ARTEMIS GOLD INC

Blackwater Mine

Surface Erosion Prevention and Sediment Control Plan

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Version:	E.1
Replaces:	D.5
Creation Date:	06/01/2023
Scheduled Review Date:	
Review Date:	
Document Team Members:	
Document Owner:	
Document Approver:	
Related Documents:	
Key Contacts:	
Change Requests:	

Acronyms and Abbreviations

Indigenous nations[1]	Lhoosk'uz Dené Nation, Ulkatcho First Nation, Nadleh Whut'en First Nation, Stellat'en First Nation, Saik'uz First Nation and Nazko First Nation (as defined in Environmental Assessment Certificate #M19-01)
Joint MA/EMA Application	Joint *Mines Act/Environmental Management Act* Application
Artemis	Artemis Gold Inc.
AQDMP	Air Quality and Fugitive Dust Management Plan
BC	British Columbia
Blackwater	Blackwater Gold Project
BC EAO	BC Environmental Assessment Office
BC EMLI	BC Ministry of Energy, Mines and Low Carbon Innovation
BC EMPR	BC Ministry of Energy, Mines and Petroleum Resources
BC ENV	BC Ministry of Environment and Climate Change Strategy
BC MOE	BC Ministry of Environment
BC MOF	BC Ministry of Forests
BMP	best management practices
BW Gold	BW Gold LTD.
CD	collection ditch
CDA	Canadian Dam Association
CEMP	Construction Environmental Management Plan
CEO	Chief Executive Officer
CM	Construction Manager
COO	Chief Operating Officer
CPESC	Certified Professional in Erosion and Sediment Control
DD	diversion ditch
DS	Decision Statement
EAC	Environmental Assessment Certificate
EM	Environmental Manager
EMPs	Environmental Management Plans
EMS	Environmental Management System
EPCM	Engineering, Procurement and Construction Management
ESC	erosion and sediment control
FSR	Forest Service Road

GM	General Manager
IFC	Issued for Construction
km	kilometre
KP	Knight Piésold Ltd.
LDN	Lhoosk'uz Dené Nation
masl	metres above sea level
ML/ARD Management Plan	Metal Leaching / Acid Rock Drainage Management Plan
NFN	Nazko First Nation
NTUs	Nephelometric turbidity units
OMS	Operations, Management, and Surveillance
PMP	Probable Maximum Precipitation
The Project	Blackwater Gold Project
QRP	Qualified Registered Professional
RUSLE	Revised Universal Soil Loss Equation
RUSLEFAC	Revised Universal Soil Loss Equation for Applications in Canada
SCP(s)	sediment control pond(s)
SEPSCP	Surface Erosion Prevention and Sediment Control Plan
SFN	Saik'uz First Nation
StFN	Stellat'en First Nation
SOPs	Standard Operating Procedures
t/d	tonnes per day
TRP	Trigger Response Plan
TSS	total suspended solids
UFN	Ulkatcho First Nation
USLE	Universal Soil Loss Equation
VP	Vice President

[1] *Indigenous Nations replaces the term 'Aboriginal Groups' defined in the Project's Environmental Assessment Certificate #M19-01.*

1.0 Project Overview

The Blackwater Gold Project (the Project) 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 (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 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 (BC EAO 2019a, 2019b).

Project construction is anticipated to take two years. Mine development will be phased with an initial milling capacity of 15,000 tonnes per day (t/d) for the first five years of operation. After the first five years, the milling capacity will increase to 33,000 t/d for the next five-years, and to 55,000 t/d in Year +11 until the end of the 23-year mine life. The Closure Phase is Year +24 to approximately Year +45, ending when the Open Pit has filled to the target closure level and the TSF is allowed to passively discharge to Davidson Creek via a closure spillway. The Post-closure phase begins in Year +46.

New Gold Inc. received Environmental Assessment Certificate #M19-01 (EAC) on June 21, 2019 under the 2002 *Environmental Assessment Act* (BC EAO 219c) 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 Inc. 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.

BW Gold received *Mines Act* Permit M-246 on June 22, 2021, and *Environmental Management Act* Permit PE-110602 on June 24, 2021, authorizing early construction works for the Project. These works include clearing, grubbing ditching, and site levelling at the Plant Site location and sediment and erosion controls, including construction of ditches, diversions, and a sediment control pond (SCP). BW Gold received an amended *Mines Act* Permit M-246 on March 8, 2023, approving the Mine Plan and Reclamation Program and superseding the previous version. On May 2, 2023, BW Gold received *Environmental Management Act* Permits PE-110650 authorizing discharge of air contaminants to the atmosphere and PE 110652 authorizing discharge of effluent to surface water and groundwater from the Blackwater mine.

2.0 Purpose and Objectives

This Surface Erosion Prevention and Sediment Control Plan (SEPSCP) has been developed to proactively manage water, erosion, and sedimentation throughout all phases of the Project, and applies to the entire mine site and associated activities, with a focus on the Construction phase, as this is when the greatest ground disturbance will occur. Land clearing and construction activities for development of mine components will increase the mine site's susceptibility to erosion. Movement of eroded soil off the site associated with actions of water, wind, or ice, has the potential to impact water quality if unmitigated.

