERN GULLY	FRASERS WEST (NBWR)	MURPHYS CREEK	BACK ROAD	AVERAGE
Arsenic	0.011	0.00001	0.00001	0.001	0.001	0.00001	0.00001	0.0016
Sulfate	38.6	15.4	1,200	2,300	1,500	1,320	2,200	1084
Cyanide$_{WAD}$	0.00001	0.00001	0.00001	0.013	0.00001	0.00001	0.00001	0.0016
Copper	0.001	0.00001	0.00001	0.003	0.001	0.001	0.002	0.0010
Iron	0.170	0.00001	0.00001	0.93	0.42	0.52	0.91	0.3734
Lead	0.001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0001
Sodium	16	10.8	36	57.7	26.2	33	56.4	29.81
Potassium	5.5	1.89	10	12	5.47	6.69	11.7	6.72
Calcium	68.5	40.2	290	434	199	250	425	215.5
Magnesium	14.5	7.7	200	360	165	204	352	164.7
Zinc	0.00001	0.00001	0.00001	0.032	0.015	0.018	0.032	0.012
Chloride	11.5	7.1	10	10.2	4.69	6.03	9.99	7.49

1. - All values presented in units of mg/L

The assessment by Golder in 2011 for Macraes did not consider the risks associated with nitrogenous compounds. Recent work in 2020 identified that nitrate can be elevated up to 10.5 mg/L in WRS seepage (OceanaGold, 2020).

Data presented in this section indicates that a number of PCOC could be elevated in WRS seepage including sulfate, nitrate, and zinc. Further details are provided in the ELF model report (MWM, 2025d) on PCOC and the potential risks for water quality from this mine domain.

5.3   Source Terms

Two source terms for the WLBM are required for the proposed engineered landforms at the BOGP including ELF surface run-off and ELF seepage. ELF surface run-off is assumed to have the source term for Mine Impacted Surfaces (Table 19). ELF seepage requires numerical modelling and is a function of the ELF average height (e.g., Navarro-Valdivia, et al., 2024). Further details of how the ELF seepage source terms were developed are provided in MWM (2025d). Modelling associated with the WLBM are discussed in MWM (2025c).

5.4   Assumptions

Assumptions relating to the source terms for ELF seepage are discussed in MWM (2025d).

5.5   Performance Monitoring

Performance monitoring is discussed in MWM (2025d).

6   PIT VOIDS

Active pits are likely to be a significant source of contaminants due to the blasting and exposure of overburden that will generate a large reactive surface area.

6.1   Literature Review – Pit Lakes

Golder (2011c) identifies that PCOC can be elevated in pit lakes at Macraes with:

- Sulfate ranging from 24 – 3,000 mg/L.

- Arsenic ranging from <0.005 – 0.8 mg/L.

- Cyanide$_{WAD}$ ranging from <0.005 – 0.87 mg/L, which indicates that process waters are discharged to some of these pits and this would also account for the elevated sulfate in some pit voids.

These data are shown in Table 8 to Table 12 and summarise the Macraes pit water quality from Frasers Pit, Golden Bar Pit, Golden Point Pit, Innes Mills South, and Round Hill Pit. It is reasonable to expect that pit lake water quality for RAS Pit at BOGP will be comparable to the larger pits at Macraes (e.g., Frasers Pit) once developed to maximum footprint and depth due to a similar lithologies and mineralisation style.

Table 8. Pit Lake Water Quality – Frasers.

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
pH (unitless)	7.2	8.1	8.8	9.8
Conductivity (mS/m)	320	760	1,100	1,200
Calcium	29	67	96	110
Chlorine	1.7	11	18	20
Magnesium	15	39	56	74
Potassium	2.8	7.8	16	16
Na	4.9	35	61	72
Sulfate	24	200	350	470
CN$_{WAD}$	<0.005	<0.013	0.018	0.15
Arsenic	<0.005	<0.18	0.42	0.80
Copper	<0.001	<0.003	0.010	0.022
Iron	<0.02	<0.17	0.60	1.2
Lead	<0.0010	<0.0010	0.0020	0.011

Source: Golder (2011d) – Appendix E.

Notes: All units in mg/L unless otherwise stated; and all data presented to two significant figures or less.

Table 9. Pit Lake Water Quality – Golden Bar Pit.

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
pH (unitless)	7.0	8.1	8.3	8.4
Conductivity (mS/m)	270	640	810	860
Calcium	26	70	86	100
Chloride	3.7	6.6	8.5	9.6

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
Magnesium	14	32	46	48
Potassium	1.8	4.6	7.3	8.2
Sodium	8.2	13	17	18
Sulfate	50	160	260	290
Arsenic	0.07	0.36	0.60	0.72
Copper	<0.001	<0.006	0.024	0.074
Iron	<0.02	<0.067	0.16	0.16
Lead	<0.0001	<0.001	0.002	0.005

Source: Golder (2011d) – Appendix E.

Notes: All units in mg/L unless otherwise stated; and all data presented to two significant figures or less.

Table 10. Pit Lake Water Quality – Golden Point Pit.

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
pH (unitless)	6.7	7.5	8.1	8.3
Conductivity (mS/m)	780	2,700	4,400	4,600
Calcium	110	370	550	560
Chloride	4.1	14	22	23
Magnesium	26	192	333	345
Potassium	2.4	17	31	54
Sodium	19	130	260	280
Sulfate	200	1,600	3,000	3,000
CN_{WAD}	<0.005	NA	NA	0.040
Arsenic	<0.005	<0.039	0.15	0.17
Iron	<0.04	<0.23	0.69	0.78
Lead [A]	<0.001	NA	NA	NA

Source: Golder (2011d) – Appendix E.

Notes: All units in mg/L unless stated; all data presented to two significant figures or less; NA = not applicable; CN_{WAD} was analysed five times, with all but one below detection limit of 0.005 g/m^3

[A] lead was below the detection limit on each sampling occasion.

Table 11. Pit Lake Water Quality – Innes Mills South.

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
pH (unitless)	7.3	8	8.3	8.3
Conductivity (mS/m)	1,200	2,500	3,600	3,900
Calcium	130	310	430	470
Chloride	1.8	33	86	110
Magnesium	46	100	130	140
Potassium	9.4	31	49	55
Sodium	60	180	340	360
Sulfate	400	1,400	2,100	2,300
$Cyanide_{WAD}$	<0.005	<0.20	0.83	0.87
Arsenic	<0.005	<0.022	0.049	0.052
Copper	<0.001	<0.016	0.057	0.060

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
Iron	<0.050	<1.4	6.3	8.2
Lead [A,B]	<0.001	NA	NA	NA
Zinc [C]	<0.04	NA	NA	NA

Source: Golder (2011d) – Appendix E.

Notes: All units in mg/L unless stated; all data presented to two significant figures or less; NA = not applicable; [A] - Summary statistics were derived after excluding detection limits superseded by lower limits.

[B] - lead was below the detection limit on each sampling occasion; [c] - sampled on only one occasion.

Table 12. Pit Lake Water Quality – Round Hill.

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
pH (unitless)	7.3	7.8	8.2	8.3
Conductivity (mS/m)	560	840	1,100	1,100
Sulfate	58	200	350	370
CN_{WAD}	<0.005	<0.009	0.021	0.022
Arsenic	<0.002	<0.61	1.4	1.6
Copper [A]	<0.0005	NA	NA	NA
Iron	<0.040	<1.1	4.3	6.3
Lead [A]	<0.0002	NA	NA	NA
Zinc [A]	<0.005	NA	NA	NA

Source: Golder (2011d) – Appendix E.

Notes: All units in mg/L unless stated; all data presented to two significant figures or less; NA = not applicable.

[A] copper, lead and zinc concentrations were below the respective detection limits on each sampling occasion.

As noted by Navarro-Valdivia et al. (2023) pit lakes can also be elevated in nitrogenous compounds due to the presence of blasting residues, with nitrate nitrogen concentrations peaking in the Golden Bar Pit Lake at 30 mg/L due to an initial nitrate load of 400 kg, yet steadily decreases at 20-30% per year due to biogeochemical processes (Figure 4). Similar processes are expected at BOGP within the final pit lakes. Such decreases in nitrogenous compounds are in agreement with literature (Figure 5).

Navarro-Valdivia et al. (2023) noted that the quantity of nitrogen as NH_4NO_3 was estimated to be 5.35 g/m^2 once the pit lake started to fill.
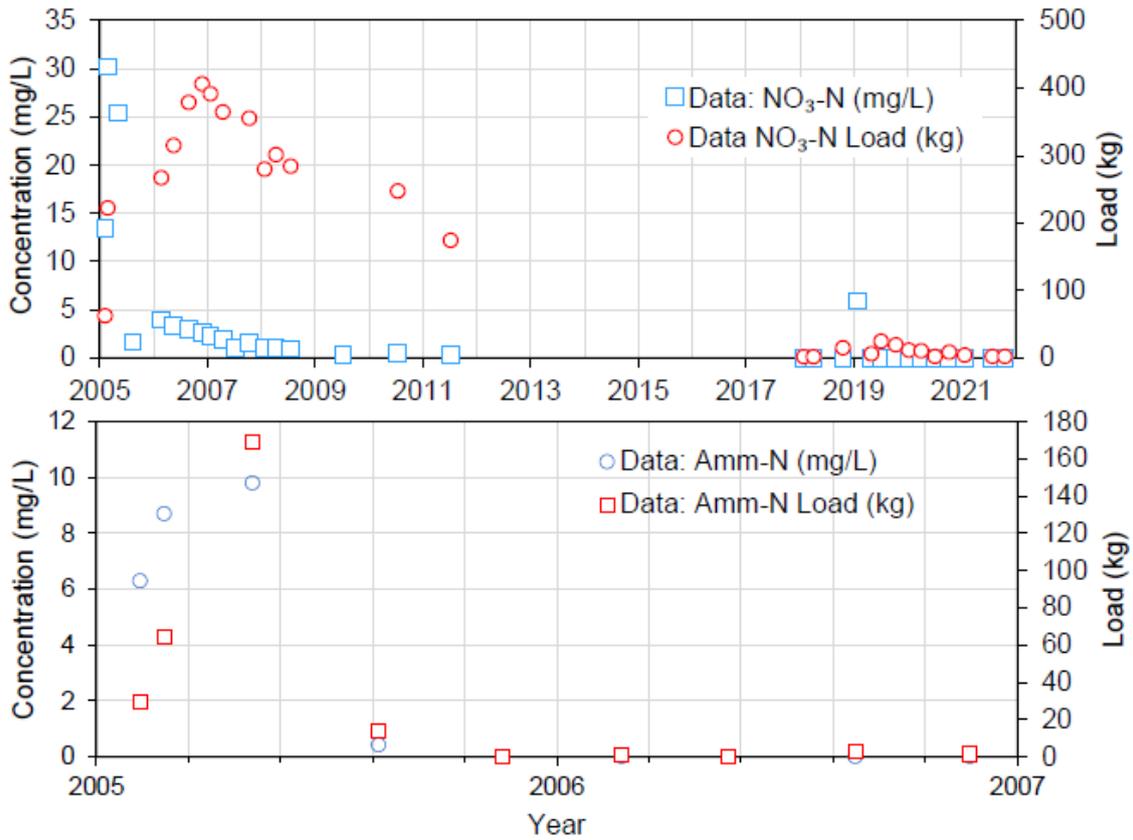
Figure 4. Golden Bar Pit Lake nitrate-N and ammoniacal-M concentrations and loads over time.
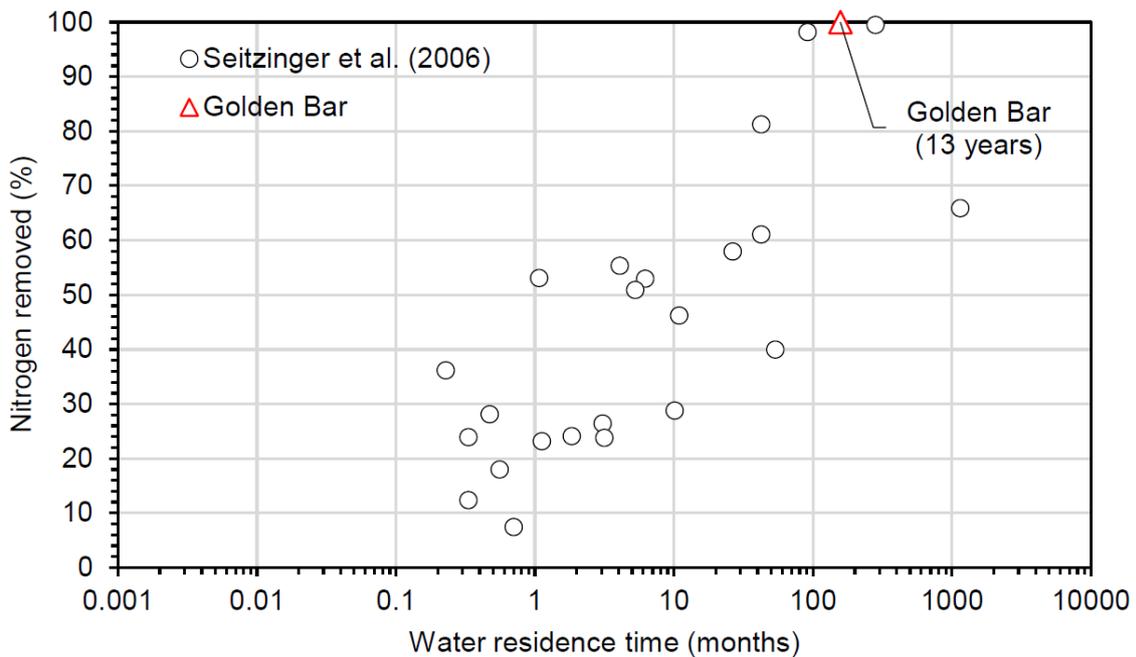
Source: Navarro-Valdivia et al. (2023)

Figure 5. Lake water residence time and nitrogen removal

Source: Navarro-Valdivia et al. (2023) with data from Seitzinger et al. (2006).

