APPENDIX 9-B SOIL MANAGEMENT PLAN

BW GOLD LTD
a subsidiary company of Artemis Gold Inc

Blackwater Gold Project

Soil Management Plan

November 2021

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ACRONYMS AND ABBREVIATIONS

Aboriginal Groups or Indigenous nations	Lhoosk'uz Dené Nation, Ulkatcho First Nation, Nadleh Whut'en First Nation, Saik'uz First Nation, Stellat'en First Nation, and Nazko First Nation (as defined in Environmental Assessment Certificate #M19-01)
A&P	Arya & Paris
AQDMP	Air Quality and Dust Management Plan
Application	Blackwater Gold Mine Joint *Mines Act / Environmental Management Act* Permits Application
Artemis	Artemis Gold Inc.
AWSC	available water storage capacity
BC	British Columbia
Blackwater or Project	Blackwater Gold Project
BW Gold	BW Gold LTD.
CCME	Canadian Council of Ministers of the Environment
CEO	Chief Executive Officer
COO	Chief Operating Officer
CM	Construction Manager
DS	Decision Statement
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
EM	Environmental Manager
EMP	Environmental Management Plan
EMS	Environmental Management System
EMLI	Ministry of Energy, Mines and Low Carbon Innovation
EMPR	BC Ministry of Energy, Mines and Petroleum Resources
EPCM	Engineering, Procurement and Construction Management
ENV	Ministry of Environment and Climate Change Strategy
F	fermentation
FSR	Forest Service Road
GM	General Manager
H	humic
km	kilometres
KP	Knight Piésold Ltd.

L	litre
LDN	Lhoosk'uz Dené Nation (LDN)
masl	metres above sea level
MP	Management Plan
Mm^3	million cubic metres
MOE	BC Ministry of Environment
MOFR	BC Ministry of Forests and Range
Mtpa	million tonnes per annum
NAG	non-acid generating
New Gold	New Gold Inc.
NFN	Nazko First Nation
NWFN	Nadleh Whut'en First Nation
OM	organic matter
OVB	overburden
PSD	particle-size distribution
QP	Qualified Professional
RCP	Reclamation and Closure Plan
RSMR	relative soil moisture regime
S&R	Saxton & Rawls
SESCP	Surface Erosion and Sediment Control Plan
SFN	Saik'uz First Nation
SMP	Soil Management Plan
StFN	Stellat'en First Nation
t/d	tonnes per day
TARP	Trigger Action Response Plan
Tfc	field capacity tension
TSF	Tailings Storage Facility
UFN	Ulkatcho First Nation
WRC	water retention curve

1. PROJECT OVERVIEW

The Blackwater Gold Project (the Project or Blackwater) is a gold and silver open pit mine located in central British Columbia (BC), approximately 112 kilometres (km) southwest of Vanderhoof, 160 km southwest of Prince George, and 446 km northeast of Vancouver. The Project 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 (the Mine Access Road) 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 (OVB) 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 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 (LDN), Ulkatcho First Nation (UFN), 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 (NWFN), Saik’uz First Nation (SFN), and Stellat’en First Nation (StFN; collectively, the Carrier Sekani First Nations) as well as the traditional territories of the Nazko First Nation (NFN), Nee Tahi Buhn Band, Cheslatta Carrier Nation and Yekooche First Nation (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 24 to approximately 45 years, ending when the Open Pit has filled and the TSF is allowed to passively discharge to Davidson Creek, and the Post-closure phase is 46+ years.

New Gold Inc. (New Gold) received Environmental Assessment Certificate (EAC) #M19-01 on June 21, 2019 under the 2002 *Environmental Assessment Act* (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 2018 *Environmental Assessment Act*. 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.

1.1 Overview of Project Soils

Excerpts from the AMEC (2013) baseline report on soils, terrain and surficial geology are presented here to provide an overview of soils in the Project area. A detailed summary of soils present in the Project is presented in AMEC (2013).

1.1.1 Terrain Units

The surficial sediments in the Project area consist of Quaternary and Holocene deposits. Morainal, glaciofluvial, and glaciolacustrine deposits are Quaternary in age, with deposition associated with the last glacial period. Holocene sediments include materials deposited since the end of glaciation to the present day, and include fluvial, colluvial, eolian, and organic (peat) deposits. The western portion of the Project area consists of bedrock-controlled topography capped with moraine (till), localized glaciofluvial material, and colluvium. Localized areas of bedrock outcroppings are also present near the flanks and peak of Mount Davidson. The lower slopes of Mount Davidson transition to deeper, sediment-controlled topography, consisting of undulating moraine and hummocky to slightly undulating glaciofluvial deposits. Colluvium is identified throughout the Project area as thin veneers overlying bedrock or till, or as erosion along fluvial and gully sidewalls, creating a complex landscape of colluviated and unaltered parent materials. Glaciolacustrine and eolian materials were identified outside the boundary of the Certified Project Description.

1.1.2 Soil Associations and Descriptions

The Project area covers multiple landscape features, including: the Nechako Plateau, which extends to an elevation of approximately 760 metres above sea level (masl); the Nechako Range, which consists of predominantly Miocene and Upper Cretaceous igneous volcanic rock; and the Fraser Lake Basin, which has irregular boundaries and borders the Nechako Plateau (BC DOA 1974).

Soil profiles were categorized according to The Canadian System of Soil Classification (Soil Classification Working Group 1998). This hierarchical system has five taxonomic levels: order, great group, subgroup, family, and series. A brief description of the soil orders and great groups identified in the Project area is presented in Table 1.1-1.

Table 1.1-1: Soil Orders and Great Groups in the Project Area

Order	Great Group	Distinguishing Characteristics
Brunisolic: Sufficient development to exclude from the Regosolic order, but lacking degrees or kinds of development specified for other orders.	Dystric Brunisol / Eutric Brunisol	Ah < 10 cm, pH < 5.5 / Ah < 10 cm, pH > 5.5
Luvisolic: Soils that have eluvial (Ae) horizons, and illuvial (Bt) horizons in which silicate clay is the main accumulation product.	Gray Luvisol	Leached elluviated horizon (Ae) overlying a clay-enriched illuviated horizon (Bt)
Organic: Composed dominantly of organic materials; most are water-saturated for prolonged periods.	Mesisol / Fibrisol	Dominantly mesic (moderate degradation of organic material) / Dominantly fibric (little degradation of organic material)
Podzolic: B horizon accumulation of aluminum and iron with a reddish-brown colour overlying a sharp boundary, with progressively more yellow colour with depth.	Humo-Ferric Podzol	Bf, or thin Bhf plus Bf at least 10 cm thick, with 0.5% to 5% organic carbon and 0.6% aluminum and iron
Gleysolic: Associated with periods of water inundation of the soil. Expressed as mottling or reduced gleying features in the soil.	Gleysol	Evidence of strong mottling (oxidation) or gleyed (reduced) features within the upper 50 cm of the soil profile combined with reduced colors in the soil matrix
Regosolic: Development too weak to meet requirements of any other order.	Regosol	Ah < 10 cm, Bm absent or < 5 cm

The designation of soil associations for the Project is based on two soil survey reports on areas adjacent to the study area, *Soils of the Nechako – Francois Lake Area Soil Survey* (BC DOA 1974) and *Soils of the Prince George – McLeod Lake Area* (Dawson 1989). A soil association is a sequence of soils of about the same age, derived from similar parent material and occurring under similar climatic conditions, but having different characteristics due to variations in relief and drainage. Soils were initially stratified based on landform and parent material characteristics. Combined with soil profile development, they formed the basic framework of the soil associations. The soil associations present are described in Table 1.1-2.

Table 1.1-2: Summary of Soil Associations in the Project Area

Soil Association	Dominant Order	Subgroups	Parent Material
Alix	Brunisol	Orthic District Brunisol	Glaciofluvial
Barrett	Luvisol	Orthic Gray Luvisol Gleyed Orthic Gray Luvisol Brunisolic Gray Luvisol	Morainal (basal till)
Berman	Luvisol	Orthic Gray Luvisol Gleyed Orthic Gray Luvisol Gleysols	Glaciolacustrine
Chief	Mesisol	Typic Mesisol Terric Mesisol	Organics
Deserters	Luvisol	Brunisolic Gray Luvisol Gleyed Brunisolic Gray Luvisol Orthic Gray Luvisol	Morainal (Basal Till)
Knewstubb	Brunisol	Orthic Dystric Brunisol Orthic Eutric Brunisol	Glaciolacustrine
Moxley	Mesisol	Typic Mesisol Terric Mesisol	Organics
Nechako	Luvisol	Orthic Gray Luvisol Gleyed Gray Luvisol	Fluvial
Nithi	Brunisol	Orthic Dystric Brunisol Orthic Eutric Brunisol	Fluvial
Ormond	Brunisol	Orthic Dystric Brunisol Lithic Regosol	Colluvium/Bedrock
Pinkut	Brunisol	Orthic Eutric Brunisol Orthic Dystric Brunisol	Colluvium/Till
Twain	Podzol	Orthic Hum-Ferric Podzol Brunisolic Gray Luvisol Gleyed Orthic Humo-Ferric Podzol	Morainal (basal till)
Vanderhoof	Luvisol	Orthic Gray Luvisol Gleyed Orth Gray Luvisol Gleysols	Glaciolacustrine
Non-Soil Units			
Disturbed Land	DL	-	Anthropogenically-modified parent materials
Exposed Bedrock	R	-	Local bedrock exposed in situ
Water	LA	-	Open water bodies (lakes, ponds, streams)

2. PURPOSE AND OBJECTIVES

Using soils and other suitable materials as reclamation covers is an important component of successful ecosystem development in reclaimed areas. This Soil Management Plan (SMP; the Plan) describes soil management activities that will provide soil for mine-site reclamation, including salvage, stockpiling and placement of reclamation materials. The Plan provides a reclamation materials balance based on the availability of reclamation materials for salvage and projected demands for reclamation materials following mine closure.

The SMP addresses the requirements in Section 9.3 of the Joint Application Information Requirements for *Mines Act* and *Environmental Management Act* Permits (BC EMPR & BC ENV 2019). This plan also addresses Section 10.7.8 of the *Mines Act* Health, Safety and Reclamation Code for Mines in BC (the Code; EMLI 2021), which states "[o]n all lands to be re-vegetated, the growth medium will satisfy land use, capability, and water quality objectives. All surficial soil materials removed for mining purposes will be saved for use in reclamation programs unless these objectives can be otherwise achieved".

The SMP is linked to the Project's mine development schedule, Reclamation and Closure Plan (RCP; Chapter 4 of the Joint *Mines Act / Environmental Management Act* Permits Application [Application]), Surface Erosion Prevention and Sediment Control Plan (Appendix 9-A of the Application), Construction Environmental Management Plan (Appendix 9-C of the Application), and Vegetation Management Plan (Appendix 9-G of the Application).

3. ROLES AND RESPONSIBILITIES

BW Gold has the obligation of ensuring that all commitments are met and that all 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 all phases of the mine 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, the Independent Tailings Review Board, the TSF qualified person, and other qualified persons and professionals.

Table 3-1: Blackwater Roles and Responsibilities

Position	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 Environment & Social Responsibility	The Vice President is responsible for championing the Environmental Policy Statement and Environmental Management System (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, 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 their responsibilities to 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)	The EM is responsible for the day-to-day management of the Project's environmental programs and compliance with environmental permits, and updating the EMS and management plans (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 EM.
Community Relations Advisor	Community Relations Advisor is responsible for managing the Community Liaison Committee and Community Feedback Mechanism. Reports to Mine Manager.

Position	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. Reports to EM.
Aboriginal Monitors	Aboriginal Monitors are required by EAC #M19-01 Condition 17 and will be responsible for monitoring the Project's potential effects on Aboriginal interests. Aboriginal Monitors will be involved in adaptive management and follow-up monitoring programs.
Qualified Professionals (QPs) and Qualified Persons	QPs 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 Environmental Manager (EM) who will ensure that throughout the Construction phase the Environmental Management System (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 (QPs) with specific scientific or engineering expertise to provide direction and management advice in their areas of specialization. The EM will be supported by Environmental Monitors that will include Environmental Specialists and Technicians and a consulting team of subject matter experts in the fields of environmental science and engineering.

During the Construction phase, the Engineering, Procurement and Construction Management (EPCM) contractor and sub contractors, will report to the Construction Manager (CM). The EPCM contractor will 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 management plans (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 has been addressed and concerns 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 Vice President 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 Managers (e.g., mining, milling, and plant/site services) will be directly responsible for implementation of the EMS and MPs and Standard Operating Procedures relevant to their areas. All employees and contractors are responsible for daily implementation of the practices and policies contained in the EMS.

During closure and post-closure, staffing levels will be reduced to align with the level of activity associated with these phases. Prior to initiating closure activities, BW Gold will revisit environmental and health and safety roles and responsibilities to ensure the site is adequately resourced to meet permit monitoring and reporting requirements. The Mine Manager will maintain overall responsibility for management of Closure and Post-closure activities at the mine site.

Pursuant to Condition 19 of the Project's EAC #M19-01, 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), UFN, LDN, NWFN, StFN, SFN, NFN, Ministry of Energy, Mines and Low Carbon Innovation (EMLI), Ministry of Environment and Climate Change Strategy (ENV) and Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

Pursuant to Condition 17 of the EAC, Aboriginal Group Monitor and Monitoring Plan, BW Gold will retain or provide funding to retain a monitor for each Aboriginal Group prior to commencing construction and through all phases of the mine life. The general scope of the monitor's activities will be related to monitoring for potential effects from the Project on the Aboriginal Group's Aboriginal interests.

4. COMPLIANCE OBLIGATIONS, GUIDELINES, AND BEST MANAGEMENT PRACTICES

Federal legislation relevant to the SMP includes:

- *Canadian Environmental Protection Act, 1999*
- *Impact Assessment Act*
- *United Nations Declaration on the Rights of Indigenous Peoples Act*

Provincial legislation relevant to the SMP includes:

- *Declaration on the Rights of Indigenous Peoples Act*
- *Environmental Assessment Act*
- *Environmental Management Act*
  - *Contaminated Sites Regulation*
- *Mines Act*
  - Health, Safety and Reclamation Code for Mines in British Columbia (EMLI 2021a)

4.1 Environmental Assessment Certificate and Federal Decision Statement Conditions

EAC conditions relevant to soil management include Condition 13, which requires the development of a Construction Environmental Management Plan. This plan includes measures related to soil management during construction.