The SEPSCP has been prepared in accordance with Section 9.2 of the *Joint Application Information Requirements for Mines Act* and *Environmental Management Act* Permits (BC EMPR & BC ENV 2019). The SEPSCP and/or referenced design documents adhere to the following guidance documents:

- Forest Road Engineering Guidebook (BC MOF 2002).
- Revised Universal Soil Loss Equation for Application in Canada. A Handbook for Estimating Soil Loss from Water Erosion in Canada (Wall et al. 2002).
- Dam Safety Guidelines 2007 (2013 Edition) (CDA 2013).
- Technical Guidance 3 – *Environmental Management Act* – Developing a Mining Erosion and Sediment Control Plan (BC MOE 2015a).
- Technical Guidance 7 – *Environmental Management Act* – Assessing the Design, Size and Operation of Sediment Ponds Used in Mining (BC MOE 2015b).
- Technical Guidance MIN-12 – Development and Use of Trigger Response Plans Mining (BC ENV 2022).
- Health, Safety and Reclamation Code for Mines in British Columbia (BC EMLI 2021).

This SEPSCP should be read in conjunction with Project design reports for early works, construction, and operation, as appropriate, and is intended to be used in conjunction with other management and monitoring plans pertinent to the protection of the aquatic receiving environment, including the following:

- Reclamation and Closure Plan
- Aquatic Effects Monitoring Program Plan
- Soil Management Plan
- Construction Environmental Management Plan (CEMP)
- Metal Leaching / Acid Rock Drainage Management Plan (ML/ARD Management Plan)
- Mine Site Water and Discharge Monitoring and Management Plan
- Vegetation Management Plan; and
- Air Quality and Fugitive Dust Management Plan (AQDMP).

The intent of this document is to outline strategies and design objectives, with appropriate flexibility, to allow the facilities to be field-fit to suit the site conditions encountered (i.e., an adaptive management approach). The SEPSCP describes best management practices (BMPs) that will be implemented – it is not meant to be prescriptive, and therefore does not systematically provide project-wide or activity specific detail, given the temporal scale and size of the Project. Specific measures to be implemented for each work area will be based on detailed design drawings prepared for construction, and site specific areas and specific construction activities. The overall objective of the SEPSCP is to manage contact water within the Project footprint, so as to prevent runoff from potentially impacting adjacent watercourses.

The term “contact water” is used to describe water that has come into contact with mine facilities and/or any disturbed areas, road runoff, borrow areas, or vegetation cleared areas. Conversely, “non-contact water” is used to describe water that has not come into contact with any project facilities or disturbed areas.

2.1 Activities Schedule

This Project has five phases:

- Early Works (approved under *Mines Act* M-246 Permit on June, 22, 2021 and the *Environmental Management Act* Permit 110602 on June 24, 2021);
- Construction Phase: Year-2 to Year-1;
- Operations Phase: Year+1 to Year+23;
- Closure Phase: Year+24 to Year+45; and
- Post-closure Phase: Year+46.

The mine development sequence and schedule for all mine components for all phases of mine life (construction, operation, closure, and post-closure) are provided in detail in Section 3.3 of the *Joint Mines Act/Environmental Management Act* Application (Joint MA/EMA Application; BW Gold 2022).

2.1.1 Construction

Activities during the Construction Phase that have the potential to cause erosion and sedimentation include:

- Vegetation clearing, grubbing, and surface preparation for the Open Pit and other facilities;
- Foundation construction and initial stockpiling for the Run of Mine stockpile at the Processing Plant;
- Vegetation clearing for the TSF C Main Dam, excavation of cut-off trench, and construction of starter dam;
- Construction of Interim Environmental Control Dam; and
- Vegetation clearing, grubbing, and surface preparation for Waste Rock Storage Facilities and Ore Stockpiles and construction of foundation and perimeter drainage.

In the initial construction area, Davidson Creek will be diverted around the site along the north bank. A diversion berm will be located approximately 500 m upstream of the TSF C Main Dam centreline to facilitate diversion of Davidson Creek through a pipeline, around the TSF work area, and back into Davidson Creek (downstream of the SCP). An initial fill area and downstream SCP will be constructed close to the initial construction area prior to site preparation and initial embankment construction. Construction of the Stage 1 dam will be completed by the end of Year-1 to provide sufficient capacity for a start-up pond and to impound tailings and PAG/NAG3 waste rock generated during the first year of operations. The remaining Davidson Creek catchment upstream of the TSF C West Dam will be redirected to Creek 705 to the southwest, away from TSF C, by a berm built in Year-1, which will permanently change the natural catchment divide in this area; all surface runoff west of the berm is diverted to Creek 705 starting in Year-1 (KP 2021a). This catchment does not contribute to the water balance for the mine site (KP 2021a). See Section 4.2 of KP (2022a) for further details on construction of the Stage 1 TSF C Main Dam.

2.1.2 Operations

During operations, erosion and sediment control (ESC) measures will be implemented as needed based on site inspections evaluating climactic fluctuations and seasonal conditions (e.g., spring freshet). These are anticipated to include collection ditches and SCPs associated with the following facilities:

- Downstream aggregate borrow area;
- Plant site; and
- Camp site

Ditches along mine site haul roads and the access road will also be maintained as needed to control erosion from spring freshet and surface runoff from large precipitation events.

Efforts will be made throughout mine operations to maximize progressive reclamation of landforms where they have been completed to the final closure design surface.

2.1.3 Closure and Post-Closure

Reclamation activities are described in Section 4 of the Joint MA/EMA Application (BW Gold 2022). The Open Pit, Upper and Lower Waste Stockpiles, and TSF will remain following closure. Stockpiles will be re-sloped to apply a growth medium prior to re-vegetation. Some of the waste rock and overburden will be used for reclamation activities across the site, particularly reclamation of the TSF.