6.2   Literature Review – Pit Wall Runoff

Data provided by Golder (2011d) for Frasers pit runoff water quality is comparable to Frasers Pit water quality (95th percentile), which suggest wall runoff is a good indication of pit water quality prior to dilution by other inflows (e.g., MIW, process water, rainfall) and evaporation. Results indicate that sulfate can range from 12 – 390 mg/L with a mean sulfate of 160 mg/L.

Table 13. Frasers Pit wall runoff water quality.

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
pH (unitless)	7.6	8.2	8.4	8.5
Conductivity (mS/m)	400	640	970	1,100
Calcium	20	55	93	110
Chloride	2.9	13	20	27
Magnesium	7.8	37	78	88
Potassium	1.4	3.9	7.1	10
Sodium	4.6	33	59	63
Sulfate	12	160	320	390
Arsenic	<0.005	<0.093	0.36	0.48
Copper	<0.001	<0.0034	0.0082	0.041[2]
Iron	<0.040	9.1[1]	21	220[2]
Lead	<0.001	<0.004	0.010	0.051[2]

Source: Golder (2011d) – Appendix F.

Notes: All units in mg/L unless otherwise stated; all results presented to two significant figures or less; Data measured at FR3 North Wall, Frasers East Wall, S452RL and W435RL.

[1] – This data point as presented as <9.1 mg/L. For this report, it is assumed that 9.1 is the mean, which appears reasonable based on the graphed information.

[2] – this datapoint is an outlier and appears erroneous from the graphed data in the Golder (2011d) report. All other data appear reasonable.

6.3   Description

This section describes the three pits that will be constructed as part of the BOGP. No discussion is provided on SRE pit, due to its small size and for the fact it will be backfilled by SRX ELF that will dominate any effects on water quality from the area.

6.3.1   RAS Pit

The RAS Pit design is ~200 m deep, approximately 1,000 m long in a roughly north-south direction and approximately 900 m wide (MGL, 2024). Data are provided in Table 14.

Table 14. RAS Pit Material Summary.

PIT STAGE	TOTAL TONNES (Mt)	ORE TONNES (Mt)	ORE GRADE (g/t)	WASTE TONNES (Mt)
Shell 32	187.2	11.6	2.49	175.6
Final Design	214.0	11.9	2.42	202.1
Variance	14%	3%	-3%	15%

Source: MGL, 2024

6.3.2   SRX Pit

The SRX Pit design is ~88 m deep, 650 m long and 210 m long (MGL, 2024). Data are provided in Table 15.

Table 15. SRX Pit Material Summary.

PIT STAGE	TOTAL TONNES	ORE TONNES	ORE GRADE	WASTE TONNES
	(Mt)	(Mt)	(g/t)	(Mt)
Shell 33	8.2	1.9	0.69	6.3
Final Design	7.3	1.4	0.68	5.9
Variance	-11%	-11%	9%	-11%

Source: MGL, 2024

6.3.3   CIT Pit

Waste rock (TZ3) will be placed as backfill in the CIT Pit to return the ground to its pre-mining topography (or similar). The CIT backfill is shown in Figure 6 and indicates that the long-term groundwater level will be equivalent to the spill point of 503 m. Waste rock will be constructed as an ELF to minimise long term risks to water quality. The volume of the CIT Pit has been estimated at ~923,000 m^3 and this will include 700 kt ore, 475kt soil, 2,550 kt TZ3, and 850 kt TZ4 materials[7].
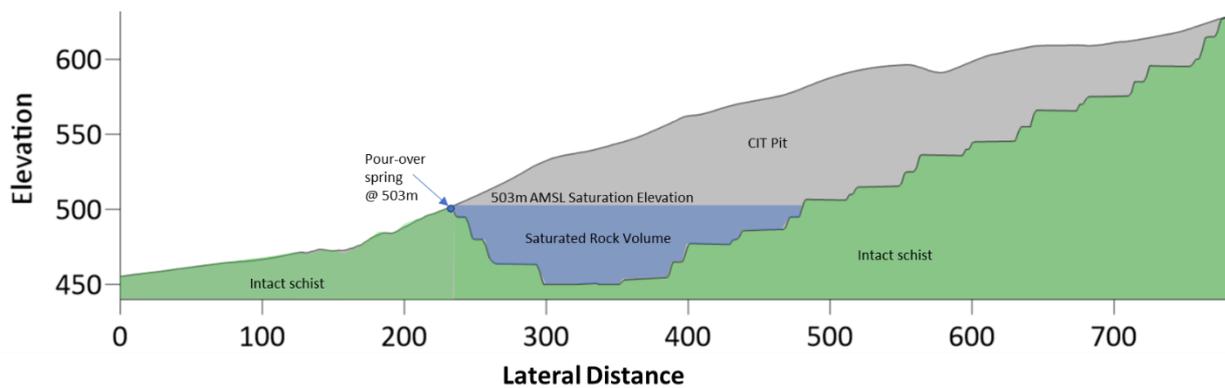
Figure 6. CIT Backfill.
Source: Rekker and Dumont, 2025

6.4   Source Terms

Definition of pit lake water quality is required for the various pits proposed at BOGP including RAS, SRX and CIT. Modelling associated with the WLBM are discussed in MWM (2025c). Inputs to the pit lake models include:

- Pit wall runoff.

- Rainfall.

- Groundwater inflow.

- Surface water.

The following sections define the derivation of source terms for pit wall runoff.

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[7] *Pers. comm. Rod Redden: email dated 12 February 2025.*

6.4.1   RAS and SRX Pit Wall Runoff

Data for Frasers Pit and Pit wall runoff are presented in Table 16. Generally, the concentrations in the pit lake are higher than the pit wall runoff (as evidenced by an increase in conductivity). This suggests an increase in concentration due to evaporation. Data are presented for mean and 95th percentile data and source terms for the BOGP Pit Wall runoff are based on these terms. Other data, absent from the Frasers Pit dataset are derived from column leach test data (MWM, 2025f) and analogue datasets.

Table 16. BOGP Pit Wall Runoff Source Term.

PARAMETER	FRASERS PIT LAKE WATER QUALITY		FRASERS PIT WALL RUNOFF WATER QUALITY		BOGP PIT WALL RUNOFF SOURCE TERM	
	MEAN	95TH PERCENTILE	MEAN	95TH PERCENTILE	MEAN[4]	95TH PERCENTILE [5]
Alkalinity (mg $CaCO_3$/L)					61.3	140.5
pH (pH units)	8.1	8.8	8.2	8.4	8.2	8.4
EC (µS/cm)	760	1,100	640	970	566 [6]	1037 [6]
Ca	67	96	55	93	55	93
Cl	11	18	13	20	13	20
F					0.21	0.83
Mg	39	56	37	78	37	78
Na	35	61	33	59	33	59
K	7.8	16	3.9	7.1	3.9	7.1
TOC	-	-	-	-	-	-
Al					0.114	0.24
As	<0.18	0.42	<0.093	0.36	0.093	0.36
B					0.046 [3]	0.104
Cd					0.0001	0.0001
Co					0.0005	0.001
Cr					0.0005	0.0005
Cu	<0.003	0.010	<0.0034	0.0082	0.0034	0.0082
Fe	<0.17	0.60	9.1 [1]	21	9.1	21
Mn					0.014	0.039
Mo					0.023	0.045
Ni					0.0009	0.003
Pb	<0.0010	0.0020	<0.004	0.010	0.004	0.010
Sb					0.027	0.14
Se					0.00025	0.00025
Sr					0.91	1.84
Tl					0.00025	0.00025
U					0.0106 [6]	0.0162 [6]
V					0.0005	0.0005
Zn					0.002	0.007
Sulfate	200	350	160	320	160	320
Ammoniacal-N					10 [2]	10 [2]
Nitrate-N					30 [2]	30 [2]

Note: All units in mg/L unless otherwise stated; and all data presented to two significant figures or less.

Note: Green data are ½ LOR and are included in the source term as '0' for water modelling purposes.

Source: Blue cells from Golder (2011d) – Appendix E.

Cyanide is not included as a source term for pit voids as it is assumed no tailings water and/or process water will be pumped to the pit.

1. This data point as presented as <9.1 mg/L by Golder (2011d). It is assumed for this report that 9.1 mg/L is the mean, which appears reasonable based on the graphed information in the Golder report.

2. From Navarro-Valdivia et al. (2023) – see Figure 4.

3. A total of 21 of 30 TZ4 samples are <LOR.

4. Mean of all column leach test data (CLT) data for TZ3 and TZ4 (as of 17-2-25)

5. 95th percentile of all CLT data for TZ3 and TZ4 (as of 17-2-25).

6. where there is a relationship between sulfate and the constituent for the sulfate concentration of interest, then the average of the two relationships for TZ3 and TZ4 is used (based on the presented sulfate concentration).

6.4.2   CIT Pit Backfill

Water quality for the CIT Pit Backfill is discussed in MWM (2025d) where closure water quality is dominated by the materials above the long-term groundwater level.

6.5   Assumptions

The following assumptions are presented for the source term for groundwater:

- It is assumed the Frasers pit and pit wall runoff water quality dataset is a reasonable analogue for BOGP due to a similar lithologies and mineralisation style with both mean and 95th percentile data being available.

- It is assumed that the concentrations of nitrogenous compounds will be similar to the Golden Bar Pit Lake as a comparable analogue site (same lithologies, same mineralisation style, and the same explosives that generate the ammonium-nitrate source hazard) and that these will decrease at a rate of 20-30% per year due to biogeochemical processes.

- It is assumed that the use of mean and 95th percentile column leach test data provides a suitable conservative source term for other water quality parameters absent in the analogue data to understand AMD risks.

6.6   Performance Monitoring

The following performance monitoring is recommended for the RAS and SRX pit lakes:

- Once pit lakes have evolved, it is assumed that nitrogenous compounds will be at low concentrations due to biogeochemical processes. The pit lakes should be monitored for the decay of nitrogenous compounds to validate model assumptions.

- Pit sumps should be monitored to confirm water quality trends for PCOC.

- Pumping records and the quantity of water extraction from the pits for dust extraction should be recorded to validate contaminant load models and the water balance model.

7   RAS UNDERGROUND WORKINGS

A review was undertaken of available data to determine a source term for the RAS underground workings, with the water quality and quantity being a function of groundwater flow through the underground workings and flow from the proposed RAS Pit Lake once it fills.

7.1   Literature Review – Golden Point Adit – Macraes

Data are publicly available for the Golden Point Adit, Macraes, from 1993 to 2007 when the frequency of sampling was increased to monthly water quality sampling due to the increase in flow rates from the adit in ~October 2006 (Golder, 2011d). As noted by Golder (2011d) the historic golden point underground workings intersect the Golden Point Pit, which explains the change in water quality from the 1990's to the 2000's. Pertinent available data are presented in Figure 7 and in Table 17.

Data indicates that there is a decrease in arsenic and iron concentrations across this time period, with the adit discharge being similar to the Golden Point Pit after the pit commenced draining through the workings (Table 10), although sulfate is slightly lower. Given the hydraulic connection of the adit to the pit void, only earlier data would be representative of adit seepage water quality (e.g., pre-2002) prior to the Golden Point Pit filling.