With respect to the federal DS, soil is referenced as follows:

- Soil conservation is referenced in the definition of *wetland functions*.
- Condition 6.11 requires the development and implementation of a follow-up program to verify the accuracy of the environmental assessment as it pertains to adverse environmental effects of the Designated Project on the health of Indigenous Peoples caused by changes in concentrations of contaminants of potential concern in water, soil, vegetation and wildlife, including fish, and determine the effectiveness of mitigation measures.

A standalone follow-up program will be prepared to address Condition 6.11. The federal DS does not include any specific conditions related to soil management.

4.2 Existing Permits

BW Gold received *Mines Act* Permit M-246 on June 22, 2021, authorizing early construction works for the Project. Part C (Protection of Land and Watercourses) Condition 6 of the permit includes the following requirements for soil salvage and stockpiling:

a. *The Permittee must salvage and stockpile all topsoil, overburden, and organic material including large woody debris for use in reclamation.*

b. *The Permittee must ensure that a qualified professional monitors and directs sampling, soil salvage, segregation, and stockpiling activities on-site.*

c. *(c) The Permittee must ensure that materials salvaged for use in reclamation are segregated based on salvage origin and measured suitability for reclamation purposes. Prior to mixing with* *other sources and/or applying on-site, the Permittee must characterize and evaluate the suitability for reclamation of any materials with the potential to be contaminated.*

d. The Permittee must maintain an inventory of stockpiles of salvaged soil, overburden and organic matter including large woody debris specifying the locations, origins, and quantities of material. The Permittee must report this information in the Annual Reclamation Report.

e. The Permittee must protect stockpiles from erosion, degradation, and contamination through revegetation and/or other practices.

f. The Permittee must ensure that stockpiles are clearly marked to ensure that they are protected during construction and mine operations.

g. The Permittee must not use soil suitable for use in reclamation as fill.

The Project received *Environmental Management Act* Permit 110603 on June 24, 2021, which authorizes discharge of treated stormwater effluent to ground from early-stage construction activities.

4.3 Guidelines and Best Management Practices

Best management practices presented in this SMP draw from the scientific literature (e.g., Rokich et al. 2000; Paterson et al. 2019) and available guidelines including the *Best Management Practices for Conservation of Reclamation Materials in the Mineable Oil Sands Region of Alberta* (Mackenzie 2011) and *A Guide to Soil Salvage* (Natural Resources Canada 2017).

5. ADAPTIVE MANAGEMENT FRAMEWORK

The SMP is a living document that will evolve over time in response to monitoring results and regulatory changes. The Plan incorporates an adaptive management as follows:

- Plan
  - Identify reclamation material salvage areas and material types.
  - Evaluate reclamation material volume needs.
  - Determine a reclamation materials balance.
  - Identify soil management strategies.
- Do
  - Schedule for operational implementation of the SMP, including implementation of soil salvage, stockpiling and placement best practices.
  - Schedule for implementation of the monitoring program, as per the SMP and regulatory requirements.
  - Describe record-keeping procedures for reclamation material salvage.
  - Undertake progressive reclamation.
  - Describe training procedures.
- Monitor
  - Implement the SMP monitoring program, including inspections and sampling during soil salvage operations, and inspections of soil stockpiles and reclaimed areas.
- Adjust
  - Review the effectiveness of management measures.
  - Update the SMP and associated documents as required.

6. TRAINING AND AWARENESS

Relevant employees and contractors will receive training in soil management from the environmental team prior to the start of work as part of the Site Orientation. The purpose of this training is to provide relevant site personnel with a basic level of environmental awareness and an understanding of their obligations regarding compliance with regulatory requirements, commitments, and best practices to conserve soils for future reclamation needs. This training will cover:

- What types of soils are important for reclamation;
- How they are salvaged, stockpiled and inventoried;
- How to minimize stockpile erosion, protect stockpiles from contamination and machinery, and prevent the spread of invasive plants;
- Soil stockpile locations; and
- How to report observations of erosion at soil stockpiles.

Site supervisors will be provided with a copy of the SMP and will receive additional training with respect to the requirements that are outlined. Targeted training will be provided to individuals and/or groups of workers engaged in environmental and soil management activities. This training will be delivered by means of classroom instruction, toolbox/tailgate meetings or other means as appropriate.

BW Gold will regularly review and update the training and awareness plan based on changes in training needs and regulatory requirements.

7. DEFINITION OF TERMS

Reclamation materials referred to throughout the SMP are defined as follows:

- **Reclamation materials** – surface soil and OVB that will be salvaged and used in reclamation.
- **Overburden** – overburden is defined as unconsolidated soil that underlies surface soils (> 0.5 m below the interface between organic and mineral soil horizons). These materials have not undergone pedogenesis, except the uppermost OVB (e.g., 0.5 to 1.0 m below the interface between organic and mineral soil horizons), which has undergone a lesser degree of pedogenesis than surface soil and has lower organic-matter (OM) content. Overburden within the Project area consists primarily of morainal deposits. Overburden, in the context of reclamation materials and this SMP, does not include any waste rock material.
- **Organic soil** – soils classified to the Organic soil order. The Organic order comprises soils with greater than 40-cm deep litter (L), fermentation (F) and/or humic (H) horizons, greater than 40-cm deep Of layers, or greater than 60-cm deep Om or Oh layers.
- **Mineral soil** – soils classified to non-organic soil orders (e.g., from colluvial, morainal, and glaciofluvial parent materials). Mineral soil orders may have LFH horizons, but these organic horizons will be mixed in with the underlying mineral soil during salvage and are grouped under mineral surface soils in this SMP.
- **Surface soil** – surface soils include organic horizons, if present, and the upper 0.5 m of mineral horizons underlying organic horizons. Surface soils have undergone pedogenesis, which includes accumulation of organic matter. For mineral soils, the organic layers are thin (< 0.1 m), while the organic layers of organic soils are approximately 1 m deep in the Project area.[1]
- **Mixed-mineral surface soil** – surface soils from colluvial, fluvial and morainal parent materials combined. Moraine (till) is expected to make up approximately 80% of this material. This term represents a grouping of surface-soil types that will be combined during salvage operations.
- **Mixed-parent-material surface soil** – surface soils from organic and mixed-mineral surface soils (i.e., non-glaciofluvial surface soils). This term is used to group non-glaciofluvial surface soils for the purposes of material-balance calculations.

[1] Terrain polygons with organic soils either had a surface expression code of veneer (Ov) or blanket (Ob) in the baseline survey (AMEC 2013), indicating that the organic horizons of organic soils were either less than 1 m deep or between 1–2 m deep, respectively.

8. RECLAMATION MATERIALS BALANCE

8.1 Required Volumes of Reclamation Materials

The volumes of materials required for reclamation are based on the ecohydrological modelling conducted in the RCP. It is estimated that 10.73 million cubic metres (Mm^3) of reclamation materials will be required as follows:

- Salvaged glaciofluvial surface soil – 1.46 Mm^3;
- Salvaged mixed-parent-material surface soils – 3.43 Mm^3; and
- Overburden – 5.84 Mm^3.

Planned reclamation material cover depths developed in the RCP are shown in Figure 8.1-1. Volume requirements by Project component are provided in Table 8.1-1.

Table 8.1-1: Reclamation Material Volume Requirements for Project Components by Material Type (OVB, Glaciofluvial Surface Soils, and Mixed-Parent-Material Surface Soils), Arranged in Descending Order of Salvage Volume

Project Component	Material Type[1]	Volume[2] (Mm^3)
Site C Tailings	OVB	4.127
	Mixed-parent-material surface soil	1.769
Site D Tailings	OVB	1.691
	Mixed-parent-material surface soil	0.725
Low Grade Ore Stockpile footprint	Glaciofluvial surface soil	0.616
Topsoil Stockpile footprints	Mixed-parent-material surface soil	0.318
Borrow Source	Glaciofluvial surface soil	0.256
Upper Waste Stockpile	Mixed-parent-material surface soil	0.191
Lower Waste Stockpile	Mixed-parent-material surface soil	0.170
Aggregate Screening Area	Glaciofluvial surface soil	0.147
Lower Waste Stockpile - uppermost plateau	Glaciofluvial surface soil	0.123
Mine Site Road (TSF Service Road)	Mixed-parent-material surface soil	0.076
Plant Site	Glaciofluvial surface soil	0.070
Camp	Glaciofluvial surface soil	0.055
Ready Line and Bulk Fuel Storage	Glaciofluvial surface soil	0.050
Upper Waste Stockpile - uppermost plateau	Glaciofluvial surface soil	0.048
Haul Road (Main)	Mixed-parent-material surface soil	0.046
Freshwater Pond (Borrow Pit)	Glaciofluvial surface soil	0.043
Haul Road (Processing Plant Haul Road)	Mixed-parent-material surface soil	0.035
Core Storage Facility	Glaciofluvial surface soil	0.030
Water Management Pond	Mixed-parent-material surface soil	0.024
Mine Site Road (East Processing Plant Service Road)	Mixed-parent-material surface soil	0.017

Project Component	Material Type[1]	Volume[2] (Mm^3)
Mine Site Road	Mixed-parent-material surface soil	0.016
Haul Road (Pit)	Mixed-parent-material surface soil	0.015
Mine Site Road (Borrow and Preparation Area Service Road)	Mixed-parent-material surface soil	0.012
Water Management Pond Dam	OVB	0.012
Contractor Laydown	Glaciofluvial surface soil	0.011
Haul Road (NAG and Lower Overbuden)	Mixed-parent-material surface soil	0.010
Lower Waste Stockpile - uppermost crest	Glaciofluvial surface soil	0.006
Environmental Control Dam	OVB	0.005
Haul Road (Main Dam C)	Mixed-parent-material surface soil	0.005
Mine Site Road (Explosives Storage Service Road)	Mixed-parent-material surface soil	0.005
Freshwater Dam	Glaciofluvial surface soil	0.003
Membrane Water Treatment Plant	Glaciofluvial surface soil	0.003
Upper Waste Stockpile - uppermost crest	Glaciofluvial surface soil	0.003
Diversion Structure (Northern)	OVB	0.001
Sub-total	*OVB*	*5.84*
Sub-total	*Mixed-parent-material surface soil*	*3.434*
Sub-total	*Glaciofluvial surface soil*	*1.464*
Total	**All types**	**10.734**

Notes:

[1] Mixed-parent-material surface soils are organic surface soils and non-glaciofluvial mineral surface soils combined.

[2] Final volumes may vary as components are constructed.

The soil volume demand is conservative (i.e., affords extra soil). In ecohydrological modelling, predicted SMR classes are downgraded (i.e., made drier) by a quarter class, increasing predictions of required soil depths, which are then rounded up to the next 10-cm increment (e.g., 52 cm is rounded to 60 cm). These adjustments in the modelling process are incorporated to ensure conservatism in reclamation materials demand-side estimates (i.e., to ensure that adequate volumes of reclamation materials are salvaged and stored for use in reclamation).

The OVB-demand volume excludes the material required to generate the 30-cm NAG tailings engineered cover over the tailings beach, but includes 5.84 Mm^3 of OVB for the 70-cm growing-medium cover on the tailings beach areas. BW Gold intends to complete site-specific research to support an engineered cover over the tailings beaches in lieu of a complete water cover with the intent of moving towards a drier TSF. OVB required for the upper lifts of the TSF dams is not included, as this volumes is accounted for separately in the mine plan. As per the RCP, residual concrete foundations, pads, voids and pedestals will be covered with at least 0.5 m of OVB prior to placement of prescribed cover materials. These volumes are not included in OVB-demand calculations, but given the large OVB surplus (Section 8.3), there is expected to be sufficient volumes to satisfy this closure requirement.

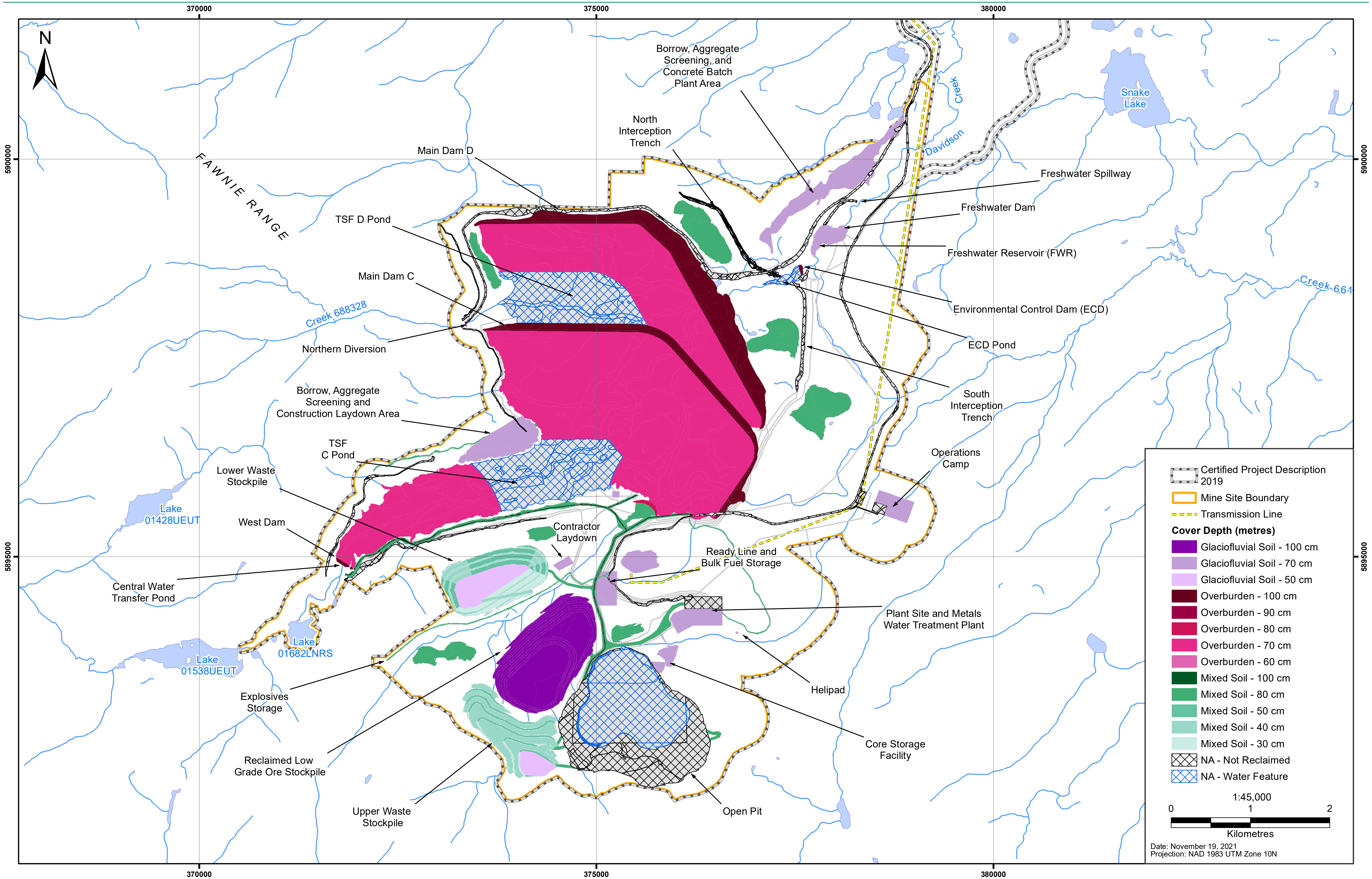

Figure 8.1-1: Reclamation Material Depths for Mine Closure

8.2 Available Volumes of Reclamation Materials

Reclamation material supply was evaluated to support development of a reclamation materials balance and confirm that sufficient reclamation materials are available to meet volume demands for implementing the designed reclamation covers.

