Blackwater Gold Project

EAC #M19-01 Condition 33, Mine Waste and Water Management Plan

October 2022

CONTEXT STATEMENT

The Blackwater Gold Project (Project) received Environmental Assessment Certificate (EAC) #M19-01 on June 21, 2019, under the 2002 *Environmental Assessment Act* and a Decision Statement on April 15, 2019 under the *Canadian Environmental Assessment Act, 2012,* approving the Project with conditions. Blackwater is an open pit gold and silver mine with associated ore processing facilities located 112 kilometres southwest of Vanderhoof in central British Columbia.

The Mine Waste and Water Management Plan addresses Condition 33 of the Project's EAC #M19-01, which requires this plan to be developed in consultation with Aboriginal Groups, Ministry of Environment and Climate Change Strategy, and Ministry of Energy, Mines and Low Carbon Innovation.

BW Gold LTD. (BW Gold) has prepared the initial draft of the Mine Waste and Water Management Plan at the request of the Environmental Assessment Office and Aboriginal Groups, to support the early engagement of Aboriginal Groups on the contents. As per the Document Submission Plan (July 2022), BW Gold will develop the final Mine Waste and Water Management Plan in consultation with Aboriginal Groups. The plan will be submitted in October 2022 for EAO review and approval.

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ACRONYMS AND ABBREVIATIONS

Aboriginal Groups or Indigenous nations	Aboriginal Groups include: Lhoosk'uz Dené Nation, Ulkatcho First Nation, Nadleh Whut'en First Nation, Stellat'en First Nation, Saik'uz First Nation and Nazko First Nation (as defined in the Project's Environmental Assessment Certificate #M19-01)
AP	acid potential
ARD	Acid rock drainage
Artemis	Artemis Gold Inc., owner/operator of BW Gold Project
BC	British Columbia
BC EAO	British Columbia Environmental Assessment Office
BW Gold	BW Gold LTD.
CEO	Chief Executive Officer
COO	Chief Operating Officer
CM	Construction Manager
C&M	Care and Maintenance
COO	Chief Operating Officer
DS	Decision Statement
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
EDF	environmental design flood
EIS	Environmental Impact Statement
EM	Environmental Manager
EMS	Environmental Management System
ENV	Ministry of Environment and Climate Change Strategy
EMLI	Ministry of Energy, Mines and Low Carbon Innovation
EOR	Engineer of Record
EPCM	Engineering, Procurement and Construction Management
FSR	Forest Service Road
FWR	Fresh Water Reservoir
GM	General Manager
HDPE	High Density Polyethylene
IDF	inflow design flood

KP	Knight Piésold Ltd.
LGO	Low Grade Ore
Lorax	Lorax Environmental Services Ltd.
LoM WBM	Life of Mine Water Balance Model
MAC	Mining Association of Canada
masl	metres above sea level
ML	Metal leaching
ML/ARD	Metal Leaching/Acid Rock Drainage
MMTS	Moose Mountain Technical Services
MWWMP	Condition 33 Mine Waste and Water Management Plan
NAG	non acid generating
NP	neutralization potential
NPR	neutralization potential ratio
OVB	overburden
PAG	potentially acid generating
POCs	Parameters of Concern
Project	Blackwater Gold Project
QPOs	quantitative performance objectives
TARPs	trigger action response plans
TSF	tailings storage facility
TSS	total suspended solids
VCC	Variable Climate Case
VP	Vice President
WMP	Water Management Pond
WTP	Water treatment plant
WQG	Water Quality Guidelines
Zn	zinc

1. PROJECT OVERVIEW

The Blackwater Gold Project (the Project) is a gold and silver open pit mine located approximately 112 kilometres (km) southwest of Vanderhoof, 160 km southwest of Prince George, and 446 km northeast of Vancouver, British Columbia (BC).

The Project site is presently accessed via the Kluskus Forest Service Road (FSR), the Kluskus-Ootsa FSR and an exploration access road, which connects to the Kluskus-Ootsa FSR at km 142. The Kluskus FSR joins Highway 16 approximately 10 km west of Vanderhoof. A new, approximately 13.8 km road (Mine Access Road; MAR) will be built to replace the existing exploration access road, which will be decommissioned. The new planned access is at km 124.5. Driving time from Vanderhoof to the mine site is about 2.5 hours.

Major mine components include a tailings storage facility (TSF), ore processing facilities, waste rock, overburden, and soil stockpiles, borrow areas and quarries, water management infrastructure, water treatment plants, accommodation camps, and ancillary facilities. The gold and silver will be recovered into a gold-silver doré product and shipped by air and/or transported by road. Electrical power will be supplied by a new approximately 135 km, 230 kilovolt (kV) overland transmission line that will connect to the BC Hydro grid at the Glenannan substation located near the Endako mine, 65 km west of Vanderhoof.

The Blackwater mine site is located within the traditional territories of Lhoosk'uz Dené Nation, Ulkatcho First Nation, Skin Tyee Nation and Tsilhqot'in Nation. The Kluskus and Kluskus-Ootsa FSRs and Project transmission line cross the traditional territories of Nadleh Whut'en First Nation, Saik'uz First Nation, and Stellat'en First Nation (collectively, the Carrier Sekani First Nations) as well as the traditional territories of the Nazko First Nation, Nee-Tahi-Buhn Band, Cheslatta Carrier Nation and Yekooche First Nation (BC EAO 2019a, 2019b).

Project construction is anticipated to take two years. Mine development will be phased with an initial milling capacity of 15,000 tonnes per day (t/d) or 5.5 million tonnes per annum (Mtpa) for the first five years of operation. After the first five years, the milling capacity will increase to 33,000 t/d or 12 Mtpa for the next five-years, and to 55,000 t/d or 20 Mtpa in Year 11 until the end of the 23-year mine life. The Closure phase is from Year +24 to approximately Year +36 and is defined by the duration required to fill the Open Pit to the target closure level and the TSF is allowed to passively discharge to Davidson Creek via a closure spillway. The Closure phase is shorter than that what was presented in the Joint *Mines Act / Environmental Management Act* Permits Application (March 2022) as a result of optimizations to the Project (KP 2022a). The Post-closure is now estimated to begin in Year +37.

New Gold Inc. (New Gold) received Environmental Assessment Certificate #M19-01 (EAC) on June 21, 2019 under the *Environmental Assessment Act* (2002) (BC EAO 2019c) and a Decision Statement (DS) on April 15, 2019 under the *Canadian Environmental Assessment Act, 2012* (CEA Agency 2019). In August 2020, Artemis Gold Inc. (Artemis) acquired the mineral tenures, assets and rights in the Blackwater Project that were previously held by New Gold. On August 7, 2020, the Certificate was transferred to BW Gold Ltd. (BW Gold), a wholly-owned subsidiary of Artemis, under the *Environmental Assessment Act* (2018). The Impact Assessment Agency of Canada notified BW Gold on September 25, 2020 to verify that written notice had been provided within 30 days of the change of proponent as required in Condition 2.16 of the DS, and that a process had been initiated to amend the DS.

Approximately 667 Mt of waste materials will be stripped over the life of mine, comprising 83 Mt of overburden (OVB) and 584 Mt of waste rock. Waste rock and OVB will be managed in engineered storage facilities (the TSF and Lower and Upper Waste Stockpiles). The Project general arrangement at Year +13 indicating locations of mine waste storage is shown on Figure 1-1. Mine waste was classified based on whether it is predicted to be potentially acid generating (PAG) or non acid generating (NAG) as defined by the calculated neutralization potential ratio (NPR). Waste rock classified as NAG and with low metal leaching (ML) potential and OVB will be prioritized for use in construction of mine facilities. The NAG waste rock and OVB not used immediately for construction will be stored in the Lower Waste Stockpile and later in the Upper Waste Stockpile. The TSF will permanently store all tailings, PAG waste rock, and NAG waste rock with a higher ML potential generated during operation of the mine. The Low Grade Ore (LGO) Stockpile will store ore that will be processed towards the end of the mine life. The quantity of ore and waste material handled from the open pit during Operations is illustrated on Figure 1-2.

Water within the Project area will be recycled and used to the maximum practical extent by collecting and managing runoff from both undisturbed and disturbed areas. Site runoff water will be collected and stored within the TSF or water management pond. Water stored within the TSF will be used to inundate the waste rock stored in the TSF to limit oxidation and subsequent acid generation and minimize ML. Water will be stored in the supernatant pond within the TSF and recycled to the mill for use in the milling process. The water treatment systems proposed for the Project during Operations include a Metals water treatment plant (WTP), a Membrane WTP, and a lime neutralization system.

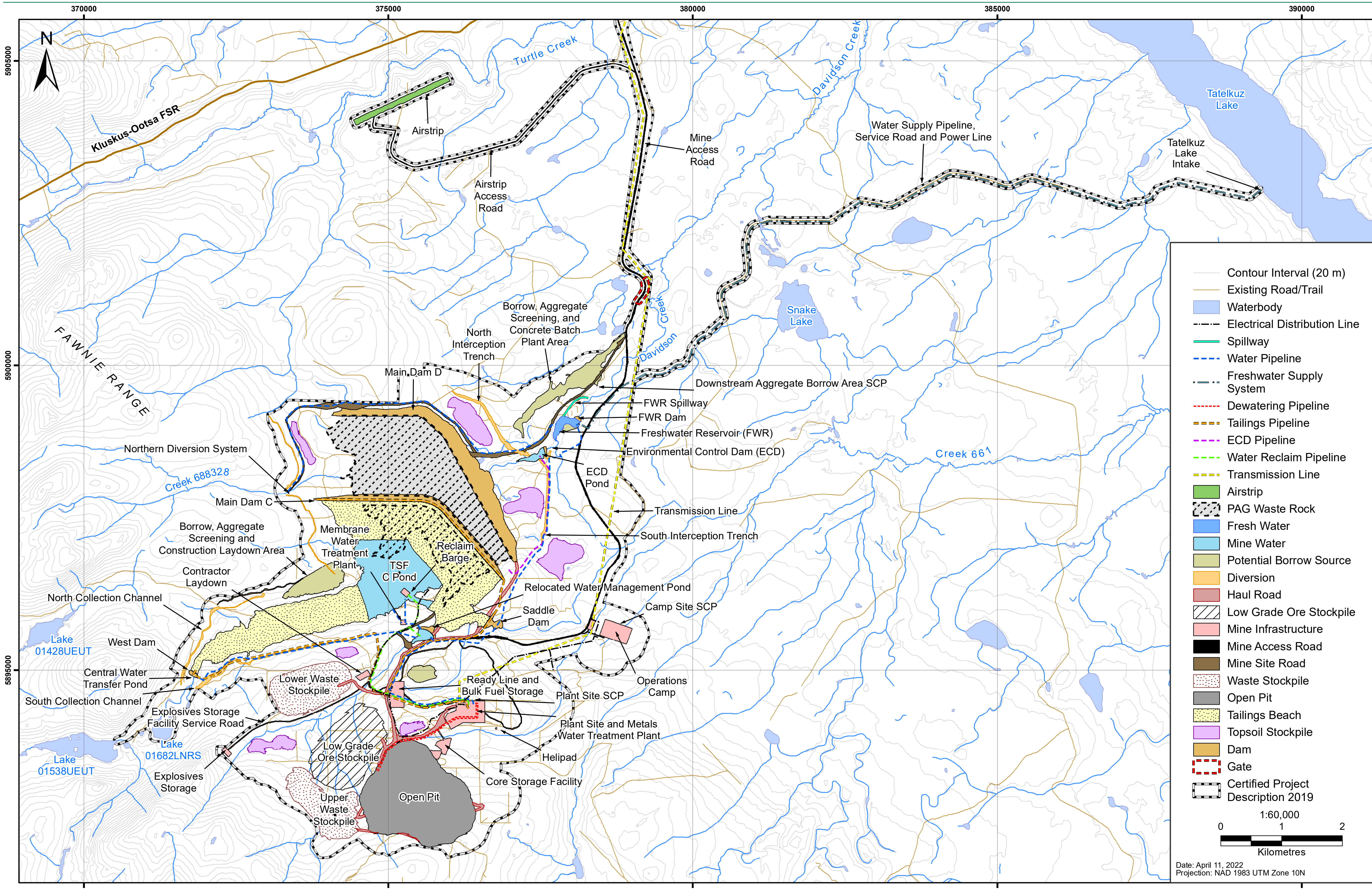


Figure 1-1: Mine Site Infrastructure at Year +13 (Maximum Materials Handled)

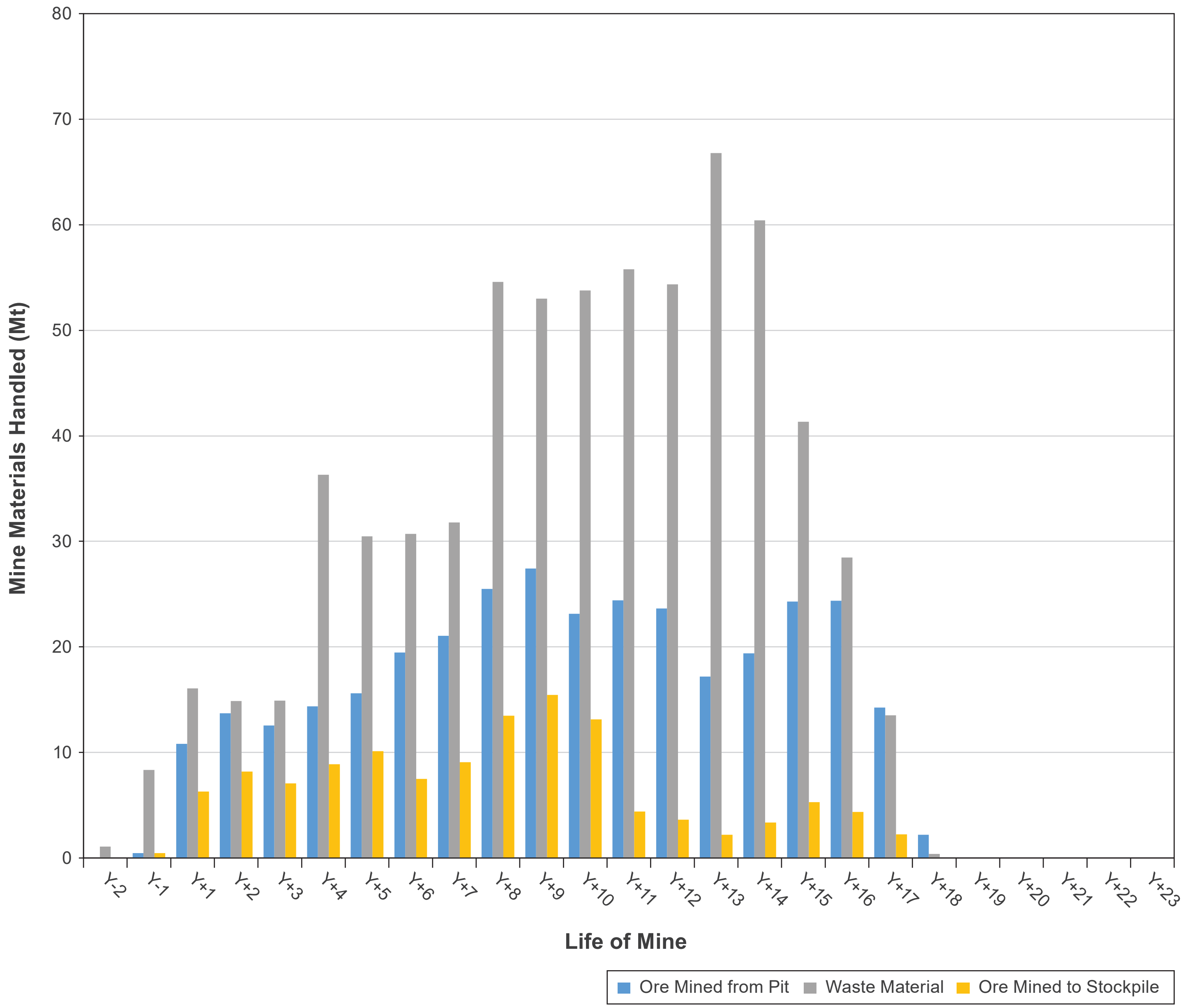


Figure 1-2: Material Handled over the Life of Mine

2. PURPOSE AND OBJECTIVES

The purpose of the EAC Condition 33 Mine Waste and Water Management Plan (MWWMP) is to manage mine waste and water in a manner that is protective of the receiving environment. The plan must be developed in consultation with Aboriginal Groups, Ministry of Environment and Climate Change Strategy (ENV) and BC Ministry of Energy, Mines and Low Carbon Innovation (EMLI). The EAC Condition 33 MWWMP focusses on the management of accumulated water in the TSF, management of Metal Leaching/Acid Rock Drainage (ML/ARD) from the tailings, waste rock, and LGO Stockpile, and water treatment. The EAC Condition 33 MWWMP is applicable to the Operations phase.

The EAC Condition 33 MWWMP objective is to identify measures to manage the potential effects of mine waste and water on the receiving environment.

Condition 33 specifically indicates that the MWWMP must include at least the following (see Appendix A for a EAC Condition table of concordance):

- The means by which the Holder will implement an oxygen-preventing barrier to cover waste rock, tailings and other mine by-products to prevent adverse effects from rock that is currently or potentially acid-generating or ML. The barrier may include coverage with additional tailings, water, or another mitigation measure that will be effective at limiting the potential for ML/ARD, as determined by the Qualified Professional(s).
- The means by which the Holder will limit the year-over-year accumulation of water stored in TSF that exceeds the amount necessary to:
  - address water needed under paragraph a); and
  - meet the needs for the operation of the mill.

  This determination must be made by a Qualified Professional(s), taking into account safety and concerns expressed by Aboriginal Groups. The plan must identify whether treatment and discharge of water from the TSF during Operations was considered and if not, provide a rationale;
- The means by which the Holder will monitor and document the year-over-year water accumulation in the TSF.
- The management of ML/ARD from low grade ore stored on land during Operations, which must include placement of the ore on a low permeability foundation and collection, monitoring, and treatment of low grade ore contact water.
- A requirement that any remaining low-grade ore stockpile be backfilled into the pit or TSF at the end of Operations.
- Identification of water treatment technology or technologies proposed to be used during Operations to treat pit water for discharge.
- If any water treatment technology proposed for use during Operations differs from that proposed in the memo submitted as part of the Application (Document: Appendix F: Preliminary Design of Pit Sump and Pit Perimeter Dewatering Well Network Water Treatment Plan for the Blackwater Gold Project in Blackwater Gold Project: Updated Surface Water Quality Model Report (Aug 2016). Prepared by ERM), an assessment of how the new proposed technology achieves the same or better results as the technology proposed in the Application.

3. ROLES AND RESPONSIBILITIES

BW Gold has the obligation of ensuring that commitments are met and that relevant obligations are made known to mine personnel and site contractors during all phases of the mine life. A clear understanding of the roles, responsibilities, and level of authority that employees and contractors have when working at the mine site is essential to meet Environmental Management System (EMS) objectives.

Table 3-1 provides an overview of general environmental management responsibilities during construction and operations life for key positions that will be involved in environmental management. Other positions not specifically listed in Table 3-1 but who will provide supporting roles include independent environmental monitors, an Engineer of Record for the tailings storage facility, an Independent Tailings Review Board, TSF qualified person, geochemistry qualified professional, and other qualified persons and qualified professionals.

Table 3-1: Blackwater Roles and Responsibilities

Role	Responsibility
Chief Executive Officer (CEO)	The CEO is responsible for overall Project governance. Reports to the Board.
Chief Operating Officer (COO)	The COO is responsible for engineering and Project development and coordinates with the Mine Manager to ensure overall Project objectives are being managed. Reports to CEO.
Vice President (VP) Environment & Social Responsibility	The VP Environment & Social Responsibility is responsible for championing the Environmental Policy Statement and EMS, establishing environmental performance targets and overseeing permitting. Reports to COO.
General Manager (GM) Development	The GM is responsible for managing project permitting, the Project's administration services and external entities, and delivering systems and programs that ensure Artemis's values are embraced and supported, Putting People First, Outstanding Corporate Citizenship, High Performance Culture and Rigorous Project Management and Financial Discipline. Reports to COO.
Mine Manager	The Mine Manager, as defined in the *Mines Act*, has overall responsibility for mine operations, including the health and safety of workers and the public, EMS implementation, overall environmental performance and protection, and permit compliance. The Mine Manager may delegate some of their responsibilities to other qualified personnel. Reports to GM.
Construction Manager (CM)	The CM is accountable for ensuring environmental and regulatory commitments/ and obligations are being met during the construction phase. Reports to GM.
Environmental Manager (EM) or designate	The EM is responsible for the day-to-day management of the Project's environmental programs and compliance with environmental permits, updating EMS and MPs. The EM or designate will be responsible for reporting non-compliance to the CM, and Engineering, Procurement and Construction Management (EPCM) contractor, other contractors, the Company and regulatory agencies, where required. Supports the CM and reports to Mine Manager.
Departmental Managers	Departmental Managers are responsible for implementation of the EMS relevant to their areas. Report to Mine Manager.
Indigenous Relations Manager	Indigenous Relations Manager is responsible for Indigenous engagement throughout the life of mine. Also responsible for day-to-day management and communications with Indigenous groups. Reports to VP Environment & Social Responsibility.
Community Relations Advisor	Community Relations Advisor is responsible for managing the Community Liaison Committee and Community Feedback Mechanism. Reports to Indigenous Relations Manager.

Role	Responsibility
Environmental Monitors	Environmental Monitors (includes Environmental Specialists and Technicians) are responsible for tracking and reporting on environmental permit obligations through field-based monitoring programs. Report to EM.
Aboriginal Monitors	Aboriginal Monitors are required under EAC condition 17 and will be responsible for monitoring for potential effects from the Project on the Indigenous interests. Indigenous Monitors will be involved in the adaptive management and follow-up monitoring programs. Report to EM.
Employees and Contractors	Employees are responsible for being aware of permit requirements specific to their roles and responsibilities. Report to departmental managers.
Qualified Professionals and Qualified Persons	Qualified professionals and qualified persons will be retained to review objectives and conduct various aspects of environmental and social monitoring as specified in EMPs and social MPs.

BW Gold will employ a qualified person as an EM who will ensure that throughout the construction phase the EMS requirements are established, implemented and maintained, and that environmental performance is reported to management for review and action. The EM is responsible for retaining the services of qualified persons or qualified professionals with specific scientific or engineering expertise to provide direction and management advice in their areas of specialization. The EM will be supported by a staff of Environmental Monitors that will include Environmental Specialists and Technicians and by a consulting team of subject matter experts in the fields of environmental science and engineering.

During the Construction phase, BW Gold will be entering into multiple EPC contracts, likely for the Process Plant, Tailings and Reclaim System, and 25 kV Power Distribution. Each engineer/contractor will have their own CM and there will be a BW Gold responsible PM and/or Superintendent who ultimately reports to the GM Development. Some of the scope, such as the TSF and Water Management Structures will be self-performed by BW Gold, likely using hired equipment. Other smaller scope packages may be in the form of EPCM contracts. The EPCM contractors will report to the CMs who will ultimately be responsible for ensuring that impacts are minimized, and environmental obligations are met during the Construction phase. For non-EPCM contractors, who will perform some of the minor works on site, the same reporting structure, requirements, and responsibilities will be established as outlined above. BW Gold will maintain overall responsibility for management of the construction and operation of the mine site and will therefore be responsible for establishing employment and contract agreements, communicating environmental requirements, and conducting periodic reviews of performance against stated requirements.