Analysis of these data (Figure 7; Table 17) suggests that adit seepage could have sulfate concentrations of ~120 mg/L; 4.1 mg/L arsenic; and 11 mg/L Fe (Table 17), which is higher than that observed at the Lower Bendigo Adit at the BOGP (Section 7.2 below). This needs consideration as part of the source term development for underground workings.
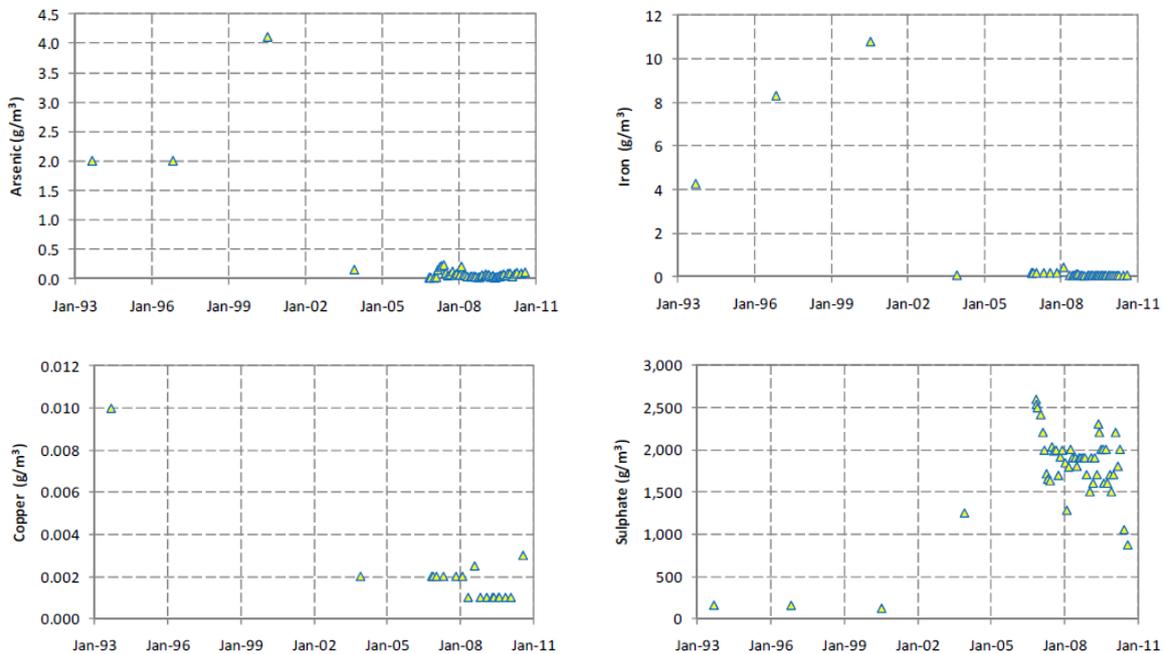

Figure 7. Golden Point Adit water quality

Source: Golder (2011d).

Table 17. Golden Point Adit Water Quality. From Golder 2011c.

PARAMETER	MINIMUM	MEAN	95TH PERCENTILE	MAXIMUM
pH (unitless)	6.8	7.2	7.6	7.7
Conductivity (mS/m)	830	3,200	3,900	4,400
Calcium	130	480	610	620
Chloride	10	13	17	18
Magnesium	28	220	300	320
Potassium	2.4	18	22	27
Sodium	18	100	160	190
Sulfate	120	1,800	2,500	2,600
CN_{WAD}	<0.001	<0.0032	0.0062	0.011
Arsenic	0.014	0.23	1.1	4.1
Copper[A]	<0.0010	<0.0016	0.0026	0.003
Iron	<0.02	<0.65	4.5	11
Lead	<0.0002	<0.0011	0.0032	0.010
Zinc[B]	<0.005	NA	NA	0.011

Golder (2011c) Notes: All units in mg/L unless stated; all data presented to two significant figures or less. NA = not applicable.

[A] - summary statistics were derived after excluding detection limits superseded by lower limits.

[B] - zinc was analysed twice and was below detection on one occasion.

7.2   Lower Bendigo Adit

Data are available from the MGL water quality database for the Lower Bendigo Adit (LBA), which have been reported in MWM (2025a). These data are presented in Table 18. Data indicates that moderate impacts to water quality are identified compared to groundwater data (Table 6) with COPC such as SO_4 and As being elevated.

Based on SO_4 data, results indicate that the water quality in the Bendigo adit is 4.3 times lower; and based on As data it is 3.9 times lower than the Golden Point Adit. The SO_4 ratio between the two datasets is used to derive an estimate of the source term for the RAS underground as shown in Table 18.

Column Leach Test (CLT) data was used to derive a source term for the proposed RAS Underground, where analogue data were not available, using the relationship with SO_4 to determine other water quality constituents. This analysis and the derivation of relationships for each constituent is described in MWM (2025f). Analysis indicated that concentrations are generally lower than those proposed using the ratio approach, although Al, B, Co, Cu, Mo, V, and ammoniacal N are higher (Table 18). The mean of all data (TZ3 and TZ4) was used to derive the source term for the RAS Underground (Table 18).

The following notes are provided for the data presented in Table 18:

- CLT EC (relationship data) provides a reasonable match to EC data for both the Bendigo Adit and the Golden Point Adit. This suggests similar geochemical reactions / ions in solution from scaling off SO_4.

- Alkalinity is comparable across the models, suggesting reasonable reliability.

- Calcium is low in the CLT relationship with sulfate.

- Arsenic concentrations are elevated in both models, however the data from Golden Point Adit of 4.1 is used even though this is a maximum (see Figure 7) to provide a conservative number for modelling of potential effects.

Table 18. Groundwater source term for the RAS Underground based on LBA.

PARAMETERS	Lower Bendigo Adit (this study) (mg/L)	Golden Point Adit (Macraes) (mg/L)	RAS Underground (Ratio [x4.3]) (mg/L)	RAS Underground (CLT Relationship) (mg/L)[3]	RAS Underground Source Term (mg/L)
Alkalinity (mg CaCO$_3$/L)	191.4		191.4[1]	185.1 [5]	191.4
pH (pH units)	8.06	6.8	6.8 [2]	-	6.8
EC (µS/cm)	467.6	830	830 [2]	448.1 [6]	-
Ca	53.1	130	130 [2]	13.59	130
Cl	7.19	10	10 [2]	2.04	10
F	0.292		1.27	0.21	1.27
Mg	15.4	28	28 [2]	5.33	28
Na	19.9	18	18 [2]	20.02	20.02
K	1.94		8.4	10.8	10.8
TOC	1.40				1.4
Al	0.00329		0.0143	0.114	0.114
As	1.0527	4.1	4.1	0.42	4.1
B	0.0175		0.076	0.046	0.046
Cd	0.00007		0.00030	0.0001	0.0003
Co	0.00016		0.00070	0.0005	0.0007
Cr	0.00043		0.00187	0.0007	0.00187
Cu	0.00029		0.00126	0.0005 [7]	0.00126
Fe	0.0452		0.19652	0.04	0.196
Mn	0.0233		0.10130	0.014	0.101
Mo	0.00107		0.00465	0.023	0.042
Ni	0.00028		0.00122	0.0005 [7]	0.00122
Pb	0.00016		0.00070	0.0005 [7]	0.00070
Sb	0.00030		0.00130	0.027	0.027
Se	0.0017		0.0074	0.0025	0.0074
Sr	0.468		2.03	0.91	2.03
Tl	0.00012		0.00052	0.00025	0.00052
U	0.00211		0.009	0.0092 [6]	0.092
V	0.00050		0.002	0.0005 [7]	0.01
Zn	0.00137		0.0060	0.005 [7]	0.006
Sulfate	27.6	120	120 [2]	120	120
Ammoniacal-N	0.0061				0.0061
Nitrate-N	0.2141				0.2141

1. Uses lower Bendigo Adit values

2. Uses Golden Point Adit data

3. 'r' indicates a relationship is used as explained in MWM (2025f)

4. Mean of all column leach test data (CLT) data for TZ3 and TZ4 (as of 17-2-25) where red data are identified as a maximum and are applied to the source term for RAS underground.

5. Based on TZ3 sulfate relationship data, which provided a dataset that comparable to other data from Lower Bendigo Adit

6. where there is a relationship between sulfate and the constituent for the sulfate concentration, then the average of the two relationships for TZ3 and TZ4 is used.

7. Multiple LOR provided by various labs. The highest LOR is presented.

Note: Green data are ½ LOR and are included in the source term as '0'

7.3   Underground Working Source Term

For the WLBM two source terms are required:

- During the operational phase of the BOGP, once the underground is established there will be seepage to the underground, which will be introduced into the mine water BOGP management system.

- During the closure phases of the project there will be seepage from the RAS underground portal that will be a combination of flow from groundwater and the RAS Pit void. It is assumed that the RAS Pit Void water quality will dominant the source term (as seen at Golden Point Adit).

7.3.1   RAS Underground – Operational Phase Source Term

The source term for the RAS Underground working during the operation phase of the project are provided in Table 18.

7.3.2   RAS Underground – Closure Phase Source Term

Water quality for seepage from the RAS Underground in the closure phases of the project utilises RAS Pit Lake water quality. As shown at Macraes, adit seepage at Golden Point Adit is dominated by pit lake water quality and the same process is expected at the BOGP once the crown pillar is removed and the pit lake is connected to the underground workings. Flow will be a function of pit lake seepage flow. This mixing is managed by the GoldSim model.

7.4   Assumptions

The following assumptions are presented for the source term for the underground workings:

- It is assumed the Macraes Golden Point Adit provides a reasonable example of the effects of the mineralisation (i.e., SO_4) on underground water quality and that the data are more reliable than the Lower Bendigo Adit that may not have intersected the RSSZ. Higher PCOC data are chosen to ensure that AMD risks are considered.

- It is assumed that mean PCOC derived from column leach testing is reasonable to develop a water quality source term for the RAS underground for those parameters that are missing from the analogue dataset and would account for subtle differences in mineralisation between BOGP and Macraes.

- The WLBM (MWM, 2024c) indicates that the seepage from the RAS underground working will discharge many decades after mining operations cease. It is expected that with such residence times that nitrogenous compounds are degraded by biogeochemical reactions (e.g., Navarro-Valdivia, et al., 2023) such that the nitrate nitrogen and ammoniacal nitrogen resembles the water quality shown in Table 18.

- It is assumed that there is no first flush of contaminants from the underground workings and that the combined source terms (dominated by the pit water quality rather than water in the deeper underground workings that is unlikely to move upwards) will be reasonable to understand risks to the receiving environment and consider any appropriate management options.

7.5   Performance Monitoring

The following performance monitoring is recommended for the Underground Workings water quality:

- Install a piezometer to confirm groundwater levels and provide guidance on when discharge from the RAS underground portal might occur (with comparison to RAS Pit Lake water levels)

- Monitor the underground workings seepage water quality prior to it discharging to validate management requirements.

8   SOURCE TERMS – MINE IMPACTED WATERS

This section summarises the source terms used for general mining areas that will generate MIW.

8.1   Impacted Run-off Water Quality

A literature review of data available from Macraes was undertaken to provide empirical analogue data for MIW runoff. Golder (2011a) defines two surfaces as impacted and non-impacted where:

- Impacted surfaces include pits, ore processing areas, mine roads, unrehabilitated waste rock stacks (WRSs) and rehabilitated tailings surfaces.

- Non-impacted surfaces are those surfaces that are in a natural state but might be impacted by mine dust and the definition also include rehabilitated WRS.

The water quality associated with these surfaces is provided in Table 19 and was derived by Golder (2011c) from Frasers Pit runoff where 25th percentile data from Frasers Pit run off was used for non-impacted runoff and 50th percentile data was used for impacted runoff. For this report, we have refined the terminology to be rehabilitated WRS surfaces and mine impacted areas. Areas affected by dust would be considered mine impacted surfaces and further studies are required to define these areas and any effects (once the project is operational)

During consenting of Deepdell North Stage III Project these source terms were updated using recent empirical data (OceanaGold, 2020a; GHD, 2020) with GHD (2020) stating that these data were derived from water quality monitoring data provided by OceanaGold and represent mean values.

<div align="center">Table 19. MIW – Macraes</div>

PARAMETER	REHABILITATED WRS SURFACES		MINE IMPACTED SURFACES	
Source	*Golder (2011a)*	*OceanaGold (2020a)[1]*	*Golder (2011a)*	*OceanaGold (2020a)[1]*
Units	*mg/L*	*mg/L*	*mg/L*	*mg/L*
Arsenic	0.021	0.02	0.1	0.04
Sulfate	125	470	201	930
Cyanide	0.001		0.001	
Copper	0.001	0.001	0.002	0.0012
Iron	0.05	0.14	0.135	0.032
Lead	0.0001	0.00019	0.001	0.0002
Zinc	0.005	0.001	0.005	0.001
Sodium	15		28	
Potassium	3		4	
Calcium	46		63	
Magnesium	26		34	
Chloride	6		13	
Nitrate		0.4		0.094
Ammonia		0.012		0.012

Source: Golder (2011a) and OceanaGold (2020a)

Red Text *is greater than the proposed consent limits for BOGP noting the Cu has no toxicity modifying factors applied.*

1 – Derived by GHD (2020)

Data are available for runoff from the Fraser Pit Wall (Table 13 and Table 16), which suggests a broad range in pit wall runoff water quality. For the purposes of this report, it is assumed that runoff from mine impacted surfaces is fairly represented by:

- TZ3 mine impacted surfaces is best represented by mean data (as shown in Table 20 below).