8.2.1 Available Surface Soil

Table 8.2-1 summarizes the available salvageable area and corresponding volumes of surface soils for each Project component, arranged in descending order of salvage volume. Surface soils were classified according to their parent material from terrain polygons (BC Government GeoBC Data Distribution via AMEC 2013) and assigned to one of the three soil parent material categories that will be segregated during salvage: organic, glaciofluvial and mixed-mineral surface soil.

The following constraints were applied to the salvageable area estimates in Table 8.2-1:

- Areas classified as water, disturbed land (anthropogenic) and bedrock were excluded.
- Project components beyond the boundary of the current Project application were excluded, including the airstrip, airstrip access road, portions of the Mine Access Road and powerline right-of-way.

Table 8.2-1: Available Salvage Areas and Volumes of Surface Soils within the Project Footprint, by Project Component Based on Salvage Depths of 0.5 m for Glaciofluvial Surface Soil, 1.3 m for Organic Surface Soil, and 0.3 m for Mixed-mineral Surface Soils

Project Component[1,2]	Area (ha)	Glacio-fluvial Volume (Mm^3)	Organic Volume (Mm^3)	Mixed-mineral Volume (Mm^3)	Total Volume[3] (Mm^3)	Proportion of Salvage Volume (%)
Site C Tailings	577	353,485	306,542	1,447,024	2,107,052	29.6
Site D Tailings	238	475,950	222,697	378,413	1,077,060	15.2
Low Grade Ore Stockpile	125	42,895	43,956	339,585	426,436	6.0
Topsoil Stockpile footprints	105	225,036	25,080	174,083	424,198	6.0
Site D Tailings Dam	92	223,050	59,231	127,780	410,061	5.8
Open Pit	116	0	44,826	336,695	381,521	5.4
Site C Tailings Pond	106	30,000	54,600	287,400	372,000	5.2
Site D Tailings Pond	92	52,000	44,200	235,893	332,093	4.7
Upper Waste Stockpile	74	0	37,750	212,273	250,023	3.5
Lower Waste Stockpile	80	0	0	238,721	238,721	3.4
Borrow Source	43	163,500	11,700	28,200	203,400	2.9
Site C Tailings Dam	47	30,370	18,192	117,993	166,555	2.3
Mine Site Roads	35	12,351	13,980	95,015	121,347	1.7
Camp	21	33,663	34,727	34,663	103,053	1.5
Aggregate Screening Area	28	0	20,121	78,683	98,805	1.4
Haul Roads	26	3,376	2,132	76,761	82,270	1.2
Plant Site	21	0	0	62,474	62,474	0.9
ECD Diversion Structure	14	32,507	3,906	21,438	57,851	0.8

Project Component[1,2]	Area (ha)	Glacio-fluvial Volume (Mm^3)	Organic Volume (Mm^3)	Mixed-mineral Volume (Mm^3)	Total Volume[3] (Mm^3)	Proportion of Salvage Volume (%)
Freshwater Pond	8	0	9,100	21,900	31,000	0.4
Ready Line and Bulk Fuel Storage	9	0	0	26,735	26,735	0.4
Central Diversion (South)	7	0	5,536	18,614	24,150	0.3
ECD Pond	5	13	6,083	12,652	18,749	0.3
Diversion Road	4	11,624	2,600	3,831	18,054	0.3
Pit Lake	5	0	0	15,641	15,641	0.2
Central Diversion (North)	4	5,000	0	9,000	14,000	0.2
Water Management Pond	3	788	32	8,968	9,789	0.1
Reclaim Barge	1	0	7,800	1,200	9,000	0.1
Diversion Structure (Northern)	1	15	1,301	3,721	5,036	0.1
Contractor Laydown	2	0	0	4,571	4,571	0.1
Explosives Storage	1	1,221	0	2,930	4,151	0.1
Freshwater Reservoir Spillway	1	0	1,300	2,700	4,000	0.1
Site C West Tailings Dam	1	0	1,300	2,700	4,000	0.1
Core Storage Facility	1	0	0	2,081	2,081	< 0.1
Membrane Water Treatment Plant	< 1	0	0	921	921	< 0.1
Freshwater Dam	< 1	0	88	183	271	< 0.1
Total	**1,892**	**1,696,844**	**978,781**	**4,431,444**	**7,107,069**	**100**
Total assuming 15% not salvageable	**1,608**	**1,442,317**	**831,964**	**3,766,727**	**6,041,00**	**-**

Notes:
[1] Areas for pipeline right-of-ways were not available at the time of writing and were not included.
[2] ECD = Environmental Control Dam
[3] Arranged in descending order of salvage volume.

Salvage depths of 0.3 m for mixed-mineral surface soils, 0.5 m for glaciofluvial surface soils and 1.3 m for organic surface soils were assigned. For mineral soils, these depths are not inclusive of surface organic layers (i.e., L, F, and/or H horizons), which will be additional and mixed with underlying mineral layers (Section 9.1.3). Rationale for depth selections is presented in Section 9.1.3. It was assumed that 15% of available surface soils will not be operationally salvageable due to inaccessibility for equipment due to steep slopes (terrain polygons corresponding to open water and areas of bedrock areas were already excluded).[2] Factoring in this assumption, 7.1 Mm^3 of surface soils are estimated to be available within the Project disturbance footprint (1.7 Mm^3 of glaciofluvial surface soil and 5.4 Mm^3 of organic and mixed-mineral surface soils). Salvage areas are presented in Figure 8.2-1. Polygons designated as “not suitable for salvage” in Figure 8.2-1 are water bodies, areas that have already undergone anthropogenic disturbance, or those classified as bedrock terrain polygons.

[2] 15% was estimated based on the AMEC (2013) terrain stability assessment. 4.6% of the Local Study Area was assessed as potentially unstable (class IV) or unstable (class V). 9% was assessed as class III, which is stable but can include slopes over 26°, so these areas were considered unsalvageable to produce a conservative estimate of 13.6%. This value was conservatively rounded up to 15%.

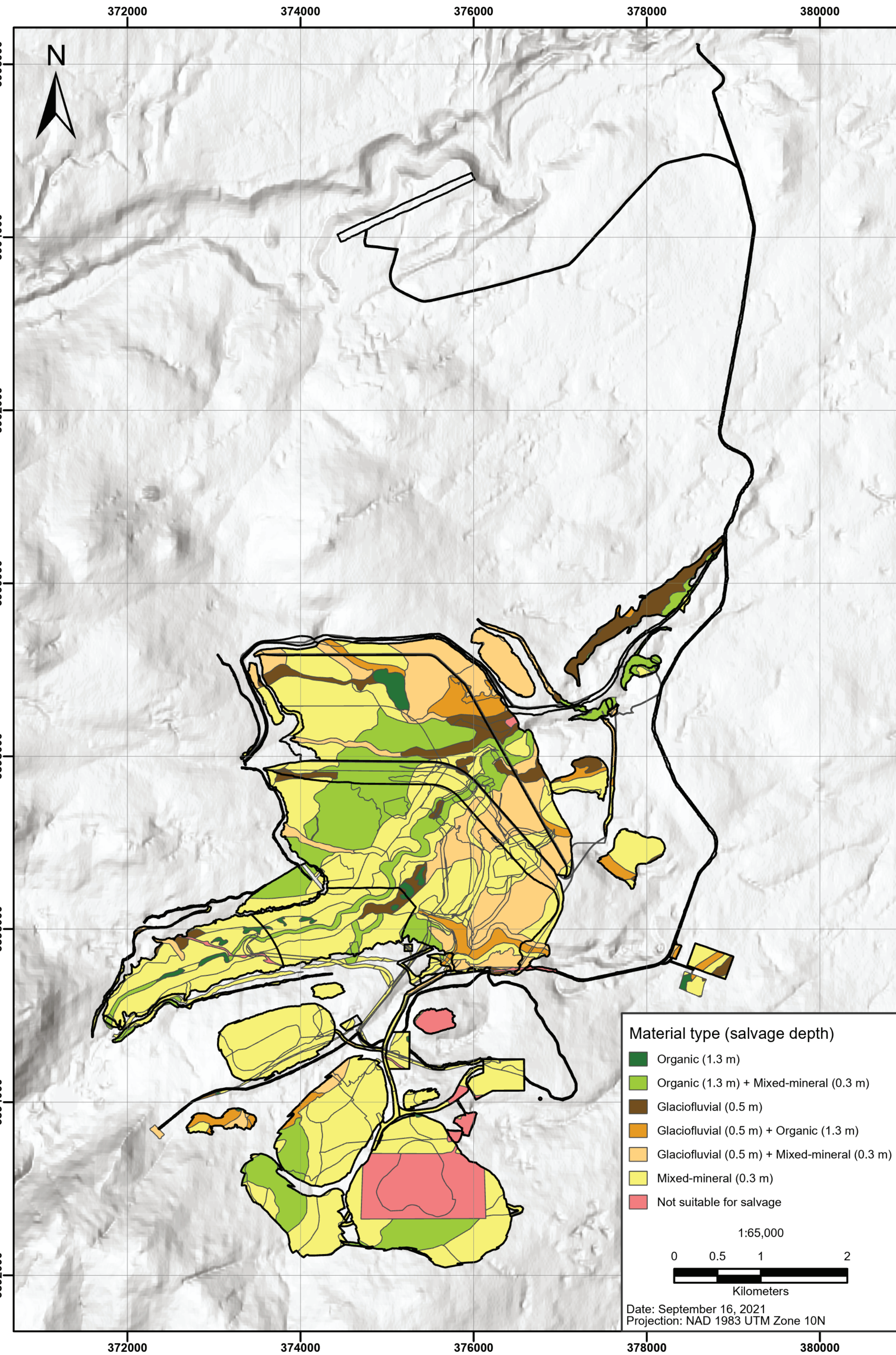

Figure 8.2-1: Surficial Soil Salvage Areas by Material Type for the Blackwater Gold Project

Source: IEG (2021).

The volume of available surface soil does not include the soil salvaged and stockpiled under the Early Works permit, making the estimated available volume of soil conservative. Blackwater will retain all the soil salvaged during early works, and the volume of this soil will be added to the volume of available soil when volume estimates are available from Early Works.

8.2.2 Available Overburden

Over the life of mine, 83 Mt of OVB are projected to be stripped from the Open Pit footprint (Section 3.3.2.2 of the Application). Following use of OVB in construction of the mine site and TSF dams, approximately 9.8 Mt will be stockpiled in the Upper Waste Stockpile and 28.7 Mt will be stockpiled in the Lower Waste Stockpile (Section 3.3.2.2 of the Application). Assuming a dry density 2.10 tonnes per cubic metre, this corresponds to 4.7 Mm^3 of OVB in the Upper Waste Stockpile and 13.7 Mm^3 of OVB in the Lower Waste Stockpile. OVB for use in reclamation will come from the Lower Waste Stockpile.

8.3 Reclamation Materials Balance

Table 8.3-1 summarizes the available and required volumes of reclamation materials from Section 8.1 and Section 8.2 to generate a reclamation materials balance. Sufficient volumes of reclamation materials are anticipated to be salvaged to meet reclamation needs with surplus materials available as a contingency.

Table 8.3-1: Reclamation materials Balance

Reclamation Material	Potentially Salvageable (Mm^3)	Operationally Unsalvageable (Mm^3)*	Non-suitable (Mm^3)	Suitable for Salvage (Mm^3)	Required (Mm^3)	Balance (Mm^3)	Surplus (%)
Glaciofluvial surface soil	1.70	0.25	0.00	1.44	1.46	-0.02	-1
Mixed-mineral surface soil	4.43	0.66	0.75	3.01	3.43	0.42	12
Organic surface soil	0.98	0.15	0.00	0.83			
OVB	13.7	NA	Data not available	13.7	5.84	7.86	135

** 15% of the salvage area is assumed to be operationally unsalvageable, as per Section 8.2.1.*

A 1% (0.02 Mm^3) shortfall in glaciofluvial surface soil is projected, however we anticipate that classifying 15% of these soils as operationally inaccessible is likely conservative, as glaciofluvial soils are typically in low-lying outwash and esker deposits that are accessible by equipment. In the event of a shortfall, surpluses of mixed-parent-material surface soil and OVB are projected to compensate.