The CM is accountable for ensuring that environmental and regulatory commitments/obligations are being met during the construction phase. The EM will be responsible for ensuring that construction activities are proceeding in accordance with the objectives of the EMS and associated MPs. The EM or designate will be responsible for reporting non-compliance to the CM and EPCM contractor, other contractors, and regulatory agencies, where required. The EM or designate will have the authority to stop any construction activity that is deemed to pose a risk to the environment; work will only proceed when the identified risk and concern have been addressed and rectified.

Environmental management during operation of the Project will be integrated under the direction of the EM, who will liaise closely with departmental managers and will report directly to the Mine Manager. The EM will be supported by the VP of Environment and Social Responsibility in order to provide an effective and integrated approach to environmental management and ensure adherence to corporate environmental standards. The EM will be accountable for implementing the approved MPs and reviewing them periodically for effectiveness. Departmental area managers (e.g., mining, milling, and plant/site services) will be directly responsible for implementation of the EMS and EMPs relevant to their areas.

All employees and contractors are responsible for daily implementation of the practices and policies contained in the EMS.

Pursuant to Condition 19 of the Project’s EAC, BW Gold has established an Environmental Monitoring Committee to facilitate information sharing and provide advice on the development and operation of the Project, and the implementation of EAC conditions, in a coordinated and collaborative manner. Committee members include representatives of the Environmental Assessment Office (EAO), Lhoosk’uz Dené Nation, Ulkatcho First Nation, Nadleh Whut’en First Nation, Saik’uz First Nation, Stellat’en First Nation, Nazko First Nation, EMLI, ENV, and Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

4. COMPLIANCE OBLIGATIONS, GUIDELINES, AND BEST MANAGEMENT PRACTICES

4.1 Legislation

Federal legislation pertinent to mine waste and water management includes:

- *Canadian Environmental Protection Act, 1999;*
- *Fisheries Act;*
  - *Metal and Diamond Mining Effluent Regulations;*
- *Impact Assessment Act*; and
- *United Nations Declaration on the Rights of Indigenous Peoples Act*.

Provincial legislation pertinent to mine waste and water management includes:

- *Declaration on the Rights of Indigenous Peoples Act;*
- *Environmental Assessment Act;*
- *Environmental Management Act;*
  - *Waste Discharge Regulation;*
- *Mines Act;*
  - Health, Safety and Reclamation Code for Mines in British Columbia (Code);
- *Water Sustainability Act;*
  - *Water Sustainability Regulation;*
  - *Groundwater Protection Regulation;* and
  - *Dam Safety Regulation.*

4.2 Environmental Assessment Certificate

The MWWMP addresses EAC Condition 33 and has been developed for coordinated implementation in parallel with other Blackwater EAC management plans (when, if as required) as listed below, and *Mines Act* Permit Management Plans:

- Care and Maintenance Plan (EAC Condition 11), which requires measures to monitor, manage, and avoid build-up of water surplus to that required under Condition 33; and
- Closure and Post-Closure Water Quality Management Plan (Condition 34), which requires the continuation of mitigation measures identified in paragraphs a) and b) i) of Condition 33. This plan's development is detailed in the EAC Condition 10 - Document Submission Plan.

EAC Condition 3 requires that, where an EAC condition plan includes monitoring, a discussion of adaptive management must be included in the plan to address the circumstances that will require the implementation of alternate or additional mitigation measures to address potential effects of the Project. The MWWMP is required to incorporate the following monitoring activities (in accordance with EAC Condition 33c and d):

- The means by which the Holder will monitor and document the year-over-year water accumulation in the TSF; and

- The management of ML/ARD from low grade ore stored on land during Operations, which must include placement of the ore on a low permeability foundation and collection, monitoring, and treatment of low grade ore contact water.

Adaptive management related to water accumulation in the TSF and monitoring of low grade ore contact water are discussed in Section 8.

4.3 Existing Permits

BW Gold received *Mines Act* Permit M-246 on June 22, 2021 and *Environmental Management Act* Permit 110602 on June 24, 2021 in relation to the early works program. Part C (Protection of Land and Watercourses) Condition C.3 of the *Mines Act* permit pertains to the MWWMP with the requirement to ensure materials are managed to minimize the generation ML/ARD.

4.4 Guidelines and Best Management Practices

Federal and provincial guidelines, standards, and guidance documents related to mine waste and water management include:

- Mine Rock and Overburden Piles: Investigation and Design Manual – Interim Guidelines, May 1991 (BC MWRPRC 1991);
- Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (BC MEM 1998a);
- Policy for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (BC MEM & BC MELP 1998b);
- Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (Price 2009);
- Metal Mining Technical Guidance Document for Environmental Effects Monitoring (EC 2012);
- Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Development Activities (Wels et al. 2012);
- British Columbia Field Sampling Manual: For Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (BC MWLAP 2013);
- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators. Version 2 (BC MOE 2016);
- Guidance Document on Application of Part 10 of the Health, Safety and Reclamation Code for Mines in British Columbia, July 2016 (BC EMPR 2016);
- Site Characterization for Dam Foundations in BC (APEGBC 2016);
- Guidelines for Mine Waste Dump and Stockpile Design. CRC Press, April 2017 (Hawley and Cunning 2017);
- Towards Sustainable Mining Water Stewardship Protocol (Mining Association of Canada [MAC] 2018);
- Dams in Canada (CDA 2019);
- Tailings Storage Facility – Design Document (MCA 2019);
- Towards Sustainable Mining Tailings Management Protocol (MAC 2019);
- British Columbia Environmental Laboratory Manual (ENV 2020a);
- British Columbia Source Drinking Water Quality Guidelines: Guideline Summary (ENV 2020b);

- Global Industry Standard on Tailings Management (GTR 2020);
- A Guide to the Management of Tailings Facilities. Version 3.2. (MAC 2021);
- British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Guideline Summary (BC ENV 2021a);
- British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Guideline Summary (BC ENV 2021b); and
- Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME 2021).

4.5 Source Documents

The information presented in this EAC Condition 33 MWWMP has been compiled from the following engineering reports and letters that were prepared, signed, and sealed by Qualified Professionals:

- Blackwater Gold Project – 2013 Geochemical Characterization Report. Technical Report prepared for New Gold Inc. in September 2014. AMEC. 2014.
- Water Treatment Plant (WTP) for Sulphate Control at Blackwater during Operation and Post-Closure. Preliminary Design Report – Rev B. Prepared for Artemis Gold Inc. BQE. 2021.
- Chapter 4: Reclamation and Closure Plan IN Blackwater Gold Project Joint *Mines Act / Environmental Management Act* Permits Application. April 2022. BW Gold. 2022a.
- Chapter 3: Mine Plan IN Blackwater Gold Project Joint *Mines Act / Environmental Management Ac*t Permits Application. April 2022. BW Gold. 2022b.
- Blackwater Gold Project Mine Site Water and Discharge Monitoring and Management Plan. Appendix 9-E in Blackwater Gold Project Joint *Mines Act / Environmental Management Act* Permits Application. March 2022. BW Gold. 2022c.
- Blackwater Gold Project Aquatic Effects Monitoring Program Plan. Appendix 7-A IN Blackwater Gold Project Joint *Mines Act / Environmental Management* Act Permits Application. March 2022. BW Gold. 2022d.
- Blackwater Gold Project Care and Maintenance Plan. August 2022. BW Gold. 2022e.
- Water Treatment Plant (WTP) for Sulphate Control at Blackwater during Operation and Post-Closure. Preliminary Design Report – Rev B. Prepared for Artemis Gold Inc. by BQE Water. August 2021. BQE. 2021.
- Blackwater Gold Project: Conceptual Site Model. Prepared for BW Gold by Entia Environmental Consultants Ltd. March 2022. Entia. 2022.
- Blackwater Gold Project: Updated Surface Water Quality Model Report. Prepared for BW Gold by ERM Consultants Canada Ltd. August 2016. ERM. 2016.
- Blackwater Gold Project: Water Treatment Responses for Comments 1266, 1270, 1271, 1272, and 1273. Memorandum prepared for BW Gold by ERM Consultants Canada Ltd. February 2017. ERM. 2017.
- Blackwater Gold Project TSF Stage 1 Detailed Design Report. Rev 1. VA101-457/33-6. Prepared for BW Gold by Knight Piésold Ltd. KP. 2021a.
- Blackwater Gold Project Life of Mine Water Balance Model Report. Rev 1. VA101-457/33-1. Prepared for BW Gold by Knight Piésold Ltd. KP. 2021b.

- Blackwater Gold Project – Updated Water Balance Modelling in Support of Closure/Post-Closure Water Quality Optimization. File No.: VA101-00457/37-A.01. Cont. No.: VA22-01082. KP. 2022a.
- Blackwater Gold Project Tailings Storage Facility – Life of Mine Design Report. Rev 1. VA101-457/33-5. Prepared for BW Gold by Knight Piésold Ltd. KP. 2022b.
- Blackwater Gold Project Stockpiles Geotechnical and Water Management Design Report. Rev 1. VA101-457/33-22. Prepared for BW Gold by Knight Piésold Ltd. KP. 2022c.
- Upper Waste Stockpile – Geotechnical and Water Management Design. File No.: VA101-00457/37-A.01. Cont. No.: VA22-00305. Prepared for BW Gold by Knight Piésold Ltd. KP. 2022d.
- Response for EMLI Geotechnical Screening Comment 11 – TSF Water Balance. File No.: VA101-00457/37-A.01. Cont. No.: VA22-00192. KP. 2022e.
- Response for EMLI Geotechnical Screening Comment 12 – Monitoring Threshold Conditions. File No.: VA101-00457/37-A.01. Cont. No.: VA22-00219. KP. 2022f.
- Issue Tracking Table IDs 531 to 536, 538, 539, 543 & 559– Accounting for Extreme Wet and Dry Events. File No.: VA101-00457/37-A.01. Cont. No.: VA22-01152. KP. 2022g.
- Issue Tracking Table IDs 338 and 339 – Stockpiles Geotechnical Clarifications. File No.: VA101-00457/37-A.01. Cont. No.: VA22-01571. September 1, 2022. KP. 2022h.
- Blackwater Gold Project Water Balance and Water Quality Model Report. Prepared for Artemis Gold Inc. by Lorax Environmental Services Ltd. Lorax. 2021.
- Water Balance/Water Quality Model Update. Prepared for BW Gold by Lorax Environmental Services Ltd. Lorax. 2022a.
- Blackwater Gold Project ML/ARD Management Plan. Prepared for BW Gold by Lorax Environmental Services Ltd. Lorax. 2022b.
- Detailed Design for the Blackwater Gold Water Treatment Plant. Prepared for BW Gold by McCue Engineering Contractors. McCue. 2021.
- Blackwater – Open Pit Mining Schedule. Moose Mountain Technical Services (MMTS). 2020.
- Blackwater Gold Project – Open Pit and Stockpile Design Report, prepared for Artemis Gold Inc. Moose Mountain Technical Services (MMTS). 2021.

Implementation of an oxygen-preventing barrier to cover waste rock and tailings to prevent adverse effects from rock that is currently or potentially acid-generating or ML are addressed in the following documents:

- Sections 1.3.2 and 5.6.2 in Blackwater Gold Project TSF Stage 1 Detailed Design Report (KP 2021a)
- Sections 3.2.1, 4.4, and 6.3.3 of Blackwater Gold Project Life of Mine Water Balance Model Report (KP 2021b)
- Sections 3.2, 4.1, 5.2.3, 6.2.3, and 10.2 in Blackwater Gold Project Tailings Storage Facility – Life of Mine Design Report (KP 2022b)
- Section 3.2.6 in Blackwater Gold Project: Water Balance and Water Quality Model (Lorax 2021)
- Section 6.1 in Blackwater Gold Project ML/ARD Management Plan (Lorax 2022b)

Information related to covers in this plan is focused on coverage of PAG/NAG3 waste rock and tailings with fresh tailings within the TSFs, and soil covers on the waste stockpiles, during the Operations phase.

The means by which BW Gold will limit the year-over-year accumulation of water stored in TSF is addressed in the following documents:

- Sections 5.6 and 9 in Blackwater Gold Project TSF Stage 1 Detailed Design Report (KP 2021a):
- Section 6.3 in Blackwater Gold Project Life of Mine Water Balance Model Report (KP 2021b):
- Section 3.1 in Response for EMLI Geotechnical Screening Comment 11 – TSF Water Balance (KP 2022e):
- Section 3.3 in Response for EMLI Geotechnical Screening Comment 12 – Monitoring Threshold Conditions (KP 2022f):

5. MINE WASTE CHARACTERIZATION AND MANAGEMENT

5.1 Mine Waste Characterization

5.1.1 Waste Rock

The Project will produce five types of waste rock, differentiated by ARD and ML potential. Waste rock is classified based on whether it is predicted to be PAG or NAG as shown by the calculated NPR, quantified as the ratio of neutralization potential (NP) to acid potential (AP). Typically, if the NPR falls below a value of 2 a sample can be considered PAG, whereas samples with NPR ≥ 2 can be considered NAG (Price 2009). Further details on the determination of the NP, AP, and NPR are provided in the ML/ARD Management Plan (Lorax 2022b).

The Project waste rock classification scheme developed by AMEC (2014) subdivides PAG rock into two categories: higher-risk PAG1 (NPR ≤ 1.0) and lower-risk PAG2 (1.0 < NPR ≤ 2.0). NAG material is divided into three categories based on zinc (Zn) content, all of which have an NPR > 2: NAG3 (Zn ≥1,000 ppm), NAG4 (600 - 1,000 ppm Zn), and NAG5 (< 600 ppm Zn). NAG3 is considered to have the highest zinc leaching potential, while NAG4 and NAG5 have lower zinc leaching potential (Lorax 2022b). While the difference in zinc leaching potential between NAG4 and NAG5 is small to negligible (AMEC 2014), NAG5 is used preferentially for construction. Zinc content was used to develop the NAG waste rock categories as zinc was identified as a main parameter of interest for the Project due to the elevated concentrations in waste rock (AMEC, 2014).

Approximately 584 Mt of waste rock will be produced over the life of mine (Moose Mountain Technical Services [MMTS] 2020). The majority of the waste rock is classified as PAG1 (58%) and PAG2 (17%). NAG5 (16%) is the dominant rock classification of the three NAG rock units and NAG3 and NAG4 each represent approximately 4% of the total waste rock (Lorax 2022b). Undefined waste rock (zones that could not be reliably delineated based on environmental block model output) is conservatively considered to be PAG1 for the purpose of mine planning. Waste rock will be stored in multiple locations across the mine site, depending on the ARD and ML potential.

5.1.2 Ore

The majority (92%) of ore samples are classified as PAG based on an NPR threshold of 2 (Lorax 2022b). Humidity cell testing conducted on two LGO samples (PAG) demonstrated little to no lag time to ARD onset (AMEC 2014), and although no high-grade ore samples underwent kinetic testing in the geochemical assessment program it can be assumed that high-grade ore would also be PAG with little to no lag time to ARD onset and potentially even higher metal loading rates (Lorax 2022b).

5.1.3 Tailings

The ARD potential of tailings is similar to or lower compared to ore. Tailings are expected to have a similar AP to ore as the AP of the material will remain unchanged through processing (from ore to tailings); however, some NP will be introduced in the form of lime during the mill process. This additional NP may result in slightly higher NPR values for tailings in comparison to ore, although in general, tailings samples analyzed for the Project had NPR values less than two and were classified as PAG. The onset to acidic conditions in tailings humidity cells were slightly longer than those observed for waste rock, with the lag time to onset of ARD for the whole ore leach tailings humidity cell estimated to be on the order of one year.

5.2 Mine Waste Management

5.2.1 Overview

Waste management concepts for OVB and the various classifications of waste rock are discussed in KP (2022b). The NAG4 and NAG5 waste rock and OVB will be used to construct the TSF embankments, while surplus and unsuitable materials will be disposed of in one of two NAG waste rock and overburden stockpiles.

The quantities of waste rock type that will be placed in the various facilities over the life of mine are summarized in Table 5.2-1.

Table 5.2-1: Waste Rock Placement

Mine Facility	PAG1	PAG2	NAG3	NAG4	NAG5	Total
TSF C impoundment	48,816	16,646	5,515	-	-	**70,976**
TSF D impoundment	299,808	78,266	18,785	-	-	**396,860**
Main Dam C – downstream embankment	-	-	2,600	8,924	14,863	**26,387**
Main Dam D – downstream embankment	-	-	-	11,176	55,837	**67,013**
Lower Waste Stockpile	-	-	-	400	57	**457**
Upper Waste Stockpile	-	-	-	1,440	19,475	**20,916**

Source: Lorax (2022b)

Notes: All units in kilotonnes.
Sub-tonnages may not add up to total tonnages due to rounding.

5.2.2 Tailings Storage Facility

The TSF design is described in detail in the TSF Stage 1 Detailed Design Report (KP 2021a) and the Tailings Storage Facility - Life of Mine Design Report (KP 2022b). The principal design objectives for the TSF and associated water management facilities are to protect the regional groundwater and surface water during operations and after closure, and to achieve effective surface reclamation at mine closure (KP 2022b). The TSF is designed to permanently store tailings, and PAG1, PAG2, and NAG3 waste rock.

A dam classification of Very High was selected for the TSF embankments (KP 2022b). Design flood criteria were selected for the TSF in consideration of the TSF dam hazard classification and the following needs (KP 2022b):

- Temporary storage of the environmental design flood (EDF). The EDF is the most severe flood that is to be managed without release of untreated water to the environment. Selection of the EDF is site-specific, with typical return period events of 50 to 200 years considered. The selected EDF for the design of Stage 1 of Main Dam C is the 24-hour, 1 in 200-year precipitation event with a total runoff depth of 95 mm. The EDF has an estimated total runoff volume of approximately 2.8 Mm^3 for the 29 km^2 TSF C catchment area, assuming a 100% runoff coefficient. Storage of the EDF requires storm storage freeboard of approximately 3 m below the invert elevation of the emergency spillway, and the facility water level will be managed to accommodate seasonal inflows without impacting the storage requirement for the EDF.
- Storage and/or safe passage of the inflow design flood (IDF) runoff to maintain the integrity of the containment dams. The IDF is the most severe flood (considering peak flow, volume, shape, duration, and timing) for which a dam and its associated facilities are designed to withstand. The IDF for

Stages 1 and 2 of TSF C was estimated to be 721 mm, generated by the 1 in 100-year spring storm plus the Probable Maximum Snow Accumulation. Emergency spillways for Stages 1 and 2 of Main Dam C were designed to pass the IDF, meaning that the peak flow and total volume of water associated with the IDF can be safely conveyed, avoiding the need for storage of the IDF until completion of Stage 3.

TSF C will comprise a valley-fill style impoundment formed by construction of three zoned water-retaining earth-rockfill embankments (Main Dam C, the Saddle Dam, and the West Dam) in the upper reaches of the Davidson Creek drainage area (KP 2022b). TSF C will contain a designated PAG/NAG3 waste rock disposal area, tailings distribution system, tailings beaches, a supernatant water pond, and a reclaim water system (KP 2022b). TSF C will be constructed first to provide storage capacity for start-up of the processing plant and was designed to contain tailings (approximately 232 Mm^3) for approximately 21 years of mine operations; PAG/NAG3 waste rock generated during the first six years of mining (approximately 32 Mm^3); and a supernatant pond to provide a continuous source of process water for mill operations (supernatant pond volume ranging from 1 to 10 Mm^3). The supernatant pond volume allowance in each year is equivalent to approximately four months of process water, considering the planned ore throughput rate and tailings slurry solids content. The actual rate of TSF filling during operations will be affected by a variety of factors, including the mining rate and pit development sequence, ore processing rates achieved at the mill, tailings beach slopes, the supernatant pond area and volume, variability of tailings density throughout the facility, and on-going consolidation of the tailings mass throughout operations (KP 2022b). The waste rock disposal area adjacent to Main Dam C will reach an elevation of approximately 1,305 metres above sea level (masl) by Year +6, enhancing long-term stability on the upstream side of the dam.

The IDF for the Main Dam C Stage 1 and Stage 2 Emergency Spillways was estimated as the runoff generated by the spring PMP and 1 in 10,000-year snowpack (KP 2021a). The spillways were conservatively designed to pass the IDF assuming that the facility is full to the spillway invert elevation at the start of the storm; the Main Dam C Stage 1 and Stage 2 spillway invert elevations are 1,268.3 masl and 1,279.0 masl, respectively (KP 2021a). The Stage 1 and 2 spillways are not anticipated to be operational due to the TSF capacity at crest elevations of 1,273 masl and 1,283 masl and the anticipated waste/water storage volumes. The Stage 1 and Stage 2 spillway outlets will have an average slope of 3%, outlet channel freeboard of 0.5 m, channel length of 800 m, and side slopes of 1.5H:1V. The Peak Design Flow is 165 m^3/s for Stage 1 and 132 m^3/s for Stage 2.

The TSF D will be constructed adjacent to and downstream of TSF C. TSF D was designed to contain PAG/NAG3 waste rock generated during mining between Years +6 and +18 (approximately 180 Mm^3) and up to approximately two years of tailings (25 Mm^3) beginning in Year +21 when TSF C reaches design capacity. Initial construction of TSF D will begin in approximately Year +5. PAG/NAG3 waste rock will be disposed of in the area between Main Dam C and Main Dam D beginning in Year +6. The waste rock disposal area in TSF D will also form part of the downstream raises of Main Dam C beginning in approximately Year +10. The waste rock disposal area will reach an elevation of approximately 1,320 masl by Year +18, gradually enhancing long-term stability on the downstream side of Main Dam C, and tailings may be discharged into TSF D to cover the PAG/NAG3 waste rock dump beginning in approximately Year +21.

All PAG1, PAG2, and NAG3 waste rock will be stored under saturated conditions in the TSF in the long-term. The intent is that waste rock will be submerged within one year (Lorax 2022b). The NAG3 waste rock will be used to construct the internal zones of the TSF embankments or otherwise stored in the TSF and submerged within three to five years of mining to reduce metal leaching (KP 2022b). The estimated time to saturate the PAG/NAG3 waste rock placed in TSF C and TSF D was assessed using the AutoCAD Civil3D dump staging and Muk3D® tailings deposition model results with consideration for the LoM WBM

pond volume predictions. The estimated timelines for PAG/NAG3 waste rock saturation based on this assessment are summarized in Table 5.2-2. During this exposure time, a portion of the waste rock may become acid generating; however, the long-term ARD potential and related potential effects of PAG rock in the impoundment will be mitigated through saturation within the TSF ponds (Lorax 2022b).
This scenario is accounted for in the source terms and water quality model (Lorax 2022b).