Landform grading and placement of reclamation materials using large equipment, primarily bulldozers, are the key activities anticipated to require ESC measures. Diversion and collection ditches to manage surface water runoff, SCPs, stabilizing disturbed land surfaces, and establishing vegetation cover will minimize erosion.

Specific ESC measures to be implemented for each work area for closure and reclamation activities will be prepared prior to the Closure Phase.

3.0 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 that will provide supporting roles include independent environmental monitors, an Engineer of Record for each tailings storage facility and dam, an Independent Tailings Review Board, TSF qualified person, geochemistry qualified registered professional (QRP), and other qualified persons and QRPs.

Table 3-1: BW Gold Roles and Responsibilities

Role	Responsibility
Chief Executive Officer (CEO)	The CEO is responsible for overall Project governance. Reports to the Board.
Chief Operating Officer (COO)	The COO is responsible for engineering and Project development and coordinates with the Mine Manager to ensure overall Project objectives are being managed. Reports to the CEO.
Vice President (VP) Environment & Social Responsibility	The VP Environment & Social Responsibility is responsible for championing the Environmental Policy Statement and EMS , establishing environmental performance targets and overseeing permitting. Reports to the COO.
General Manager (GM) Development	The GM is responsible for managing project permitting, the Project's administration services and external entities, and delivering systems and programs that ensure Artemis's values are embraced and supported, Putting People First, Outstanding Corporate Citizenship, High Performance Culture and Rigorous Project Management and Financial Discipline. Reports to the COO.
Mine Manager	The Mine Manager, as defined in the Mines Act, has overall responsibility for mine operations, including the health and safety of workers and the public, EMS implementation, overall environmental performance and protection, and permit compliance. The Mine Manager may delegate some of their responsibilities to other qualified personnel. Reports to the 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 the 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, updating EMS and Management Plans. 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. The EM informs the Environmental Monitors of current site conditions that may influence monitoring programs. Supports the CM and reports to the Mine Manager.

Role	Responsibility
EPCM contractor and other contractors	The EPCM contractor and other contractors report to the CM and provide day to day project management and assurance in their areas of responsibility that the SEPSCP is being effectively implemented in accordance with applicable contractual terms and conditions. The Contractors liaise closely with the Construction and Environmental Managers and Environmental Monitors on a day-to-day basis regarding the implementation and maintenance of the measures outlined in the SEPSCP. The EPCM contractor will be responsible for ensuring that impacts are minimized, and environmental obligations are met, during the Construction Phase. EPCM and other contractors are responsible for the following: • Ensure that ESC measures are installed/constructed based on plans and according to design specifications approved by and under the supervision of a Certified Professional in Erosion and Sediment Control (CPESC). • Ensure that workers are appropriately trained, supervised, and have the necessary experience and competency to implement the requirements of the SEPSCP. • Provide input to BW Gold on construction-related aspects of SEPSCP implementation including labour, equipment and materials requirements, construction procedures, and field constraints. • Inform the CM if the conditions of the environment or construction practices vary materially from that as anticipated under this SEPSCP and make suggestions/recommendations for control measure modifications as needed. • Undertake corrective and preventative measures in response to non-conformances with the SEPSCP and ensure that such measures are implemented in a timely manner. • Correct deficiencies and any non-compliances upon direction from CM or EM/Environmental Monitor.
Departmental Managers	Departmental Managers are responsible for implementation of the EMS relevant to their areas. Report to the 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 the VP Environment & Social Responsibility.
Community Relations Advisor	Community Relations Advisor is responsible for managing the Community Liaison Committee and Community Feedback Mechanism. Reports to the Indigenous Relations Manager.
Environmental Monitors	Environmental Monitors (Environmental Specialists and Technicians, including CPESC) are responsible for tracking and reporting on environmental permit obligations through field-based monitoring programs. Report to the EM.
Aboriginal Monitors	Aboriginal Monitors are required under EAC #M19-01 Condition 17 and will be responsible for monitoring for potential effects from the Project on the Indigenous interests. Aboriginal Monitors will be involved in the adaptive management and follow-up monitoring programs. Report to the EM.
Employees and Contractors	Employees are responsible for being aware of permit requirements specific to their roles and responsibilities. Report to Departmental Managers.
Qualified Registered Professionals and Qualified Persons	Qualified registered professionals and qualified persons will be retained to review objectives and conduct various aspects of environmental and social monitoring as specified in Environmental and Social Management Plans.

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

During the Construction phase, BW Gold will be entering into multiple Engineering, Procurement and Construction contracts, likely for the Transmission Line, Process Plant, and Tailings. Each engineer/contractor will have their own CM and there will be a BW Gold responsible project manager and/or superintendent who ultimately reports to the GM Development. Some of the scope, such as the TSF and Water Management Structures will be self-performed by BW Gold, likely using hired equipment. Other smaller scope packages may be in the form of Engineering, Procurement and Construction Management (EPCM) contracts. The EPCM contractors will report to the CMs who will ultimately be responsible for ensuring that impacts are minimized, and environmental obligations are met during the Construction phase. For non EPCM contractors, who will perform some of the minor works on site, the same reporting structure, requirements, and responsibilities will be established as outlined above. BW Gold will maintain overall responsibility for management of the construction and operation of the mine site and will therefore be responsible for establishing employment and contract agreements, communicating environmental requirements, and conducting periodic reviews of performance against stated requirements.The CM is accountable for ensuring that environmental and regulatory commitments/obligations are being met during the construction phase. The EM will be responsible for ensuring that construction activities are proceeding in accordance with the objectives of the EMS and associated management plans. The EM or designate will be responsible for reporting non-compliance to the CM and EPCM contractor, other contractors, and regulatory agencies, where required. The EM or designate will have the authority to stop any construction activity that is deemed to pose a risk to the environment; work will only proceed when the identified risk and concern have been addressed and rectified.