Without application of suitability criteria (i.e., quality thresholds), a 34% (1.17 Mm^3) surplus of mixed-parent-material surface soil (organic surface soils and non-glaciofluvial mineral surface soils) is projected. Suitability criteria that classify the 20% lowest-quality mixed-mineral surface soil as unsuitable and not requiring salvage are presented in Section 9.1.1 and reduce the surplus of mixed-parent material surface soil to 12% (0.41 Mm^3). The suitability criteria, which are primarily based on coarse-fragment content and soil water storage capacity, are not intended for glaciofluvial surface soils because the ecosystems they will be used to target (lichen-rich, open-forest xeric to submesic site series) exist on the coarsest surface soils in the pre-disturbance landscape. Similarly, no suitability criteria will be applied to organic surface soils; all available organic surface soils will be salvaged, given the high reclamation value of this material.[3]

Given the large surplus of stockpiled OVB (13.7 Mm^3 available versus 5.8 Mm^3 required), it is expected that suitability criteria to remove the coarsest OVB can be applied without inducing shortages. The projected surpluses of mixed-mineral and organic surface soils and OVB provide a buffer to allow for minor adjustments to reclamation prescriptions and the mine disturbance footprint.

[3] Ecohydrological modelling was conservatively done using the AWSC of mixed-mineral surface soil. Organic surface soil can be applied in select locations where wetter site series (or wetlands) are projected to form, or can substitute a portion of the applied mineral surface soil to act as a soil amendment.

9. RECLAMATION MATERIAL SALVAGE

9.1 Surface Soil Salvage

9.1.1 Surface Soil Suitability Criteria

9.1.1.1 Development of Suitability Criteria

AWSC-based Suitability Criteria

Available water storage capacity (AWSC) is proposed as the primary basis for suitability criteria because soil water supply is a dominant control on the characteristics of an ecosystem, including its nutrient regime (Pojar et al. 1987; Baker et al. 2020). AWSC is directly related to soil particle-size distribution (PSD), with coarse-fragment content (> 2 mm) having a particularly strong relationship given that coarse particles typically do not form pores that store water at plant-available tensions. Importantly, coarse-fragment content is a parameter that can be evaluated relatively easily in the field during salvage operations. Methods for estimating the AWSC of waste (waste rock) and reclamation materials (OVB and surface soils) for Blackwater are presented in Appendix A, with results summarized in Table 9.1-1. All reclamation materials have AWSC values far exceeding waste rock, which has negligible water-holding capacity and would be expected to have a very limited ability to support vegetation if left uncovered.

Table 9.1-1: Summary of Available Water Storage Capacity (AWSC) of Surface Soils by Parent Material and Mine Wastes (OVB and Waste Rock)

Primary Parent Material	AWSC Values (Mm/M)		Soil Pits Surveyed		Salvageable Area	
	Range	Median	Number	Proportion	Surface (ha)	Proportion
Colluvial	38 - 180	77	6	2%	147	9%
Fluvial	28 - 249	100	14	5%	102	7%
Glaciofluvial	14 - 177	75	59	20%	322	20%
Morainal	2 - 313	109	188	66%	944	60%
Organic	160 - 300	280	21	7%	59	4%
OVB*	50 - 206	81	16	-	-	-
Waste rock*	2 - 7	4	5	-	-	-
Total	**-**	**-**	**288**	**100%**	**1,574**	**100%**

Notes:

Surface soil survey coverage is presented based on the available salvage areas presented in Table 8.2-1.

** Overburden and waste rock values are not from soil pits but from samples, or in the case of waste rock an estimated envelope around a mean sample provided by Moose Mountain Technical Services. The waste materials are not included in the summary row at the bottom or the survey coverage columns.*

No suitability criteria will be applied to organic or glaciofluvial surface soils. Organic soils have high AWSC (Table 9.1-1) and high organic-matter and nutrient contents, making them desirable reclamation materials. These beneficial properties extend through the full depth of the organic-soil profile and are typically higher with depth from surface; thus, all organic surface soils will be salvaged. Glaciofluvial materials deposited by glacial meltwater are characterized by stratified gravel and sand with minor components of silt and clay. The coarser glaciofluvial surface soils have a lower AWSC and are typical of xeric to submesic ecosystems on the pre-mining landscapes. Glaciofluvial surface soils will be salvaged to support reclamation of these ecosystems and lower-AWSC materials do not need to be avoided, as that is a typical property of these soils. All operationally-accessible glaciofluvial surface soils will be salvaged to meet reclamation volume needs (Section 8.3).

Suitability criteria will be applied to the remaining salvaged mixed-mineral surface soils (from colluvial, fluvial and morainal parent materials). Due to (1) the large range of AWSCs of these parent material types in the Project area, and (2) the low salvageable area of colluvial and fluvial materials compared to morainal materials (Table 8.1-1), these materials will be salvaged together as mixed-mineral surface soil, with suitability criteria applied to target the higher quality soils across the different mineral surface soil types.

Given the soil volumes available from the proposed salvage areas for mixed-mineral surface soils relative to requirements for reclamation identified in Section 8.3, it is proposed that the 20% of the mixed-mineral surface soils with the lowest AWSC (i.e., the coarsest 20%) can be excluded from salvage for reclamation, which still conservatively allows for a surplus. This suitability threshold results in the minimum AWSC of mixed-mineral surface soils being comparable to the median AWSC of OVB samples. Thus, mixed-mineral surface soils with consistently higher AWSC than OVB (i.e., that can support wetter, richer ecosystems) will be selected for use in reclamation covers to recreate more mesic ecosystems in accordance with ecohydrological modelling results and post-mine land-use planning. The threshold AWSC value to remove the 20% lowest-AWSC materials (with sample data weighted by relative salvage area of each parent material) is 75 mm/m. To translate the AWSC threshold into a visual operational criterion for selecting salvageable soils, a regression of AWSC against volume of coarse fragments > 2 mm for mixed-mineral surface soils was generated. Based on the regression formula, the AWSC threshold of 75 mm/m corresponds to a threshold of ≤ 63% coarse fragments (> 2 mm) for the mixed-mineral surface soil (Figure 9.1-1). For operational simplicity, this calculated threshold has been rounded to 60%.

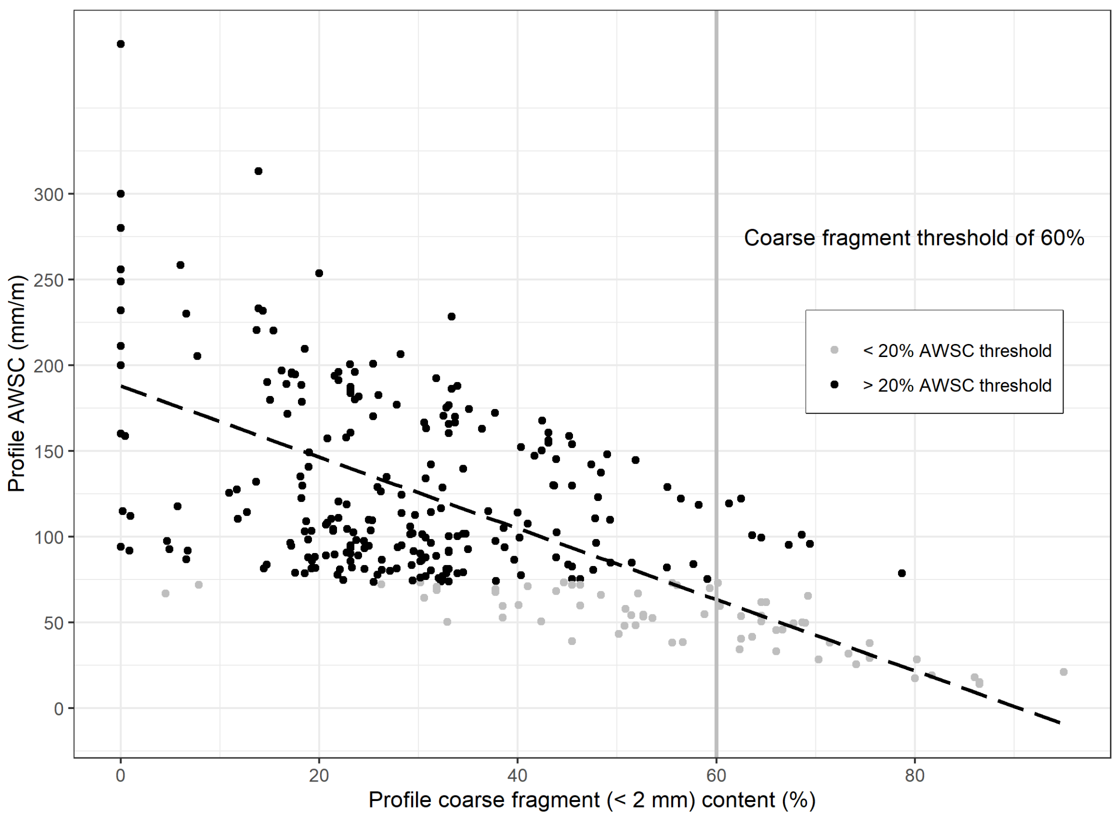

Figure 9.1-1: Coarse Fragment (> 2 mm) Threshold Criteria Selection Based on the Relationship between Soil Profile Available Water Storage Capacity (AWSC) and Coarse Fragment Content Based on Baseline Soil Samples

Chemistry-based Suitability Criteria

Limited data were available on elemental concentrations from soil surveys, but the reclamation materials monitoring program will help address this knowledge gap (Section 9.1.2). Soil samples will be taken during salvage to confirm that all measured elements have concentrations less than or equal to allowable parkland concentrations provided by the Canadian Council of Ministers of the Environment (CCME), and to identify any surface soils with consistently elevated levels. Based on the fact that disturbance levels are low in baseline conditions in the Project area, any elevated concentrations should be interpreted as reflecting natural mineralization of surface soils rather than contamination, and do not affect suitability ratings for reclamation. Soil pH and electrical conductivity criteria have not been proposed for salvaged soils because the soils at site are currently supporting healthy forests that are similar to those being proposed for revegetation.

9.1.1.2 Application of Suitability Criteria

Figure 9.1-2 presents the AWSC range of the mixed-mineral surface soil following removal of the lowest 20% of AWSC values as per the threshold described above. Prior to application of the threshold, the median AWSC of mixed-mineral surface soils was 103 mm/m (21–249 mm/m), which increased to 119 mm/m (75-249 mm/m) after threshold application. This AWSC range falls mostly within the levels associated with the mesic SMR class, which means that mixed-mineral surface soil with the AWSC-based suitability criterion applied is well suited for the reclamation of zonal site series.

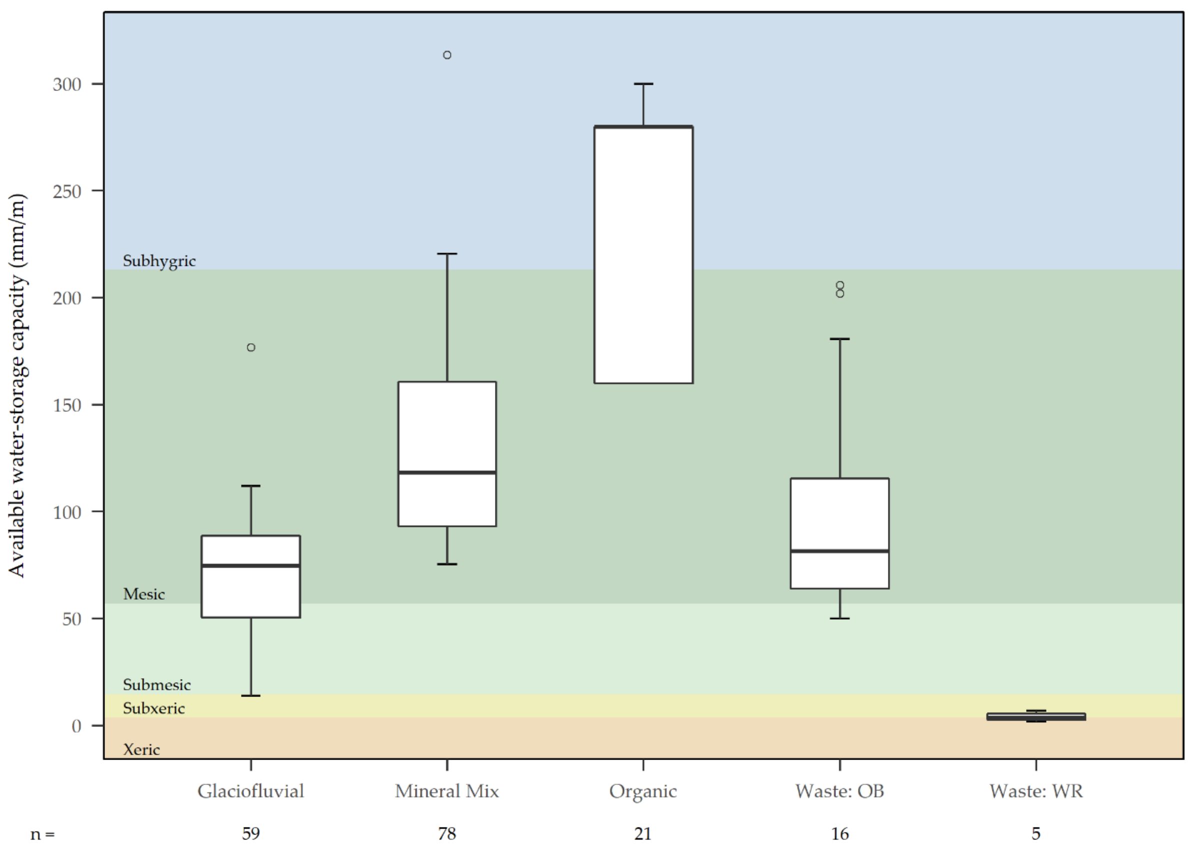

Figure 9.1-2: Available Water Storage Capacity (AWSC) of Salvageable Soils (by Salvage Grouping Type), Overburden (OB), and Waste Rock (WR)

In Figure 9.1-2, mixed-mineral surface soil contains surface soils formed on colluvial, fluvial, and morainal parent materials weighted by relative area available for salvage. This figure shows only potential salvage pits in the upper 80% of AWSC values for mixed-mineral surface soil samples. The coloured bands represent relative soil moisture regime (RSMR) classes for flat sites without root restriction in the upper metre. The middles of the boxplots represent the 50th percentile, the hinges represent the 25th and 75th percentiles, and the whiskers represent 1.5x the interquartile range of the hinges.