Table 5.2-2: Time to Saturation of PAG Rock in TSF

Facility	Mine Year	Time to Saturate (Months)
TSF C	-2 and -1	< 1
	1	1
	2	3
	3	6
	4+	12
TSF D	6	< 1
	> 6	3

Source: KP (2022b)

The tailings distribution system will transport tailings slurry from the tailings discharge box within the process plant to TSF C and TSF D (KP 2022b). There will be three phases of tailings distribution infrastructure sized to accommodate mill throughput capacities of up to 6 Mtpa (Year +1), 12 Mtpa (Year +6), and 20 Mtpa (Year +11). All phases of operation will consist of gravity-fed pipelines located around the facility to accommodate tailings beach development to manage the supernatant pond location and PAG waste rock cover as required. The initial stage of tailings distribution will consist of a single, gravity-fed pipeline to convey tailings from the plant site to the southwest side of the TSF. The tailings distribution infrastructure will be expanded in Year +6 with the addition of a secondary line to the southwest end of TSF C, as well as two pipelines to convey tailings along the crest of Main Dam C to discharge into the northeast side of the TSF: the additional pipelines are required to manage the supernatant pond location and cover the PAG/NAG3 waste rock disposal area with an oxygen limiting barrier (KP 2022b). The final stage of tailings distribution will require the addition of a third pipeline from the process plant to both the southwest and northeast sides of the TSF, to accommodate a maximum mill throughput of 20 Mtpa. The operational tailings management plan is to cover any unsaturated tailings beaches with fresh tailings within one year of tailings deposition, which will likely require relatively frequent adjustment of tailings lines and spigots (Lorax 2022b). Covering existing tailings with fresh tailings limits the duration of exposure to oxidative weathering conditions, thereby minimizing the potential for the development of acidic drainage.

The following surveillance activities will typically be performed for the PAG/NAG3 waste rock disposal area at the frequency indicated below (KP 2022b):

- The position and elevation of the dump will be observed daily by staff involved in the construction and maintenance of the facility.
- The elevation of the water level within the dump will be monitored continuously and recorded daily.
- The extents and elevation of the dump will be surveyed approximately monthly along with recording the estimated tonnage placed.
- An aerial image and topographic survey of the facility will be collected approximately annually.

The following surveillance activities will typically be performed for the supernatant pond at the frequency indicated below (KP 2022b):

- The position of the supernatant pond will be observed daily by staff involved in the construction and maintenance of the facility.
- The elevation of the supernatant pond will be monitored continuously and recorded daily.
- Satellite-based imagery will be reviewed approximately monthly to remotely observe the position of the pond relative to the embankments, tailings beaches, and waste rock disposal area.
- A bathymetric survey of the supernatant pond will be conducted approximately once per year. The survey will typically occur in summer, roughly at the same time as the aerial survey, when weather conditions are appropriate. The bathymetric survey is used to evaluate the subaqueous extents of the tailings surface and to support estimation of supernatant pond volume.

The following surveillance activities will typically be performed for the tailings beaches at the frequency indicated below (KP 2022b):

- The development of the tailings beaches will be observed daily by staff involved in the construction and maintenance of the facility. Daily surveillance activities will include observation of the discharge stream position and identification of beach areas at risk of blowing tailings that may require mitigation.
- The elevation of the tailings beach adjacent to the active tailings locations is surveyed approximately once per week.
- Satellite-based imagery will be reviewed approximately monthly to remotely observe the shape of the tailings beaches. The tailings beach length will be visually estimated.
- An aerial image and topographic survey of the facility will be collected approximately annually.

The ML/ARD Management Plan (Lorax 2022b) describes the specific monitoring methodology for sampling of tailings to track the geochemical properties over time and validate pre-mine ML/ARD characterization data and associated geochemical source term model assumptions. The tailings monitoring standard operating procedure includes: sample selection and collection protocols, sample shipping and handling details, select laboratory analyses and procedures, quality assurance and quality control requirements, communications with the analytical laboratories, and documentation of results (Lorax 2022b).

In the case that the Project enters into a Care and Maintenance (C&M) period, with no new tailings deposition planned, ML/ARD management strategies for the remaining exposed tailings beaches will be identified in the C&M Plan (EAC Condition 11; BW Gold 2022e).

BW Gold developed three C&M scenarios that differ in how the tailings and PAG/NAG3 waste rock in the TSF are covered and also consider details related to management of water surplus in the TSF C pond during C&M (BW Gold 2022e). The three TSF management scenarios include the following:

- Scenario 1 – No temporary cover on the tailings beach: water is allowed to accumulate to cover the PAG/NAG3 waste rock stored in the TSF and the remaining tailings beach is sub-aerial.
- Scenario 2 – Closure soil cover: water covers the PAG/NAG3 waste rock stored in the TSF, and the remaining tailings beach area is covered with soil.
- Scenario 3 – Full water cover: water covers the PAG/NAG3 waste rock and tailings beach area in the TSF.

The water quality model results indicate the system is relatively insensitive to differences in cover types between the three scenarios. This is primarily a result of the mitigations that are in place to manage

Project-related loading to the receiving environment including the treatment of pit sump water and TSF C pond water prior to discharging to the receiving environment during a C&M period.

The selection of the ML/ARD management scenario for C&M will be dependent upon a variety of factors, including the relative elevations of the Main Dam C crest, PAG/NAG3 dump crest, tailings beaches, and site wide water management considerations. These strategies will be reviewed by the TSF Engineer of Record (EOR) upon entering C&M, and the EOR will determine the appropriate C&M ML/ARD management strategy in consultation with other qualified professionals, relevant regulatory agencies, and Indigenous nations. The TSF EOR may include recommendations in addition to those specific to ML/ARD management to improve ML/ARD management success or, for example, to align with dam safety requirements.

5.2.3 Upper and Lower Waste Stockpiles

Only OVB, NAG4, and NAG5 waste rock types are planned for surface disposal in the waste stockpiles. The Lower Waste Stockpile will be 83 ha in size and will primarily contain OVB from the open pit footprint, while the Upper Waste Stockpile will be 74 ha in size and will primarily contain NAG4 and NAG5 waste rock, which will make up 68% of its final volume (BW Gold 2022a). Management of waste rock in the Lower Waste Stockpile is detailed in the Stockpiles Geotechnical and Water Management Design Report (KP 2022c). The Lower Waste Stockpile will be located northwest of the Open Pit and will have a maximum capacity of 38.4 Mt (MMTS 2021). The Upper Waste Stockpile and water management design are described in the Upper Waste Stockpile – Geotechnical and Water Management Design letter (KP 2022c). The proposed Upper Waste Stockpile will be located west of the Open Pit and will have a maximum capacity of approximately 28.8 Mt: construction is expected to begin in Year +11 and receive final material in Year +17 (KP 2022c).

The waste stockpiles will remain through to post-closure, with a soil cover placed on the stockpiles through progressive reclamation (of the Upper Waste Stockpile) and/or at the end of operations (BW Gold 2022a). The surface soil covers on the waste stockpiles will facilitate quicker revegetation and erosion control on slopes (BW Gold 2022a).

6. MINE WATER MANAGEMENT

6.1 Overview

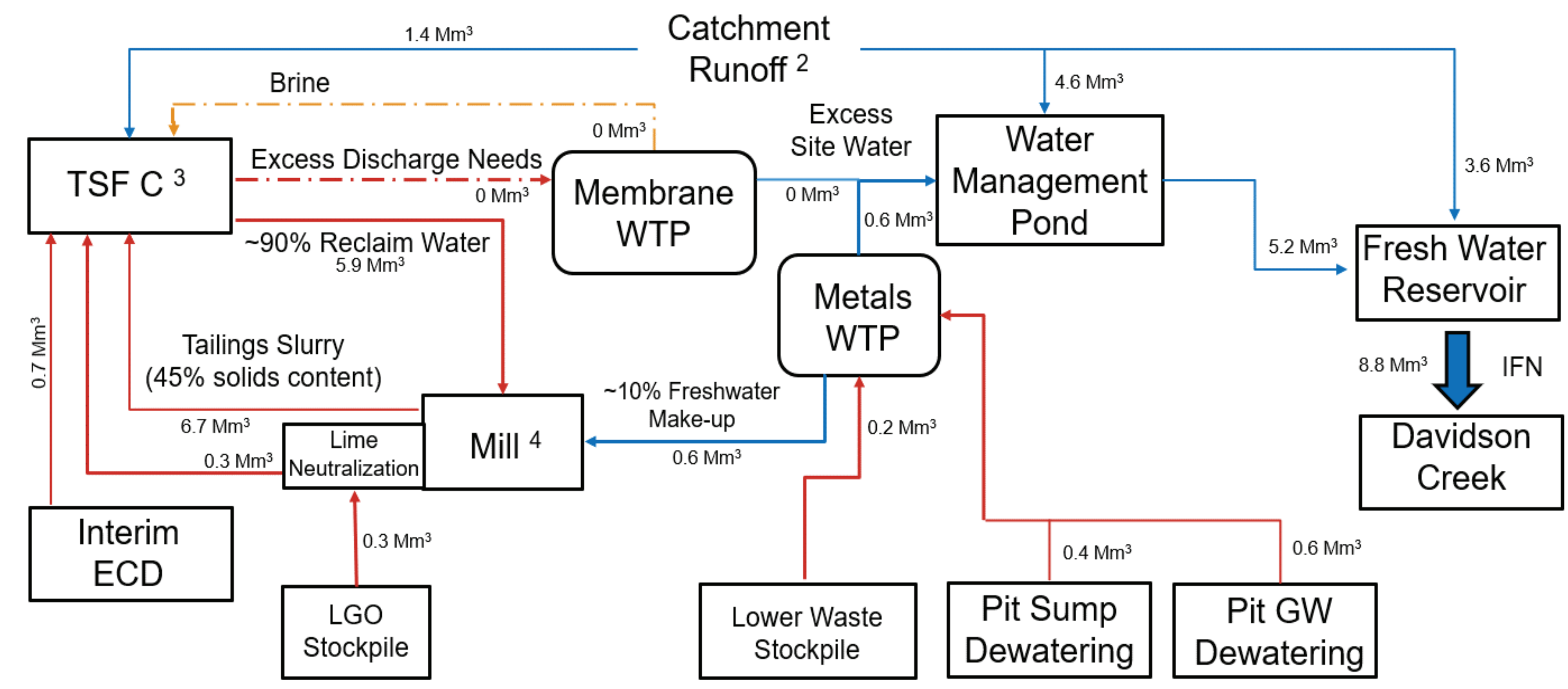
Surface runoff from the majority of the mine area flows by gravity into the TSF, following natural topographical drainages, which simplifies water management, spill control, and mine closure (KP 2022b). Mine affected runoff within the Project area will be captured and recycled for use as process water, and surplus water not required to support mine operations will be discharged to augment flows in lower Davidson Creek, if compliant with applicable water quality criteria (KP 2022b).

A Life of Mine Water Balance Model (LoM WBM) has been developed to support permitting (KP 2021b). The key objectives of the LoM WBM were to develop surface water and groundwater flow estimates for input to an updated water quality model and to assess water management strategies (KP 2021b). Mine water management components included in the LoM WBM through Operations are illustrated on Figures 6.1-1 through 6.1-4 (from KP 2021b). For information purposes, water management components included in the LoM WBM during the Closure and Post-Closure phases are illustrated on Figures 6.1-5 and 6.1-6. Flows from the mine components in wet and dry conditions during specific years of mine life are provided on Figures 6.1-7 and 6.1-8, respectively. The wet year flow schematic is provided for Year +8, which is a year that may require mitigations to maintain the TSF C Pond volume below the maximum normal operating volume in wetter than average conditions based on the results of water balance modelling (KP 2021b). The dry year flow schematic is provided for Year +10, which is the year with the greatest volume of waste rock placed in TSF D and therefore has the greatest volume of interstitial space (voids) to submerge. Additional detail on the depicted years for the wet and dry conditions are provided in Section 6.4.1.

The Open Pit is located on the flank of Mount Davidson, and the sloped topography is expected to control the surface and groundwater flow direction and to cause groundwater inflows and the radius of influence to vary radially around it. Construction of the Open Pit will start in Year -1 and mining operations will cease in Year +18. Water inflows to the Open Pit will include both groundwater and surface water runoff (direct precipitation into the pit and runoff from the contributing catchments around the pit excavation) with contributions progressively increasing as the pit extends below the groundwater table and the pit area increases in size.

The TSF-specific water balance is integrated within the LoM WBM. Specific water management structures planned for the mine operations period and incorporated into the TSF water management plan (KP 2022b) are the:

- Freshwater Reservoir (FWR) to store water and provide flows to lower Davidson Creek to meet Instream Flow Needs downstream of the mine and to provide water for mine operations when required.
- Water Management Pond (WMP) located downslope of the Open Pit and stockpiles area to manage runoff from contributing areas and water pumped from collection points, as well as surplus water from the TSF not needed for mine operations after treatment in the Membrane WTP. The WMP will provide fresh make-up water to support ore processing. Water not required to support mine operations will be conveyed by pipeline to the FWR.
- Central Diversion System to divert freshwater around the TSF to the Central Water Transfer Pond, from which it can be pumped to the WMP. Phase 1 of the Central Diversion System will be operational between Year -1 and Year +6, and the system components will be re-located during Phase 2 (Year +7 to closure) due to the expanding footprint of the TSF.



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 5 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR.
3. PROCESSES INTERNAL TO THE TAILINGS STORAGE FACILITY (TSF) ARE NOT PRESENTED SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS AND RETURNED FROM CONSOLIDATION SEEPAGE.
4. MILL WATER BALANCE ALSO INCLUDES 0.2 Mm^3 INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
5. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, MILL, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	20OCT'22	ISSUED WITH TRANSMITTAL	MCW	CAS

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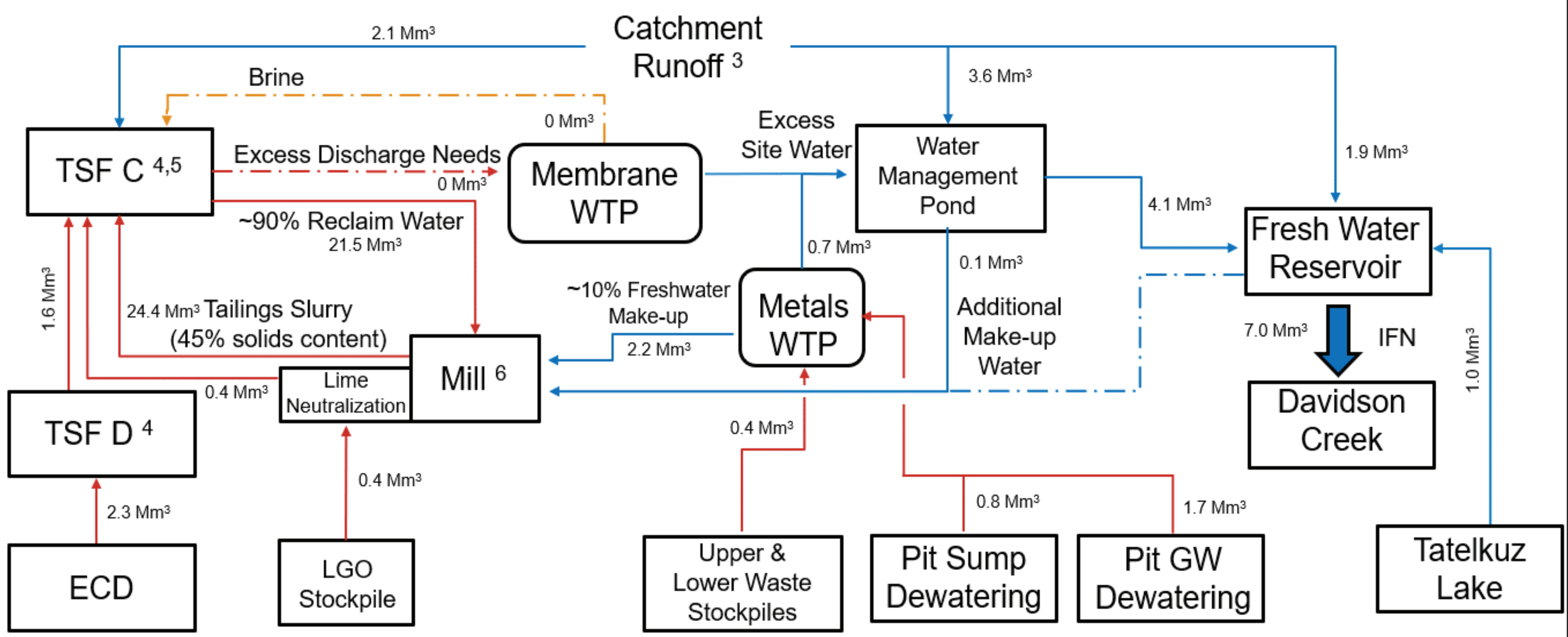
BLACKWATER GOLD PROJECT

SIMPLIFIED FLOW SCHEMATIC OPERATIONS YEAR 1 TO 6

Knight Piésold CONSULTING

P/A NO. VA/101-457/37 | REF. NO. VA22-02009 | REV 1

Figure 6.1-1: Simplified Flow Schematic Operations Year 1 to 6



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 17 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. MATERIAL STARTS TO BE PLACED IN THE UPPER WASTE STOCKPILE IN YEAR 11.
3. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 2.0 Mm³ (NOT SHOWN).
4. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS, WATER RETURNED FROM CONSOLIDATION SEEPAGE, AND THE CHANGE IN POND VOLUME.
5. TSF C RECEIVES 0.2 Mm³ OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 17.
6. MILL WATER BALANCE ALSO INCLUDES 0.6 Mm³ INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
7. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, MILL, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

NON-CONTACT WATER
CONTACT WATER
BRINE FROM MEMBRANE WTP

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SIMPLIFIED FLOW SCHEMATIC
OPERATIONS YEAR 7 TO 17

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REV 1

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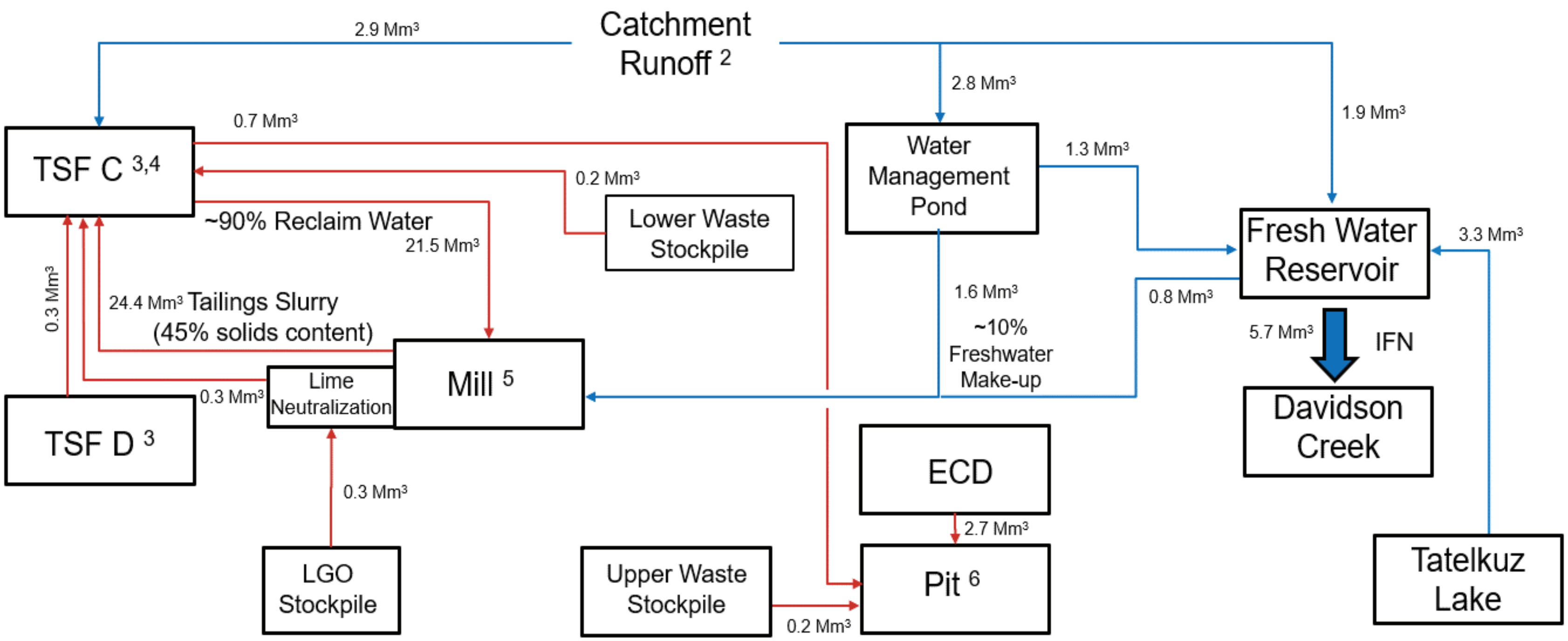
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Figure 6.1-2: Simplified Flow Schematic Operations Year 7 to 17



NON-CONTACT WATER
CONTACT WATER

NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 20 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 2.0 Mm^3.
3. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS, WATER RETURNED FROM CONSOLIDATION SEEPAGE, AND THE CHANGE IN POND VOLUME.
4. TSF C RECEIVES 0.3 Mm^3 OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 20.
5. MILL WATER BALANCE ALSO INCLUDES 0.6 Mm^3 INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
6. PIT LAKE VOLUME INCREASES 4.6 Mm^3 IN YEAR 20. ADDITIONAL INPUTS TO THE PIT FROM NET PRECIPITATION, GROUNDWATER INFLOWS, AND SURFACE RUNOFF ARE 1.1 Mm^3.
7. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, MILL, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
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SIMPLIFIED FLOW SCHEMATIC
OPERATIONS YEAR 18 TO 20

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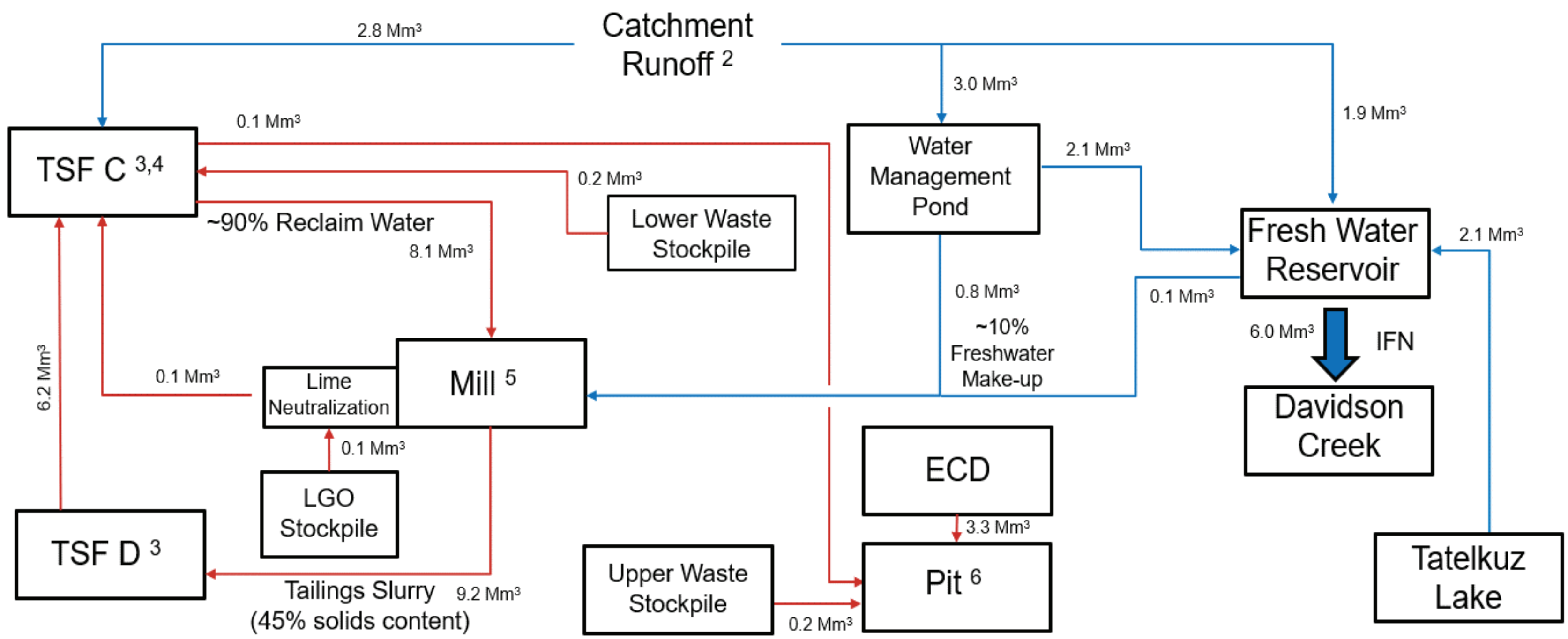
REF. NO. VA22-02009