Environmental management during operation of the Project will be integrated under the direction of the EM, who will liaise closely with Departmental Managers and will report directly to the Mine Manager. The EM will be supported by the VP of Environment and Social Responsibility 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 management plans and reviewing them periodically for effectiveness. Departmental area managers (e.g., mining, milling, and plant/site services) will be directly responsible for implementation of the EMS, management plans, 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. 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 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 BC Environmental Assessment Office (BC EAO), UFN, LDN, NWFN, StFN, SFN, NFN, BC Ministry of Energy, Mines and Low Carbon Innovation (BC

EMLI, formerly the BC Ministry of Energy, Mines and Petroleum Resources (BC EMPR)), BC Ministry of Environment and Climate Change Strategy (BC ENV), and BC Ministry of Forests (BC MOF, formerly the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development).

Pursuant to Condition 17 of the EAC #M19-01, Aboriginal Group Monitor and Monitoring Plan, BW Gold will retain or provide funding to retain a monitor for each Indigenous nations defined in the EAC #M19-01 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 Indigenous nations' interests.

Contact information for the Environmental Manager is provided in Table 3-2.

Table 3-2: BW Gold Roles and Responsibilities

Position	Email
Environmental Manager	envirogeneral@artemisgoldinc.com

4.0 Compliance Obligations, Guidelines, and Best Management Practices

4.1 Legislation

Federal legislation pertinent to this plan includes:

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

Provincial legislation pertinent to water management includes:

- *Declaration on the Rights of Indigenous Peoples Act*;
- *Environmental Assessment Act*;
- *Environmental Management Act*;
- *Mines Act*;
- Health, Safety and Reclamation Code for Mines in British Columbia (BC EMLI 2022);
- *Water Sustainability Act*.

4.2 Environmental Assessment Office Certificate Conditions and Federal Decision Statement Conditions

Condition 13 of the EAC requires that the means by which erosion and sediment control are addressed be identified in the CEMP.

Section 7 of the SEPSCP addresses Conditions 3.1 in federal DS which requires:

The Proponent shall implement measures to control erosion and sedimentation within the Designated Project area to avoid the deposit of deleterious substances in water frequented by fish. The Proponent shall submit these measures to the Agency and to Indigenous groups before implementing them.

4.3 Existing Permits

BW Gold received *Mines Act* Permit M-246 on June 22, 2021, and *Environmental Management Act* Permit PE-110602 on June 24, 2021, authorizing early construction works for the Project. The early works include clearing, grubbing ditching, and site levelling at the Plant Site location and sediment and erosion controls, including construction of ditches, diversions, and a SCP.

BW Gold received the amended *Mines Act* Permit M-246 on March 8, 2023, approving the Mine Plan and Reclamation Program and superseding the previous version. BW Gold received *Environmental Management Act* Permit PE-110652 on May 2, 2023, authorizing discharge of effluent to surface water and groundwater from the Blackwater mine. BW Gold received *Environmental Management Act* Permit PE-110650 on May 2, 2023. Permit PE-110650 authorizes the discharge of air contaminants to the atmosphere from the Blackwater Mine.

5.0 Environmental Setting and Site Conditions

5.1 Watersheds

The Blackwater deposit lies within the upper reaches of the Davidson Creek and Creek 661 catchment areas. The terrain within these catchments is predominantly gently inclined, except along the incised portions of Davidson Creek. Davidson Creek flows northeast from the Project site towards lower Chedakuz Creek, the confluence of the two creeks is approximately 800 m downstream of Tatelkuz Lake. Creek 661 flows northeast from the Project site into upper Chedakuz Creek upstream of Tatelkuz Lake.

Chedakuz Creek drains Tatelkuz Lake and flows north-west, passing under a bridge at the Kluskus FSR approximately 2 km downstream from the lake. An unnamed catchment drains Snake Lake, which is located between the Davidson Creek and Creek 661 catchments. The Snake Lake catchment area drains directly into Tatelkuz Lake, while Creek 661 flows northeast from the Project site into Chedakuz Creek upstream of Tatelkuz Lake.

Turtle Creek flows in a north-east direction parallel to Davidson Creek before flowing north under the Kluskus FSR to its confluence with Chedakuz Creek downstream of the Kluskus FSR. Chedakuz Creek flows north-west from this point for approximately 25 km to the Nechako Reservoir.

Along the south-west side of the Project site, Fawnie Creek, Matthews Creek and Creek 705 all flow south-west from the deposit area. Creek 705 is a tributary of Fawnie Creek, which flows towards Laidman Lake and joins with Matthews Creek. Fawnie Creek continues to Johnny Lake, into Entiako Provincial Park, and ultimately forming a portion of the flow of the Entiako River into the Nechako Reservoir.

5.2 Terrain and Natural Hazards

The Project is situated on the Nechako Plateau of British Columbia, part of the Interior Plateau east of the Coast Mountain Range. The area is characterized by gently undulating, northwest-trending hills cut by small to medium-sized drainages. The elevation of the Blackwater property ranges from just over 1,000 metres above sea level (masl) in low-lying areas northeast of the proposed mine site to 1,800 masl on the southwest side of the property at the summit of Mount Davidson, which is the highest peak in the Fawnie Range. The Blackwater deposit is located on the northern flanks of the mountain.