- TZ4/RSSZ mine impacted surfaces is best represented by 95th percentile data (as shown in Table 20 below).

However, the use of these source terms is complicated by the source of dust suppression water. Further consideration is given to whether these data are conservative and adequately reflect the potential risk to the receiving environment given these waters may discharge from site during the operational phase of the project.

8.2   Discussion – Dust Suppression Water

Water is required for dust suppression and this water can be sourced from the pit void and also groundwater bores. Dust suppression water will be applied to all haul roads, hardstands, and the operating surfaces of the engineered landforms. If the water for dust suppression is sourced from the RAS pit sump it could introduce contaminants to these surfaces from the pit water.

No management of MIW is proposed for haul roads and run-off from the ELF other than sediment management (and sediment sumps), with discharge of these waters off site during higher rainfall periods (EGL, 2025b). Hence dissolved constituents that remain in solution such as sulfate in the pit water might be elevated and affect the downstream receiving environment.

To address the potential effects of poorer water quality associated with the effects of dust suppression water derived from the pit sump, a numerical analysis was undertaken using sulfate as an indicator of effect.

8.2.1   Analysis – Dust Suppression Water

Table 19 indicates that the source terms for mine impacted surface runoff derived by Golder in 2011 and by GHD in 2020 are generally comparable except for a significant increase in sulfate from 2011 to 2020. It is unlikely that mine surfaces can generate such elevated sulfate without the ongoing addition (and evaporation) of MIW to these surfaces. For instance, pit wall runoff (which would include runoff from mineralised rock, ore zones, and waste rock has a sulfate concentration ranging from 12 – 390 mg/L; a mean of 160 mg/L; and a 95th percentile value of 320 mg/L. This is considerably lower than 930 mg/L proposed by GHD (2020). It is reasonable to assume that the elevated sulfate is related to ongoing dust control with mine water elevated in sulfate (e.g., from pit voids).

Based on flow rates into the RAS Pit of 7-14 L/s (Rekker and Dumont, 2025), and the assumption this mixes to generate the water quality observed at the Frasers Pit of (Table 8) this would result in 240 – 570 kg sulfate per day being applied to mine surfaces, which is likely to produce a comparable load to that observed at Macraes.

8.3   Source Terms: Mine Impacted Surfaces and Rehab Surfaces

The source terms are provided in Table 20. The following discussion is provided:

- Where mine surfaces do not use pit water elevated in sulfate for dust suppression, a source term derived from Frasers Pit Wall runoff is used. Data are provided for run-off from TZ3 and

TZ4/RSSZ materials. To assess stability and transport at surface conditions the original source term for TZ4/RSSZ, which had elevated iron of 21 mg/L, was assessed with PHREEQC. It was seen that through precipitation iron, copper, aluminium and lead concentrations are likely to decrease. Adsorption ratios from Raven et al. (1998) show that the iron precipitate will be sufficient to reduce arsenic concentrations to <LOR.

- For mine impacted surfaces that have pit lake water applied (that is elevated in sulfate), the source term for these surfaces is based on data in Table 19 (e.g., a sulfate concentration of 930 mg/L).

- For rehabilitation surfaces, the source term for these surfaces is based on data in Table 19 (e.g., a sulfate concentration of 470 mg/L).

- OceanaGold (2020) report that impacted and rehabilitated surfaces have ammoniacal-N concentrations of 0.012 mg/L and nitrate-N concentrations of 0.094 mg/L and 0.4 mg/L respectively based on pit water quality of 0.9 mg/L ammonia and 10.5 mg/L nitrate. Nitrate concentrations within the RAS pit have been estimated at 30 mg/L nitrate-N, and 10 mg/L ammoniacal-N. These values are used as conservative datasets to derive a source term for mine impacted surfaces that use the pit sump for dust suppression.

Table 20. Source terms: Mine Impacted Surfaces and Rehabilitated Surfaces

PARAMETER	MINE IMPACTED SURFACES (BORE WATER DUST SUPPRESSION)		MINE IMPACTED SURFACES (DUST SUPPRESSION USING PIT SUMP WATER)	REHABILITATION SURFACES
	TZ3	TZ4/RSSZ	ALL SURFACES	BROWN ROCK
Alkalinity (mg CaCO$_3$/L)	61.3	140.5	140.5 [3]	140.5 [3]
pH (pH units)	8.2	8.4	8.4 [4]	8.4 [4]
EC (µS/cm)	566 [6]	1,037 [6]	3,738 [6]	1,952 [6]
Ca	55	90.4 [7]	22.94 [3]	15.68 [5]
Cl	13	20	17.7 [3]	3.1 [5]
F	0.21	0.83	1.14 [3]	0.34 [5]
Mg	37	76.4 [7]	3.06 [3]	1.95 [5]
Na	33	59	94.2 [3]	32.88 [5]
K	3.9	7.1	13.64 [3]	8.66 [5]
TOC	-	-	-	2.01 [8]
Al	0.114	0.00016 [7]	0.438 [3]	0.155 [5]
As	0.093	0.005 [7]	0.04	0.02
B	0.046	0.104	0.11 [3]	0.064 [5]
Cd	0.0001	0.0001	0.0001	0.0001
Co	0.0005	0.0005 [7]	0.0005	0.0005
Cr	0.0005	0.0005	0.0005	0.0005
Cu	0.0034	0.0005 [7]	0.0012	0.001
Fe	9.1 [1]	0.005 [7]	0.032	0.14
Mn	0.014	0.039	0.028 [3]	0.0115 [5]
Mo	0.023	0.045	0.285 [6]	0.147 [6]

PARAMETER	MINE IMPACTED SURFACES (BORE WATER DUST SUPPRESSION)		MINE IMPACTED SURFACES (DUST SUPPRESSION USING PIT SUMP WATER)	REHABILITATION SURFACES
	TZ3	TZ4/RSSZ	ALL SURFACES	BROWN ROCK
Ni	0.0009	0.003	0.0005	0.0005
Pb	0.004	0.003 [7]	0.0002	0.00019
Sb	0.027	0.14	0.155 [3]	0.049 [5]
Se	0.00025	0.00025	0.00025	0.00025
Sr	0.91	1.84	1.77 [3]	0.67 [5]
Tl	0.00025	0.00025	0.00025	0.00025
U	0.0106 [6]	0.0162 [6]	0.099 [6]	0.053 [6]
V	0.0005	0.0005	0.0005	0.0005
Zn	0.002	0.007	0.001	0.001
Sulfate	160	320	930	470
Ammoniacal-N	0.012	0.012	10 [2]	0.012
Nitrate-N	0.094	0.094	30 [2]	0.4

Note: All units in mg/L unless otherwise stated; and all data presented to two significant figures or less.

Note: Green data are ½ LOR and are included in the source term as '0'

Source: Blue cells from Golder (2011d) – Appendix E.

Source: Orange cells are from OceanaGold (2020a)

1. This data point as presented as <9.1 mg/L by Golder (2011d). It is assumed for this report that 9.1 mg/L is the mean, which appears reasonable based on the graphed information in the Golder report.

2. From Navarro-Valdivia et al. (2023) – see Figure 4.

3. Uses 95th percentile data from Column Leach Tests

4. Uses 95th percentile data from the Frasers Pit wall runoff.

5. Mean of all column leach test data (CLT) data for TZ3 (as of 17-2-25)

6. Where there is a relationship between sulfate and the constituent for the sulfate concentration of interest, then the TZ3 relationship is used.

7. Reduced from original runoff source term due to likely precipitate formation and adsorption as per PHREEQC equilibrium phases modelling and Raven et al. 1998.

8. TOC defined from SC01 baseline water quality.

Note: Mine impacted surfaces are defined in Section 8.1 of this report.

8.4   Assumptions

The following assumptions are presented for the source term for mine impacted surfaces:

- It is assumed that mine impacted surfaces use mean (160 mg/L) and 95th percentile (320 mg/L) SO_4 data from Frasers Pit runoff (and other available parameters) for runoff from TZ3 and TZ4 materials respectively. This is considered conservative, as concentration will remain constant for higher flow events, when there is likely to be considerable dilution.

- Where pit sump water is used for dust suppression it is assumed there is the potential to accumulate salts that could generate poor water quality. This risk is likely to be lesser at the start of operations and higher once the pit is at maximum volume and water quality is poorest. It is assumed that the empirical data provided by GHD (2020) is representative of mine impacted surfaces that utilise pit sump water for dust suppression (e.g., 930 mg/L sulfate). This

is considered conservative, as concentration will remain constant for higher flow events, when there is likely to be considerable dilution.

- It is assumed that that data from Macraes provides a reasonable estimate of runoff water quality from rehabilitated slopes (e.g., 470 mg/L sulfate) as this is based on empirical data from similar materials.

- It is assumed that the assumptions presented in Table 20 (footnotes) are reasonable in regards to the development of appropriate source terms to understand AMD risk and that the direct application of column leach test data (mean and 95th percentile) is conservative.

8.5   Performance Monitoring

The following performance monitoring is recommended for the water quality of mine impacted surfaces:

- Monitoring of water quality and flow rates of runoff from mine impacted surfaces such as haul roads and the ELF (e.g., monitoring of runoff within sediment sumps).

- Monitoring or water quality from rehabilitation surfaces (e.g., measurement of runoff water quality)

Mine impacted surfaces are released directly to the receiving environment. Hence, they represent a diffuse source of potentially poor water quality. Modelling (MWM, 2025c) suggests that there are some risks to the receiving environment, and it would be advantageous to develop a Trigger Action Response Plan (TARP) to manage this risk. One management option would be to use bore water for dust suppression rather than pit sump water.

8.6   Ore Stockpile

An ore stockpile area is proposed as part of the BOGP that will be used to blend low grade ore (LGO) and ore to supply the processing plant. The source term presented in Table 20 for mine impacted surfaces is considered appropriate if the effects require assessment. At closure the ore stockpile is removed and during operations any runoff water is returned to the process plant.

9   SOURCE TERMS – TAILINGS STORAGE FACILITY

This section describes the process to derive source terms for the WLBM for MIW from the Shepherds TSF. Two source terms are required including:

- Decant water quality – Influenced by chemical composition of the ore being processed, processing reagents, operational water management discharges to the TSF surface, recycling of process water, climatic effects including evaporation and dilution by rainfall, and geochemical processes.

- TSF seepage water quality – Influenced by the decant water quality and geochemical processes occurring as decant water migrates through the tailings to report as seepage.

9.1   Background

The proposed Shepherds TSF will retain all tailings (other than those used for paste backfill) for the BOGP. Supernatant water will be managed on top of the tailings within the decant pond. During operations the TSF will operate as a zero-release facility with sufficient freeboard to manage both operational water and the inflow design flood without discharge (EGL, 2025b). Water on the TSF will be lost via evapotranspiration or be reused in the Process Plant.

EGL (2025b) note that during operation seepage collected in the TSF and ELF underdrainage will be collected in a HDPE lined sump and will be pumped back the TSF. The HDPE lined sump is proposed to be 4,500 m^3 to allow time for reestablishment of the pumps if there is a breakdown. The Shepherds Creek Silt Pond is immediately downstream of the sump and allows a contingency option (in dry conditions) if the sump filled up. As an alternative option a gravity line could be run down to the Process Plant (Note: the need for this is considered a detailed operational decision (EGL, 2025b).

During the active- and post- closures stages, seepage from the TSF and ELF will continue to collect in the underdrainage and at the toe of the ELF. This will be either sent to a water treatment plant or passive treatment ponds before discharge to Shepherds Creek.

During the active- and post- closure stages, the TSF will be fully dry capped with brown rock, topsoil, and revegetated. On the northern side of the TSF a shallow amount of water will be allowed to pond on the dry capping to attenuate flood flows and form a wetland (if desired as a final closure landform). Runoff from the top of the closure dry capping will be clean and discharge through an outlet channel around the northern edge of the ELF into Shepherds Creek.