REV 1

Figure 6.1-3: Simplified Flow Schematic Operations Year 18 to 20



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 23 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 1.4 Mm³.
3. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS, WATER RETURNED FROM CONSOLIDATION SEEPAGE, AND THE CHANGE IN POND VOLUME.
4. TSF C RECEIVES 0.2 Mm³ OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 23.
5. MILL WATER BALANCE ALSO INCLUDES 0.6 Mm³ INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
6. PIT LAKE VOLUME INCREASES 4.7 Mm³ IN YEAR 23. ADDITIONAL INPUTS TO THE PIT FROM NET PRECIPITATION, GROUNDWATER INFLOWS, AND SURFACE RUNOFF ARE 1.1 Mm³.
7. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, MILL, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

NON-CONTACT WATER
CONTACT WATER

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SIMPLIFIED FLOW SCHEMATIC
OPERATIONS YEAR 21 TO 23

Knight Piésold CONSULTING

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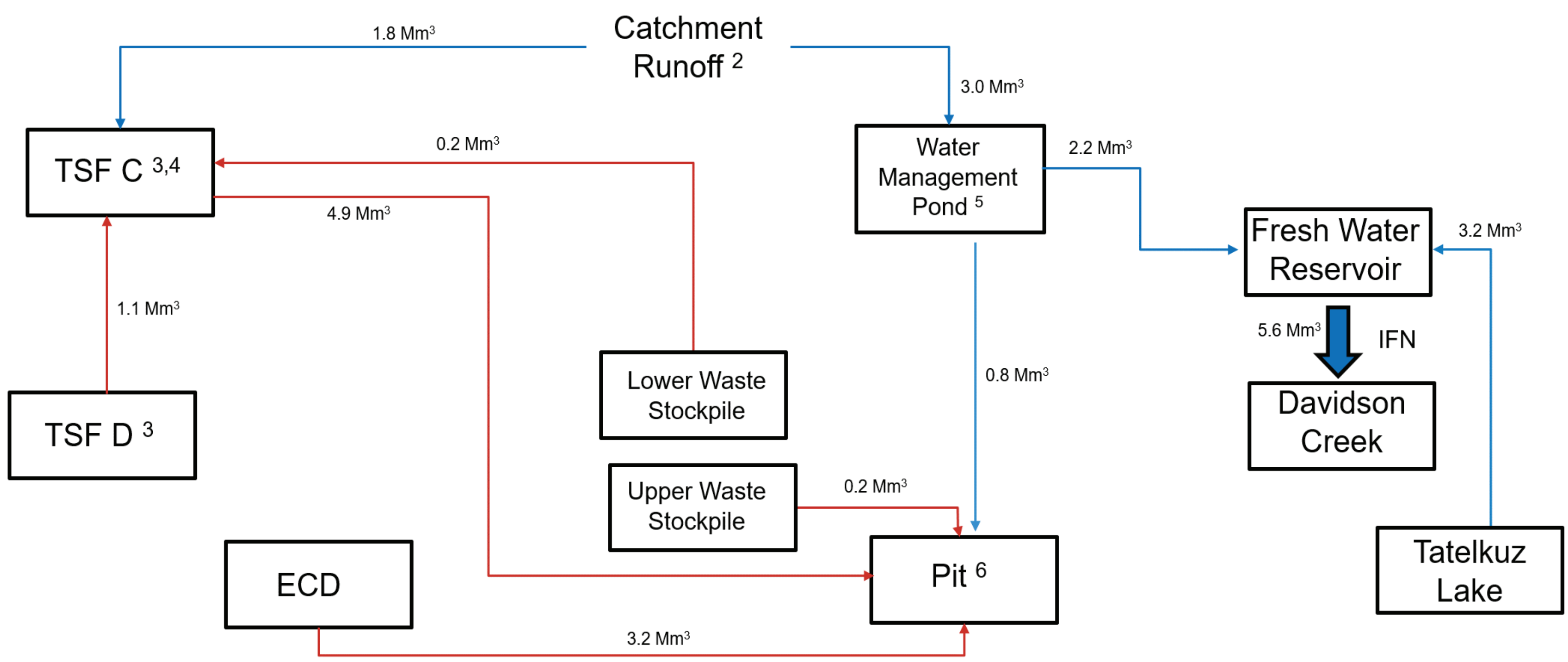
1	20OCT'22	ISSUED WITH TRANSMITTAL	MCW	CAS

Figure 6.1-4: Simplified Flow Schematic Operations Year 21 to 23



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 25 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 2.1 Mm^3.
3. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITIES DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER RETURNED FROM CONSOLIDATION SEEPAGE AND THE CHANGE IN POND VOLUME.
4. TSF C RECEIVES 1.1 Mm^3 OF WATER FROM EMBANKMENT RUNOFF AND 0.2 Mm^3 OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 25.
5. INFLOWS TO THE WATER MANAGEMENT POND INCLUDE 0.05 Mm^3 SEEPAGE FROM CONTACT SOURCES.
6. PIT LAKE VOLUME INCREASES 10 Mm^3 IN YEAR 25. ADDITIONAL INPUTS TO THE PIT FROM NET PRECIPITATION, GROUNDWATER INFLOWS, AND SURFACE RUNOFF ARE 1.2 Mm^3.
7. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR FOR CLOSURE ARE PRESENTED IN APPENDIX G OF KP (2022a).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
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SIMPLIFIED FLOW SCHEMATIC CLOSURE

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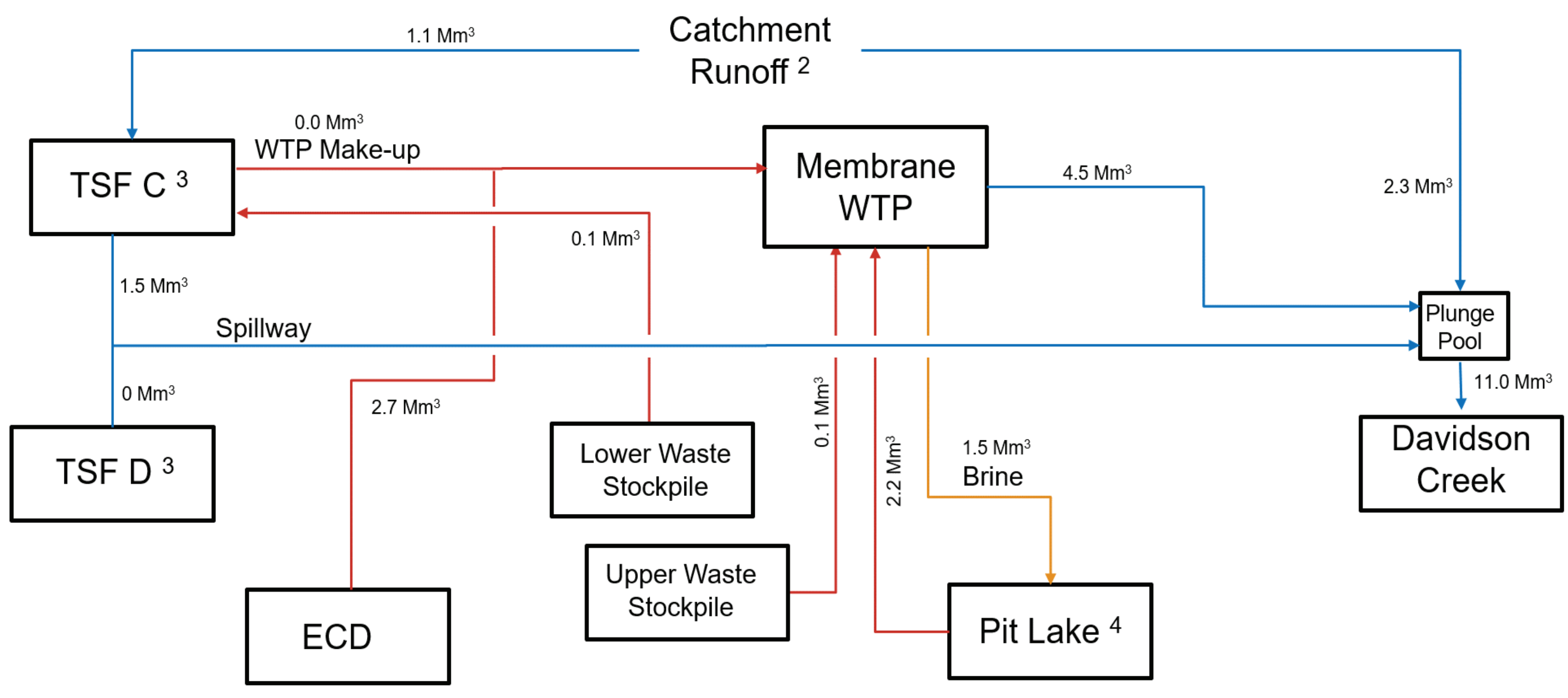
REF. NO. VA22-02009

REV 1

Figure 6.1-5: Simplified Flow Schematic Closure



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 55 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 1.1 Mm^3.
3. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS SEEPAGE AND RUNOFF FROM EMBANKMENTS.
4. TABLES SUMMARIZING ALL COMPONENTS OF THE WATER BALANCE FOR POST-CLOSURE ARE PRESENTED IN APPENDIX G OF KP (2022a).
5. CONTRIBUTIONS TO THE PIT LAKE FROM NET PRECIPITATION, GROUNDWATER INFLOWS, AND SURFACE RUNOFF AND ALSO ACCOUNTING FOR EVAPORATION FROM THE POND ARE AN ADDITIONAL 0.8 Mm^3.

NON-CONTACT WATER
CONTACT WATER
BRINE FROM MEMBRANE WTP

BW GOLD LTD
BLACKWATER GOLD PROJECT

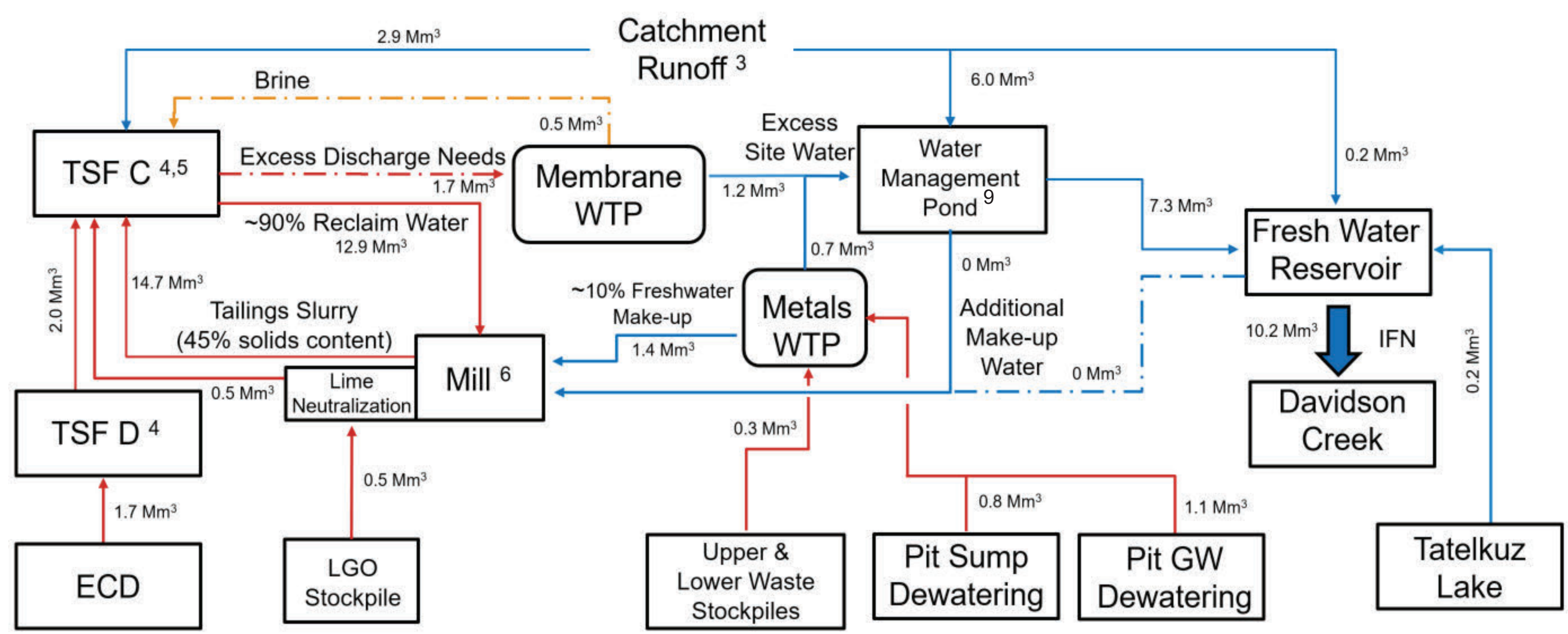
SIMPLIFIED FLOW SCHEMATIC POST-CLOSURE

Knight Piésold CONSULTING

P/A NO. VA/101-457/37
REF. NO. VA22-02009
REV 1

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	20OCT'22	ISSUED WITH TRANSMITTAL	MCW	CAS

Figure 6.1-6: Simplified Flow Schematic Post-closure



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 8 OF THE LIFE OF MINE WATER BALANCE MODEL (KP, 2022b). A WET CLIMATE YEAR IS POSITIONED IN THE YEARS LEADING UP TO AND INCLUDING YEAR 8.
2. MATERIAL STARTS TO BE PLACED IN THE UPPER WASTE STOCKPILE IN YEAR 11.
3. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 1.9 Mm^3 (NOT SHOWN).
4. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS, WATER RETURNED FROM CONSOLIDATION SEEPAGE, AND THE CHANGE IN POND VOLUME.
5. TSF C RECEIVES 0.01 Mm^3 OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 8.
6. MILL WATER BALANCE ALSO INCLUDES 0.4 Mm^3 INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
7. DASHED LINE INDICATES ADAPTIVE WATER MANAGEMENT FLOW PATH USED AS NEEDED WITH VARIABLE CLIMATE INPUT.
8. ADAPTIVE WATER MANAGEMENT AT THE WATER MANAGEMENT POND (WMP) UNDER WET CONDITIONS INCLUDES A SPILLWAY TO TSF C POND. THE WMP DOES NOT SPILL TO TSF C IN YEAR 8 OF THE WET CLIMATE SCENARIO.

NON-CONTACT WATER
CONTACT WATER
BRINE FROM MEMBRANE WTP

BW GOLD LTD
BLACKWATER GOLD PROJECT

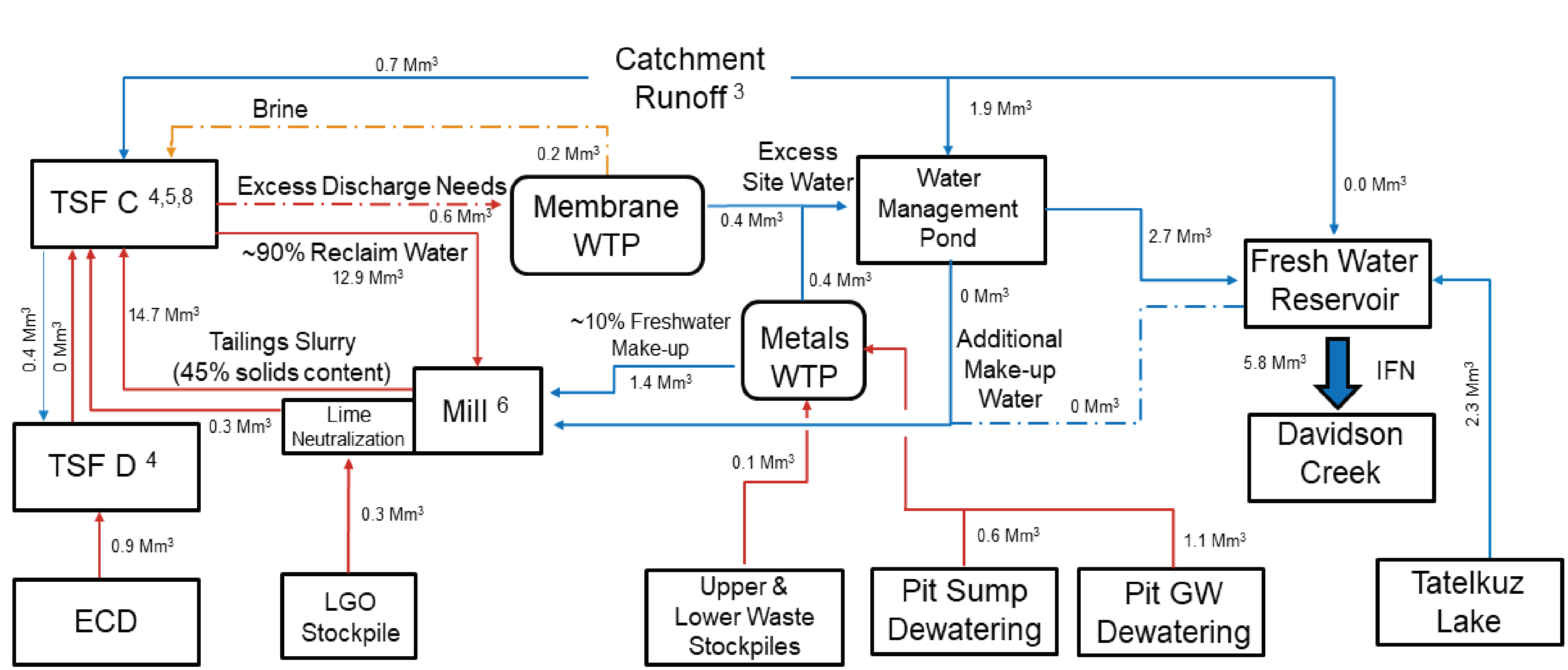
SIMPLIFIED FLOW SCHEMATIC
WET YEAR (OPERATIONS YEAR 8)

Knight Piésold CONSULTING

P/A NO.	REF. NO.	REV
VA/101-457/37	VA22-02009	0

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	20OCT'22	ISSUED WITH TRANSMITTAL	MCW	CAS

Figure 6.1-7: Simplified Flow Schematic Wet Year (Operations Year 8)



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 10 OF THE LIFE OF MINE WATER BALANCE MODEL (KP, 2022b). A DRY CLIMATE YEAR IS POSITIONED IN YEAR 10.
2. MATERIAL STARTS TO BE PLACED IN THE UPPER WASTE STOCKPILE IN YEAR 11.
3. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 1.2 Mm^3 INCLUDING 0.2 Mm^3 RE-DIRECTED FROM THE NORTHERN DIVERSION (NOT SHOWN).
4. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS, WATER RETURNED FROM CONSOLIDATION SEEPAGE, AND THE CHANGE IN POND VOLUME.
5. TSF C RECEIVES 0.04 Mm^3 OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 10.
6. MILL WATER BALANCE ALSO INCLUDES 0.4 Mm^3 INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
7. DASHED LINE INDICATES ADAPTIVE WATER MANAGEMENT FLOW PATH USED AS NEEDED WITH VARIABLE CLIMATE INPUT.
8. DEPICTED WATER BALANCE INCLUDES PROVISION TO DIRECT SURPLUS WATER FROM TSF C TO TSF D TO FACILITATE SUBMERGING WASTE ROCK IN TSF D DURING DRY CONDITIONS. THE TSF C SURPLUS WATER IS OTHERWISE DIRECTED FOR TREATMENT AT THE MEMBRANE WTP AND DISCHARGED DOWNSTREAM.

NON-CONTACT WATER
CONTACT WATER
BRINE FROM MEMBRANE WTP

0	20OCT'22	ISSUED WITH TRANSMITTAL	MCW	CAS
REV	DATE	DESCRIPTION	PREP'D	RVW'D

BW GOLD LTD

BLACKWATER GOLD PROJECT

SIMPLIFIED FLOW SCHEMATIC
DRY YEAR (OPERATIONS YEAR 10)

Knight Piésold CONSULTING

P/A NO. VA/101-457/37

REF. NO. VA22-02009

REV 0

Figure 6.1-8: Simplified Flow Schematic Dry Year (Operations Year 10)

- Northern Diversion System to divert freshwater around TSF D to the FWR or allow it to bypass diversion and flow into TSF D, depending on the needs of the mine, and is required beginning in approximately Year +6 following TSF D construction.
- Interim Environmental Control Dam to collect TSF C seepage and surface runoff until approximately Year +6.; a pumpback system will convey the recovered flows to TSF C.
- Environmental Control Dam to collected TSF seepage and storm water inflows beginning in approximately Year +6 once TSF D is commissioned; a pumpback system will be used to convey recovered flows to the TSF.

The TSF components explicitly represented in the LoM WBM include the supernatant ponds, tailings mass, PAG/NAG3 waste rock, tailings beaches, and embankments.

6.2 Open Pit

From Year -1 until the end of mining, open pit dewatering is achieved by pumping surface water that collects in the pit sump and groundwater from in-pit dewatering wells and perimeter dewatering wells to the Metals WTP. The flow from depressurization systems will be combined with flow from the surface water system at a junction header near the rim of the Open Pit before discharging by gravity to the Metals WTP. Water from the pit dewatering system is treated for metals and sent to the mill for the freshwater reclaim requirement; treated water in excess of the Mill freshwater requirement is sent to the WMP (KP 2021b). After mining of the Open Pit ceases and the LGO is being processed (starting in Year +18), the Open Pit fills naturally with groundwater inflows and surface water runoff to create a pit lake. Surplus water from TSF C and water collected at the ECD and from the Upper Waste Stockpile is pumped to the pit lake to accelerate filling during Years +18 to +36.

6.3 Water Management Pond

The WMP is used to manage water released from the water treatment plants (from open pit dewatering, contact water from waste and ore stockpiles, and surplus water from the TSF) as well as non-contact surface runoff diverted from catchment area upslope of TSF C. The WMP provides make-up water to support ore processing and is operational by mid-Year -1 and decommissioned by the start of Post-Closure. The WMP is originally located in the southeastern portion of the TSF C footprint and is relocated upslope of the original location by the start of Year +11 (KP 2021b).

Detailed engineering has been completed for the initial WMP, which will be constructed in Year -2 and commissioned in Year -1. The initial WMP will be formed using natural topography enclosed by construction of three earthfill berms on the West, North, and East sides of the pond (KP 2021a). Each berm is designed with a crest elevation of 1,325 masl. The basin and berms will be fully geomembrane-lined up to 1,324.5 masl, providing a total water storage capacity of 825,000 m^3 at this elevation (KP 2021a). Alternative lining methodologies may be evaluated following geotechnical investigations at the WMP during construction (KP 2021a). The initial WMP will be decommissioned in Year +13 when it is inundated by TSF C (BW Gold 2022b).