The natural terrain has resulted in relatively few past landslides in the Project area; however, naturally occurring recent debris slides, rock falls, and potentially two relic (pre-aerial photography) rock avalanches have been identified outside of the mine site boundary in gullied terrain southwest of the explosives storage area. All of the identified relic or recent slides have limited areal extent, and no infrastructure is planned to be built at these locations.

Terrain mapping did not reveal any widespread areas of sheet or gully erosion within the mine site.

5.3 Climate and Hydrology

5.3.1 Mean Annual Precipitation

Two climate stations are installed in the Blackwater Project study area: Blackwater Low and Blackwater High. Blackwater Low was installed in July 2011 at an elevation of 1,050 masl and Blackwater High was installed in July 2012 at an elevation of 1,470 masl. Precipitation data from Vanderhoof were used to develop an estimate of long-term precipitation conditions for Blackwater Low and Blackwater High.

The mean annual precipitation estimates are 564 mm for Blackwater High and 489 mm for Blackwater Low (KP. 2021b).

5.3.2 Monthly Precipitation Distribution

The monthly distribution of precipitation was estimated for the purpose of water management planning. Mean monthly precipitation values range from a low of 30 mm in March to 68 mm in June for Blackwater High, and 24 mm in March to 59 mm in June for Blackwater Low (KP. 2021b). Approximately 41% of the annual precipitation at the project site falls as snow (at the Blackwater High station). Rain may occur in any month of the year, but largely falls in the period of April to October. The monthly precipitation statistics for Blackwater High are summarized in Table 5-1.

Table 5-1: Mean Monthly Precipitation Statistics

Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Precipitation (mm)	51	35	30	33	44	68	64	52	51	65	65	56
Rain (mm)	3	3	7	24	43	68	63	52	50	47	14	2
Ratio of Rainfall (%)	6	8	24	72	98	100	100	100	97	76	24	5
Snowfall (mm)	48	32	23	9	1	0	0	0	2	15	42	46
Ratio of Snowfall (%)	94	92	76	28	2	0	0	0	3	24	76	95

Source: KP (2021b).

Note: Blackwater High station.

5.3.3 Intensity-Duration-Frequency Data

Estimates of extreme precipitation are required for a number of design aspects; the 24-hour extreme precipitation and probable maximum precipitation (PMP) for different return period events are summarized in Table 5-2.

Table 5-2: Design Storm Events

Return Period (years)	24-Hour Extreme Rainfall (mm)	Scaling Vanderhoof (mm)
2	37	32
10	50	56
100	66	86
200	71	95
1,000	82	115
PMP	195	288

Source: KP (2021b).

Note: Scaling Vanderhoof values recommended to be used as design values for the project.

For the purpose of this plan, a significant rainfall event will be considered as greater than or equal to the 1 in 2 year return period rainfall event.

5.3.4 Mean Annual Runoff

The annual stream hydrographs in the Blackwater Gold Project area are typically characterized by a very pronounced period of high flows during the spring freshet, followed by an extended period of steady low flows, with limited autumn storms. All creeks are affected by ice formation during the winter and the smaller systems typically freeze over for extended periods during cold snaps. Estimates of mean monthly and annual unit runoffs are summarized in Table 5-3.

Table 5-3: Mean Monthly and Annual Unit Runoff

Station	Area (km^2)	Mean Monthly Unit Discharge (L/s/km2)												MAUD ($L/s/km^2$)	MAUR (mm)	MAD (L/s)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
H1	9	0.8	0.8	1.1	5.6	24.9	8.6	3.7	1.0	1.4	2.1	2.0	1.0	4.4	139	39
H2	44	2.1	2.0	2.3	7.7	30.1	16.7	8.9	3.6	3.4	4.1	3.0	2.3	7.2	227	316
H2B	46	2.2	2.1	2.6	8.6	32.4	18.7	10.3	4.2	3.9	4.9	3.4	2.5	8.0	252	368
H4B	61	2.7	2.6	3.1	6.7	24.1	14.9	8.6	3.3	3.9	4.8	3.7	3.1	6.8	215	418
H5	593	1.7	1.6	1.9	5.6	15.3	9.7	6.0	3.3	2.2	2.4	2.3	1.9	4.5	142	2663
H6	55	2.3	2.2	2.7	3.8	11.6	9.1	3.7	3.3	2.7	3.5	3.8	2.6	4.3	135	233
H7	42	0.8	0.7	0.9	6.5	27.3	13.4	6.4	1.1	2.2	3.1	1.2	1.0	5.4	170	227
H10	7	3.2	3.1	3.6	12.0	46.3	27.0	14.2	5.4	5.1	6.2	4.6	3.5	11.2	353	79
H11	15	0.7	0.6	0.8	4.6	15.8	11.9	4.2	2.7	2.5	2.9	1.5	0.9	4.1	129	60
L1-Outlet	392	1.5	1.4	1.7	5.4	15.3	9.6	5.6	3.1	2.0	2.1	2.1	1.7	4.3	136	1687

Source: Table 3.4 from KP (2021b).

Note: MAUD - Mean Annual Unit Discharge MAUR - Mean Annual Unit Runoff– MAD - Mean Annual Discharge.