9.2   Literature Review

Publicly available water quality data for the Macraes was reviewed to provide an analogue dataset of TSF water quality for the TSF decant surface water and TSF seepage water quality. However, the processing of ore at Macraes post ~1999 is different to that proposed at BOGP. Since 1999 Macraes have introduced a pressure oxidation (POX) stage to the ore processing plant that oxidises all sulfide minerals to sulfate liberating the refractory gold. Hence pre-1999 data is of relevance as POX of ore is not proposed at the BOGP. The tailings were originally stored in separate impoundments until 1993, with the sulfate rich cyanidation tailings stored in the Concentrate Tailings Impoundment (CTI), and the other tailings stored in the Flotation Tailings Impoundment (FTI). From 1993 onwards these were combined and stored in the Mixed Tailings Impoundment (MTI).

Hence it is anticipated that sulfate concentrations (including other contaminants associated with sulfides) in BOGP tailings water will be comparable to pre-POX water quality at Macraes. Hence, the most appropriate tailings water quality data at Macraes, as an analogue for BOGP is prior to 1999 when POX commenced. Prior to the introduction of POX sulfate concentrations were gradually increasing, but appear to have stabilized between 1994 – 1999 with an average concentration of 952 mg/L. The change in water quality following the introduction of POX is shown in Figure 8 with sulfate concentrations increasing to ~5,000 mg/L.
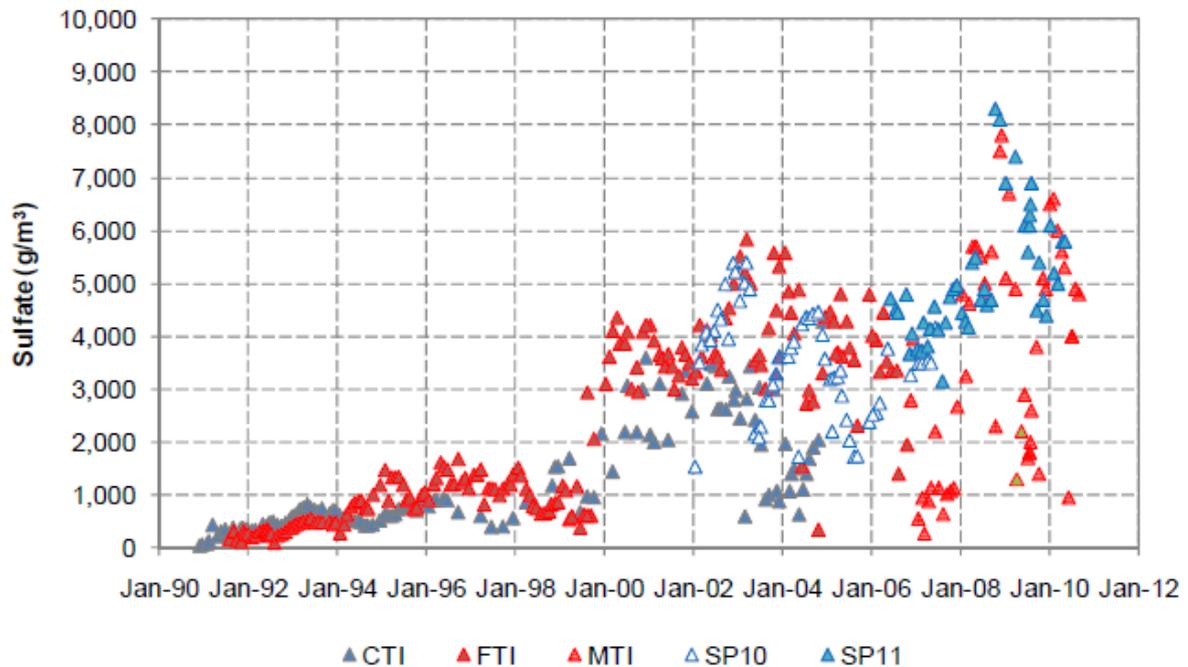

Figure 8. Macraes Gold Mine TSF Decant Water Quality - Sulfate

Source: Golder (2011d) – Appendix B

Decant water quality shows a decrease in arsenic concentrations following the introduction of POX at Macraes from 0.1 - 450 mg/L (average 39 mg/L) to ~0.1 - 5 mg/L (Figure 9). Craw and Pope (2017) indicated that this decrease in dissolved As concentrations is due to greatly increased Fe-oxyhydroxide formation associated with the POX, which provides adsorption sites for As. Dissolved iron (Fe) concentrations in the decant water remained reasonably consistent until 2002 when concentrations increased (Figure 10).
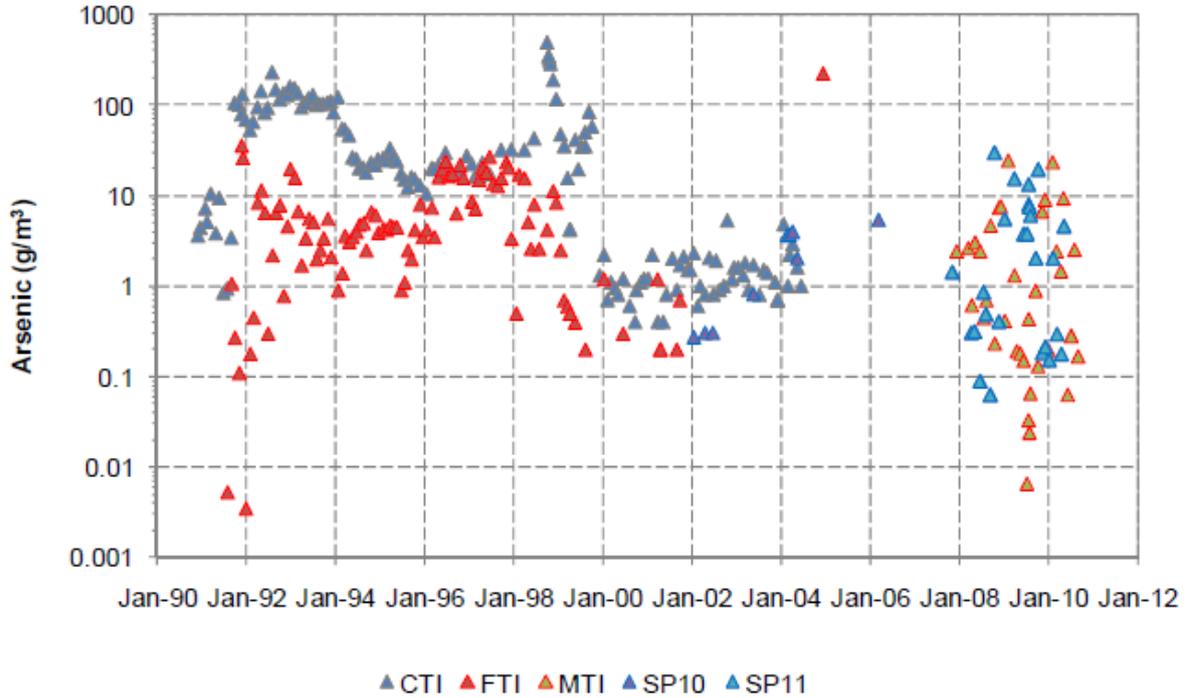
Figure 9. Macraes Gold Mine TSF Decant Water Quality - Arsenic
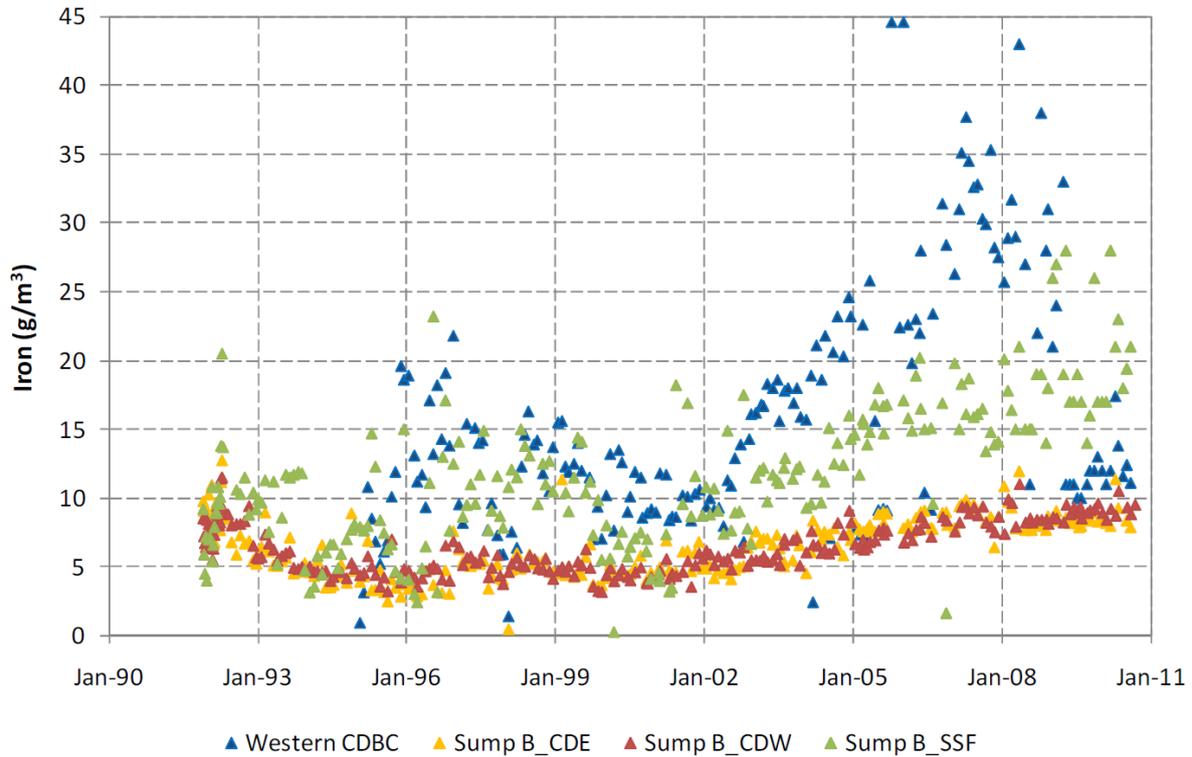
Source: Golder (2011d) – Appendix B

Figure 10. Macraes Gold Mine TSF Decant Water Quality - Iron

Source: Golder (2011d) – Appendix C

9.2.1   Tailings Cyanide Concentrations

Cyanide may be elevated in the BOGP TSF due to its use in the gold recovery process (e.g., MACA, 2025). Golder (2011f) not a general decline in cyanide with time for the Macraes Project (Figure 11). Data presented by Golder (2011c) indicates that operational seepage water quality for the TSF's at Macraes (TTTSF, MTI, SPI) ranged from 0.022 – 0.051 mg/L and that TSF seepage water following closure would be 0.08 mg/L. Golder (2011a) note that tailings pore water seepage post closure would be 0.35 mg/L and that operationally TSF decant water was 0.47 mg/L.
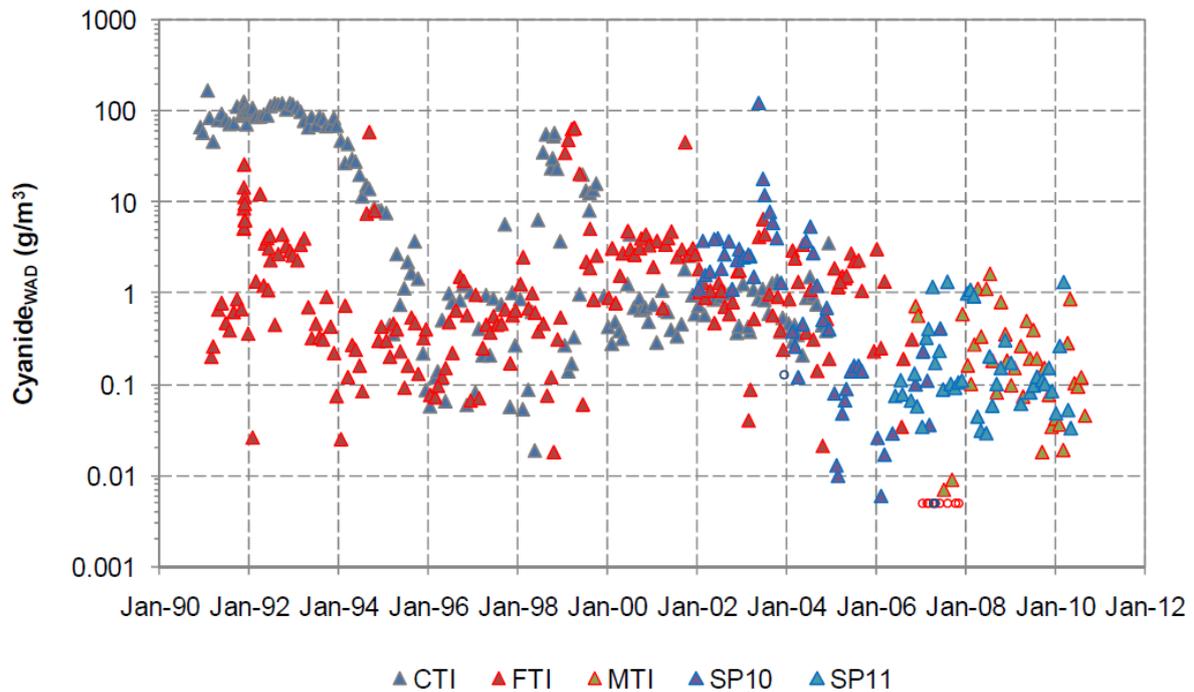

Figure 11. Cyanide – WAD – Macraes
Source: Golder 2011d

9.2.2   Geochemical Maturation of Seepage Waters

Golder (2011a,c) note that the quality of the tailings pore water, as represented by TSF drain discharges differs from that of tailings decant water due to complex hydrogeochemical interactions, which includes precipitation and dissolution reactions, adsorption and desorption processes, hydraulic residence times of pore water in the TSF, and the redox environment within the TSF.