The WMP volume will be managed via pumping systems and two secondary outflow mechanisms designed to maintain dam safety (KP 2021a). The pumping systems will provide the primary control of water level within the WMP on a day-to-day basis. A High Density Polyethylene (HDPE) outlet pipe installed at the West Berm will provide supplemental outflow capacity to the TSF supernatant pond during periods of elevated runoff, such as during freshet. Larger storm inflows up to the 1 in 200-year, 24-hour return period storm event will be managed by an emergency spillway constructed along the left abutment of the North Berm. The outlet pipe will convey the mean freshet inflows for a 50-year return period wet year without activating the emergency spillway; the emergency spillway will convey up to the 1 in 200-year, 24-hour return period flow, and assumes that the outlet pipe is blocked during the event (KP 2021a). A trapezoidal outlet channel will convey flow from the spillway away around the North Berm into a stilling basin in the Mine Area Creek upstream of Main Dam C (KP 2021a).

Geotechnical instrumentation will be installed along one plane through each of the initial WMP West Berm, North Berm, and East Berm during Stage 1 construction to assess the performance of the berms and identify any conditions different to those assumed during design and analysis and will be supplemented with additional instrumentation over the life of the Project (KP 2021a). Digital ultrasonic flow meters will be installed in the initial WMP low level outlet, and water level meters will be installed immediately upstream of the embankments to allow quick identification of current water levels and changes as they occur (KP 2021a).

6.4 Tailings Storage Facility

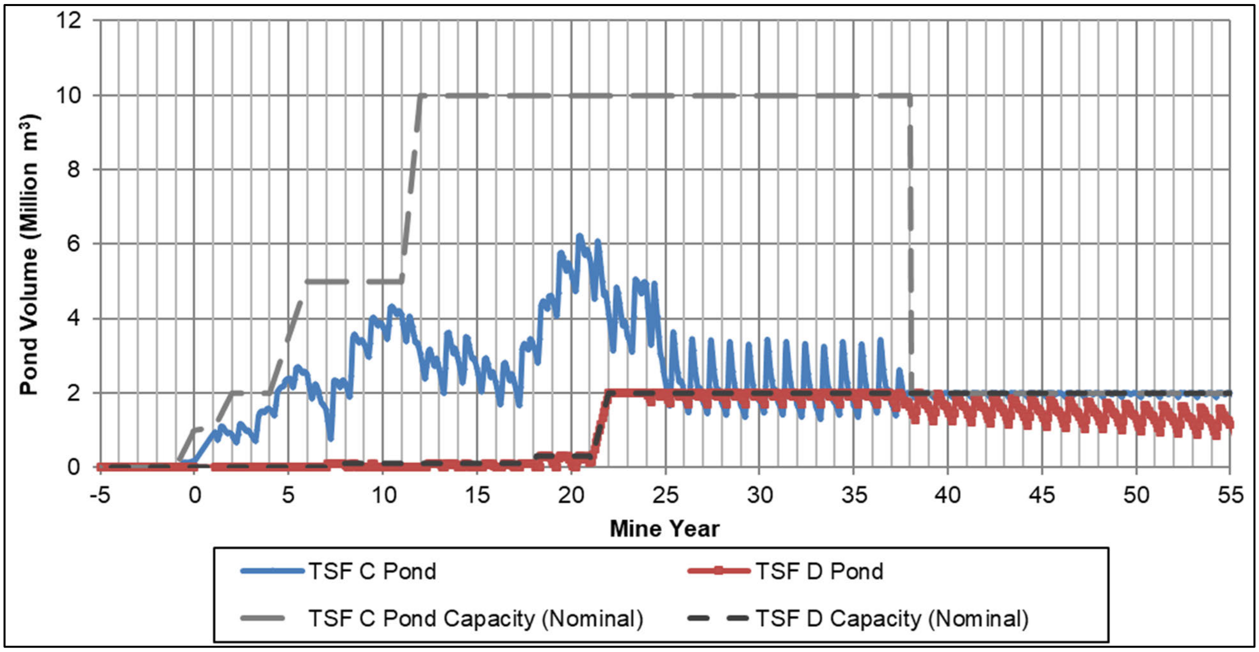
6.4.1 Management and Monitoring of Water Volume

The water management strategy for the TSF is to store water primarily in TSF C for use in ore processing and to maintain a low inventory of water in TSF D (KP 2021b). Water storage begins in the TSF C starter pond in Year -1 and water is available for ore processing in Year +1. Water begins to accumulate behind Main Dam D starting in Year +6: to maintain a minimum water volume in TSF D, supernatant pond water is pumped to TSF C (KP 2021b). Water inventory that develops in wetter than average conditions in excess of the optimum supernatant pond volume in TSF C during Operations will be sent to a Membrane WTP between April and October for treatment prior to discharge to the WMP (see Section 6.6).
This section summarizes the LoM WBM results (KP 2021b).

With average climate inputs, the predicted TSF C supernatant pond volume fluctuates between approximately 1 and 6 Mm^3 during Operations without requiring treatment and release. Estimated operating volumes from the LoM WBM using average climate conditions are shown on Figure 6.4-1. The modelled volume under average climate conditions approaches the nominal operating storage allowance for the TSF (shown as the upper dark grey dashed line on the figure) in certain years.

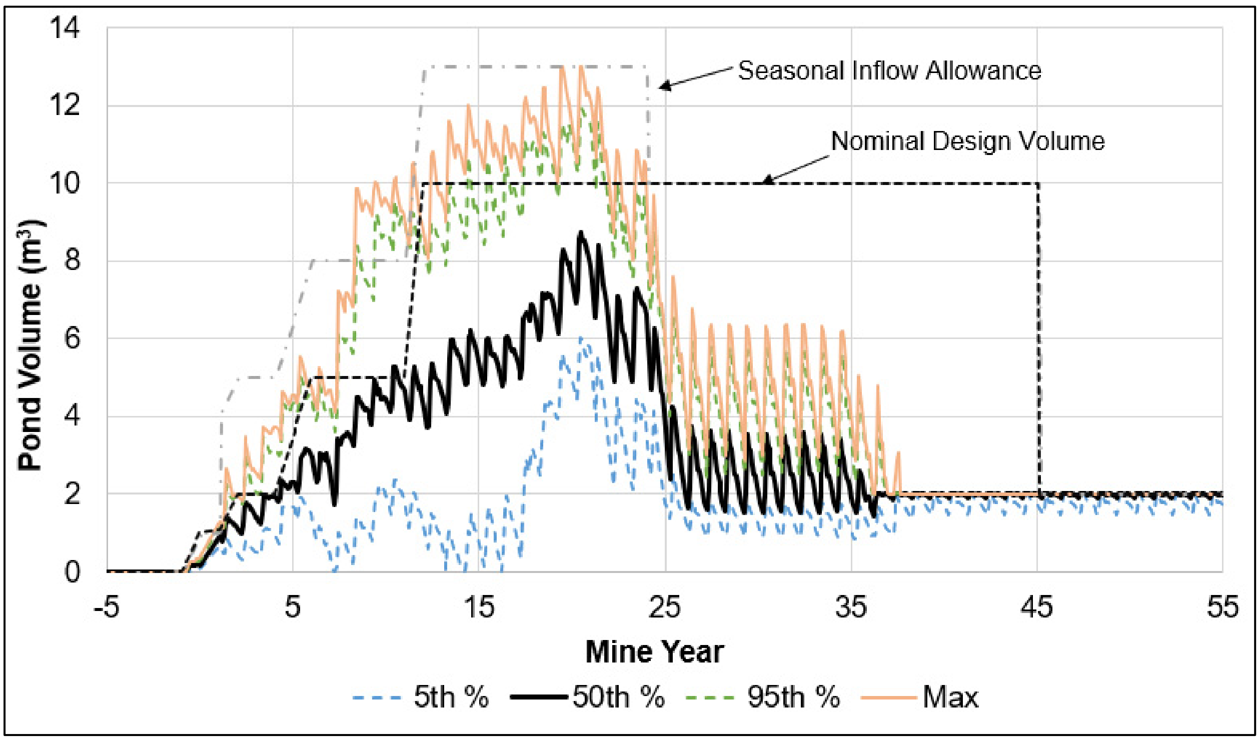
The rate of water accumulation in TSF C increases in Years +3, +4, and +8 due to less water being 'lost' to the waste rock voids (KP 2021b). By Year +8 all waste rock in TSF C is assumed to be submerged. The Central Diversion System is relocated in Year +7, increasing the contributing catchment area to TSF C and subsequently increasing the rate of water accumulation in TSF C. The TSF C supernatant pond volume is simulated to decrease in Years +6 and +11 due to an increase in ore processing requirements, and again in Year +21 at the start of tailings deposition in TSF D.

The Variable Climate Case (VCC) LoM WBM results for the 5th percentile, 50th percentile, 95th percentile, and maximum modelled volume for TSF C are shown on Figure 6.4-2. The water management strategy simulated in the VCC Model includes treatment of water from TSF C at a membrane WTP at an influent rate of 72 L/s (KP 2021b). Treatment is modelled to occur from April to October if the supernatant pond volume exceeds three to four times the mill requirement, depending on the year of mining.



Source: Figure 2 in KP (2022a)

Figure 6.4-1: LoM WBM Simulated TSF Pond Volumes (Average Climate Conditions)



Source: Figure 3 in KP (2022a)

Figure 6.4-2: TSF C Pond Volume (Variable Climate Case Model Results)

The 50th percentile TSF C Pond volume of all variable climate iterations remains within the nominal design volume, although seasonal increases in volume approach the nominal design value of 5 Mm^3 in Years +9 and +10. The simulated volume of water in TSF C predicted by the VCC model could exceed the nominal design volume during wetter than average climate periods and require membrane treatment and discharge (KP 2021b). Wetter than average climate conditions predicted by the water balance to occur in Years +7 through +10 of Operations could require a different water management strategy than represented in the LoM WBM to maintain the TSF C Pond below the maximum normal operating pond volume (the nominal design volume combined with the seasonal inflow allowance). Strategies to manage TSF C Pond volumes could include increased water treatment and pre-emptively drawing down the WMP to provide more storage of treated water. Drawing down the WMP would involve pumping the stored water volume from the WMP and directing it to the FWR for discharge downstream. The capacity to direct water downstream from the WMP is limited by the WMP Discharge Pipeline and flows directed to the WMP in excess of the pipeline capacity overflow to the TSF. Therefore, pre-emptively drawing down the WMP in advance of large freshets pre-emptively conveys stored water downstream and creates additional capacity for storage during high flows (KP 2022g). The available storage volume in the WMP is almost 800,000 m^3 until Year 10 and approximately 250,000 m^3 thereafter (KP 2022g).

The ability to treat and remove water during an extreme wet condition (1 in 100 year wet precipitation) was also assessed using an extreme wet condition water balance model sensitivity ("wet year sensitivity"; KP 2022g). Potential alternate water management strategies were simulated using the wet year sensitivity model to evaluate the ability to manage TSF surplus water during an extreme wet year occurring after several wetter than average years. Simulations with the wet year sensitivity model suggest potential water accumulation in TSF C during an extreme wet condition occurring after several wet years could successfully be managed by incorporating the following mitigations (KP 2022g):

- Making operational water treatment at the Membrane WTP available during all months of the year at a treatment rate consistent with the base case rate (72 L/s) as indicated in the Joint *Mines Act/Environmental Management Act* Permits Application.
- Holding a volume of water in TSF D instead of transferring the water immediately to TSF C. A contingency storage allowance is included in the design staging and construction sequencing of TSF D that can accommodate at least 2 Mm^3 of water in extremely wet conditions.

Increased water treatment capacity during Operations can be accommodated by operating the WTP all months of the year, which would increase the available treatment capacity from approximately 1.3 Mm^3/yr to 2.3 Mm^3/yr. Operating the WTP for a longer duration does not require any lead time to implement other than what would be required to plan for logistics (i.e., having reagents and staff onsite). Similarly, no lead time is required to hold water in the contingency storage allowance available in TSF D.

The grey dashed line on Figure 6.4-2 (TSF C Seasonal Inflow Allowance) represents the maximum allowable operating pond volume used for site water management planning, excluding additional design allowances for storm storage (e.g., for the EDF and IDF). The volume of water in the TSF can be maintained below the Seasonal Inflow Allowance when mitigations discussed above are considered.

The LoM WBM predicts that the 5th percentile volume of TSF C Pond decreases toward zero in dry conditions, when the mill processing requirements increase, and in Year +21 when tailings discharge to TSF D begins. To maintain PAG saturation and meet the mill reclaim requirement in this model scenario, water is diverted to the TSF from the WMP. Flows diverted around the TSF by the Northern Diversion System and Central Diversion System could be directed to the facility if required to support mine operations and maintain PAG saturation (KP 2021b).

TSF D Pond volumes calculated in the VCC Model are presented on Figure 6.4-3. The TSF D Pond volume is minimal prior to discharge of tailings into the facility and remains at 2 Mm^3 while tailings are discharged into the facility in Years +21 through +23. Water from TSF D is pumped to TSF C during Operations at predicted rates of up to 2,400 m^3/hr in the 50th percentile case and up to 4,280 m^3/hr in the 95th percentile case. Predicted pumping rates to transfer water from TSF D to TSF C are highest when tailings are being deposited in TSF D.

The VCC Model was rerun with water allowed to flow onto TSF D from the Northern Diversion System to maintain a minimum volume of water in the pond and maintain saturation of the waste rock – model results are shown on Figure 6.4-4 (KP 2022g). The 5th percentile TSF D pond volume depicted in Figure 6.4-4 considers the flexibility built into the water management plan to operate the diversions or allow water to flow onto the TSF and therefore presents a better representation of the predicted 5th percentile pond volume than shown in Figure 6.4-3, which does not consider allowances for water to bypass the Northern Diversion System and flow onto TSF D.

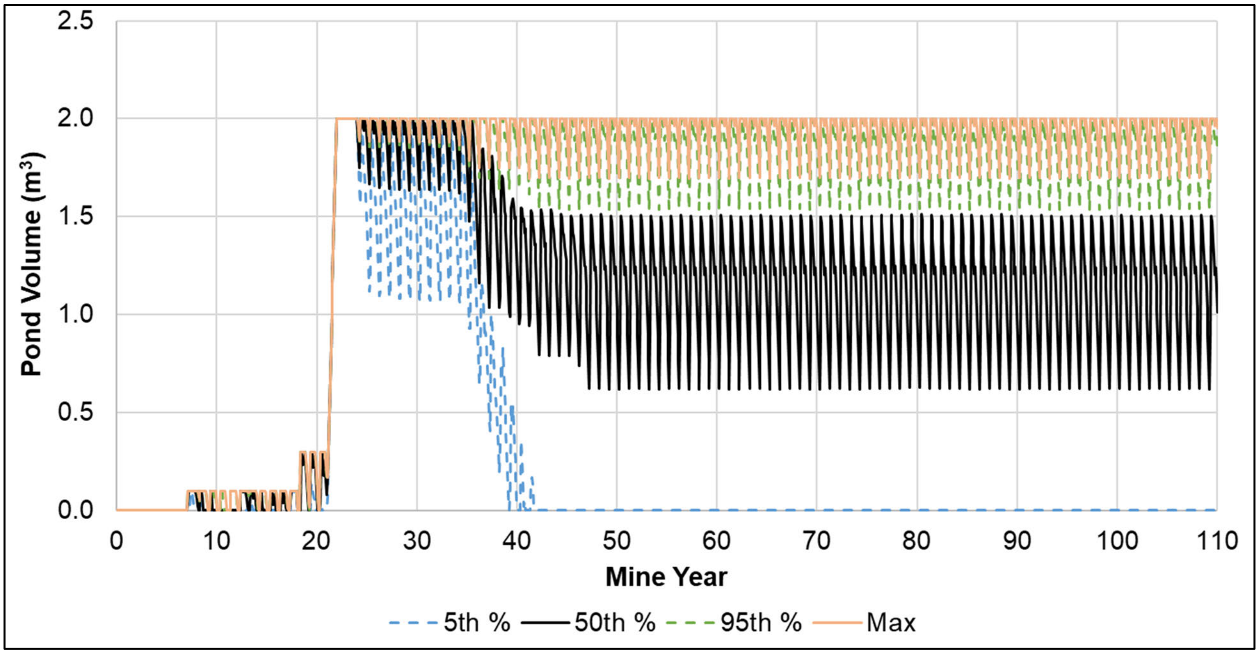
Placement of waste rock in the TSF is predicted to create between 0.7 to 1.4 Mm^3 of interstitial space (voids) annually that will consume water in TSF C during Years +1 through +6 and between 1 to 4 Mm^3 of voids annually in TSF D during Years+ 6 through +18. Under all climate conditions, the waste rock voids in TSF C are able to be saturated within the time frame specified in Table 5.3-1. Modelling results indicate that all waste rock placed in TSF D can be saturated within one year of placement, even in the driest conditions. The minimum (driest) condition generated with the VCC Model does not result in depleted TSF pond volumes. The TSF C and D Pond volumes are maintained by allowing more water from the upgradient catchments to be directed onto the TSF than is simulated in the base case VCC Model and the sensitivity model (KP 2022g).

In TSF D, the rate of waste rock placement is highest in Years +9, +10, and +14; therefore, waste rock submergence may take longer than approximately three months to achieve under drier than average conditions. Under the driest modelled conditions, when the rate of waste rock placement is highest (Year +10) waste rock submergence was predicted to take up to nine months, assuming additional water from the Northern Diversion System is directed to TSF D. The deficit in waste rock saturation is generally only seasonal (through late winter) due to the larger contribution of water available during freshet.

There is a 95% certainty the waste rock in TSF D will be submerged within the following timelines:

- 8 months in Years 10 and 11
- 7 months in Year 17
- 5 to 6 months in Years 8, 9 and Years 12 through 16
- 3 or 4 months in Years 6 and 7

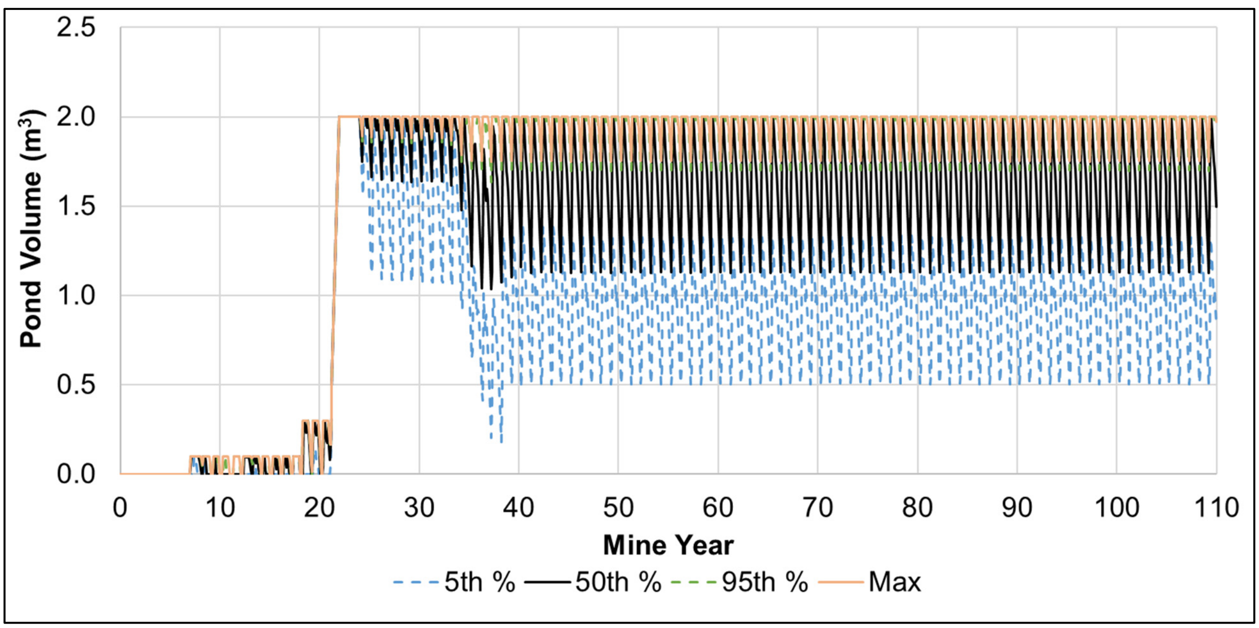
Making additional provisions to direct water to TSF D from other sources (e.g., TSF C, WMP, Open Pit dewatering or Upper and Lower Waste Stockpiles) would help submerge waste rock in TSF D more rapidly than the months predicted with the base case modelling, if warranted. Including provision to direct surplus water from TSF C to TSF D to facilitate waste rock submergence rather than directing surplus TSF C Pond water for treatment at the Membrane WTP would decrease the time to submerge the TSF D waste rock and is depicted in the dry year flow schematic presented as Figure 6.1-8. In TSF D, the waste rock voids are able to be saturated within one year of placement under all climate conditions.



Source: Figure 4 in KP (2022a)

Predicted pond volume does not consider ability to allow water to bypass Northern Diversion and flow onto the TSF to contribute to the pond.

Figure 6.4-3: TSF D Pond Volume (Variable Climate Case Model Results)



Source: Figure 6 in KP (2022a).

Maximum and percentile pond values were calculated using the results of the 40 iterations of the VCC model.

Figure 6.4-4: TSF D Pond Volume (Variable Climate Case Model Results) with Updated Representation of the Modelled Northern Diversion

Geotechnical instrumentation will be installed along three planes through the Main Dam C during Stage 1 construction and will be supplemented with additional instrumentation over the life of the Project. The geotechnical instrumentation will be used to assess the performance of Main Dam C and to identify any conditions different to those assumed during design and analysis (KP 2021a). The geotechnical instrumentation will comprise vibrating wire piezometers, slope inclinometers, and survey prisms installed in the foundations, embankment fill, and on the embankment crests (KP 2021a). Other instrumentation to be installed include flow monitoring devices and water level meters. The instrumentation systems include some degree of overlap and redundancy to enable verification of problems that may be detected.

Vibrating wire piezometers will be installed in the foundation materials, embankment fill, tailings, and PAG/NAG3 waste rock disposal area to measure pore water pressures and piezometric elevations within these units. Slope inclinometers will be installed immediately downstream of the Main Dam C. Survey prisms will be installed on the crests of the Main Dam C embankment following construction completion to monitor surficial deformation: continuous real-time survey via automatic total stations will record movements and provide warning of any acceleration of movement that may be critical to dam safety (KP 2021a). Water level meters will be installed at the Main Dam C supernatant pond to quickly identify current water levels and changes as they occur. An Operations, Maintenance and Surveillance (OMS) Manual will be prepared following initial construction and prior to commissioning of the TSF to provide comprehensive operating instructions and monitoring frequencies for the TSF instrumentation, as required by Section 10.5.2 (1) of the Health, Safety and Reclamation Code for Mines in BC. The OMS Manual will be prepared by one or more qualified persons and submitted to the chief inspector prior to operation of the TSF. The OMS Manual will include the threshold conditions in the form of quantitative performance objectives (QPOs) and associated trigger action response plans (TARPS). These thresholds and response plans will be reviewed annually and updated progressively during mine operations as the facility and monitoring instrumentation evolves (KP 2022f).