5.3.5 Wet Month Runoff

Wet monthly flow values were estimated for the project area on the basis of the variability of the long-term flow series developed for the H5 hydrology monitoring station. The monthly return period values were estimated in the 2020 Hydrometeorology Report (KP 2021b). The return period ratios (estimated by fitting statistical distribution to the monthly flow values) are shown in Table 5-4.

Table 5-4: H5 Wet Monthly Return Period Streamflow Relationships

Month	Return Period Mean Monthly Discharge (L/s)				
	Mean	Wet			
		5 Year	10 Year	20 Year	50 Year
January	1,012	1,218	1,317	1,393	1,469
February	955	1,168	1,219	1,248	1,269
March	1,145	1,322	1,563	1,845	2,300
April	3,293	4,456	6,012	7,819	10,722
May	9,044	11,627	14,523	17,682	22,411
June	5,762	7,220	9,232	11,591	15,423
July	3,531	4,290	5,567	7,156	9,916
August	1,976	2,430	3,052	3,781	4,963
September	1,298	1,590	1,986	2,448	3,194
October	1,443	1,680	2,102	2,636	3,580
November	1,374	1,522	1,916	2,458	3,513
December	1,117	1,287	1,483	1,701	2,032
Mean Annual	2,663	3,318	4,164	5,147	6,733

Source: Table 3.5 from KP (2021b).

6.0 Risk Determination

6.1 Surface Preparation Activities

Construction activities that have the potential to cause erosion and sedimentation include:

- Clearing and Grubbing: Clearing operations include slashing, cutting, stockpiling, and removal (or burning) of trees and brush. Grubbing operations include the removal of the tree stumps and root masses left behind during clearing operations. Grubbing operations may cause localized soil exposure in areas where roots and stumps are removed.
- Stripping: Stripping is the removal of the organic mat from the construction site to expose the underlying mineral soil.
- Stockpiles: Stockpiles may include material removed from excavations, stripping, clearing, and borrow pits. The creation of stockpiles may disturb the vegetated soil surface and create exposed slopes.
- Road Construction: access roads are constructed to accommodate construction equipment on the Project site. Construction of roads may involve cut slopes, fill slopes, ditches, or culvert installation.
- Culvert Installation: Culverts are installed to connect drainage courses and surface drainage flow. Installation of culverts may cause flow concentrations, create cut slopes, disturb the soil surface on slope faces, and create scour zones at the culvert inlet or outlet.
- Ditch Construction: Where channels or ditches are constructed to direct and transport water along or transverse to the road alignment, the original drainage pattern may be altered, concentrating flows, and increasing flow velocity and erosion potential. Ditch construction creates exposed slopes that can be subject to erosion.
- Borrow Excavations: Borrow excavations can either be landscape borrows or dugout borrows.

Ice or snow blocked culverts at freshet can cause overtopping or washout of roads, and lead to erosion and sedimentation.

Potential effects from the construction activities in the absence of planned mitigation measures include:

- Increased surface erosion from disturbed and rehabilitated areas;
- Increased sediment load entering the natural water system or the terrestrial environment;
- Loss or degradation of soil materials for use in reclamation; and
- Siltation or erosion of watercourses and water bodies.

Heavy rainfall events and freshet runoff can create erosion and sedimentation in areas that did not have previously known erosion. Heavily trafficked areas and land disturbance caused by heavy mobile equipment can be a continuous source of soil displacement and compaction. With compaction, infiltration is reduced, and surface water has a greater potential for erosion. Proper planning prior to the commencement of heavy equipment and construction work can limit the disturbed footprint and mitigate erosion potential. During unusually heavy rain events oversaturated soils can exacerbate the problem.

6.2 Soil Loss Estimation

The potential for soil erosion to occur in undisturbed areas is determined by surface cover, topography, climate, land use practices and soil texture (the proportion of sand, silt, and clay), soil structure, and soil permeability (Wall et al. 2002).

The Universal Soil Loss Equation (USLE) is a mathematical model developed in the 1960s by the U.S. Department of Agriculture Soil Conservation Service to predict soil erodibility for agriculture (Wall et al. 2002). The USLE and its derivatives (Revised Universal Soil Loss Equation (RUSLE)), are based on erosion plot and rainfall simulator experiments, primarily for crops in the Eastern United States (Wall et al. 2002). The Revised Universal Soil Loss Equation for Application in Canada (RUSLEFAC) was developed to specifically reflect Canadian conditions (Wall et al. 2002). The USLE or RUSLE equation to estimate the potential long-term average annual soil loss per hectare (Wischmeier and Smith 1978, presented in Wall et al. 2002) is:

$$A = R \times K \times L \times S \times C \times P$$

Where:

A = potential, long-term, average annual soil loss per hectare [tonnes/ha/year]

R = rainfall factor [MJ•mm/ha/hr]

K = soil erodibility factor [tonnes•hr/MJ/mm]

L = slope length factor [dimensionless]

S = slope steepness factor [dimensionless]

C = cropping-management factor [dimensionless]

P = support practice factor [dimensionless]

These factors will be obtained from baseline reports for each discipline (e.g., hydrometeorology reports; soils and terrain reports; and site investigations). Where required, additional field truthing will be completed: test pits will be excavated to a maximum depth of 1.0 metre (hand-dug or using other means of excavation), and the soils will be characterized and analyzed for particle size, organic matter, structure and permeability.

The potential soil loss calculated for each worksite/area will be compared to guidelines for assessing potential soil erosion classes summarized in Table 6-1 (Wall et al. 2002). The suggested soil loss tolerance in Canada is 6 tonnes/ha/year (Wall et al. 2002).