The AWSC values presented in Figure 9.1-2 show that the available reclamation materials have a range of AWSCs suitable for creating the desired post-closure ecosystems. Mixed-mineral and organic surface soils have the greatest AWSC values (higher than OVB), suitable for establishing mesic or wetter ecosystems. Therefore, mixed-mineral and organic surface soils are considered to be higher-quality reclamation materials than OVB, particularly since salvaged soil is expected to contain viable plant and soil-organism propagules, and have greater soil nutrient content than OVB (Mackenzie and Naeth 2010). Glaciofluvial surface soils have a lower AWSC, consistent with the desired materials for re-establishing the drier site series that existed on the pre-disturbance landscape.

Evaluation of the volume of coarse fragments in soil during field operations will require supervision by a QP (Section 9.1.5). As additional data are collected during salvage operations, the proposed 2-mm criterion should be reviewed and refined. Survey data on volumes of larger coarse fragments are not currently available, but it is recommended that this information be collected when soil salvage commences to evaluate the potential of developing a threshold for coarse fragments based on a larger size criterion (e.g., > 10 cm) that will be easier to put into practice.

9.1.1.3 Data Limitations

The following limitations to the suitability analysis reported in this section should be noted:

- Baseline soil survey data representing surface soils consisted almost exclusively of hand-textures and visual estimates of coarse-fragment contents. These data sources are less accurate than laboratory data.
- Colluvial parent materials were under-represented in the sampling effort relative to their proportion of salvageable area (Table 9.1-1). Since most of the salvaged mixed-mineral surface soils are likely to be morainal, this may not be a significant shortcoming. However, the lack of differentiation observed in AWSC between surficial soils formed on colluvial and morainal parent materials (Table 9.1-1) may be an artefact of insufficient sampling of colluvium, as colluvial materials are typically expected to be coarser and hold less water than moraine.
- PSD data for OVB sufficient for analysis were only available from 16 samples taken from two drill holes. The assumption that all OVB has similar properties affects the reliability of presented comparisons of the AWSC of OVB versus those of surface soils. Compensation for this uncertainty is provided by the proposed suitability criteria for OVB (Section 9.2.1).
- PSD data for waste rock is derived from proposed material characteristics rather than actual data because mine operations have not begun. Since waste rock is not intended to be part of the upper metre (i.e., rooting zone) of any reclamation treatments, this is not expected to affect ecohydrological modelling results presented in the RCP.

These limitations can be addressed by ongoing sampling and laboratory testing during soil salvage operations or through targeted periodic stockpile sampling, as well as sampling of OVB to be used as part of reclamation cover systems. As datasets are improved, the reclamation materials balance and ecohydrological modelling will be updated. Updates will coincide with Five-Year Mine Plan and Reclamation Plan updates, with available interim updates presented in Annual Reclamation Reports.

9.1.2 Monitoring of Surface Soil Salvage

Qualified professionals will supervise soil salvage, soil stockpiling and placement of soils, and direct the sampling program to capture the range of variability in surface soil properties. A minimum sampling intensity of one sample for every 50,000 m3 of salvaged surface soil is recommended on average over the life of mine, with higher-intensity sampling occurring during early salvage operations to address any uncertainties regarding surface soil properties, followed by a decrease in sample intensity over time as confidence in surface soil properties increases[4]. Soil properties to be tested during salvage are presented in Table 9.1-2 and it is recommended that one in five samples be analyzed for the subset of additional tests. The properties to be tested include PSD, OM and total Kjeldahl nitrogen, which are the required inputs for AWSC calculations. Table 9.1-2 also summarizes the soil suitability criteria defined in Sections 9.1.1 and 9.2.1.

Table 9.1-2: Soil Properties to be Tested during Soil and Overburden Salvage

Soil Property	Tests to Perform		Suitability Criteria	Notes
	All Samples	Subset[1]		
Particle-size distribution	100, 5, 2, 1, 0.5, 0.25, 0.1, 0.05, 0.002 mm		Mixed-mineral surface soil: coarse fragments (> 2 mm) less than 60% OVB: coarse fragments > 100 mm and > 25 mm will be less than 5% and 20%, respectively.	Input for AWSC calculations. Coarse fragment thresholds should be re-evaluated as data from salvage and mine wastes become available.
Organic matter content	Loss on ignition		No criteria required; data should be collected for baseline information and to build datasets for ecohydrological modelling.	Input for AWSC calculations. If inorganic carbon is suspected due to mineralogy, testing should be done by Walkley-Black method.
Nutrients	Total Kjeldahl nitrogen	Olson available phosphorus	No criteria required; data should be collected for baseline information and to build datasets for ecohydrological modelling.	Input for AWSC calculations. Fertilization can supplement low soil nutrients during early establishment.
Soil chemistry		pH, electrical conductivity	OVB pH: 4.5-8 OVB EC: <1 dS/m	Criteria apply to OVB only.
Element concentrations	Standard metals (Al, B, Ca, Cu, Fe, K, Mg, Mn, Mo, S, Zn) + trace metals (Ag, As, Ba, Be, Cd, Co, Cr, Hg, Ni, Pb, Se, Sn, Sr, U, V)[2]	(Refer to note 2)	OVB: Element concentrations below CCME thresholds for parkland soils (or alternate Project-specific criteria)	Element concentration thresholds should be re-evaluated as operational data become available.

[1] The subset of tests is to be performed on one in five samples.

[2] Initially, all samples should be tested for the full suite of metals to determine whether any specific metals are frequently elevated in reclamation materials. As material types (e.g., OVB, salvaged soil, tailings) are characterized more thoroughly, the metals analysis can be reduced to standard metals, as well as any trace metals that are frequently elevated, provided that levels of other trace metals are within CCME acceptable ranges, as guided by QPs.

[4] This sampling intensity corresponds to 29 glaciofluvial surface soil samples, 60 mixed-mineral surface soil samples, and 17 organic surface soil samples.

9.1.3 Salvage Depths and Separation of Surface Soils

The upper 0.5 m of mineral soils plus the overlying organic layers is typically the portion of the soil profile where most biotic activity occurs, and concentrations of OM and nutrients are highest. Subsurface soils (0.5 - 1.0+ m) are minimally influenced by biotic activity and soil processes, and are expected to have material properties more similar to reclamation-suitable OVB. Recommended soil salvage depths in mine reclamation literature vary, ranging from 0.15 to 0.80 m (Mackenzie 2011; Paquin and Brinker 2011). Since there is a surplus of available mixed-mineral surface soils for salvage relative to reclamation demands (Section 8.3), sufficient volumes can be obtained from the upper 0.3 m and there is no need to salvage the lower-quality deeper soils. Additional stripping of OVB will, however, occur where required during pit stripping or as necessary for creating facility foundations in accordance with geotechnical specifications. The organic (e.g., LFH) horizons of mineral soils will be salvaged with the underlying mineral horizons in one lift.

Two exceptions exist for the 0.3-m salvage depth for this Project. First, to meet volume demands (Section 8.3), glaciofluvial surface soils will be salvaged to a depth of 0.5 m. While this extends beyond the most active biotic zone of the soil profile, the physical properties (soil PSD) of glaciofluvial surface soils at this depth are still desirable and levels of organic matter and nutrients are still elevated compared to OVB.

Secondly, organic surface soils will be salvaged to an average depth of 1.3 m. In the Project footprint, organic soils occur in wetlands that form in depressions and on floodplains. Organic soils are high in OM and nutrients, and have the potential to be used as an organic surface amendment in reclaimed areas, which may help to support initial establishment of target vegetation species that have a requirement for organic forest-floor materials. Organic horizons of organic soils at the site are, on average, 1 m deep (AMEC 2013).[5] Therefore, an average salvage depth of 1.3 m is recommended to capture the organic horizons plus an additional 0.3 m to include the underlying mineral soil, which is likely enriched in fine soil particles due to the landscape position and enriched in organic nutrients due to the overlying organic layers. In addition to identified organic polygons (Section 8.2.1), any non-delineated wetlands that are encountered during salvage operations will be salvaged and stored with organic surface soils.

Organic, glaciofluvial and mixed-mineral surface soils will be segregated by QPs based on parent-material characteristics. Key 9.13 (Key to surficial materials) in the BC Field Manual for Describing Terrestrial Ecosystems (BC MOFR and BC MOE 2015) can be used to support delineation of soils. Maps of parent-material polygons will also be available to guide operators and supervising QPs (Section 9.1.5) in delineating areas of the different reclamation materials. Supervising QPs can additionally support the operators in delineating reclamation material types through use of flagging and in-field signage.

If possible, during salvage operations, surface soils will be directly placed on newly completed, reclamation-ready landforms as part of progressive reclamation or reclamation research.[6] When surface soils are not directly placed (the typical scenario for this Project), organic, glaciofluvial and mixed-mineral surface soils will be stockpiled separately to avoid mixing and dilution of their specific properties.

9.1.4 Equipment to Be Used

Dozers will be used to push surface soil into piles, from which it will be picked up by loaders along the road and placed in dump trucks and transported to designated stockpiles, where a second dozer will construct the stockpile lifts. Salvage will occur in a systematic method to avoid trafficking unsalvaged areas. Other

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[5] Terrain polygons with organic soils either had a surface expression code of veneer (Ov) or blanket (Ob), indicating that the organic horizons of organic surface soils were either less than 1 m deep or 1–2 m deep, respectively.

[6] Surface soils contain a seedbank that can result in natural regeneration of reclaimed areas and assist in early native species establishment; however, seed viability decreases over time and most viability is lost after material is stockpiled at depths greater than 1 m for a year (Mackenzie 2011).

equipment may be used to economize on travel time and distance for efficient salvage and scheduling. The overall objective in surface soil salvage is to maximize salvage in operationally feasible conditions. Salvage by dozers is not possible on slopes steeper than 26˚ (or as designated unsafe by QPs) and is not recommended in areas where the soil is consistently less than 50 cm deep to bedrock. Field assessments by a QP (Section 9.1.5) will be required to verify areas where soil depths are sufficient for salvage.

9.1.5 Supervision by a Qualified Professional

A QP who has appropriate training for delineating operationally salvageable areas and surface soil suitable for salvage will be present to supervise salvage operations. They will be required to clearly mark and/or communicate to operators all salvageable areas and areas that should be avoided during salvage (e.g., areas with exposed bedrock that are expected to have shallow soils). Supervising QPs will be responsible for designating the parent-material type of salvaged surface soil (i.e., glaciofluvial, mixed-mineral or organic) and the corresponding appropriate salvage depths and segregation as outlined in Section 9.1.3. They will be present during salvage operations to verify compliance with the SMP and to collect soil samples of recently-stockpiled surface soil during salvage operations to confirm that the properties of salvaged surface soils meet suitability criteria as described in Section 9.1.1.

9.1.6 Surface Soil Salvage Best Practices

The practices listed below should be followed to maintain the quality of reclamation materials and protect the adjacent environment:

- Avoid or minimize salvage during dry and/or windy conditions to prevent loss of fine-textured material and dust deposition on adjacent areas. If it is necessary to conduct salvage under these conditions, measures will be taken to minimize erosion and dust generation (e.g., water application).
- Avoid salvaging surface soils during excessively wet conditions to prevent loss of fine materials due to erosion and degradation of soil structure.
- Soil salvage may occur under frozen conditions with the benefit of reducing soil compaction, but snow should be removed prior to salvaging to reduce undesired settling or erosion in stockpiles or reclamation areas. Avoid salvage where frost penetrates deep into the soil profile, making it challenging to accurately target the desired salvage depth and causing admixing.
- Where the water table is within 50 cm of the surface (e.g., wetlands), drain salvage areas using trenching[7] prior to salvage and manage salvage operations in accordance with the Surface Erosion Prevention and Sediment Control Plan, as described in the following bullet.
- As per the Surface Erosion Prevention and Sediment Control Plan, establish erosion and sediment controls on stripped areas to reduce erosion risk and protect water quality, such as:
    - Temporary covers, such as hydroseed with mulch including a fall rye or coconut matting can also be applied in high-risk areas (e.g., slopes);
    - Use berms, waterbars and ditches to direct runoff away from rivers and streams;
    - Create sediment ponds to allow settling of sediments during higher-runoff events; and
    - Install silt fencing, straw wattles and check dams for additional sediment capture.

A Trigger Action Response Plan (TARP) is provided in Table 9.1-3 to guide implementation of best practices. The TARP from the Surface Erosion Prevention and Sediment Control Plan is also applicable to soil salvage practices outlined in this SMP.

[7] Trenches are dug along the edges of a salvageable wetland area and allowed to fill with water. Drained soil can then be salvaged and stockpiled.

9.2 Overburden Salvage

9.2.1 Suitability Criteria

Overburden will be used as the primary reclamation material on dams and TSF beaches, and will be part of the upper metre of reclamation covers underlying salvaged soils on the Lower Waste Stockpile and the Upper Waste Stockpile. Although salvaged soil is typically a preferable growing medium to OVB because it has greater soil organic-matter and nutrient content and contains viable plant propagules (Mackenzie and Naeth 2010), use of OVB as a reclamation material on select areas due to operational considerations[8] is not expected to be an obstacle for reclamation given that OVB has an AWSC in the range of glaciofluvial and mixed-mineral surface soils (Figure 9.1-1).

In order for OVB used as rooting-zone (i.e., uppermost 1 m) material in reclamation to meet the specifications used in ecohydrological modelling, it must be as fine or finer than the samples in the modelled dataset. For operational purposes, these thresholds have been set using coarse-fragment sizes that can be visually identified in the field. Namely, the volume of coarse fragments larger than 100 mm and 25 mm in diameter must be less than 5% and 20%, respectively. Furthermore, the OVB must appear to be morainal in origin, as identified by predominance of sub-rounded and sub-angular coarse fragments and sandy loam, loam, or silt loam fine-fraction (< 2-mm) textures (BC MOFR and BC MOE 2015).

For dams, which will primarily be revegetated with grass, herbs, and shrubs (not trees) for geotechnical reasons, nutrient limitations in OVB can be overcome with broadcast fertilization, as the risk of fertilized grasses and forbes out-competing non-nitrophilic tree species is not a concern. For the TSF beaches, to address uncertainty regarding direct revegetation of OVB, trials will be conducted to verify the revegetation potential of OVB as described in the RCP. Sufficient surface soil is planned to be salvaged to place a 30-cm cover of mixed-parent-material surface soil on the TSF beaches if necessary.