Craw and Pope (2017) presented the water quality in the MTI decant pond and the chimney drain, which collected water that had percolated through the tailing impoundment (Figure 12). The average concentrations in the pre-POX period (1994-1999) are presented in Table 21. This data was derived from manually extracting data from Craw and Pope (2017) published graphs with WebPlotDigitizer (Rohatji, 2011), which may have a small level of imprecision.
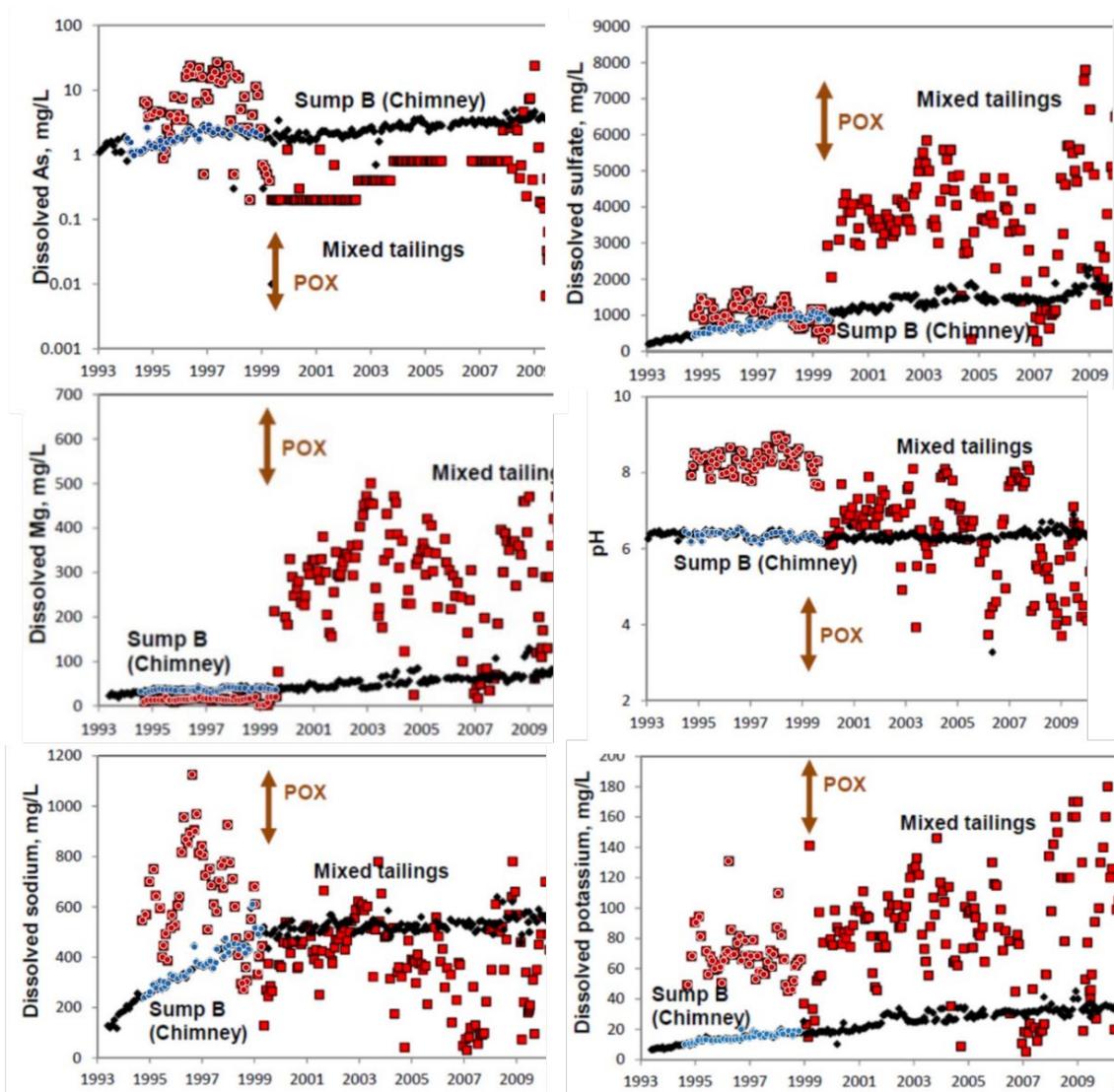
Figure 12: Macraes Tailings seepage water quality

Source: Craw and Pope (2017). The blue and red dots were used for the analysis presented in this report (Table 21).

Table 21: Macraes MTI average water quality between 1994 – 1999: decant water and the outflowing chimney drain.

PARAMETER	MIXED TAILINGS IMPOUNDMENT DECANT (mg/L)	SUMP B CHIMNEY DRAIN (mg/L)	% CHANGE
Alkalinity	138.1	158.6	15%
As	8.6	1.9	-78%
Ca	98.3	69.1	-30%
Cl	342.7	173.3	-49%
K	69.1	14.9	-78%
Mg	14.8	36.9	150%
Na	634.7	383.1	-40%
Sulfate	1,049.4	734.6	-30%
pH	8.3	6.3	--

Note: pH is unitless.

Source: Craw and Pope (2017).

Since the geology and processing procedure over this period was similar to what is proposed at BOGP, the derived water quality provides an indication of how the decant water quality at the BOGP may mature as it percolates through the TSF, where:

- pH decreased from an average of 8.3 to 6.3 through the MTI.

- Sulfate decreased by 30%, arsenic decreased by 78%, calcium decreased by 30%, potassium decreased by 78%, and sodium decreased by 40%.

- Alkalinity increased by 15% and magnesium concentrations increased by 150%.

Copper concentrations were not presented in Craw and Pope (2017) however they were discussed in Craw and Nelson (2000), which presented representative concentrations in the decant ponds and Sump B from when the CTI and FTI were active in 1993 (Table 22). In this period the tailings were split into different impoundments, which results in different water qualities due to the geochemical differences of the tailings. However, the trends between the difference in the average decant water quality to the average sump water quality were similar to the later data from the MTI.

Craw and Nelson (2000) indicate that the Sump B (seepage) water is made up of approximately half regional groundwater and half tailings seepage, with the two mixing beneath the tailings dam before reaching Sump B. Ca, Fe and Mg concentrations were seen to increase between the decant water and the sump water, while other analytes decreased in concentration, some by the approximate value expected amount given the groundwater dilution, and some by more, indicating other attenuation factors were occurring. Copper was seen to decrease from an average of 14.4 mg/L in the decant water to below the LOR to <0.01 mg/L, while arsenic was seen to decrease 98% from an average of 56.06 mg/L in the decant water to ~0.9 mg/L in sump B.

Golder (2011c) note that sulfate concentrations in the TSF decant water quality increased with time, which was assumed to be the result of ongoing recycling of decant water quality, evaporation, dilution, and changes to the process and water management methods over the 20 years of mining operations.

Table 22: Representative water quality in November 1993, when the CTI and FTI were active.

	DECANT		SUMP B			% CHANGE
	CTI DECANT	FTI DECANT	SUMP B CDE	SUMP B CDW	SUMP B SSF	
As (total)	110	2.1	1.1	1.3	<0.5	-98%[1]
Cu	28.2	0.67	<0.01	<0.01	<0.01	-100%[1]
Fe (total)	8	1.31	4.97	4.96	11.8	56%
Na	915	394	172	188	96.8	-77%
K	52.9	60.1	8.14	8.09	6.26	-87%
Ca	31.8	33.4	55.1	45.6	85	90%
Mg	3.8	6.4	26.9	25.3	39.1	497%
Cl	787	323	141	154	67.6	-78%
HCO_3^-	564	125	183	186	277	-37%
Sulfate	695	425	344	317	296	-43%
pH	9.8	8.4	6.4	6.5	6.2	-

All units are in mg/L other than pH, which is unitless.

1. - where readings were below the detection limit, half the detection limit was used for calculating the % change. Percent (%) change calculated from the average between the decant concentrations and the average of the Sump B measurements.

Source: Data from Craw and Nelson (2000) when the TSF was active (e.g., 1993).

9.2.3   Literature Review Summary

The following summary is provided:

- TSF water quality in the BOGP decant and seepage is expected to be comparable to pre-POX water quality at Macraes (pre-1999).

- Fe is expected to be elevated, with pre-POX water at Macraes showing average concentrations of 4.6 mg/L in decant water and 7.2 mg/L in outflowing sump water.

- Nitrate is expected to be elevated due to the use of nitrogenous compounds (e.g., ANFO, cyanide).

- Cu is expected to decrease through the TSF. Cu is added to the process water to facilitate the destruction of cyanide (MACA, 2025). Assessment of

9.3   Process Water

This section reviews the process water that will be the discharge water quality from the processing plant to the TSF. Further details on the ore processing plant are provided in MACA (2025). Mineralis (2025) provide additional discussion on the use of Cu to facilitate cyanide destruction (Appendix B).

9.3.1   Process Water Treatment

MGL (2024) state that an air/SO_2 circuit has been selected for cyanide destruction based on the relatively lower operating cost of these circuits, the less hazardous reagents required in comparison to Caros acid and the amenability shown in the testwork of the ore to this form of cyanide destruction. The circuit will reduce the weakly acid dissociable cyanide to less than 30 ppm at discharge of the TSF spigot. Current data indicates that cyanide may be elevated and MGL indicates this is being retested to confirm the cyanide destruction works. It is assumed that cyanide concentrations measured in the Macraes TSF (0.47 mg//L: Golder, 2011a) can be achieved at the BOGP and that the long-term seepage water quality post closure for $Cyanide_{WAD}$ will be 0.35 mg/L as proposed for Macraes (Golder, 2011a).

Ferric chloride precipitation of solubilised arsenic as a ferric arsenate has been selected based on the amenability of the ore to this removal method, and the anticipated stability of the arsenate species generated (MGL, 2024). Test results indicate that as of <0.7 mg/L was achieved and that significant additional testwork is required for the arsenic removal step, including undertaking Toxicity Characteristic Leaching Procedure (TCLP) testing of solids generated in the arsenic removal process to determine the stability of the precipitate formed, and undertaking further testing to confirm the reproducibility of these results (MGL, 2024).

9.3.2   Metallurgical Test Data

This section discusses water quality data derived from metallurgical testing (MACA, 2025), which provides a source term for the expected process water. Metallurgical testing was coordinated by MACA, with final leachate analysis after detox and As removal providing an estimation of the expected water quality for the decant water in the TSF (Table 23).

Only one dataset is available for the process water quality (MACA, 2025), which introduces some uncertainty into the model. To account for this, the WLBM does not consider any improvement in water quality with time after closure to ensure MIW risks for water quality are identified and managed

appropriately in the long term. For instance, Golder (2011e) note that at Macraes following closure of the TSF it is expected that a gradual change in seepage water quality will occur that reflects a change from process water to rainwater. Golder (2011) note the infiltrating rainwater will continue to leach PCOC but that concentrations will be lower. Data presented (Golder, 2011e) indicates that in the long term, TSF seepage water quality could change from 2,769 mg SO_4/L to 2,260 mg SO_4/L, i.e., a ~20% decrease.

Table 23: Source Terms: Process water quality and tailings seepage water.