Table 6-1: RUSLEFAC – Soil Loss Classes

Soil Erosion Class	Potential Soil Loss [tonnes/ha/yea–]
1 - Very Low	–6
2 - Low	6 – –1
3 - Moderate	11 – –2
4 - High	22 – –3
5 - Severe	>33

Source: Table 1.1 from Wall et al. (2002).

The site-wide soil erosion class for existing conditions and during construction are shown on Figures B3 and B4, respectively, of Appendix B (KP 2022b). The annual average soil loss is estimated to be Very Low during pre-construction and range from Very Low to Moderate within the Project footprint during construction.

The site EM and Environmental Staff will select appropriate erosion and sediment control measures based on the erosion class presented in Appendix B, in addition to other variables including:

- Facility design details presented on Issued for Construction (IFC) drawings
- Surface preparation and construction activities
- Volume and velocity of runoff from precipitation
- Size of the disturbance area
- Proximity to natural watercourses
- Timing (seasonality) and duration of construction activity, and
- Whether the measures are designed to be temporary or permanent.

The CM and all contractors will coordinate with the EM and Environmental Staff to ensure that appropriate ESC measures are implemented and maintained.

7.0 Erosion and Sediment Control Measures

7.1 Erosion Management and Sediment Control Strategies

The key strategy to control erosion and sedimentation is to protect the soil surface from mechanical erosion as a result of rain and runoff (water management) or wind erosion, and to capture eroded soil on site. These will be addressed through:

- Review of baseline conditions and erosion risk potential.
- Minimizing the extent and duration of exposure through planning and scheduling of ESC measure selection, installation, inspection, repair/modification, and decommissioning for every part of the construction schedule.
- Prioritizing drainage control, then erosion control, then sediment control - protecting areas to be disturbed from runoff by intercepting runoff and diverting it away from disturbed areas and keeping runoff velocities low.
- Retaining sediment on site by planning the location where sediment deposition will occur and constructing containment systems before other land-disturbance occurs.
- ESC performance monitoring and routine inspection of ESC measures, documentation of inspections, and prompt response to problems (maintenance and replacement of ESC measures as needed).
- Progressive reclamation, as practicable.
- Permanent site stabilization and decommissioning of ESC measures.

Erosion control practices protect the soil surface against erosion mechanisms (wind and water), while sediment control practices retain soil particles after they have been dislodged, thereby minimizing their movement off site. Erosion control should be viewed as the primary means in preventing the degradation of downstream aquatic and terrestrial resources, while sediment control should be viewed as a contingency plan and installed after all opportunities for erosion control have been implemented.
A greater emphasis will be placed on erosion control measures, especially in areas of elevated erosion potential; however, measures to address both erosion control and sediment control are required. Erosion control measures prevent exposed soils from being entrained by water or wind, while sediment controls address prevention of sediment mobilizing into natural waterbodies impacting fish and aquatic life and the removal of sediment suspended in water once erosion has occurred. Erosion and sediment control measures applied in series create a resilient system capable of protecting the natural environment from sediment impacts.

This SEPSCP describes design elements and provides guidance for control of all water originating from, or brought into, the mine site area during construction. Water will be controlled in a manner that minimizes erosion in areas disturbed by construction activities and prevents the release of contact water, which could adversely affect the water quality of receiving waters or terrestrial environments.

Water management will focus on diverting non-contact water away from working areas, retention of the understory vegetation (brush and root networks) as much as possible during logging, and interception of contact water using BMPs. Temporarily disturbed areas with an observed risk to erosion and sediment transport will be seeded (as required at the direction of the EM) using quick establishing, weed-free seed mixes (native and approved non-native) for initial soil stabilization; during closure, disturbed areas will be reclaimed by planting of native vegetation in accordance with Reclamation and Closure practices to facilitate progressive closure and reclamation of the project where final slopes are created and available.

Erosion management and sediment control at the project will be a process of establishing diversion and collection ditches to manage surface water runoff, constructing SCPs, stabilizing disturbed land surfaces to minimize erosion as a result of wind, rainfall, or runoff, establishing temporary vegetation cover, and reclaiming the final slopes in temporarily disturbed areas in accordance with the Reclamation and Closure Plan (Chapter 4 of the Joint MA/EMA Application; BW Gold 2022).

The type of ESC measure will be selected based on site-specific conditions such as:

- Site erosion potential classification;
- Area of up-gradient soil exposure;
- Terrain conditions and space constraints;
- Construction method;
- Anticipated concentrated rainfall amounts due to ditching or drainage pattern changes; and
- Level of risk to the receiving environment.

Environmental monitoring procedures and associated actions are described in Section 9. Performance monitoring and routine inspection of ESC measures are described in Section 11.

7.2 Procedural Controls

A work schedule that coordinates the timing of land-disturbing activities and the installation of ESC measures is a cost-effective way to help reduce erosion risk. Runoff-control measures and diversions should be installed up-gradient of areas to be disturbed prior to grading. Principal sediment basins and traps should be installed before any major site grading takes place, and additional sediment traps and sediment fences should be erected as grading takes place to keep sediment contained on-site at appropriate locations. In steeper terrains, where construction of sediment basins may not be feasible, a combination of silt retention structures and filter bags may be employed, or diversion ditches may redirect flows to an area of flatter terrain where a sediment basin may be implemented.