Preliminary QPOs and associated TARPs are presented in KP (2022e). The preliminary QPOs and TARPs for the TSF follow the tiered risk-response framework recommended by the Mining Association of Canada (MAC 2021). The TSF will gradually evolve over the life of the mine, and the QPOs and TARPs in place at any given time will be dependent on the constructed facilities, active surveillance practices, and available monitoring instrumentation. The TARP requires that the Engineer of Record and TSF Qualified Person be notified when conditions transition between Risk Situations (e.g., from Acceptable to Low Risk Situations; KP 2022f). The preliminary QPOs and TARPS are focused on the early Operations phase, and have been developed to demonstrate the proposed TARP structure, including consideration of:

- Routine surveillance/monitoring to determine prevailing operating conditions;
- Identification of surveillance/monitoring results that would correspond with changing conditions and increasing risk; and
- Response plans to evaluate and manage risk to return conditions to lower risk situations.

The preliminary QPOs related to TSF operations include:

- Main Dam C Crest Elevation;
- PAG/NAG3 Waste Rock Disposal Area Elevation;
- Emergency Spillway Capacity; and
- TSF C Pond Volume.

The QPOs are selected to enable a high-level comparative assessment with the performance objectives for the TSF and must be reviewed annually and revised as required to remain current during on-going construction of the TSF. The presence/amount of tailings may be considered as a QPO once a beach is present in front of the dam; a QPO for the presence/amount of tailings beach, if applicable, will change depending on the timing in the life of the project. Several QPOs will require regular (minimum annual) updates with the initial values provided being relevant to the Stage 1 TSF design (KP 2021a) and first year (or several years) of mine operations. Construction as-built surveys, instrumentation installation and calibration records, and additional technical analysis will be required to assign quantitative values to specific instruments, for some QPOs (e.g., TSF C pond volume), which will be completed during development of the OMS Manual and confirmation of QPO/TARP structure for operations.

Piezometric, surface and subsurface deformation, and flow monitoring instrumentation will be established for the TSF during initial construction to meet the detailed design specifications (KP 2021a). Initial data collection will begin once the instrumentation is established to collect baseline readings, further characterize spatial trends, and assess instrument reliability. These data are an important indicator of facility performance and will be regularly reviewed following the protocols and monitoring procedures identified in the OMS Manual. The initial monitoring period will also be used to assess opportunities to incorporate additional data types and monitoring instrumentation into future updates of the QPOs and TARPs. Construction record drawings and instrumentation installation and calibration records will be required to assign quantitative values and develop the OMS Manual for operations.

6.4.2 Water Quality Monitoring

The TSF C and TSF D pond water quality will be monitored as part of the mine site water monitoring program (BW Gold 2022c). Monitoring will be conducted monthly. The parameters to be measured in TSF Pond water and their recommended detection limits are summarized in Table 6.4-1 and include those constituents recommended by the BC MOE (2016) as well as parameters identified as Parameters of Concern (POCs) and Parameters of Potential Concern identified in the Project Conceptual Site Model (Entia 2022). Analytical water quality samples will be submitted to ALS Environmental, or another CALA certified analytical laboratory, as appropriate. Analytical testing procedures will vary with parameters. Analyses will be performed using standard analytical methods, consistent with the most recent edition of the British Columbia Environmental Laboratory Manual and supplements to the manual (BC ENV 2020a).

Table 6.4-1: Water Chemistry Parameters and Detection Limits[1]

Parameter	Detection Limit	Parameter	Detection Limit
Physical Parameters		**Major Anions**	
pH	0.01	Alkalinity – Total	1 mg/L
Specific Conductivity	2 μS/cm	Acidity	2 mg/L
Hardness as $CaCO_3$ (Dissolved)	1 mg/L	Chloride	0.5 mg/L
Total Dissolved Solids	10 mg/L	Fluoride	0.02 mg/L
Total Suspended Solids	2 mg/L	Bromide	0.05 mg/L
Turbidity	0.1 NTU	Sulphate	0.5 mg/L
Colour	5 CU		

[1] A review of this plan by interested parties resulted in a request that thiocyanate and cyanate be added the list of water chemistry parameters to be analyzed. Table 6.4-1 is specific to the TSF water quality monitoring therefore adding thiocyanate and cyanate is not required and instead as suggested by the response to the comment are applicable to monitoring of the Membrane WTP effluent. Therefore, thiocyanate and cyanate have been added for Membrane WTP effluent water chemistry parameters to be monitored in the next iteration of the Mine Site Water and Discharge Monitoring and Management Plan.

Parameter	Detection Limit	Parameter	Detection Limit
Nutrients		**Organics**	
Nitrate Nitrogen	0.005 mg/L	Total Organic Carbon	0.5 mg/L
Nitrite Nitrogen	0.005 mg/L	Dissolved Organic Carbon	0.5 mg/L
Nitrogen – Total	0.05 mg/L	**Cyanide**	
Ammonia Nitrogen	0.02 mg/L	Total Cyanide	0.001 mg/L
Ortho phosphorus – dissolved	0.005 mg/L	Weak Acid Dissociable (WAD) Cyanide	0.001 mg/L
Phosphorous – Total	0.005 mg/L		
Total and Dissolved Metals		**Total and Dissolved Metals**	
Aluminum	0.001 mg/L	Manganese	0.0002 mg/L
Antimony	0.0001 mg/L	Mercury	0.00001 mg/L
Arsenic	0.0002 mg/L	Molybdenum	0.0001 mg/L
Barium	0.0001 mg/L	Nickel	0.0005 mg/L
Beryllium	0.0001 mg/L	Potassium	0.1 mg/L
Bismuth	0.0005 mg/L	Selenium	0.0003 mg/L
Boron	0.01 mg/L	Silicon	0.05 mg/L
Cadmium	0.00001 mg/L	Silver	0.00001 mg/L
Calcium	0.05 mg/L	Sodium	0.1 mg/L
Chromium	0.0005 mg/L	Strontium	0.0002 mg/L
Cobalt	0.0001 mg/L	Thallium	0.00001 mg/L
Copper	0.0002 mg/L	Tin	0.0002 mg/L
Iron	0.01 mg/L	Titanium	0.01 mg/L
Lead	0.0001 mg/L	Uranium	0.00001 mg/L
Lithium	0.001 mg/L	Vanadium	0.001 mg/L
Magnesium	0.1 mg/L	Zinc	0.001 mg/L

Field (*in situ*) measurements will be recorded for:

- Temperature;
- Dissolved oxygen;
- Conductivity;
- Salinity;
- pH; and
- Oxidation-Reduction Potential.

Field measurements will be collected using a regularly calibrated multi-parameter water quality meter. Field protocols will follow the BC Field Sampling Manual (BC MWLAP 2013).

6.5 Lower and Upper Waste Stockpiles

6.5.1 Lower Waste Stockpile Water Management Design

The water management components for the Lower Waste Stockpile have been designed for the Year +18 ultimate stockpile configuration and will be installed prior to Year -1 when initial overburden and waste rock materials are planned for placement (KP 2022c). The Lower Waste Stockpile water management components are comprised of (KP 2022c):

- North and South Collection Channels;
- Cut/fill glacial till and erosion protection-lined earthfill collection channels;
- A corrugated steel pipe culvert under the stockpile access road;
- Geomembrane-lined contact water collection pond;
- Pump system and pipeline;
- Emergency spillway and stilling basin; and
- Water level and flow monitoring devices.

The NAG4/NAG5 waste rock will be selectively placed along the base of the piles to convey infiltrated water and control pore water buildup within the stockpiles. Stockpile drainage will be confirmed through the monitoring of pore water pressure instrumentation (piezometers) to be installed in the foundation and stockpile fill materials, distributed throughout the various foundation and fill zones to provide a spectrum of monitoring data (KP 2022h).

The North and South collection channels will be constructed along the stockpile periphery to collect and convey contact surface runoff to the Lower Waste Stockpile geomembrane-lined collection pond. The collection channels are sized to convey the 1 in 10-year return, 24-hour flood with a minimum of 300 mm of freeboard and have sufficient capacity to pass the 1 in 200-year, 24-hour flood at bankfull conditions (KP 2022c). The Lower Waste Stockpile Collection Pond will be constructed upstream of the WMP and has an assumed design life of approximately 25 years (life of mine).

The Lower Waste Stockpile Collection Pond will be lined with HDPE geomembrane to limit seepage loss to groundwater to the maximum practicable extent and will have two outlets: a pumping system and pipeline (primary outlet), which will convey the water to the Metals WTP pond, and an emergency spillway (secondary outlet) which will outlet to the Mine Area Creek and eventually to the WMP (KP 2022c). The Lower Waste Stockpile Collection Pond will impound approximately 50,000 m^3 at the spillway invert and has the ability to store the 1 in 10-year, 24-hr flood. The emergency spillway was designed for the 1 in 200-year, 24-hr flood.

The Lower Waste Stockpile Collection Pond will be maintained in a dewatered condition to the extent practical. The pumping system will provide a total design head of 90 m at a flowrate of 62.5 L/s: the design flow was selected to minimize spillway usage, and the selected flow rate corresponds to the collection pond storage capacity. The pump was designed to draw down the full storage of the collection pond in 10 days (KP 2022c).

6.5.2 Upper Waste Stockpile Water Management Design

The Upper Waste Stockpile will be constructed in Year +11 and will be located west of the Open Pit. All the surface contact runoff from the proposed Upper Waste Stockpile will be collected by the North Collection Channel and conveyed to the Upper Waste Stockpile Collection Pond (KP 2022d). All contact surface runoff from the Upper Waste Stockpile will be diverted by grading and/or collection swales located at the toe of the Upper Waste Stockpile slopes to the North Collection Channel located around the north toe of the Upper Waste Stockpile.

Non-contact water from contributing upslope catchment areas will be diverted around the stockpile via the South Diversion Channel and will discharge to natural ground downstream of the collection pond, where it will follow existing drainages to the WMP (KP 2022d).

The Upper Waste Stockpile Collection Pond is designed to provide temporary storage to facilitate water being pumped to the Metals WTP, if required, prior to being conveyed to the WMP. The emergency spillway from the Upper Waste Stockpile Collection Pond would release flows to a drainage that ultimately flows to the WMP (KP 2022d). The Upper Waste Stockpile Collection Pond will provide runoff storage for the 1 in 10-year, 24-hour precipitation event without any discharge, and controlled discharge of flows up to the 1 in 200-year, 24-hour precipitation event through a broad crested rectangular weir spillway. The pond will be lined with an HDPE geomembrane placed on top of 500 mm of engineered fill to limit seepage loss to groundwater to the maximum practicable extent (KP 2022d).

The North Collection Channel and South Diversion Channel for the Upper Waste Stockpile will be designed as open channels to pass the 1 in 10-year storm event with a minimum freeboard allowance equal to or greater than 300 mm above this design flow level (KP 2022d). Both channels will also be designed to pass the 1 in 200-year storm event with no freeboard and will consist of 2.5H:1V slopes, with a 1.0 m base width and a height of 0.9 m (KP 2022d).

6.5.3 Waste Stockpile Collection Ponds Monitoring

The stockpiles and associated water management facilities must be inspected and maintained regularly to detect any changes to the condition and performance of the facilities, and to identify any potentially hazardous conditions that need to be promptly addressed (KP 2022c). Surveillance activities are described in KP (2022c) and include:

- Water level elevation will be recorded daily;
- Pumped flow rate and volumes will be recorded daily;
- Dead storage and sediment build up within the pond will be visually inspected weekly; and
- Surface drainage ditches, the outlet pipe, and the spillway will be visually inspected weekly for signs of erosion, blockage, and/or damage.

6.6 Water Treatment

The water treatment systems proposed for the Project during Operations include a Metals WTP, a Membrane WTP, and a lime neutralization system. These treatment technologies were developed using the most recent water quality and water quantity model predictions for the Project to identify parameters that are expected to require treatment (Lorax 2021; KP 2021b). It is anticipated that monitoring results collected during treatment commissioning and throughout operations will be used to confirm treatment performance, and adjustments will be made as needed to maintain compliance with permit conditions.

6.6.1 Metals Water Treatment Plant

6.6.1.1 Design Overview

Water collected by the Open Pit dewatering system and from the waste stockpiles will be sent to the Metals WTP during Construction (Year -1) and Operations. Treated water not used in ore processing is directed to the WMP for storage. After mining of the Open Pit ceases and the only ore being processed is that from the LGO stockpile (Year +18 onwards), the Open Pit fills naturally with groundwater inflows and surface water runoff to create a Pit Lake. Surplus water from TSF C and water collected at the ECD is pumped to the Pit Lake to accelerate filling. Water collected from the Upper Waste Stockpile will also be sent to the Pit Lake during this time. Thus, during Operations there will be no discharge of water (and no treatment) from the Pit Lake.

A preliminary design of the Metals WTP was presented in ERM (2016) to support the Environmental Assessment which was advanced to detailed design in 2021 (McCue 2021) to support the Joint *Mines Act* / *Environmental Management Act* Permits Application. The preliminary design consisted of a two-stage precipitation, coagulation, and flocculation chemical program and solids removal (Appendix F in ERM 2016). At the time the preliminary design was developed, bench scale testing had not been completed and it was uncertain whether the two-stage treatment process would include hydroxide precipitation optimized at two target pH ranges or whether a hydroxide precipitation followed by sulphide precipitation treatment program would be required. Bench testing was completed in 2016 and 2021 to advance the treatment process developed during detailed design in 2021 (McCue 2021) and incorporated into the current LoM WBM.

The hydroxide-sulphide integration technology was selected for the Metals WTP in 2021 and has been designed to target total suspended solids (TSS) and metals identified as POC in mine contact water (McCue 2021). The treatment of the mine contact water will consist of a three-stage precipitation, coagulation, and flocculation chemical program and solids removal. The chemical reactions will take place in a four-chamber reactor tank where each precipitant is added to the first three chambers and the flocculant added to the fourth chamber. Two inclined-plate clarifiers will be used for solids settling and removal, one following the first precipitation stage and the other one after the water is treated through the second precipitation, third precipitation, and flocculation stages. Following the second clarifier the water will be directed to multimedia filters and bag filters as polishing stages for solids removal. As a final step, the water will be buffered to a suitable pH before discharge to the WMP or the mill (for make-up water).

Considering the incremental water quantities to be treated at the Metals WTP during the mine life, a sequenced deployment of Metals WTP trains is proposed. A total of four trains (WTP A, WTP B, WTP C, and WTP D) will be deployed throughout the 23 years of Construction and Operation (Year -1 to Year 23). WTP A will have a design capacity of 55 L/s and WTP B, WTP C & WTP D will have a design capacity of 50 L/s. The Metals WTP trains will have the flexibility to operate at half capacity to accommodate increasing flow rates as the mine is developed and also lower flow rates during the winter seasons.

Both WTP A and B will be deployed during the initial year of mine construction and located within the process plant building. The two WTP trains will share some resources such as an effluent tank, electrical panels, chemical storage, and chemical make-down equipment to reduce the overall system footprint, minimize operational requirements and reduce system costs (Figure 6.6-1).

The plan for a staged installation of WTP A/B/C/D provides room to treat flow rates higher than the expected maximum for most of the Construction and Operation phases: if peak precipitation flows are experienced to a level above the WTP capacity, accumulation of water in the metals treatment pond will occur depending on the operating level of the pond at the time (McCue 2022). The pond could be drawn down in advance of high flow period to provide buffer capacity (McCue 2022). In wet conditions, should water exceed the upstream WTP ponds capacity (9,000 m^3), the pit sump is assumed to manage additional volumes of water until treatment capacity resumes. Installation of WTP C and WTP D is planned for Years +5 and +9, respectively, to accommodate the expected increment in influent water flow rates: expedited construction of Metals WTP trains C and D would be triggered if flow rates become higher earlier than predicted (McCue 2022).

The Metals WTP chemical program is based on the 2016 and 2021 bench test results (McCue 2021) and the Metals WTP design basis. Based on bench tests results, flocculation will not be required after the first precipitation stage. This means that the removal of non-flocculated metal hydroxide solids in the first clarifier would be sufficient to lower the concentration of the metals targeted in this stage to a satisfactory level.

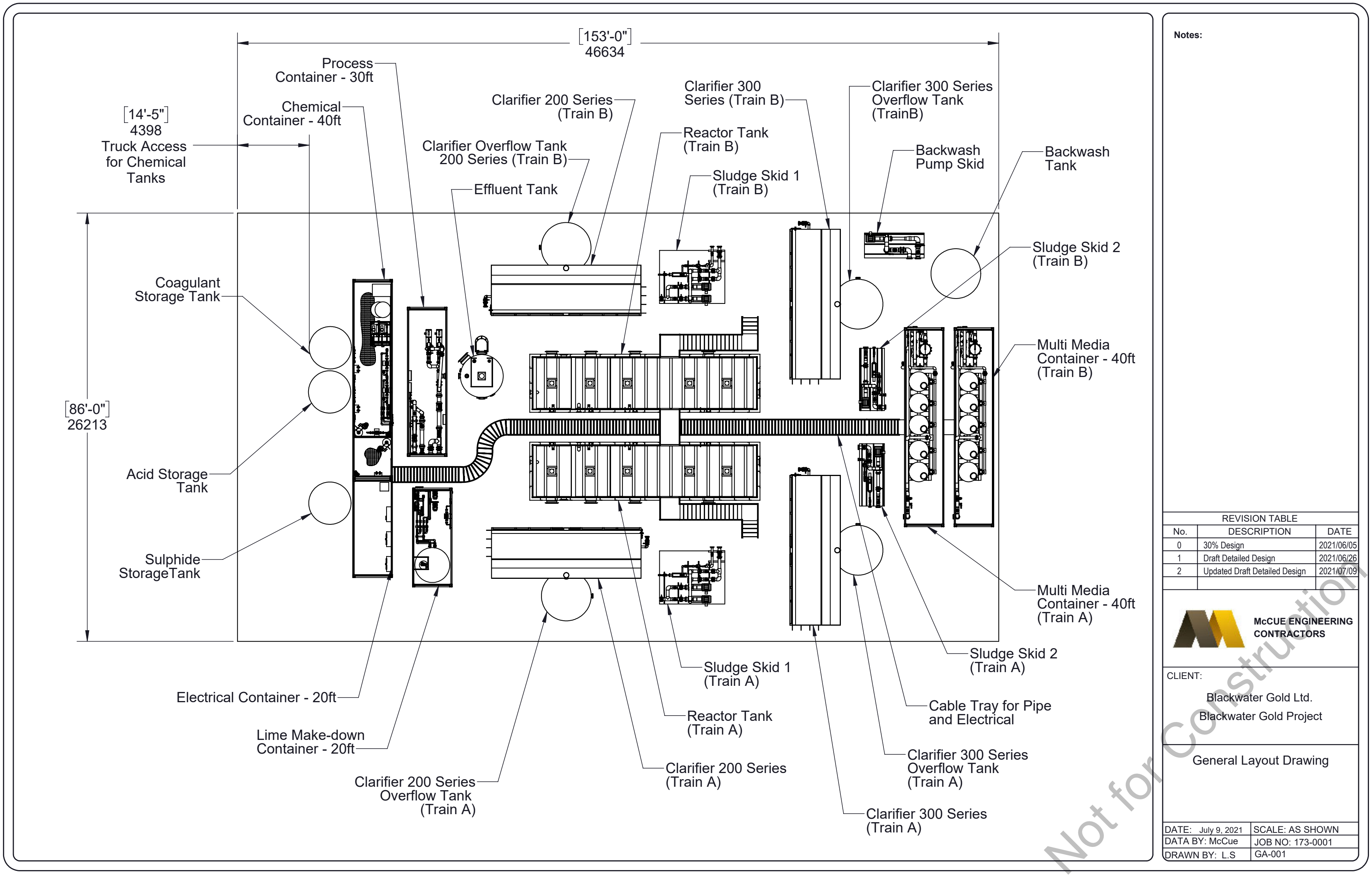


Figure 6.6-1: General Layout of the Metals Removal Water Treatment Plant

source: McCue (2021).

Inlet surge ponds will function to receive and temporarily store inlet water for the Metals WTP. The inlet surge ponds will homogenize the inlet water streams (from the pit sump, pit groundwater dewatering, and Upper and Lower Waste Stockpiles) as well as dampen inlet flow surges.

6.6.1.2 Treatment Performance

Target limits for the Metals WTP discharge have been set at the lowest of the BC water quality guidelines (BC WQG) for freshwater aquatic life (BC ENV 2019, 2021) or federal guidelines (MDMER; EC 2012) and source drinking water quality guidelines (BC ENV 2020b). If a chronic guideline is not available, then an acute guideline was used as the treatment target. The effectiveness of the proposed treatment process is based on the bench testing and operational monitoring will be used to confirm treatment performance. The treatment performance presented in ERM 2016 Appendix F (Preliminary Design of Pit Sump and Pit Perimeter Dewatering Well Network Water Treatment Plan for the Blackwater Gold Project) was based on literature values for hydroxide/sulphide precipitation and a comparison of literature values and results of the neutralization testing of PAG waste rock humidity cell leachates for single stage and two stage lime addition since bench scale testing results were not available (Table 6.6-1).

Table 6.6-1: Summary of 2016 Predicted Effluent Concentrations (Lime/Sulphide Precipitation Treatment Process) and 2016/2021 Bench Test Results

Parameters of Concern	Units	2016				2021	
		Lime/Sulphide Precipitation[a]	Synthetic Inlet Water	Bench Test 9	Bench Test 10	Test Water Sample	Bench Test
pH	pH units	-	4.23	6.84	6.89	7.14	8.69
TSS	mg/L	-	4.5	-	31.4	19.4	<3.0
Metals (Dissolved)							
Aluminum	mg/L	0.05	2.21	0.0161	0.119[b]	0.0019	0.0048
Antimony	mg/L	NR	0.304	0.0078	0.0129[c]	<0.0001	<0.0001
Arsenic	mg/L	0.005	0.00864	0.00043	0.00046	0.00016	0.0001
Cadmium	mg/L	0.0005	0.0291	<0.000005	<0.000005	0.0000092	<0.000005
Cobalt	mg/L	0.001	0.0094	0.00094	0.00021	<0.0001	0.0001
Copper	mg/L	NR	0.04	<0.0002	0.00029	<0.0002	<0.0002
Iron	mg/L	0.03	0.032	<0.01	<0.01	<0.01	<0.01
Lead	mg/L	0.006	0.106	<0.00005	<0.00005	<0.00005	<0.00005
Manganese	mg/L	0.01	1.37	0.624[d]	0.226	1.21	0.359
Nickel	mg/L	0.004	0.0168	0.00171	0.00051	<0.0005	0.00346
Zinc	mg/L	0.01	4.23	<0.001	0.000059	0.0063	0.0018

Notes:

NR = No removal predicted.

Dashes indicate not predicted.

[a] Theoretical minimum dissolved concentration based on literature review (Appendix F of ERM 2016).

[b] Concentration of dissolved aluminum exceeds the long-term BC water quality guideline of 0.05 mg/L.

[c] Concentration of dissolved antimony exceeds the long-term BC water quality guideline of 0.009 mg/L for total antimony.

[d] Concentration of dissolved manganese exceeds the long-term BC water quality guideline of 0.53 mg/L for total manganese.

The treatment effectiveness of the Metals WTP (McCue 2021) was examined under the range of expected influent water quality, flow rates, and temperatures:

- Influent Water Quality – the effectiveness of the proposed treatment process is based on the bench testing summarized below. It has been observed during the bench testing programs that the concentrations of the parameters of concern can be effectively reduced to below the treatment targets with a hydroxide/sulphide precipitation process.
- Flow Rates – the design considers a conservative approach to determining the design flow. The flows predicted for different sources are used to estimate the design flow rate for the WTP, with maximum values for each period/scenario used. Moreover, water from the different sources is directed to a metals treatment pond upstream of the WTP which will act to homogenize the inlet water quality and dampen inlet flow surges, allowing for some accommodation of varying influent water quality and flow rates.
- Temperature – the temperature of the influent water is assumed to have minimal impact on the treatment effectiveness of the WTP as the hydroxide/sulphide precipitation process is considered flexible in handling temperature variations.