Preliminary suitability criteria for selection of OVB that is appropriate for use as a reclamation material are:

- The volume of coarse fragments larger than 100 mm and 25 mm in diameter will be less than 5% and 20%[9], respectively;
- Must appear to be morainal in origin, as identified by predominance of sub-rounded and sub-angular coarse fragments and sandy loam, loam, or silt loam fine-fraction (< 2-mm) textures;
- Element concentrations are below CCME thresholds for parkland soils (or alternate Project-specific criteria if elevated concentrations of surface soils are detected at baseline);
- pH between 4.5 and 8; and
- Electrical conductivity <1 dS/m.[10]

Additionally, as per the Metal Leaching and Acid Rock Drainage Management Plan, OVB will be monitored to verify that it is not non-acid generating.

[8] Dams have been designed for geotechnical stability to have an outer shell of OVB.

[9] The 25-mm threshold is inclusive of all coarse fragments greater than 25 mm in diameter, i.e., including the 5% of coarse fragments greater than 100 mm.

[10] The proposed thresholds for pH and electrical conductivity in OVB should be evaluated relative to the baseline range of natural variation to be assessed as samples of salvaged soil and OVB samples are sent for laboratory testing.

Table 9.1-3: Soil Salvage and Soil Stockpiling Trigger Action Response Plan

Activity	Issue	Normal		Caution		Stop Work	
		Trigger	Action	Trigger	Action	Trigger	Action
Soil salvage	Rain	No precipitation	Salvage as per SMP	Ongoing or recent light to moderate rain; soil not sticking to equipment (e.g., excavator bucket)	Notify supervisor; monitor precipitation gauges and soil conditions	Ongoing or recent heavy rain; soil not sticking to equipment (e.g., excavator bucket)	Notify EM; stop salvage; implement SEPSCP measures
	Wind	No or light wind	Salvage as per SMP	Moderate (some surface soil lifted, typically < 30 km/h)	Notify supervisor; monitor wind levels	Heavy wind erosion (e.g., location hazardous to personnel, substantial soil is being lifted)	Notify EM; stop salvage; implement SEPSCP and AQDMP measures
	Snow / frozen soil	No snow present; soil not frozen	Salvage as per SMP	Snow may or may not be present; soil not frozen at salvage depth	Remove any snow present	Soil frozen at salvage depth	Notify EM; stop salvage until no longer frozen to salvage depth
	Steep slope	Located on flat surface	Salvage as per SMP	Located on slope (< 26°)	Ensure machinery is stable and operator is trained for task	Location hazardous to personnel (slope ≥ 26°)	Notify EM; plan for mitigation or avoidance
Soil stockpiling	Wind erosion	No visible wind erosion	Stockpile as per SMP	Moderate (some surface soil lifted, typically < 30 km/h)	Notify supervisor; monitor wind levels	Heavy wind erosion (e.g., location hazardous to personnel, substantial soil is being lifted)	Notify EM; stop stockpiling; implement SEPSCP and AQDMP measures
	Water erosion	No visible water erosion	Stockpile as per SMP	Visible water erosion (e.g., rills)	Notify supervisor; assess existing water catchment features and vegetation on stockpile	Heavy water erosion (e.g., structural damage to surface)	Notify EM; stop stockpiling; implement SEPSCP measures
	Rain	No precipitation	Stockpile as per SMP	Ongoing or recent light to moderate rain; soil not sticking to equipment (e.g., excavator bucket)	Notify supervisor; monitor precipitation gauges and soil conditions	Ongoing or recent heavy rain; soil not sticking to equipment (e.g., excavator bucket)	Notify EM; stop stockpiling
	Snow	No snow present	Stockpile as per SMP	Starting to snow or snow in forecast	Monitor snowfall	Snow present	Stop stockpiling; remove snow prior to further placement
Soil placement	Wind erosion	No visible wind erosion	Place soil as per SMP	Moderate (some surface soil lifted, typically < 30 km/h)	Notify supervisor; monitor wind levels	Heavy wind erosion (e.g., location hazardous to personnel, substantial soil is being lifted)	Notify EM; stop placement; implement SEPSCP and AQDMP measures
	Water erosion	No visible water erosion	Place soil as per SMP	Visible water erosion (e.g., rills)	Notify supervisor; assess existing water catchment features and vegetation on slope	Heavy water erosion (e.g., structural damage to surface)	Notify EM; stop placement; implement SEPSCP measures
	Rain	No precipitation	Place soil as per SMP	Ongoing or recent light to moderate rain; soil not sticking to equipment (e.g., excavator bucket)	Notify supervisor; monitor precipitation gauges and soil conditions	Ongoing or recent heavy rain; soil not sticking to equipment (e.g., excavator bucket)	Notify EM; stop placement
	Snow	No snow present	Place soil as per SMP	Starting to snow or snow in forecast	Monitor snowfall	Snow present	Stop placement; remove snow prior to further placement

Notes:
SMP = Soil Management Plan; SEPSCP = Surface Erosion and Sediment Control Plan; AQDMP = Air Quality and Dust Management Plan; EM = Environmental Manager

9.2.2 Identifying Reclamation-suitable Overburden

Suitability of stockpiled OVB will be assessed by personnel trained by a QP as it is excavated from stockpiles for use in reclamation (i.e., prior to application at reclamation sites). Overburden ‘units’, or spatially distinct areas of OVB that appear to have similar properties, will be sampled as they are exposed and tested for PSD and chemical characteristics to verify that suitability criteria are met. The recommended sampling intensity for OVB should be determined by intended final usage for reclamation; OVB buried deeply in stockpiles that will not be used for reclamation does not require sampling, whereas OVB that is likely to be either in the outer 2 m of final reclaimed stockpiles (i.e., in or near rooting zones) or is scheduled to be placed on other areas (e.g., used on the TSF and dams) should be sampled. A minimum sampling intensity of one sample for every 50,000 m^3 of OVB available for use in reclamation is recommended on average over the life of mine, with higher-intensity sampling occurring during early salvage operations to address any uncertainties regarding soil properties, followed by a decrease in sample intensity over time as confidence in soil properties increases, as directed by a QP. Sample properties to be tested during OVB salvage are presented in Table 9.1-2. Monitoring programs will provide data to support ongoing refinement of OVB suitability criteria—in particular, proposed coarse-fragment thresholds and ranges of natural variation for pH, electrical conductivity and elemental concentrations.

9.2.3 Overburden Salvage

OVB will be excavated using a shovel or excavator during stripping and transported to stockpile locations by haul trucks. The sediment and erosion control measures listed in Section 9.1.6 and the Surface Erosion Prevention and Sediment Control Plan will be applied to salvage of OVB.

9.3 Sequencing

Due to sequencing of the Project, only minor opportunities for progressive reclamation will be available (e.g., on exploration-related disturbances that are not part of operational footprints), with the majority of reclamation to occur once operations have ceased. Progressive reclamation is planned for the Freshwater Reservoir beginning in year +1 and additional opportunities may be identified once active mining in the Open Pit ceases in Year +18 and support facilities (e.g., explosives storage facility, some roads) are no longer required. In the interim period, as per the RCP, BW Gold will actively look for opportunities for progressive reclamation, and any opportunities that do arise will be utilized for progressive reclamation and reclamation research trials to prepare for large-scale reclamation at closure.

10. RECLAMATION MATERIAL STOCKPILING

10.1 Stockpile Volumes

An estimated 5.29 Mm^3 of salvaged surface soils will be stockpiled, consisting of 1.44 Mm^3 of glaciofluvial surface soil, 3.01 Mm^3 of mixed-mineral surface soil, and 0.83 Mm^3 of organic surface soil (Table 8.3-1). Mixed-mineral and glaciofluvial surface soil volumes do not include the surface organic (LFH) layers that will be salvaged—salvage depths are measured from the organic-mineral interface. Surface organic layers are estimated to constitute an additional 0.16 Mm^3 of surface soil that will be mixed into the salvaged soils and stockpiled (0.02 Mm^3 with glaciofluvial surface soils and 0.14 Mm^3 with mixed-mineral surface soils).[11] This represents a conservative estimate, as surface organic layers are expected to compress during handling and stockpiling and not contribute substantially to stockpile volume. The resulting total volume of salvaged surface soil is 5.45 Mm^3, which is within the projected stockpile capacity of 7.89 Mm^3. An estimated 0.42 Mm^3 of the projected salvage volume will already be present at soil stockpile locations in the existing soils.

Locations of surface soil stockpiles are shown in Figure 10.1-1. Glaciofluvial, organic and mixed-mineral surface soils will be stored in separate stockpiles or separate zones of individual stockpile areas to avoid mixing and dilution of their specific properties. Overburden for reclamation will be stockpiled in the Lower Waste Stockpile location such that it remains recoverable (Figure 10.1-1). Road construction during the Early Works disturbance resulted in the creation of windrows along road edges. These windrows will be transferred to soil stockpiles for use in reclamation. Any new roads that are created during the life of the Project will be salvaged and stockpiled (i.e., not stored in windrows) to ensure that this material is not degraded or lost.

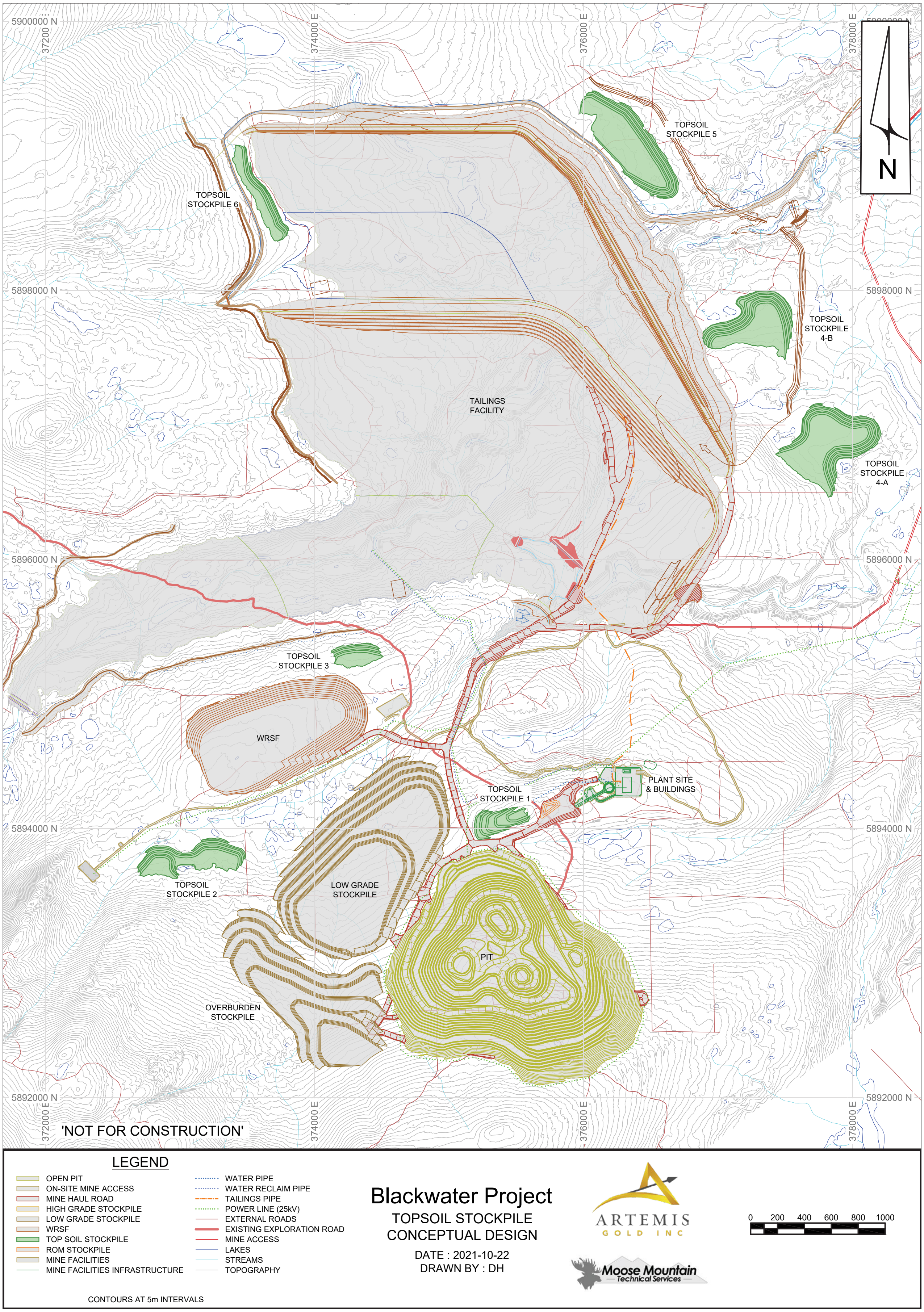
10.2 Stockpile Design

Surface soil stockpiles are designed to blend into the surrounding topography to the extent possible, with a maximum height of 20 m. Slope angles are overall 5H:1V overall, 3H:1V on each 5 m lift, with the objective of creating geotechnically stable stockpiles that have reduced slope angels to reduce erosion risk. This is in accordance with best management practice guidelines, which recommend slopes no steeper than 3H:V1 and construction with terraced slopes (Mackenzie 2011). Surface soil stockpile volumes and sources are presented in Table 10.2-1. Overburden will be stored separately in the Lower Waste Stockpile. Stockpile design details, including consideration of stability and water management, are provided in the Stockpiles Geotechnical and Water Management Design Report (Knight Piésold 2021).

Table 10.2-1: Surface Soil Stockpile Dimensions and Soil Sources

Stockpile	Volume (Mm^3)	Surface Soil Source
TS-1	0.13	Open pit, Low Grade Ore Stockpile, Plant Site, Ready Line and Bulk Storage area
TS-2	0.73	Upper Waste Stockpile, Lower Waste Stockpile, Low Grade Ore Stockpile, Explosives Storage Facility
TS-3	0.20	Open pit, Low Grade Ore, Plant Site, Ready Line and Bulk Storage area
TS-4A	2.57	Lower Waste Stockpile, Contractor Laydown Area, southern areas of the TSF C Pond
TS-4B	2.01	Infrastructure below Main Dam D
TS-5	2.02	Tailings Storage Facility C and D
TS-6	0.23	Tailings Storage Facility C

[11] Average depths of LFH layers for each parent material from baseline surveys were weighted by the relative salvage area of each parent material type.



Source: Moose Mountain Technical Services (2021).