PARAMETER	DETECTION LIMIT	PROCESS WATER QUALITY[1]	OPERATIONAL TSF DECANT QUALITY[2]	CLOSURE TSF SEEPAGE WATER QUALITY[6]
Alkalinity (mg/L as $CaCO_3$)	5	310	34.6	73.21
pH (pH units)	0.01	7.86	6.41	6.41
EC (µS/cm)	2	2,500	1,948	4,121
Ca	0.5	140	140	297
Cl	1	380	380	804
F	0.1	0.913	0.913	1.93
Mg	0.5	19	47 [3]	99
Na	0.5	400	400	847
K	0.5	24	24	50.8
TOC	-	-	-	-
Al	0.01	0.72	<0.01	<0.01
Ag	0.001	0.0034	0.0034	0.0068
As	0.001	0.12	0.97 [5]	2.05
B	0.02	0.39	0.39	0.825
Cd	0.0001	0.0001	0.0001	0.0002
Co	0.001	0.025	0.025	0.053
Cr	0.001	0.0068	0.003	0.0055
Cu	0.001	1 [10]	0.001	0.001 [8]
Fe	0.01	2.1	7.24 [4]	15.3
Mn	0.001	0.28	0.28	0.59
Mo	0.001	0.12	0.066	0.14
Ni [9]	0.001	0.32	0.32	0.678
Pb	0.001	0.013	0.013	0.0275
Sb	0.0001	0.085	0.085	0.18
Se	0.001	0.0014	0.0014	0.003
Sr	0.001	2.1	2.1	4.4
Tl	0.001	0.001	0.001	0.001
U	0.001	0.013	0.013	0.028
V	0.001	0.0018	0.0018	0.004
Zn	0.001	0.014	0.014	0.0296
Cyanide - WAD	0.01	47	0.47 [7]	0.35 [7]
Sulfate	1	450	450	954
Ammoniacal-N	0.005	2	2	2
Nitrate-N	0.005	<0.0050	0.005	0.005

Note: All units in mg/L unless otherwise stated.

Note: Green data are LOR and are included in the source term as '0'

Note: Red data are elevated compared to the unmodified surface water quality limits provided by Ryder (2025).

If no data are provided these are identified by ' - '.

1. – MACA (2025).

Source: Process water quality sourced from metallurgical testing – final liquor analysis from bulk leach, detox and As removal.

2. - Seepage water results are from solution modelling with PHREEQC. This modelling gives an indication of changes expected due to the saturation and therefore precipitation of certain minerals as the water sits in the decant pond.

3. - Evidence from the Macraes data indicates that this element had higher concentrations in the seepage water than the decant water. It has therefore been increased in by the same factor seen at Macraes.

4. – The Fe concentration has been increased from the concentration modelled by PHREEQC to the average Fe concentration for seepage observed at Macraes (Table 22).

5. – With Fe dissolving, it is assumed that some As may also be mobilised and the As concentration has been increased from the concentration modelled by PHREEQC (0.28 mg/L) to the average As concentration for seepage observed at Macraes (Table 22).

6. – To account for the recycling of water, transfer of water from ELF seepage, evaporative concentration, etc the closure source term was multiplied using sulfate as the scaling factor to be comparable to the sulfate concentrations seen at Macraes pre-POX, i.e., 954 mg/L as shown in Figure 8.

7. – Source: Golder (2011a) – Table 14 for Macraes

8. – Cu precipitation was simulated in PHREEQC to account for solubility limits reducing the process water concentration to <0.001 mg/L. A value of 0.001 mg/L is used as the source term to be conservative.

9. – Ni is elevated compared to ANZG(2018) guidelines – 90% trigger value of 0.013 mg/L

10. – Process water quality data (MACA, 2025) indicate that Cu in process water was 75 mg/L. This has been adjusted to 1 mg/L based on advice by Mineralis (2025), which is provided in Appendix B.

9.4   TSF Seepage Source Term

As seen from the Macraes data presented by Craw and Nelson (2000) and Craw and Pope (2017), the decant water quality will change as seepage percolates through the tailings facility. The change in water quality is the result of a complex array of processes which can include precipitation of minerals, dilution with rainwater and groundwater, dissolution of minerals within the tailings, and adsorption of metals and metalloids to clays and iron oxyhydroxides.

PHREEQC geochemical modelling software (Parkhurst and Appelo, 2013) has been used as an initial indication of how the seepage water will evolve from the process water due to the precipitation of minerals from the solution. The resulting seepage water quality is presented in Table 23. This seepage water quality may be conservative as it does not take into account any dilution or adsorption of metals within the tailings. Where the Macraes data showed an increase of concentrations in the seepage compared to the decant, likely due to dissolution or weathering of minerals within the tailings, the indicated seepage concentrations have been manually increased by the same factor. For example, magnesium concentrations were 150% higher in seepage compared to decant concentrations, so the results from the metallurgical testing have been increased by 150% for the seepage water.

Some data has been manually adjusted to higher concentrations (As and Fe) to account for the sub-oxic conditions in the TSF using data from Macraes (Table 22) to provide a conservative value.

9.5   Assumptions

The following assumptions are provided for the source terms for the TSF:

- It is assumed that the TSF seepage water quality represents the long-term risk to water quality from this mine domain and that this is adequately represented by the source term developed from the Process Water quality.

9.6   Performance Monitoring

The following performance monitoring is recommended:

- Validate the process water quality including the geochemistry of the tailings on a monthly basis to confirm water quality inputs to the WLBM and validate assumptions on the geoenvironmental hazards for the solids stream.

- Undertake monthly sampling of the TSF seepage for water quality to improve the source term for modelling of effects. This should also include continuous monitoring for EC, pH, and flow to improve the WLBM.

10 SOURCE TERMS - TREATED WATER

This section summarises the treatment of water during the Active Closure Phase and the Post Closure Phase of the BOGP.

10.1 Active Water Treatment

During the Active Closure Phase of the BOGP it is proposed that MIW are treated by the active water treatment plant (WTP). Further details of this WTP are provided in MWM (2025g) and Process Flow (2025).

10.2 Passive Water Treatment

During the Post Closure Phase of the BOGP it is proposed that MIW are treated by the passive treatment system (PTS). Further details of the PTS are provided in MWM (2025g) including effluent water quality following treatment.

11 CLOSING

MWM has developed this report to define the water quality source terms for the WLBM for the BOGP for MGL to provide a summary of inputs that will be used during the modelling process.

11.1 Water and Load Balance Model Summary

A WLBM, that contains water flow and quality data is required for the BOGP to understand potential deleterious effects on the receiving environment associated with these MIW (noting the management of TSS is covered by the sediment and erosion management plan: EGL (2025a)). The WLBM has been developed using the GoldSim modelling platform[8] Key water quality inputs (source terms) are defined in this report, and this includes the following key model components:

- The composition of rainfall water, for understanding its interaction with project materials.

- Baseline surface water quality.

- Groundwater inflow quality (e.g., to the RAS Pit void).

- ELF seepage.

- Process water quality associated with the tailings (assumed to be representative of TSF decant water quality).

- Pit water quality.

- TSF decant water.

- TSF seepage water quality.

- MIW quality associated with ELF runoff, haul roads, and hardstand areas.

- Underground workings (operational and closure).

- Rehabilitated surfaces.

11.2 Derivation of Source Terms

Source terms were developed from a variety of sources including analogue data sources, baseline studies at the BOGP, and laboratory derived data from environmental geochemistry testing. This report provides an explanation of how the source terms for modelling were developed for the WLBM.

11.3 Water Balance Model

Water management during the Operational Phase of the BOGP will involve discharge of only episodic runoff from haul roads and ELF surfaces. All other MIW (e.g., landform seepage) will be collected, used, and stored on site. In the Active Closure / Post Closure Phase, MIW will be treated and discharged to the receiving environment. Two models have been developed, that are reported elsewhere (MWM, 2025c) to reflect these phases:

- Operational Phase - Excel based models and calculations focussing on average annual water balance and runoff event discharge of MIW.

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[8] https://www.goldsim.com

- Active Closure / Post Closure Phase - GoldSim based models and calculations, focussing on the evolution of instream water quality over time as a result of discharge of treated MIW.

EGL (2025b) note that the site shall maintain a water balance model representing the operational conditions on site. This should be regularly reviewed and calibrated as the site develops and be used to predict the closure situation. Detailed stage models for years 1-13 (Table 1) will be developed using GoldSim[9] prior to mining commencing (i.e., during the project pre-startup phase). This will provide an operational tool for MGL to effectively manage water during operations.

During operation, for the site to operate without a water treatment plant the site needs to be in a net deficit water balance on average. Without a water treatment plant, the main mechanism for water loss is evapotranspiration from the tailings decant pond and dust suppression. There is water stored within the pores of the tailings. In a wet year, some water may accumulate in surplus on the TSF however in the following year the site should be able to return to normal operating conditions. If the site ends up in an accumulating surplus water balance then a water treatment plant will need to be installed as is proposed for closure. Preliminary analysis by MWM (2025c) indicates for the site to be in deficit the water pumped from pit and underground will need to be used for dust suppression on the ELF and runoff water from the catchment above the TSF will need to be diverted around the facility. Dust suppression in dry conditions is expected.

11.4 Summary

This report provides source terms that are used in the WLBM to understand potential effects for the proposed BCPC Project. It is recommended that:

- Source terms need to be validated through performance monitoring that should be ongoing through the operational and closure phases of the project.

- A detailed operational water balance model is required prior to mining commencing, which should be updated annually.

- Trigger Action Response Plans (TARPs) should be developed for BOGP. For instance, a TARP should be developed for water runoff from mine impacted surfaces that receive dust suppression water from the pit void.

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[9] https://www.goldsim.com

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13 LIMITATIONS

Attention is drawn to the document "Limitations", which is included in Appendix B of this report. The statements presented in this document are intended to provide advice on what the realistic expectations of this report should be, and to present recommendations on how to minimise the risks associated with this project. The document is not intended to reduce the level of responsibility accepted by Mine Waste Management, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in doing so.

APPENDIX A   ABBREVIATIONS

ABBREVIATION	DEFINITION
AMD	Acid and metalliferous drainage
BOD	Biochemical oxygen demand
CIL	Carbon-in-leach
CIT	Come in Time
CLT	Column leach test
CTI	Central tailings impoundment - Macraes
DGV	Default guideline value
DOC	Dissolved organic carbon
ELF	Engineered landform
FTI	Flotation tailings impoundment - Macraes
LOR	Limit of reporting
MAV	Maximum acceptable value
MEQ	Metal ecotox quotient
MGL	Matakanui Gold Limited
MIW	Mine impacted waters
Mt	Million tonnes
MTI	Mixed tailings impoundment – Macraes
MWM	Mine Waste Management Ltd
COPC	Constituents of potential concern
QA/QC	Quality assurance and quality control
PCOC	Potential contaminants of concern
POX	Pressure oxidation
pXRF	Portable x-ray fluorescence
RAS	Rise and Shine
RPD	Relative percent difference
RSSZ	Rise and Shine Shear Zone
SRX	Srex
SRE	Srex East
TSF	Tailings Storage Facility
TZ3	Textural zone 3 of the Otago Schist
TZ4	Textural zone 4 of the Otago Schist
UG	Underground

ABBREVIATION	DEFINITION
WAD	Weakly acid dissociable (Cyanide)
WELF	West ELF
WLBM	Water and load balance model
WRS	Waste rock stack

APPENDIX B   MINERALIS REPORT

MEMORANDUM

|	
Subject:	**Cyanide Detoc Discharge Copper Levels**
Date:	7 July 2025
Attention:	Mark Mitchell
From:	Katie Barns

Background

Cyanide detoxification test work completed as part of the IMO test program (Santana Minerals Limited (SMI) Bendigo-Ophir Gold Project RAS & SRX Deposit Metallurgical Testwork Programs Project 6680 + 6749 February 2025) reported discharge solution copper levels up to 75mg/L. Subsequent water modelling has identified the high copper levels as an issue within the long term water balance and if discharged would require ongoing water treatment for a significant period of time following mine closure.

Full Cyanide Detox Circuit

The cyanide detoxification process proposed for the Bendigo Ophir Project is based on the INCO SO_2/AIR process shown in Figure 1.