In 2016, it was concluded that a two-stage hydroxide/sulphide precipitation process (2016 Test 9) was able to achieve treatment targets, which were two times BC WQG (McCue 2021). Promising results were also achieved with flocculated two-stage hydroxide/sulphide precipitation process (2016 Test 10). Flocculation was able to further reduce the concentration of some parameters including cobalt, manganese, and nickel.

A supplemental bench test program was developed based on the 2016 results for Test 9 and Test 10. The objective of the 2021 supplemental bench test which included flocculated hydroxide and sulphide precipitation was to validate the removal of manganese. It consisted of hydroxide and sodium sulphide precipitation followed by flocculation. The 2021 bench test used a water sample collect from a flowing exploration hole approximately 90m away from the deposit area. The bench test was performed using the following chemicals:

- Ferric Sulphate Liquid (12% Fe), $Fe_2(SO_4)_3$;
- Hydrated Lime Powder, $Ca(OH)_2$, made into 15% lime slurry;
- Sodium Sulphide Liquid (15% Na_2S); and
- Polyclear A2501K, made into 0.25% w/w polymer solution.

The two-stage hydroxide and sodium sulphide precipitation program consisted of the following major steps:

- Stage 1:
  - Because of the higher pH of the water sample, Stage-1 of hydroxide precipitation was not conducted.
- Stage 2:
  - Addition and rapid mixing of a known dosage of ferric sulphate into water sample.
  - Addition and moderate mixing of 15% lime slurry into water sample to target pH of 9.0.
  - Mixing of sample for 3 minutes.
  - Addition and moderate mixing of known dosage of sodium sulphide into the water sample.
  - Mixing of sample for 3 minutes.
  - Addition and slow mixing of known dosage of polymer solution into the water sample.

- Mixing of sample for 20 minutes.
- Settling of sample for 11 minutes.
- Filtration of water through a 20-micron filter.
- Vacuum filtration of the collected filtered water through a 1.5-micron Whatman filter.
- Collection of filtered water sample for laboratory analyses.

The results for 2016 bench test 9 and 10, and 2021 supplemental bench test are summarized in Table 6.6-1. The concentration of dissolved manganese in the 2021 was observed to be lower than the BC water quality guideline for total manganese, which is in accordance with the 2016 bench Test 10 results.

The 2021 design of the Metals WTP is based on the 2016 and 2021 bench test results (Table 6.6-1). Operational monitoring will be used to confirm treatment performance and adjust treatment methods, if required (see Section 8).

6.6.2 Membrane Water Treatment Plant

6.6.2.1 Design Overview

No treatment of water in the TSF ponds was proposed during Operations for the conceptual Project-related flow provided in to support the Environmental Assessment (ERM 2016). Following BC Ministry of Energy and Mines request for additional detail regarding the water treatment technologies, a preliminary design of an ion exchange and nanofiltration WTP focussing on sulphate removal was proposed for usage during closure and post-closure (ERM 2017). With updates to the Project, a WTP was required and designed for the Operations phase to treat surplus TSF supernatant pond water (BQE 2021).

During the Operations phase, the Membrane WTP is only required for treating excess water under the variable climate scenario, and the primary water management mechanism under the average climate scenario is through planned dam wall raises. Based on the variable climate scenario, the Membrane WTP was designed to accept feed water at a rate of 72 L/s and discharge treated water at a rate of 54 L/s. The Membrane WTP does not have capacity above its design hydraulic capacity to discharge treated water at a higher rate. However, given that the design basis for contingency treatment during operations is 7 months of year, if additional capacity is required, then the operating season could be extended to increase the annual treatment capacity by up to 71% or from approximately 1.3 Mm^3/yr to 2.3 Mm^3/yr.

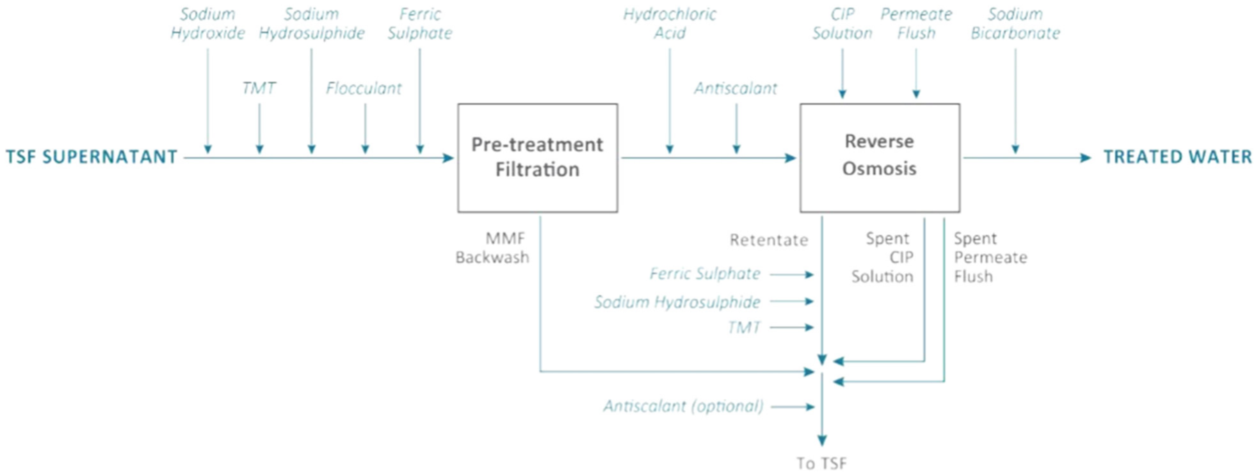
To manage surplus water in the TSF under variable climate conditions during the Operations phase, a Membrane WTP will be used to treat water from the TSF C Pond and convey treated water to the WMP or use in ore processing at the mill. Treatment will occur between the spring and fall months (April through October) during operations when the TSF C Pond volume exceeds the nominal pond volume.

The reverse osmosis (RO) technology was selected for the Membrane WTP during Operations and has been designed to remove sulphate, nitrogen (N)-species, and trace heavy metals in mine contact water (BQE 2021).

The operations phase Membrane WTP consists of three main treatment steps:

1. Pre-treatment to remove trace heavy metals and suspended solids.
2. RO to remove sulphate, N-species, and trace heavy metals.
3. Treatment of retentate with ferric and sulphide reagents to remove trace heavy metals.

Process flow sheets are provided in BQE 2021 and summarized in Figure 6.6-2.



Source: BQE 2021

Figure 6.6-2: Operations Phase Membrane Water Treatment Plant Block Flow Diagram

The pre-treatment step involves the addition of ferric and sulphide reagents (sodium hydrosulphide (NaHS) and trimercapto-triazine (TMT)-15), to precipitate heavy metals such as cadmium, copper, and zinc. The precipitated sulphide solids are then removed using multimedia filtration (MMF) and cartridge filtration (CF). Flocculant is dosed upstream of the MMFs to facilitate particle removal. The provision for the addition of sodium hydroxide (NaOH) is made in the design in the event that feed water pH becomes slightly acidic or ferric needs to be added to achieve enhanced removal of metalloids such as arsenic, antimony, and molybdenum. However, as long as the feed pH remains above an approximate pH 7, and no ferric is added to the feed, the use of NaOH will be either minimal or not required at all.

The solids-free water is directed to the RO which produces two streams: (1) permeate low in sulphate, ammonia, and trace metals; and (2) retentate containing the balance of constituents dissolved in the plant feed. Antiscalant is added upstream of the RO to protect the RO membrane from fouling by scale formation.

The retentate produced by the process does not require desaturation because it is simply recycled back to the TSF which holds a much larger volume by comparison; the impact of this recycle stream to TSF concentrations has been modelled in the WQM and can be considered negligible.

6.6.2.2 Treatment Performance

The Membrane WTP is designed to meet the strictest of the BC Water Quality Guidelines (BC WQG) as discharge limits. The treatment limits used for the design are presented in Section 2.3 of the Detailed Design Report submitted on July 30, 2021 (BQE 2021). Supporting information on the treatment effectiveness of the system is presented in Section 4.2 of BQE (2021) in the form of bench test results and minimum effluent concentrations achievable.

Table 6.6-2 provides a list of reference sites that support the treatment process selection and overall design for the Project. All Canadian and BC reference sites share the same overall conditions that are found at the Project: mining, cold climates, variable water temperature and seasonality. In most cases, the water qualities found at the listed reference sites are the same order of magnitude or beyond the predicted water qualities for the Project. Performance data from the listed reference sites shows that the treatment processes can comfortably achieve water treatment goals of meeting BC WQG over a wide range of water qualities. The removal rates applied for water treatment in the water quality model developed for the Project (Lorax 2021; 2022a) were set conservatively based on the reference site results presented in Table 6.6-2; the removal rates were always set equal to or lower than the results achieved by the reference sites.

Table 6.6-2: Reference Sites

Site	Location	Operation Type	Treatment Technology
Silvertip Mine	BC	Full Scale	Sulphide precipitation
Minto Mine	Yukon	Full Scale	Sulphide precipitation Reverse osmosis membrane
Wolverine Mine	Yukon	Pilot	Reverse osmosis membrane
Torex Mine	Mexico	Pilot	Reverse osmosis membrane Nanofiltration membrane
Site #1	Peru	Pilot	Reverse osmosis membrane
Site #2	BC	Pilot	Nanofiltration membrane
Site #3	BC	Pilot	Nanofiltration membrane
Site #4	BC	Pilot	Ferric and sulphide precipitation
Site #5	BC	Pilot	Ferric and sulphide precipitation

In the design of the Membrane WTP for the Project, the metals removal and membrane salt rejection rates were set conservatively for modelling purposes. The approach was to set conservatively achievable targets that meet the treatment needs of the site, instead of setting more aggressive targets. Discharge water quality produced by the Membrane WTP is expected to outperform estimates listed in Tables 6.6-3 and 6.6-4 based on lab/bench/pilot scale test work and full-scale operating plants.

Table 6.6-3: Treatment Targets Achievable with Ferric and Sulphide Precipitation

Parameter	Units	Target with Ferric Addition	Target with Sulphide Addition	Reference Site[1]
Silver	mg/L	-	0.001	Site #4 and #5
Arsenic	mg/L	0.020	-	Site #4 and #5
Cadmium	mg/L	-	0.0005	Silvertip
Cobalt	mg/L	-	0.010	Site #4 and #5
Copper	mg/L	-	0.010	Minto
Molybdenum	mg/L	0.050	-	Site #4 and #5
Lead	mg/L	-	0.010	Site #4 and #5
Antimony	mg/L	0.050	-	Site #4 and #5
Vanadium	mg/L	0.015	-	Site #4 and #5
Zinc	mg/L	-	0.100	Silvertip

[1] *See Table 6.6-2.*

The pre-treatment stage involving the addition of ferric reagent and sulphide reagents (sodium hydrosulphide and trimercapto-triazine) has been implemented at multiple sites, including two sites in BC. Table 6.6-3 summarizes the conservative treatment targets achievable by ferric and sulphide precipitation that were set based on operating data from other sites.

Table 6.6-4: Membrane Pilot Performance Data for Nitrogen Species

Nitrogen Species	Unit	Feed	Permeate	Salt Rejection (%)
Ammonia				
Minto RO	mg/L, as N	2.738	0.482	82%
Wolverine RO	mg/L, as N	0.760	0.028	96%
Site #1 RO	mg/L, as N	0.557	0.223	60%
Site #2 NF – Fortilife XC-N	mg/L, as N	0.241	0.036	85%
Site #2 NF – ESNA LF	mg/L, as N	-	-	-
Site #3 NF – Fortilife XC-N	mg/L, as N	2.583	1.982	23%
Site #3 NF – ESNA LF	mg/L, as N	-	-	-
Nitrate				
Minto RO	mg/L, as N	16.903	4.281	75%
Wolverine RO	mg/L, as N	0.057	0.021	63%
Site #1 RO	mg/L, as N	1.710	0.166	90%
Site #2 NF – Fortilife XC-N	mg/L, as N	6.08	6.44	<0%
Site #2 NF – ESNA LF	mg/L, as N	7.087	6.8	4%
Site #3 NF – Fortilife XC-N	mg/L, as N	45.61	44.92	2%
Site #3 NF – ESNA LF	mg/L, as N	0.904	0.837	7%
Nitrite				
Minto RO	mg/L, as N	1.247	0.199	84%
Wolverine RO	mg/L, as N	-	-	-
Site #1 RO	mg/L, as N	-	-	-
Site #2 NF – Fortilife XC-N	mg/L, as N	0.202	0.361	<0%
Site #2 NF – ESNA LF	mg/L, as N	0.658	0.399	39%
Site #3 NF – Fortilife XC-N	mg/L, as N	2.423	2.379	2%
Site #3 NF – ESNA LF	mg/L, as N	0.1	0.136	<0%
Cyanide (Total)				
Torex RO #1	mg/L	1,300	200	85%
Torex RO #2	mg/L	2,200	170	92%
Torex RO #3	mg/L	3,190	220	93%
Torex NF	mg/L	2,000	100	95%
Cyanide (WAD)				
Torex RO #1	mg/L	924	175	81%
Torex RO #2	mg/L	874	165	81%
Torex RO #3	mg/L	2,250	80	96%
Torex NF	mg/L	1,600	100	94%

Nitrogen Species	Unit	Feed	Permeate	Salt Rejection (%)
Cyanide (Free)				
Torex RO #1	mg/L	879	170	81%
Torex RO #2	mg/L	839	170	80%
Torex RO #3	mg/L	1,697	80	95%
Torex NF	mg/L	619	65	89%
Thiocyanate				
Torex RO #1	mg/L	220	76	65%
Torex RO #2	mg/L	650	230	65%
Torex RO #3	mg/L	110	51	54%
Torex NF	mg/L	4,100	3,700	10%

The membrane systems separate clean water by overcoming the osmotic pressure created by the presence of dissolved solids. Typically, higher dissolved solids content correlates with higher osmotic pressures that the feed pump needs to push water through the pores of the membrane.
Likewise, increasing water recoveries from membrane systems are achievable with increasing feed pressure or decreasing osmotic pressure. Water recovery is defined as the percentage of water that is recovered on the clean side of the membrane. The passage of dissolved solids into the product water stream depends on the types of dissolved solids (monovalent versus multivalent), membrane pore size, pressure, temperature, concentration, and water recovery. In membrane systems, salt rejection is typically defined as the concentration reduction in dissolved solids that is achieved in the product water stream. Alternatively, the rejection of dissolved solids can also be analyzed in terms of mass deportment, which considers water recovery. It is important to recognize that salt rejection is different from absolute rejection. Both are useful and can be used to analyze results.

Table 6.6-4 shows ammonia, nitrate, nitrite, total cyanide, WAD cyanide, free cyanide and thiocyanate removal data from six sites. The ion rejection values in Table 6.6-4 are presented as salt rejection values.

Ammonia concentrations in the permeate, other than for Site 3, are below BC WQG of 1.53 mg/L (as nitrogen). Based on the predicted influent water quality for the Project and the removal rates shown in Table 6.6-4, it is expected that the ammonia concentration in the permeate will be below the BC WQG limit by applying RO during the mine operations.

Table 6.6-5 (BQE 2021) summarizes the 95th percentile feed water quality, precipitation targets, salt rejection targets, effluent water quality and BC WQG. The presented achievable concentrations should not be considered the proposed discharge limits. For example, the discharge limits considered for zinc are 0.0075 mg/L (long-term BC WQG) and 0.033 mg/L (short-term BC WQG). Based on the bench testing results, the range of achievable dissolved zinc concentration is 0.059 - 6.3 ug/L. This confirms that the designed plant can meet the strictest discharge limit of 0.0075 mg/L. For the zinc example, the feed has 3.3 mg/L zinc and will be removed down to 0.1 mg/L zinc before the RO system; the RO system will further reject zinc and achieve a final effluent concentration of 0.005 mg/L zinc, which is below the BC WQG limit of 0.0075 mg/L. Nitrite and nitrate are marginally above the BC WQG in the effluent stream and fall into compliance after mixing in the initial dilution zone. For clarity, the BC WQG/MDMER concentrations are the proposed end of pipe discharge limits, with the exception of nitrate and nitrite, which would have discharge limits of 5.1 mg/L as N and 0.024 mg/L as N, respectively (Table 6.6-5).

Table 6.6-5: Effluent Water Quality Predictions

Parameter	Units	95th Percentile Influent	Pre-treatment Target	RO Salt Rejection (%)	Projected Effluent Concentrations	BC WQG / MDMER (Proposed End of Pipe Discharge Limits)
Ammonia-Ammonium Nitrogen	mg/L, as N	20.4922		93%	1.432	1.531 / 0.50
Nitrate	mg/L, as N	20		75%	5.1	3.03
Nitrite	mg/L. as N	0.15		84%	0.024	0.024
Chloride	mg/L	6		15%		150
Fluoride	mg/L	0.58		98%	0.01	0.51
Sulphate	mg/L	3,107		99%	31	128
Cyanide, WAD	mg/L	0.00002		95%	0.000001	0.005 / 0.500
Silver	mg/L	0.00156		95%	0.00005	0.00005
Aluminum	mg/L	0.0026		88%	0.0003	0.05
Arsenic	mg/L	0.035	0.02	99%	0.0002	0.005 / 0.100
Barium	mg/L	0.002		84%	0.0004	1
Beryllium	mg/L	0.00161		95%	0.00008	0.00013
Calcium	mg/L	454		97%	14	-
Cadmium	mg/L	0.067154	0.0005	95%	0.000025	0.000047
Cobalt	mg/L	0.172	0.01	95%	0.0005	0.004
Chromium	mg/L	0.003		70%	0.001	0.001
Copper	mg/L	0.067503	0.01	95%	0.0005	0.000614 / 0.100
Iron	mg/L	0.002		92%	0.0002	0.35
Mercury	mg/L	0.00004		95%	0.000002	0.00002
Potassium	mg/L	67		96%	3	-
Lithium	mg/L	0.029		32%	0.02	-
Magnesium	mg/L	15		98%	0.3	-
Manganese	mg/L	1.347		97%	0.04	0.662
Molybdenum	mg/L	0.106	0.05	99%	0.001	1
Sodium	mg/L	967		96%	39	-
Nickel	mg/L	0.045		97%	0.001	0.025 / 0.250
Phosphorus	mg/L	0.0004		98%	0.00001	-
Lead	mg/L	0.0147	0.01	83%	0.0017	0.0035 / 0.0800
Antimony	mg/L	0.046	0.05	99%	0.0005	0.009
Selenium	mg/L	0.003		99%	0.00003	0.002
Silicon	mg/L	5.5		23%	4.2	-
Strontium	mg/L	0.8		98%	0.02	-

Parameter	Units	95th Percentile Influent	Pre-treatment Target	RO Salt Rejection (%)	Projected Effluent Concentrations	BC WQG / MDMER (Proposed End of Pipe Discharge Limits)
Thallium	mg/L	0.0006		36%	0.0004	0.0008
Uranium	mg/L	0.0057		99%	0.0001	0.0085
Vanadium	mg/L	0.0071	0.015	1%	0.007	-
Zinc	mg/L	3.3123	0.1	95%	0.005	0.0075 / 0.4000

1 BC WQG applies to undissociated ammonia nitrogen (NH3-N) only and is pH and temperature dependent.

2 Concentration shown as ammonia-ammonium nitrogen (NH3-N + NH4-N) and is pH and temperature dependent. Concentration of ammonia nitrogen to be less than the value shown.

3 Proposed discharge limit for nitrate is 5.1mg/L as N.

4 Proposed discharge limit for nitrite is 0.024 mg/L as N.

6.6.2.3 Treatment Operation and Maintenance

Table 6.6-2 lists Minto Mine which has full-scale reverse osmosis system treating mine-impacted water. BQE has recently taken over operation of the Membrane WTP at Minto and is building operational data on membrane system performance, cleaning regimes and reagent consumption rates. Based on short-term operating data, nominal RO cleaning frequency at Minto is once every 2-3 weeks but can be as high as once per week depending on changes in feed water quality; all cleaning at Minto is completed with chemical cleaning solutions as there is no provision for permeate flush. On the high-end chemical cleaning costs are on the order of $0.06 USD per m^3 discharge water, which is less than the $0.09/m^3 chemical cleaning cost estimate for the Project. All present and future learnings from this site will be incorporated into the Membrane WTP design for the Project.

In contrast to Minto, the Membrane WTP for the Project will be able to run permeate flush (low-cost cleaning) in addition to chemical cleaning; in terms of operating cost, the Membrane WTP chemical cleaning frequency will be set to once per week, which is on the conservative side based on cleaning frequency observed at Minto – this can be further supplemented with permeate flush cleaning cycles as needed. The Membrane WTP design has 90% plant availability to facilitate cleaning while still maintaining required plant throughput. Additionally, WTP operation is only planned for 7 months of the year and can be extended to make-up for reduced plant availability. Membranes are planned to be replaced every three years as cleaning cycles alone are not expected to maintain system performance indefinitely. Costs for this conservative membrane replacement frequency have been incorporated into the operational and maintenance costs estimated for the Project.

A review of this plan by interested parties requested that the plan provide include information from reference sites that have operated long-term at the full scale for the calculation of the maintenance costs and plant availability and performance. Regarding the other potential reference sites in terms of length of operations the following review was completed by BQE:

- Torex – BQE is not aware of a membrane operating on process wastewater at this site. BQE is however in the process of designing a membrane treatment plant for this site that is planned to be commissioned in Q1 2024. BQE will incorporate lessons-learned into planning/design for the Project.
- Catalina Huanca – BQE is in the process of assisting Trafigura with a membrane pilot campaign at this site. The existing full scale membrane plant at this location has not operated long enough to provide data to inform the Project Membrane WTP.
- Emalahleni - BQE Water has reviewed the Emalahleni facility lessons learned report and will incorporate outcomes from this document, as well as lessons learned from other membrane plants

BQE is responsible for, into the design, planning and OMS for the Project Membran WTP. Operating cost information of \$1.50/m^3 was reported in a case study (https://mineclosure.gtk.fi/emalahleni-water-treatment-plant/), however this is not comparable to the Project because the Emalaheni system is much more complex than the system being proposed (i.e., three membrane stages, each with inter-stage treatment steps, as well as two sludge dewatering unit operations), requiring substantially more operators/power/reagent addition than will be required at the Project.

6.6.3 Lime Neutralization System

It was assumed that all water from the LGO stockpile (infiltration and runoff) would be intercepted and treated by lime neutralization in the LGO stockpile conceptual model developed in support of the Environmental Assessment (ERM 2016). Similarly, the conceptual models developed in 2021, indicated that drainage from the LGO stockpile is expected to be acidic and contain elevated metals; therefore, all water contacting the stockpiles will be collected, neutralized with lime, and discharged to TSF C.

Contact water (infiltration and runoff) from the LGO stockpile will be neutralized in the processing plant through lime addition prior to gravity conveyance to the TSF. The contact water will be pumped to an agitated neutralization tank where lime is added in the form of calcium hydroxide slurry until pH 10.0 is reached. The neutralized water can overflow into a second neutralization tank where the neutralized water is subsequently pumped to the final tailings pumpbox. Water that does not meet the pH criteria for conveyance to the TSF is recirculated within the neutralization tanks. The capacity of the system is presented below as Table 6.6-6. The treatment capacity is based on the maximum monthly flow, averaged over 30 days at 92% availability.