Figure 10.1-1: Sockpile Locations for Salvaged Reclamation Materials

Stockpiled surface soil typical undergoes a loss of biological propagules at depths greater than 1 m when stockpile for more than a year (Mackenzie 2011). The designs implemented balance the goal of maintaining a high surface area to volume ratio with not disturbing large areas of land to create space for the stockpiles.

10.3 Storage Durations

Salvaged surface soils from the undisturbed portion of the Project footprint will be stripped as mine development proceeds. BW Gold will maximize opportunities for direct placement of salvaged surface soil on newly completed areas during the life of the mine for reclamation research and progressive reclamation (Section 9.3); however, the majority the salvaged surface soil and OVB will be stockpiled and placed after completion of the Operations phase. TS-1, TS-2, TS-3, TS-4B, and TS-5 will be constructed in Year -2 to Year 3 of the project (although they will not be built to their final crest elevation until later in the project), and surface soil will be stored for 20–25 years, assuming a 23-year life of mine. TS-4A and TS-6 will not be constructed until after Year 5, meaning this surface soil will be stored for 18 years or less.

10.4 Stockpiling Best Management Practices

Over time, erosion can reduce the quality and quantity of stockpiled reclamation material. Invasive or unwanted plant species can also become established and may create a source of these species for adjacent and future reclamation areas. Best management practices have been developed based on the guidance documents referenced in Section 4.3. The following best practices will be followed to maintain and protect stockpiled reclamation materials:

- Select stable stockpile locations that are not at risk of requiring rehandling or intrusion by machinery over the stockpile life prior to use.
- Ensure that stockpiles are located at least 10 m from any materials that could negatively impact the quality of the stored reclamation materials, such as tailings, waste rock, or low-grade ore that may have elevated elemental concentrations.
- Segregate different classes of reclamation materials into separate stockpiles (OVB, glaciofluvial surface soil, mixed-mineral surface soil, and organic surface soil).
- Construct stockpiles to minimize wind and water erosion, and to meet the geotechnical stability standards required by the Code and engineered designs (Section 10.2), as applied to all landforms at Blackwater. Water erosion can be reduced by limiting the steepness of stockpile slopes to 3:1, creating surface microtopography and ensuring that salvaged reclamation materials are placed on well-drained areas. Avoid locating stockpiles in runoff pathways to ditches or watercourses to reduce the risk of sedimentation. If this is unavoidable, install appropriate erosion and sedimentation control measures as per the Surface Erosion Prevention and Sediment Control Plan.
- Reduce erosion and invasive-species establishment by seeding stockpiles with non-propagating grass species, native grasses and forbs, and planting with tree and shrub species such as Sitka alder and trembling aspen (unless sufficient natural regeneration is occurring). Aggressive agronomic species should be avoided, as they will be transferred with the reclamation materials during placement and may not meet end land use objectives. Seeding or planting reclamation stockpiles with species intended for the closure landscape can also help build a seedbank in the reclamation material.
- Clearly mark stockpile locations and reclamation material types and ensure that personnel are aware of their presence to prevent inadvertent contamination, burial, or removal.
- Semi-annual inspections of stockpiles in spring and fall will be conducted to assess revegetation status, presence of invasive or non-desirable species and evidence of erosion. Presence of

identification signage will also be confirmed. Stockpiles will also be inspected after significant rainfall events (as defined in the Surface Erosion Prevention and Sediment Control Plan).

- Maintain a reclamation materials balance, which will account for current stockpiles and will detail:
  - When a new stockpile is established, along with its initial volume;
  - Reclamation material type of each stockpile; and
  - When material is added to or removed from an existing stockpile, with the resulting volume of the stockpile.

Once topsoil stockpiles are fully consumed for meeting reclamation needs and leftover surfaces have been revegetated sufficiently to control erosion, BW Gold will remove all non-organic materials (e.g., silt fencing) and reclaim disturbed areas and sediment ponds in accordance with decommissioning of water management structures.

A TARP is provided in Table 9.1-3 to guide implementation of best practices.

10.5 Coarse Woody Debris

During site clearing and pre-stripping, large volumes of woody debris, some representing large pieces (logs, root wads) will be encountered. These materials can represent valuable biotic material for reclamation and surface micro-habitat creation. Under the direction of a QP, opportunities for salvage will be identified and coarse woody debris will salvaged and stored for future use in stockpiles that are co-located with soil stockpiles. CWD is planned to be stored within the topsoil stockpile footprints depending on diameter and nature of the CWD. Large CWD will be stored adjacent to stockpile footprints as mixing it in with the soil stockpiles may become operationally challenging for managing the size of the stockpiles and could lower the rates of anaerobism in the stockpiles over time.

11. RECLAMATION MATERIALS PLACEMENT

Reclamation materials will be placed as facilities acquire their final topography through deposition and any landform grading. Placement of reclamation materials will be accomplished using large equipment, primarily bulldozers and dump trucks with some use of backhoes and front-end loaders. All placement areas will be monitored to confirm that post-placement densities are acceptable for reclamation. It is recommended that monitoring be conducted using a nuclear densometer, which is the most efficient and reliable method for taking numerous density measurements in reclamation materials with high coarse-fragment contents. The recommended sampling intensity is one sample per hectare. Placed reclamation materials will also be checked for placement depths and erosion risks. Soil placement operations are to be directed by a QP.

Reclamation materials will be placed as facilities acquire their final topography through deposition and any landform grading. Placement within +/- 20 cm of target depths is acceptable, and achievement of target ecosystems is not expected to be compromised, as long as overall average depths for each hectare are in line with specifications.

Placement of reclamation materials will be accomplished using large equipment, primarily bulldozers, in a manner that generates microtopography to improve microsites for plants and reduces erosion. Equipment operators should not seek to create planar surfaces with exact material depths, rather it is preferable to have surface roughness and undulations. The ‘rough and loose’ technique (Polster 2009), ripping, surface loosening with an excavator bucket, or other means of site preparation may be applied if additional decompaction is necessary and/or further creation of microtopography is desired. Consideration of soil type (e.g., texture) and the following considerations will inform selection of appropriate decompaction and/or site preparation techniques:

- Excess water is removed from a site through infiltration or surface flow. While surface flow may cause erosion, forced infiltration into underlying waste materials may not be desirable depending on the geochemical properties of the underlying waste. Risks and trade-offs of surface runoff versus infiltration will be considered.
- Site preparation techniques that create large microtopography (e.g., large mounds) may reduce the accessibility for wildlife and/or land users, thus end land use objectives will be considered.
- The risk of larger-scale cover system failures caused by pooling water (e.g., cascading failures from larger depressions) will be considered.

11.1 Placement Best Practices

The following best practices will be used to maintain the quality of reclamation materials and maximize achievement of reclamation objectives:

- Ensure that stockpiles are not currently supporting or established with invasive plant species prior to soil replacement.
- Clean equipment used in placement and spreading/contouring prior to use to prevent establishment of invasive species.
- Avoid placing reclamation materials in excessively wet conditions to reduce compaction, loss of soil to erosion and instability of placed reclamation materials.
- If reclamation materials are placed in excessively dry and/or windy conditions, pause operations or wet down materials to reduce the risk of dust generation and loss of fine material.

- Remove snow prior to placement, if feasible, to prevent mixing, uneven placement, and material instability.
- Place reclamation materials so that the surface is uneven—microtopography provides shelter for seeds and plants, reduces erosion, and retains more snow and water than a flat surface (e.g., Polster 2009).
- Incorporate coarse woody debris to create microhabitats and improve water and snow retention.
- Once reclamation materials are placed, seed and/or plant species as soon as practicable to reduce erosion and the establishment of invasive species as per the Invasive Plant Management Plan.
- If fertilization of planted stems is required, use spot-treatment methods, such as in-hole slow-release fertilizer bags, as opposed to broadcast fertilization. Local native plant species targeted in revegetation planning are generally not nitrophilic, thus broadcast fertilization tends to favour establishment of weedy or non-target plant species over target plant species.
- Follow erosion and sediment controls described in the Surface Erosion Prevention and Sediment Control Plan to reduce erosion risk in reclaimed areas and protect waterways, such as:
    - Using slope contouring and landform grading to direct runoff;
    - Creating microtopography on the surface to shorten flow-path lengths on reclaimed slopes;
    - Revegetating;
    - Armouring channels in reclaimed areas as needed;
    - Using mulch, rolled erosion control product or polyethylene covers on areas with elevated erosion risk;
    - Using berms, waterbars and ditches to direct runoff away from erosion-susceptible areas;
    - Creating sediment ponds to allow settling of sediments during higher-runoff events; and
    - Installing silt fencing, straw wattles and check dams for additional sediment capture.

A TARP is provided in Table 9.1-3 to guide implementation of best practices.

12. MONITORING

Monitoring of soil salvage, stockpiling and application as described throughout the SMP is summarized below.

- **Salvage** – Daily visual inspections will be conducted during stripping to confirm that (1) weather and soil moisture conditions are appropriate for salvage, (2) all target reclamation material is being salvaged, as practical, (3) suitability criteria defined in Section 8.1.1 and Section 9.2.1 are being applied, (4) target salvage depths are being achieved (Section 9.1.3), and (5) reclamation materials are being appropriately segregated (Section 9.1.3). If, during salvage operations, greater than 15% of surficial soils are inaccessible due to steep slopes[12], then the reclamation materials balance will be reviewed to confirm that adequate volumes of each surface soil type are still available to meet reclamation material needs. Salvage plans (e.g., areas, depths, and/or suitability criteria) may need to be adjusted accordingly.
- **Sampling –** Sampling of salvaged reclamation materials will be conducted during salvage and/or application as per Section 9.1.5 (surface soils) and Section 9.2.2 (OVB) to confirm material properties and suitability for reclamation.
- **Stockpiling –** Weekly stockpile development inspections (including consideration of foundation, layout, slope, and lift height) and completion inspections of the final structure, as well as supplemental inspections as required for erosion monitoring will be conducted. Stockpile volume and location tracking will be carried out during salvage and stockpile operations as described in Section 10.3. Along with volume tracking, the reclamation materials balance will need to be reviewed to confirm the availability and suitability of reclamation materials aligns with mapped polygons and verify the accuracy of the projected reclamation materials balance.
- **Stockpile inspections** – Semi-annual inspections of stockpiles in spring and fall will be conducted to assess revegetation status, presence of invasive or non-desirable species and evidence of erosion. Presence of identification signage will also be confirmed. Stockpiles will also be inspected after significant rainfall events (as defined in the SMP).
- **Application** – Completion inspections of final grading, application depth, decompaction, surface roughening, and long-term stabilization (erosion and sediment control measures, revegetation) will be conducted.
- **Reclamation performance** – Research trials, progressive reclamation and operational reclamation areas will be monitored over time as per the RCP to validate modeled soil properties, verify the suitability of the applied reclamation materials, and assess the recovery of planned ecosystems.

[12] Or due to unanticipated unsalvageable conditions, such as bedrock or water areas that were not classified as such in the terrain polygons delineated at baseline.

13. REPORTING AND RECORD KEEPING

13.1 Annual Reclamation Report

Soils monitoring results and management activities conducted under the SMP will be reported in the Annual Reclamation Report submitted to EMLI. Results and monitoring activities will be reported until further monitoring and management is not required, as determined by the EM. As required by EMLI (EMLI 2021b), this summary will include:

- Map(s) of soil and OVB stockpiles;
- Tabulated volumes of surface soil and OVB stockpiled, records of reclamation material sources (i.e., salvage locations) and identification of areas that could not be salvaged due to safety or other reasons, along with a supporting rationale;
- Descriptions of soil characteristics and suitability for reclamation, including evaluation of results from the reclamation material monitoring program and, where applicable, updates to ecohydrological modelling;
- Review of the reclamation materials balance, based on evaluation of updated soil stockpile volumes, data from newly-collected soil samples, and projections of remaining salvageable area;
- Descriptions of activities conducted to protect soil stockpiles;
- Confirmation of monitoring of surficial-soil and OVB stockpiles for condition (e.g., records of instances of slumping or losses due to erosion, descriptions of how were issues handled, stockpile monitoring results); and
- Annual reconciliation of the reclamation materials inventory (addition and subtractions).

The Annual Reclamation Report will be submitted to EMLI and provided to Aboriginal Groups on or before March 31 each year.

Additionally, the SMP will be reviewed annually and any updates to the Plan will be documented in the Annual Reclamation Report, along with a proposed implementation timeline for any changes to the SMP. Any changes proposed outside of this annual update will be reviewed with EMLI and Aboriginal Groups prior to implementation.

Non-compliance related to the SMP will be reported to the EMLI. All incidents and related actions will be recorded and maintained in an incident database.

13.2 Record Keeping

BW Gold will maintain records of the soils-monitoring program and results using forms suitable for the Project. A database will be created to record survey and monitoring results as well as the location, dates, techniques and extent of the management techniques employed. Data will be entered in a standardized format and program that will allow for comparison between years. Monitoring data will be stored for the life of mine including into post-closure.

The EM is responsible for data management and reporting related to soil management. The data management system includes conducting routine inspections and monitoring, and providing these results to appropriate parties as required. The EM will also report key results of soil management monitoring to the Blackwater Environment Committee and Aboriginal Groups during routine meetings.

14. EVALUATION AND ADAPTIVE MANAGEMENT

BW Gold will conduct and document management reviews of the SMP annually to assess its effectiveness and evaluate soil management strategies. The strategy employed by BW Gold will be regular monitoring as summarized in Section 12, supported by operational change and adoption of other mitigating measures as warranted. Such reviews will ensure the integration of monitoring results with other aspects of the Project (e.g., other MPs) and that necessary adjustments are implemented.

The timing of SMP updates may be informed by the following: changes to other relevant MPs; changes in infrastructure or processes; monitoring results; and regulatory changes. Plans are reviewed annually and updated as required.

15. PLAN REVISION

Proposed revisions will be reviewed and discussed with the Blackwater Environment Committee prior to adopting and implementing the changes to the Plan. Revised draft and final versions of the SMP will be filed with EAO, ENV and EMLI, and provided to Aboriginal Groups.

16. QUALIFIED PROFESSIONALS

This management plan has been prepared and reviewed by the following qualified professionals:

Prepared by:	Reviewed by:
Katie (Kathleen) McMahen, Ph.D., P.Ag. Ecologist	Rolf Schmitt, P.Geo. Technical Director

17. REFERENCES

Definitions of the acronyms and abbreviations used in this reference list can be found in the Acronyms and Abbreviations section.