Figure 1: INCO Process Flowsheet
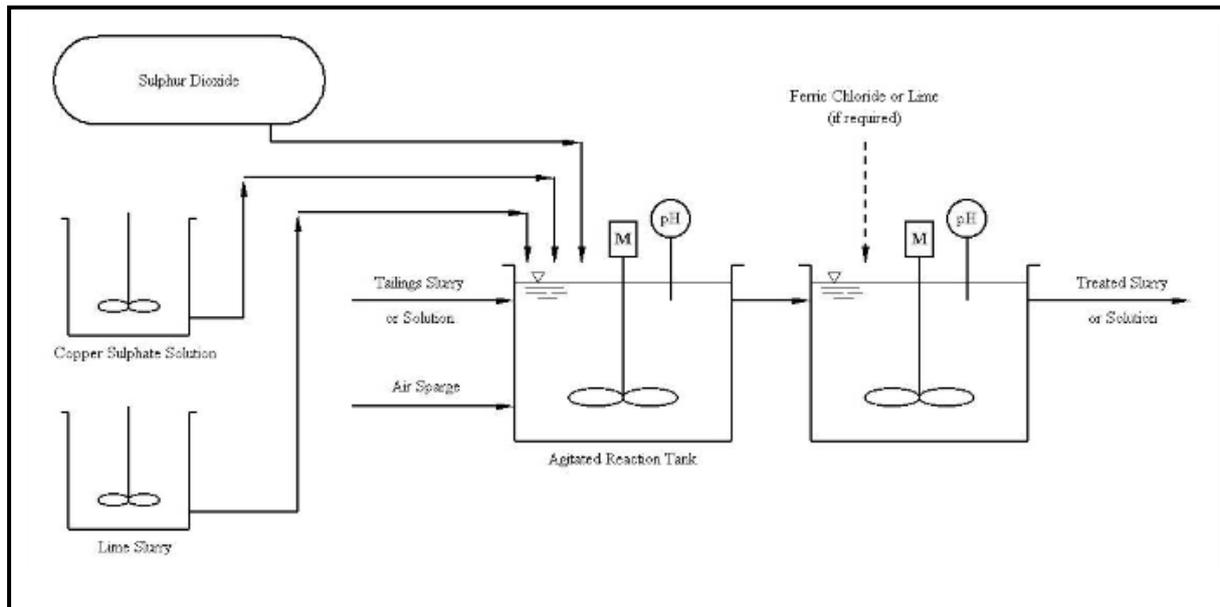
The basic chemistry of the INCO SO_2/AIR process is straight forward. In the primary reaction, weak acid dissociable cyanide (CN_{wad}), which includes free cyanide and weakly complexed metal cyanides, is oxidized to produce cyanate (OCN-) and sulphuric acid while releasing metals into solution. This reaction requires a small amount of copper in solution to serve as a catalyst which is usually added as copper sulphate. Acid produced in the oxidation reactions is neutralized with lime at a controlled pH of 8-9. The product of neutralization is calcium sulphate (gypsum). Iron cyanide, a strongly complexed metal cyanide, is normally the only other species of cyanide encountered in a typical mine efflu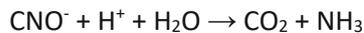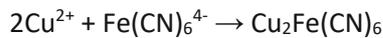ent. Metals which are dissociated during the oxidation reactions (particularly copper), precipitate the iron cyanide as an insoluble salt. This precipitate is stable within a wide range of pH values. Excess metals in solution, including the spent copper catalyst, are precipitated as hydroxides. Stoichiometrically, the reactions require approximately 2.46 grams of SO_2 per gram of CN_{wad} to be oxidized although operating ranges are more typically 3.5-4.5 grams of SO_2 per gram of CN_{wad}. (Robbins 1996).

The reactions that occur in the INCO process are written in various forms but typically as

Reagents

$SO_2 + O_2 + H_2O \rightarrow H_2SO_5$, Cu^{2+} catalyst

Reactions

$SO_2 + O_2 + H_2O + CN\text{-}WAD \rightarrow CNO^- + H_2SO_4$

$Na_2S_2O_5 + 2O_2 + H_2O + 2CN^-WAD \rightarrow 2\ CNO^- + 2NaHSO_4$

$2Cu^{2+} + Fe(CN)_6^{4-} \rightarrow Cu_2Fe(CN)_6$

$CNO^- + H^+ + H_2O \rightarrow CO_2 + NH_3$
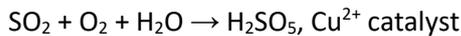
The reaction is normally carried out at a pH of 8-9, with lime normally required for pH control. The lime (or other alkali) requirement to control pH depends on the choice of reactant (Na_2SO_3,SMBS,SO_2). The reaction rate is extremely fast and is limited by the transfer of oxygen. Typical reaction times to achieve the required oxygen mass transfer vary from about 30 min to 2 h. Iron complexed cyanides are reduced to the ferrous state and precipitated with copper, nickel or zinc as insoluble metal–iron–cyanide complexes. Residual metals liberated from the WAD cyanide complexes are precipitated as metal hydroxides.

Benchmarking Published Operating Data

Literature searches of publicly available data show that the levels of copper in solution in the discharge of a full INCO process is typically <1mg/L from a fully operating INCO circuit (Table 1). This compares well with the solution copper levels in the INCO discharge from Oceanagold's Macraes INCO circuit which typically sits at 0.1mg/L and concurs with the expectations of other industry professionals familiar with the operation of INCO circuits in other gold operations.

Table 1: INCO process operating data

Operation		detox descript	stream	res time	feed (mg/L)			effluent / INCO discharge (mg/L)			Reagents (g/gCN$_T$)		pH	
				min	CNT	Cu	Fe	CNT	Cu	Fe	Cu++	SO2	barren	treated
Campbell Red Lake	laboratory				890	55	80	1.6	0.4	0.4	0.11	2.2	9.5	9.5
Campbell Red Lake	laboratory				665	62	35	0.7	0.5	0.2	0.07	3.6	10.5	9.8
Scottie gold mines	commercial				450	35	1.5	0.1-2	1-10	<0.5			9	8
McBean Mill	commercial				370	30	20	0.2	0.7	<0.2			11.5	9
Campbell red lake	laboratory		barren sltn	60	940	39	118	0.7	0.6	0.2	0.15	3	11.1	10
Equity	laboratory		CIP tails (30% sol)	30	195	42	25	0.4	1.1	0.2	0.25	3.8	10	8
Mount Skukum	laboratory		tailings (45% solids)	40	215	3	40	0.3	0.2	0.1	0.5	2.1	9.8	8
Lynn gold	laboratory		Pit water	20	13	1.5	0.1	0.6	0.4	0.1	0.4	4.8	8.7	9.9
Colosseum	laboratory		CIP tails (53% sol)	80	243	84	85	0.3	0.9	0.2	0	4.3	10.5	8
Kuntz	laboratory		electroplating rinse water	100	100	54	4.5	2.1	3.2	0.6	.	0.6		8.5
McBean	laboratory		barren sltn	90	404	35	26	0.3	0.5	<0.2	0	3.5	11.7	9
Skyline	laboratory		repulped talings	120	1124	455	73	1.5	2.7	0.1	0	4	10.4	8
Inco/ Golden Knight	laboratory		CIL Tailings	60	200	15	2.4	0.2	0.9	0.2	0.2	4.6	10.5	8
ERG	laboratory		pond water	40	155	88	6.5	0.1	0.3	<0.1	0	6.5	9	7.7
Westmin	laboratory		CIPtailings	120	278	24	13	0.3	0.8	0.1	0.07	5.3	10.7	8
Equity	commercial	1 stage	CIL Tailings		100	35	2	1-5	2-5	0	0.27	5.9	11	8
Mt Skukum	commercial	flotation cells	Repulp		100	5	15	0.9	1	0.2	0.25	4	11	8.2
McBean	commercial	1 stage	Barren		370	30	20	0.2	0.7	<0.2	0	4	11.5	9
Lynngold	commercial	2 stage	Pond		100	20	2	0.6	0.1	0.1	0.1	6	8.7	9.5
collosseum	commercial	1 stage	CIP Tailings		375	129	2.2	0.4	1.5	0.2	0.11	5.6	10.6	8.7
Ketza R*	commercial	1 stage*	CIP Tailings		150	8	<0.1	5	15	<0.1	0.3	6	9.8	8.4
Skyline	commercial	1 stage	Repulp		450	300	10	<0.1	2	0.3	0	6	10.5	8.1
Kuntz	commercial	multi	Rinse		150	90	2.8	0.2	1.2	<0.2	0	8	9.5	8.5
Ovacik	operation	3 stage	CIP Tailings		183				<1	<0.1	150	50	8-9	7
Detour Lake	NI43-101	2 stage	CILTailings	1.5				<5			0.14	5		

* only partial detox as CN and As removed in pond

Source: Devuyst EA, Conard BR Hudson W, Commecial Operation of INCO's SO2/Air Cyanide Removal Process, Conference on Cyanide and the Environment, Arizona, Dec 1984, Devuyst EA, Conard BR Robins G, Vergunst R, INCO SO2/Air Cyanide Removal Process Update, World Gold '89 1999

IMO Test work

The IMO cyanide detoxification test work for Santana Minerals was completed in two test work rounds on tails generated from the master composite. Round 1 tails sample was generated without a gravity step and round 2 tails sample was generated with the inclusion of a gravity gold recovery step. The Round 1 detoxification test work was completed on a single batch sample while the round 2 work included a 1kg batch test followed by a 29kg bulk sample detoxification test.

The copper levels in test work detoxification discharge liquor were

- Round 1 Batch test work: 0.84mg/L
- Round 2 Batch test work: 32mg/L
- Round 2 Bulk test work: 75mg/L

The elevated coper levels are not typical of a full INCO installation where copper (and other metal ions) in solution after the INCO reactor would be precipitated out as metal hydroxides and levels of less than 1mg/L would be expected in the system tails. While the full test work scope is not detailed in the IMO report it appears that the test work was a single stage test completed only to determine the amenability of the RAS CIL discharge to cyanide destruction via the INCO methodology. The single test does not appear to have an additional step to precipitate out metal ions including Cu^{2+} ions to copper hydroxide as would be typical in a commercial INCO installation. Although not explicitly this precipitation of metal ions does not appear to have been part of the test work scope.

Recommendations

While copper in solution assays of 1mg/L would be a reasonable starting point for water and tails modelling work the amenability of the full INCO process for <u>both</u> cyanide detoxification and subsequent metal ion precipitation of the Bendigo Ophir CIL discharge for should be tested and confirmed as part of the current ALS test work plan (Quote No: 32703).

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Original INCO licenses (1996)

Owner/Project	Location	Treatment
1. Scottie Gold Mine	British Columbia	Barren and slurry
2. Carolin Mines/Ladner Creek	British Columbia	Barren and slurry
3. Dupont Exploration/Baker Mine	British Columbia	Slurry
4. Placer Dome/Equity Silver	British Columbia	Slurry
5. Inco-Queenston/McBean Mine	Ontario	Barren
6. Lynngold Inc./MacLellan Mill	Manitoba	Pond water
7. Kuntz Electroplating	Ontario	Solution
8. Lac Minerals/Colosseum Mine	California	Slurry
9. Mount Skukum Gold Mining	Yukon	Slurry
10. Canamax/Ketza River	Yukon	Slurry/Pond water
11. Skyline Explorations/Johnny Mountain	British Columbia	Slurry
12. Placer Dome/Kiena	Quebec	Slurry
13. Giant Yellowknife/E.R.G. Resources	Ontario	Pond water
14. TVX-Golden Knight/Les Mines Casa Berardi	Quebec	Slurry/Pond Water
15. Precious Plate	Ontario	Solution
16. Citadel/Surluga Mine	Ontario	Barren
17. Superfinish	Ontario	Solution
18. Westmin/Premier Gold	British Columbia	Slurry
19. Minnova Inc./Lac Shortt	Quebec	Pond Water
20. TVX/Mineral Hill Mine	Montana	Barren
21. N.A. Metals/Golden Bear Mine	British Columbia	Slurry
22. St. Andrew Goldfields/Stock Mine	Ontario	Pond water
23. Echo Bay/Kettle River	Washington State	Slurry
24. Sable Resources/Baker Mine	British Columbia	Barren
25. Muscocho/Mauntoban	Quebec	Pond water
26. Barrick/East Malartic	Quebec	Slurry
27. Sunshine/Snow Caps	California	Heap rinse
28. Barrick/Mercur	Utah	Pond Water/Slurry
29. Echo Bay/McCoy-Cove	Nevada	Slurry
30. Royal Oak/Hope Brook	Newfoundland	Slurry
31. IBM	Quebec	Solution
32. ACNC/Grant Mine	Alaska	Mill Solution
33. Citigold/Ryan Lode	Alaska	Heap Solution
34. Homestake/Nickel Plate	British Columbia	Slurry
35. AJ Perron Gold/Kerr Mill	Ontario	Slurry
36. AMAX Gold/Hayden Hill	California	Slurry
37. Battle Mountain Gold/San Luis	Colorado	Slurry
38. Placer Dome/Campbell Mine	Ontario	Pond water
39. Newmont/Yanacocha	Peru	Heap solution
40. Macraes/Flat	New Zealand	Slurry
41. Placer Dome/Detour	Ontario	Slurry
42. Peñoles/La Cienega	Mexico	Slurry
43. Homestake/McLaughlin	California	Pond water
44. Devex/Gympie	Australia	Slurry
45. Battle Mountain Gold/Kori Kollo	Bolivia	Slurry
46. Eltin-Orion/Salsigne	France	Slurry
47. Kinross Gold/Q.R.	British Columbia	Slurry
48. Barrick/Bullfrog	Nevada	Slurry
49. TVX/New Britannia	Manitoba	Slurry
50. Dome Resources/Tolukuma	Papua, New Guinea	Slurry

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MINE WASTE MANAGEMENT

GREENROAD GROUP