Table 6.6-6: Lime Neutralization Water Treatment Capacity

Operations Phase	Mine Years	Water Treatment Capacity (m^3/h)	Process Plant Throughput (Mtpa)
1	1 – 5	57	6
2	6 – 10	108	12
3	11 – 23	108	20

Calcium hydroxide slurry is produced by slaking quicklime (CaO) in a detention slaker and is circulated throughout the process building to feed the water neutralization system. The lime slaking, storage, and circulation system are sized to meet total process demands of the entire facility; the lime demand for water neutralization is incidental compared to lime demand for the overall processing.

6.6.3.1 Treatment Performance

The LGO stockpile contact water is being treated for pH adjustment prior to gravity conveyance to the TSF. Acid neutralization and metals precipitation using lime is a common, industry-accepted practice.
This treatment is anticipated to be effective for achieving the desired effluent quality over a range of flowrates, influent chemistry and seasonal temperature fluctuations. It is expected that the pH of tailings slurry will be approximately 8.0 to 9.0 at an average flowrate of 1,314 m^3/h in Stage 1. The expected maximum volume of the treated run-off at pH 10.0 will not significantly change the pH of the tailings slurry.

7. LOW-GRADE ORE STOCKPILE

7.1 Operations: Management of Metal Leaching/Acid Rock Drainage

The LGO Stockpile will be located between the Open Pit and TSF C. Higher-grade LGO will be segregated and placed in the LGO Stockpile from Year +1 through Year +9, and then rehandled from the stockpile and processed from Year +9 to the end of Year +15. Lower-grade LGO will be placed in the LGO Stockpile from Year -1 through Year +17, and then rehandled and processed from Year +18 through Year +23. In total, approximately 125.5 Mt of LGO will be stockpiled over the life of mine with the maximum material stored at any one time being approximately 111 Mt. The LGO Stockpile will be entirely consumed by the end of mining.

Geochemical characterization of ore (AMEC 2014) indicated that all ore material should be treated as PAG and acidic drainage should be expected from temporary stockpiles during operations shortly after deposition. Drainage from the LGO Stockpile is therefore expected to be acidic and contain elevated concentrations of sulphate and metals shortly after exposure.

The LGO Stockpile design and water management requirements are described in the Stockpiles Geotechnical and Water Management Design Report (KP 2022c). The LGO Collection Pond will be constructed downslope of the LGO Stockpile area to manage runoff and seepage from the contributing areas (KP 2022c). The water management design for the LGO Stockpile includes a liner system across the footprint area of the stockpile, foundation drains and a series of diversion and collection channels to manage runoff and seepage (KP 2022c). The design intent is to divert non-contact water around the facility to natural drainages that flow to the WMP and to collect contact water at the LGO Collection Pond. Contact water from the collection pond will be pumped up to the lime neutralization circuit at the process plant before being discharged along with tailings to the TSF (KP 2022c). Non-contact water will be collected in diversion channels upstream of the LGO Stockpile and conveyed around the facility to the east and west using a combination of constructed channels and existing drainage channels (KP 2022c). Contact water will be collected and conveyed via collection channels and foundation drains (located below the glacial till liner) to the LGO Collection Pond at the downstream toe of the LGO Stockpile. Groundwater (springs) discharging to the foundation drains will also be collected and conveyed to the LGO Collection Pond (KP 2022c). The LGO liner system will incorporate two types of low permeability liners, including compacted glacial till and HDPE geomembrane, which will limit seepage entering the groundwater by providing physical separation and promoting drainage to the contact water collection channels (KP 2022c). The footprint area will be graded to promote drainage within the stockpile to the contact water collection channels and LGO Collection Pond to reduce infiltration/stormwater ponding. A HDPE geomembrane liner will be used in areas where flows are concentrated or ponding is expected, such as the collection channels and pond, and a compacted glacial till liner will be utilized below the stockpile itself to limit the potential for lost seepage and to enhance contact water collection where limited ponding is expected (KP 2022c).

The primary outlet of the collection pond will be a pump and pipeline to the process plant Lime Neutralization circuit; an emergency spillway will provide a secondary outlet and will discharge to the Mine Area Creek and eventually to the WMP. The pond will be maintained in a dewatered condition to the maximum practical extent to limit the potential for discharge of untreated water to the WMP during severe storms (KP 2022c). The pumping systems will have a target design flow rate of 350 m^3/hr, which will allow the full pond to be drawn down in approximately nine days. The spillway will be constructed at the northwestern corner of the pond and was designed with the conservative assumption that the collection pond would be full at the start of the storm event: the spillway was sized to handle the 1 in 200-year event while maintaining 500 mm of freeboard (KP 2022c).

It is anticipated the LGO Collection Pond will be drained and decommissioned, and the embankment breached and reclaimed during the active mine closure period, once the LGO has been processed and footprint area reclaimed (KP 2022c).

An OMS Manual will be prepared to provide comprehensive operating instructions, surveillance practices, and monitoring frequencies for the instrumentation. The OMS Manual will include:

- Roles, responsibilities, and assigned personnel for tailings and water management;
- Protocols for distribution and updates of the manual;
- A description of the facilities;
- Operations, maintenance, surveillance, and monitoring requirements for the stockpiles and associated water management facilities;
- Any operational threshold conditions and associated response plans that are developed for the facilities;
- Requirements for inspection, independent reviews, and reporting; and
- Identification of potential unusual occurrences and response procedures.

The OMS Manual, including the threshold conditions and response plans contained therein, must be reviewed annually and updated progressively during mine operations as the facility and monitoring instrumentation evolves. The OMS Manual will be prepared by the mine operator in coordination with the appropriate design engineers, reviewed and accepted by the Engineer of Record (EOR), approved by the mine manager, and submitted to the chief inspector. Changes to the OMS Manual during operations will follow the same procedures, and any changes will be provided to the relevant parties identified in the OMS Manual.

The LGO stockpile and collection pond will be inspected and maintained regularly to detect any changes to the condition and performance of the facilities, and to identify any potentially hazardous conditions that need to be promptly addressed. Surveillance activities are performed to verify that the performance objectives for the facility and operational objectives of the mine are continuously being achieved. These surveillance activities include site observations and inspections, collection of site monitoring data, and remote sensing techniques.

Routine operational surveillance activities required for the LGO collection pond include:

- The elevation of the pond will be monitored continuously and recorded daily;
- Piezometric measurements will be recorded daily;
- Pumped flow rate and volumes will be recorded daily;
- Regular inspection of pumps and pipelines;
- Regular visual inspection of the pond berm for cracking, slumping/deformation and erosion; and
- Regular visual inspection of the surface drainage ditches and spillway for erosion, blockage and/or damage to delineate any corrective maintenance requirements.

7.2 End of Operations: Management of Remaining Low-Grade Ore

BW Gold has developed a life of mine plan that would fully exhaust the ore stored in the LGO Stockpile by the end of the mine life. As much as operationally feasible, the LGO Stockpile footprint will be progressively reclaimed as ore is extracted from the stockpile and milled (see BW Gold 2022a). Thus, as operations end, the following activities will be undertaken to manage the remaining, un-reclaimed LGO Stockpile footprint:

- All equipment, debris, signage, culverts, power lines, etc. will be removed;
- HDPE geomembrane liner will be removed and disposed of appropriately;
- Till liner will be ripped and removed and deposited in the Pit Lake or the TSF C Pond;
- Surface will be recontoured to facilitate natural drainage and to support topsoil placement; and
- Non-contact and contact water management systems will be decommissioned, including decommissioning of the LGO collection pond.

In the unforeseen scenario of an early closure, BW Gold will be required to backfill remaining LGO into the open pit and initiate the reclamation of the LGO stockpile footprint as indicated above. The LGO will be submerged in the Pit Lake to prevent ARD.

8. EVALUATION AND ADAPTIVE MANAGEMENT

EAC Condition 3 requires that, where an EAC condition plan includes monitoring, a discussion of adaptive management must be included to address the circumstances that will necessitate the implementation of alternate or additional mitigation measures to address potential effects of the project. The EAC Condition 33 MWWMP is required to incorporate the following monitoring activities:

- The means by which BW Gold will monitor and document the year-over-year water accumulation in the TSF; and
- The management of ML/ARD from low grade ore stored on land during Operations, which must include placement of the ore on a low permeability foundation and collection, monitoring, and treatment of low grade ore contact water.

As per EAC Condition 3, adaptive management must include:

- The monitoring program that will be used, including methods, location, frequency, timing, and duration of the monitoring;
- The scope, content and frequency of reporting of the monitoring results;
- The identification of qualitative and quantitative triggers, which, when observed through monitoring, will require BW Gold to alter existing, or develop new, mitigation measures to avoid, reduce, and/or remediate effects;
- The methods that will be applied to detect when a numeric trigger, or type or level of change, has occurred;
- A description of the process for and timing to alter, existing mitigation measures or develop new mitigation measures to reduce or avoid effects;
- Identification of the new and/or altered mitigation measures that will be applied if effects of the project are not mitigated to the extent contemplated or were not predicted in the Application submitted for EAC #M19-01, or if triggers are exceeded, or the process by which those will be established and updated over the relevant timeframe for the specific condition;
- The monitoring program that will be used to determine if the altered or new mitigation measures and/or remediation activities are effectively mitigating or remediating the effects and or avoiding potential effects; or the process by which those will be established and updated over the relevant timeframe for the specific condition
- The scope, content and frequency of reporting on the implementation of altered or new mitigation measures

Baseline information to support the monitoring program is not relevant for this plan, as the TSF and LGO pond have not been constructed.

The monitoring program used to document the year-over-year water accumulation in the TSF, including methods, frequency, and timing, is described in Section 5.2.2. The duration of the program will be for the life of mine. The monitoring locations will vary as the TSF is constructed. The monitoring results will be reported in the annual report required for the Mines Act permit. Monitoring of the low grade ore contact water is described in Section 7.1. The development of an adaptive management framework for the TSF pond and LGO stockpile will be completed as part of the development of the OMS Manual and with defining the QPOs and TARPS for the constructed facilities. The triggers will be developed to identify surveillance/monitoring results that would correspond with changing conditions and increasing risk. Response plans will be developed to evaluate and manage risk to return conditions to lower risk situations. This Condition 33 MWWMP will be updated to reference the applicable sections of the OMS manuals for the TSF pond and LGO stockpile.

The MWWMP is a living document with the expectation that the plan will evolve and be updated in response to the results of the mine site monitoring program, changing conditions or development at the site, updates to scientific methods, and through consultation and discussions with Aboriginal Groups and other stakeholders.

Figure 8-1 identifies the components of the adaptive management framework.

Figure 8-1: Adaptive Management Framework

The plan incorporates adaptive management as follows:

- **Plan**: Planned mine waste and mine water management activities are identified in Section 5, 6, and 7.
- **Do**: Implementing the management measures described in this plan.
- **Monitor**: Conducting monitoring programs as described in Section 6.4 and identified in Section 7.3 of the Mine Site Water and Discharge Monitoring and Management Plan (BW Gold 2022).
- **Adjust**: Reviewing qualitative and quantitative triggers for upset conditions to determine whether mitigation measures related to the failure of any component needs to be altered or additional measures implemented.

A preliminary trigger response framework has been developed for mine water quality and will be refined and implemented as part of the Mine Site Water and Discharge Monitoring and Management Plan (BW Gold 2022c). Triggers identified for mine site water quality are heavily focused on ML/ARD management within the mine site due to the potential magnitude of effect to mine water and discharge quality associated with ML/ARD processes. Contingencies and adaptive management actions specific to TSF pond water quality are outlined in Table 11-1 of the Mine Site Water and Discharge Monitoring and Management Plan (BW Gold 2022c): if pH instability (i.e., pH < 6.5) is detected in the TSF ponds, for example, the adaptive management actions include a follow-up investigation and possible additional management (e.g., lime dosing in the mill, adjustments to waste rock flooding schedule, temporary lime addition to re-establish neutral pH conditions in the pond). This approach is designed to trigger actions prior to the onset of large scale ARD. Quantitative thresholds will be developed prior to Operations and any required changes to the MWWMP will be made accordingly. The effectiveness of the mitigation strategies implemented as part of the adaptive management response will be monitored and evaluated. The mitigation strategies may be subsequently altered, or additional mitigation measures considered depending on the results of the monitoring program, as appropriate.

An aquatic effects trigger response framework for surface water quality has been developed as part of the Aquatic Effects Monitoring Program Plan (BW Gold 2022d). The response framework includes the following:

- Definition of appropriate measurement endpoints, assessment endpoints, and trigger levels (none, low, and medium action levels) that will enable mitigation of Project-related effects prior to occurrence of irreversible adverse biological effects;
- Definition of the level of change that may result in irreversible adverse effects (high action level);
- Definition of the process by which the Project-related effect will be assessed for each of the trigger levels;
- Identification of the types of mitigations that may be implemented if a trigger level is exceeded; and
- Definition of the reporting procedures for exceedances of trigger levels, including the information that will be provided in a response plan.

The framework is intended to provide an early-warning system such that when defined action levels (none, low, medium, and high) are triggered there is sufficient time to prevent irreversible adverse effects. Reporting on the trigger response framework will be completed on an annual basis and will include the appropriate management responses to be completed. The management framework is reviewed annually to evaluate the effectiveness of the triggers and management actions and recommended changes are reported for comment and feedback from Aboriginal groups or regulators.

A formal Trigger Response Plan (TRP) will be developed for the Project and is anticipated to include quantitative thresholds that relate to end of pipe discharge limits, once approved, as well as receiving environment guidelines and approved Science-Based Environmental Benchmarks (SBEBs) as appropriate. It is anticipated the TRP will be updated prior to the onset of the Closure and Post-Closure phases to ensure triggers and actions appropriately reflect site conditions at that time.

9. REPORTING AND RECORD KEEPING

Reporting and record keeping will continue as per conditions in federal and provincial authorizations and regulatory requirements (as listed in Section 4). The EM will be responsible for maintaining compliance and training records. The records will be made available upon request.

As required by EAC Condition 5, reports will be submitted to EAO and Aboriginal Groups within the following timelines as follows, excluding Closure and Post-Closure at which time the Closure and Post-Closure Water Quality Management Plan (Condition 34) will be implemented:

- At least 30 days prior to the start of Construction;
- On or before March 31 in each year after the start of Construction;
- At least 30 days prior to the start of Operations;
- On or before March 31 in each year after the start of Operations; and
- At least 30 days prior to the start of Closure.

As required by EAC Condition 3, a record of consultation will be maintained regarding the EAC Condition 33 MWWMP content and adaptive management. The consultation record will be available upon request by the EAO or other party.

10. PLAN VALIDATION AND REVISION

BW Gold will develop the final MWWMP in consultation with Aboriginal Groups for submission to the EAO in alignment with the most current version of the Document Submission Plan.

The final MWWMP will be updated at least every five years from the planned commencement of Construction, unless otherwise authorized by the EAO. Revisions to the MWWMP every 5 years will include any updates from the outcomes of the modelling scenarios defined in the EAC Condition 11 Care and Maintenance Plan (BW Gold 2022e). The 5-year updates will be consistent and aligned with the timing for an updated detailed 5-year mine plan and reclamation and closure plan. Revisions may include changes in mine infrastructure or progressive refinement of the MWWMP.

11. QUALIFIED PROFESSIONALS

This management plan has been prepared and reviewed by, or under the direct supervision of, the following Qualified Professionals[2]:

Stephanie Eagen, R.P.Bio.
Specialist Environmental Scientist
Knight Piésold Ltd.
(Prepared sections 5.2, 6.1, 6.2, 6.3, 6.4, 6.5, 7.1 based on referenced engineering reports sealed by QPs)

Jennifer Stevenson, P.Geo.
Environmental Geoscientist
Lorax Environmental Services Ltd.
(Prepared sections 5.1, 6.4.2 based on referenced reports sealed by QPs)

Rolf Schmitt, P.Geo.
ERM Consultants Canada, Ltd.
(Reviewed sections 1 to 4, 7.2, 8, 9, and 10)

Veneil Sundar/Jon Reynolds
BQE Water
(Contributed to section 6.6.2 based on referenced engineering reports sealed by QPs)

Kareena Gill/Lynda Smithard
McCue Engineering Contractors
(Prepared section 6.6.1 based on referenced reports sealed by QPs)

[2] The main author of sections has been indicated for each of the Qualified Professionals however multiple authors contributed to the MWWMP as indicated by Section 4.5 Source Documents.

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APPENDIX A CONCORDANCE TABLE WITH ENVIRONMENTAL ASSESSMENT CERTIFICATE #M19-01 (JUNE 2019)

Table A-1: Environmental Assessment Certificate #M19-01 Conditions and Location in the Condition 33 Mine Waste and Water Management Plan

Condition #	Requirement	Location in Condition 33 Mine Waste and Water Management Plan
2	**Plan Development** Where a condition of this Certificate requires the Holder to develop a plan, program or other document, any such plan, program or other document must, at a minimum, include the following information: a) purpose and objectives of the plan, program or other document;	Section 2
	b) roles and responsibilities of the Holder and Employees;	Section 3
	c) names and, if applicable, professional certifications and professional stamps/seals, of those responsible for the preparation of the plan, program, or other document;	Section 11
	d) schedule for implementing the plan, program or other document throughout the relevant Project phases;	Section 9
	e) means by which the effectiveness of the mitigation measures will be evaluated including the schedule for evaluating effectiveness;	A conceptual adaptive management plan is provided in Section 8 and will be updated to meet condition requirements in the final plan[1]
	g) schedules and methods for the submission of reporting to specific agencies, Aboriginal Groups and the public and the required form and content of those reports; and	Section 9
	h) process and timing for updating and revising the plan, program or other document, including any consultation with agencies and Aboriginal Groups that would occur in connection with such updates and revisions.	Section 10
3	**Adaptive Management** Where a condition of this Certificate requires the Holder to develop a plan, program or other document that includes monitoring, including monitoring of mitigation measures or monitoring to determine the effectiveness of the mitigation measures, the Holder must include adaptive management in that plan. The objective of the adaptive management is to address the circumstances that will require the Holder to implement alternate or additional mitigation measures to address effects of the Project if the monitoring shows that those effects: a) are not mitigated to the extent contemplated in the Application; b) are not predicted in the Application; or c) have exceeded the triggers identified in paragraph g) of this condition. The adaptive management in the plan must include at least the following:	A conceptual adaptive management plan is provided in Section 8 and will be updated to meet condition requirements in the final plan[1]

Condition #	Requirement	Location in Condition 33 Mine Waste and Water Management Plan
	d) the monitoring program that will be used including methods, location, frequency, timing and duration of the monitoring;	
	e) the baseline information that will be used, or collected where existing baseline information is insufficient, to support the monitoring program;	
	f) the scope, content and frequency of reporting of the monitoring results;	
	g) the identification of qualitative and quantitative triggers, which, when observed through monitoring required under paragraph d), will require the Holder to alter existing, or develop new, mitigation measures to avoid, reduce, and/or remediate effects;	
	h) the methods that will be applied to detect when a numeric trigger, or type or level of change referred to in paragraph g), has occurred.	
	i) a description of the process for and timing to alter existing mitigation measures or develop new mitigation measures to reduce or avoid effects;	
	j) identification of the new and/or altered mitigation measures that will be applied when any of the changes identified in paragraphs a) to c) occur, or the process by which those will be established and updated over the relevant timeframe for the specific condition;	
	k) the monitoring program that will be used to determine if the altered or new mitigation measures and/or remediation activities are effectively mitigating or remediating the effects and or avoiding potential effects; and	
	l) the scope, content and frequency of reporting on the implementation of altered or new mitigation measures.	
	If there are any requirements or mitigation measures required in the plan, program or other document for which adaptive management, or elements of adaptive management listed in paragraphs d) to l) are assessed to be not appropriate or applicable, the plan must include identification of those requirements and measures, and the rationale for that assessment.	Section 9
	d) maintain a record of consultation with each such party regarding the plan, program or other document; and	
	e) provide a copy of such consultation record to the EAO, the relevant party, or both, promptly upon the written request of the EAO or such party. The copy of such consultation record must be provided to the EAO, relevant party, or both, no later than 15 days after the Holder receives the request for a copy of the consultation record, unless otherwise authorized by the EAO.	

Condition #	Requirement	Location in Condition 33 Mine Waste and Water Management Plan
33	**Mine Waste and Water Management Plan** The Holder must retain one or more Qualified Professionals to develop a Mine Waste and Water Management Plan. The goal of the plan is to manage mine waste and water in a manner that is protective of the receiving environment. The plan must be developed in consultation with Aboriginal Groups, ENV and EMLI.	
	a) the means by which the Holder will implement an oxygen-preventing barrier to cover waste rock, tailings and other mine by-products to prevent adverse effects from rock that is currently or potentially acid-generating or ML. The barrier may include coverage with additional tailings, water, or another mitigation measure that will be effective at limiting the potential for ML/ARD, as determined by the Qualified Professional(s);	Section 5.2
	b) the means by which the Holder will limit the year-over-year accumulation of water stored in TSF that exceeds the amount necessary to: i) address water needed under paragraph a); and ii) meet the needs for the operation of the mill. This determination must be made by a Qualified Professional(s), taking into account safety and concerns expressed by Aboriginal Groups. The plan must identify whether treatment and discharge of water from the TSF during Operations was considered and if not, provide a rationale;	Section 6.4 and water treatment is described in Section 6.6.2
	c) the means by which the Holder will monitor and document the year-over-year water accumulation in the TSF;	Section 6.4
	d) the management of ML/ARD from low grade ore stored on land during Operations, which must include placement of the ore on a low permeability foundation and collection, monitoring, and treatment of low grade ore contact water;	Section 7.1 and water treatment is described in Section 6.6.3
	e) a requirement that any remaining low-grade ore stockpile be backfilled into the pit or TSF at the end of Operations;	Section 7.2
	f) identification of water treatment technology or technologies proposed to be used during Operations to treat pit water for discharge; and	Section 6.6.1
	g) if any water treatment technology proposed for use during Operations differs from that proposed in the memo submitted as part of the Application (Document: Appendix F: Preliminary Design of Pit Sump and Pit Perimeter Dewatering Well Network Water Treatment Plan for the Blackwater Gold Project in Blackwater Gold Project: Updated Surface Water Quality Model Report (Aug 2016). Prepared by ERM), an assessment of how the new proposed technology achieves the same or better results as the technology proposed in the Application.	Section 6.6.1

Condition #	Requirement	Location in Condition 33 Mine Waste and Water Management Plan
	The Holder must provide the draft plan that was developed in consultation with EMLI, ENV and Aboriginal Groups to EMLI, ENV, Aboriginal Groups and the EAO for review a minimum of 60 days prior to the planned commencement of Construction or as listed in the Document Submission Plan required by Condition 10 of this Certificate.	See Context Statement[1]
	The plan must be updated at least every five years from the planned commencement of Construction, unless otherwise authorized by the EAO. The plan and any amendments thereto, must be implemented to the satisfaction of a Qualified Professional throughout Construction and Operations, and to the satisfaction of the EAO.	Section 10

[1] BW Gold has prepared the initial draft of the Mine Waste and Water Management Plan at the request of the EAO and Aboriginal Groups, to support the early engagement of Aboriginal Groups on the contents. BW Gold will develop the final Mine Waste and Water Management Plan in consultation with Aboriginal Groups in alignment with the most current version of the Document Submission Plan.