Legislation

Canadian Environmental Protection Act, 1999. SC 1999, c. 33.

Contaminated Sites Regulation, BC Reg. 375/96.

Declaration on the Rights of Indigenous Peoples Act, SBC 2019 c. 44.

Environmental Assessment Act, SBC 2018, c. 51.

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APPENDIX A CALCULATION OF AVAILABLE WATER STORAGE CAPACITY OF RECLAMATION MATERIALS

Appendix A: Calculation of Available Water Storage Capacity of Reclamation Materials

A.1 Estimating Available Water Storage Capacity of Reclamation Materials

Suitability of surface soils for salvage within the undisturbed portion of the Project footprint was evaluated using soil survey data from terrestrial ecosystem mapping fieldwork conducted between 2011 and 2013 (AMEC 2013). Of the original soil survey dataset containing 425 pits with 1,410 surveyed horizons (Figure A-1), 292 sites with 984 horizons were present in the final dataset for analysis after exclusions were made due to missing survey data, insufficient survey depths (< 35 cm without a bedrock horizon recorded) and ambiguous parent material calls. Using soil survey data for each horizon including depth, fine-fraction texture, coarse-fragment content and organic-matter (OM) content (AMEC 2013), plant-available water storage capacity (AWSC) was calculated for the upper 50 cm of each sample pit using the methods described in Baker et al. (2020), which are summarized in the following paragraphs.[13]

A standardized method of estimating AWSC from soil sample data using adaptations of peer-reviewed models has been employed (following from Straker et al. 2015a; Straker et al. 2015b; Baker et al. 2020). The primary inputs to this model are soil particle-size distribution (PSD), OM content, soil depth, and topographical data, as well as layering arrangements within the soil profile. Two AWSC models are central to this approach: Arya and Paris (1981; Arya et al. 1999) and Saxton and Rawls (2006; Saxton 2005).

The Arya and Paris (A&P) approach is a physical model based on the capillary equation and uses only PSD and bulk density as inputs. The PSD-centric approach ignores the benefit of OM and soil structure on AWSC, and thus appears better suited to poorly-developed low-OM soils. To adjust for this omission, we adjust the A&P value by the percent increase in AWSC attributable to OM according to the Saxton and Rawls (S&R) model. The S&R approach is an empirical model built on regressions of soil survey data (PSD, OM content, and bulk density) against pressure-plate AWSC results to determine a best-fit prediction of AWSC. Since it is based on agricultural soil samples, we believe this model better-suited to higher-OM, better-aggregated soils.

Fine-fraction (< 2 mm) bulk density data were estimated based on texture classes (Saxton 2005). Whole-soil bulk density was calculated inclusive of coarse fragments (> 2-mm) using an assumed particle density value of 2,700 kg/m^3 for all mineral materials, with packing voids around coarse fragments estimated as per Zhang et al. (2011).

Both the S&R and A&P models, when combined with bulk density estimates, allow the estimation of water-retention curves (WRCs, volumetric water content vs. tension) for each sample, from which the volumetric water content between field capacity and wilting point is taken, and then reduced according to volumetric coarse fragment contents. In the A&P model, which does not specify the field capacity tension (Tfc) for calculating AWSC from the WRC, Tfc is estimated between 5 and 33 kPa for each sample based on fine-fraction sand content, with coarser samples receiving a lower Tfc. This Tfc value is used in the profile layering corrections described below.

In recognition of the different applicability of the two models (A&P for unstructured vs. S&R for structured, natural soils), the final AWSC value for each layer is calculated as a weighted mean between the A&P and S&R results, with weighting derived from total-soil (as opposed to fine-fraction) OM and clay contents, which are used as proxies for aggregation.

[13] Greater salvage depths are planned for organic surface soils, but the 50 cm depth was used here to enable equivalent comparisons across parent material types. Organic horizons of organic soils are expected to be relatively consistent with depth.

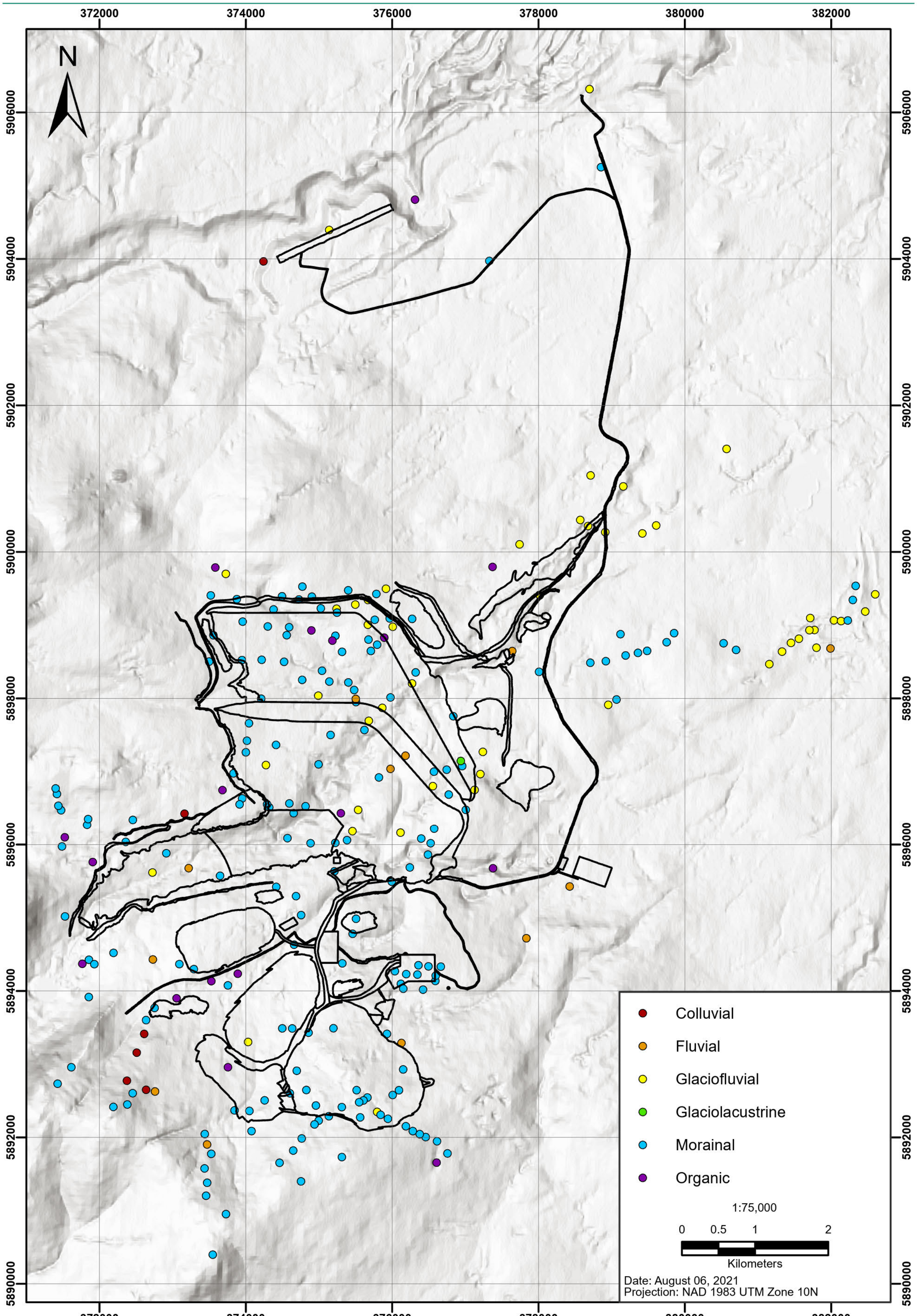

Figure A-1: Soil Sampling Locations and Associated Surface Parent Materials

The material AWSC values for each layer in a soil pit are depth-weighted and summed across the upper 0.5 m (the minimum salvage depth prescribed for the Project), or until a root-restricting layer (e.g., bedrock, basal till) occurs, to give a profile AWSC. As layers are compiled, the effects of layering on AWSC are estimated using Clothier et al.'s (1977) model, again based on the capillary equation. This model does not account for AWSC effects of coarse-over-fine layering situations, which is a shortcoming of the current approach. However, the most common layering arrangement in reclamation is the fine-over-coarse type (e.g., topsoil over waste rock), so layering at most sites is accounted for.

A.2 Estimated Available Water Storage Capacity of Waste and Soil Materials

The range of AWSC values for surface soils by parent-material type (as classified in the soil survey data; AMEC 2013) is presented in Table A-1 and Figure A-2. For comparison, AWSC of estimated Blackwater waste rock (Moose Mountain Technical Services, pers. comm.) and OVB (Knight Piésold 2013) are presented[14]. In Figure A-2, AWSC values are calculated for soil profiles to 50 cm. The coloured bands represent relative soil moisture regime classes for flat sites without root restriction in the upper metre. The middles of the boxplots represent the 50th percentile, the outer box limits represent the 25th and 75th percentiles, and the whiskers represent 1.5x the interquartile range of the hinges.

Table A-1: Summary of Available Water Storage Capacity (AWSC) of Surface Soils by Parent Material and Mine Wastes (OVB and Waste Rock)

Primary Parent Material	AWSC Values (mm/m)		Soil Pits Surveyed		Salvageable Area	
	Range	Median	Number	Proportion	Surface (ha)	Proportion
Colluvial	38 - 180	77	6	2%	147	9%
Fluvial	28 - 249	100	14	5%	102	7%
Glaciofluvial	14 - 177	75	59	20%	322	20%
Glaciolacustrine[1]	30 - 106	79	4	1%	0	0%
Morainal	2 - 313	109	188	65%	944	60%
Organic	160 - 300	280	21	7%	59	4%
OVB[2]	50 - 206	81	16	-	-	-
Waste rock[2]	2 - 7	4	5	-	-	-
Total	**-**	**-**	**292**	**100%**	**1,574**	**100%**

[1] No terrain unit polygons were classified as glaciolacustrine, so it was assumed that a negligible proportion of the Project footprint is glaciolacustrine.

[2] Overburden and waste rock values are not from soil pits but from samples, or in the case of waste rock an estimated envelope around a mean sample provided by Moose Mountain. The waste materials are not included in the summary row at the bottom or the survey coverage columns.

[14] Tailings are not included in this suitability analysis because tailings particle-size distribution data are unavailable in the pre-development phase of the Project, and, furthermore, tailings are scheduled to be covered with 1 m or more of OVB and/or surface soil, which means they will not be present within dominant rooting zones of target vegetation species.

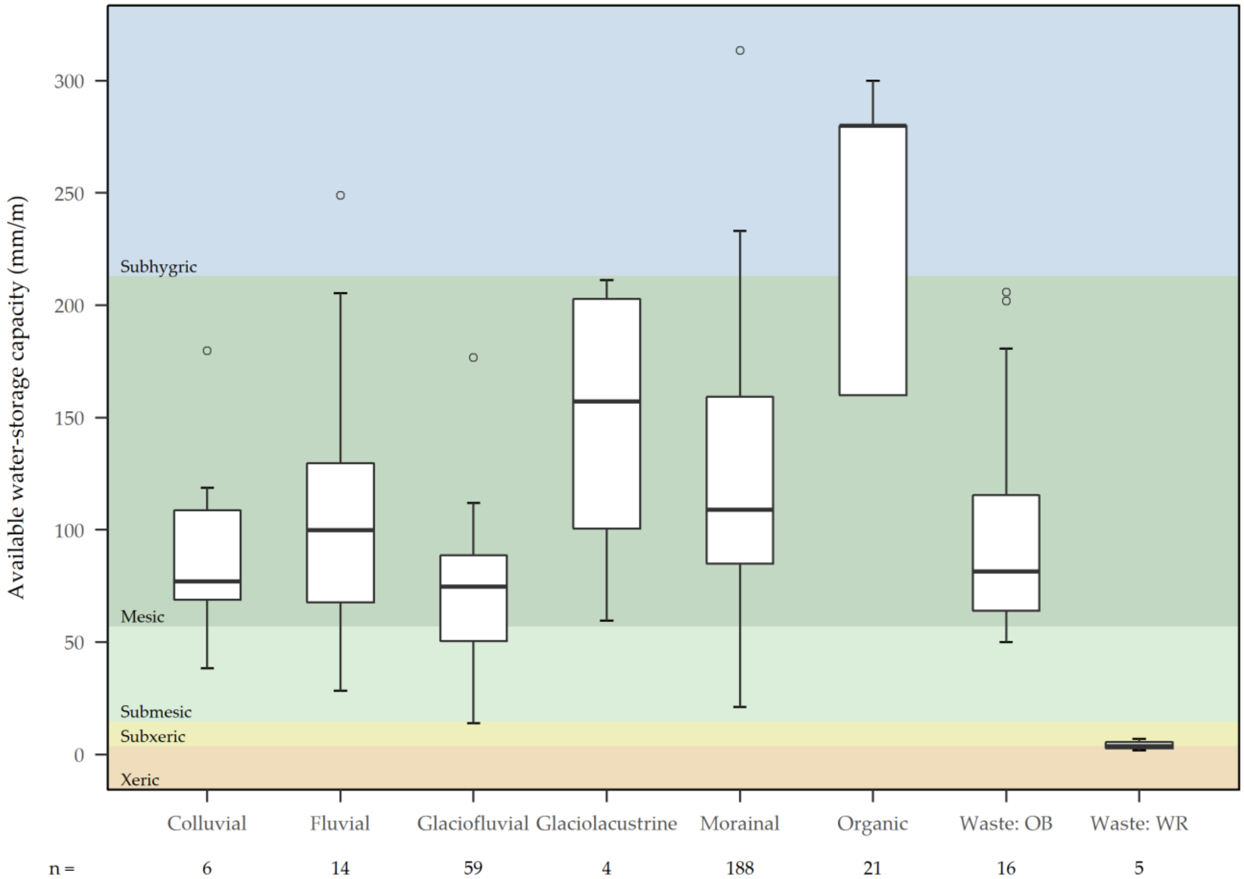

Figure A-2: Available Water Storage Capacity (AWSC) of Salvageable Soils (by Parent Material Type), Overburden (OB), and Waste Rock (WR)