7.3 Sediment Control Ponds

SCPs will be designed following the BC MOE (2015b) guidance document on size and operation of sediment ponds. SCPs will be designed to accommodate a live storage equal to an established storm event with freeboard; these will depend on the size of the runoff area and the life of the structure. The minimum design flow for removal of suspended solids in sediment ponds should correspond to the one in 10-year, 24-hour storm event. The ponds may also be designed with spillways to convey larger storm events to maintain a minimum 0.5 m freeboard on the embankment during the structural design run-off event (minimum 1 in 200 years; BC MOE 2015b). The SCPs will be designed following the BC MOE (2015b) recommendation that sediment ponds capture at least a 10 micron soil particle for the 10-year, 24-hour runoff event. Particle size analyses (the fraction of minus 2 and minus 10 micron particles) in representative soil samples will be determined, along with settling analysis required for effective sediment pond design, if required. Predicted discharge frequency and duration will be included for each pond (e.g., intermittent, continuous, or only when impounded water quality meets discharge criteria set out in applicable tables in Section 9). SCP outlets will include energy dissipation mechanisms to reduce the potential for erosion in the downslope environment: these mechanisms may include a dissipation pool/energy basin. Typical pond plan and outlet structure details are shown on Drawing C3803 (Appendix A).

The intent of this document is to outline strategies and design objectives, with appropriate flexibility, to allow the facilities to be field-fit to suit the site conditions encountered: the requirement for and location of the final SCPs will be based on the detailed facility designs.

Design information for the SCPs for the following facilities are appended:

- Appendix C: Downstream Aggregate borrow area
- Appendix D: Camp site (to be constructed pending approval)
- Appendix E: Plant site

Construction of the Camp Site SCP is not currently approved under the *Mines Act* Permit: monitoring requirements and discharge criteria will be included in future iterations of this SEPSCP. Design details for TSF C Main Dam SCP can be found in the TSF Stage 1 Detailed Design Report (KP 2022a).

During Operations Year+1 through Year+6 the construction SCPs will remain at the aggregate screening area and the camp. During Year+7 through Year+16 a new Aggregate Screening Area will be established and a SCP implemented: the camp and new Aggregate Screening Area SCPs will remain until closure.

7.4 Best Management Practices

The ESC BMPs are described in the following sections, with typical design criteria. Specific measures to be implemented for each work area will be identified in the field prior to the construction activity. If monitoring indicates that additional BMPs are required, they will be implemented based on the guidance of the EM and design engineer. Prior to construction, design reports will be prepared for the Project facilities and will include IFC drawings, which will supersede the typical design information presented herein. Typical sections and BMP details are provided in the drawings in Appendix A. The BMPs presented in Appendix A are considered to be consistent with standard ESC practices and are considered to be sufficient in scope for this Project. The BMPs are generic in nature and are intended to provide general guidance for potential ESC scenarios.

7.4.1 Sediment Basins

A sediment basin is a temporary structure that is used to detain runoff from small drainage areas to settle out sediment. The basin is typically maintained until the site is permanently protected against erosion by vegetation and/or structures. Sediment basins are generally located in areas where access can be maintained for sediment removal and proper disposal. Sediment basins are typically constructed at the end of collection ditches to detain sediment-laden runoff long enough to allow the majority of the sediment to settle out to comply with water quality objectives. A sediment basin can be created by excavating a basin, utilizing an existing depression, or constructing a dam on a slight slope downward from the work area. Sediment-laden runoff from the disturbed site is conveyed to the basin via ditches, slope drains, or diversion structures. The efficacy of sediment basins is largely dictated by the extent to which they are properly sized and constructed as designed; whether the banks are stabilized immediately following construction; and the extent to which they are regularly cleaned out / maintained.

Sediment basins may be prescribed during construction on an as-required basis, based on conditions encountered. The implementation of these will be at the direction of the supervising engineer or the Environmental Monitor. The sediment removed from the pond may be disposed of in an authorized discharge location or to an alternative location approved by the director, as per the EMA PE-110652 Condition 3.1 for sediment removed from SCPs.

The size of the temporary sediment basins is dependent on the size of the drainage areas. The exact locations and final geometry of each basin, as well as overland discharge points, will be field-fit to minimize disturbance. The supervising engineer or their designate will approve the sizing and location of the basins prior to construction. Three sizes of sediment basin (designated SB1, SB2, and SB3) are used for different size drainage areas, as summarized in Table 7-1. The width and length dimensions correspond to the top of the wet storage area, at the base of the outlet structure.

Table 7-1: Recommended Configuration of Sediment Basins

Specification	SB1	SB2	SB3
Drainage Area (hectares)	<0.5	0.5 – 1	1 - 2
Length: Width1 (m)	5:1	5:1	5:1
Depth of Wet Storage Excavation (m)	1	1	1
Embankment Height of Rock Outlet (m)	0.5	1	1
Minimum Spillway Weir Length (m)	1	2	3

Source BC ENV (2015b)

Sediment basins will be inspected as outlined in Section 11, by personnel as outlined in Section 3, and cleaned out when the sediment has accumulated to one-half of the designed wet storage volume.

The outlet will be checked regularly (see Section 11.1 for a discussion of monitoring frequency) for sediment build-up that could prevent drainage and limit the overall carrying capacity of the basin. If the outlet is clogged by sediment, it will be cleaned or replaced. If sediment basins are needed, maintenance and inspection activities will be implemented, as outlined in Section 11. A typical configuration for a sediment basin is shown on Drawing C3803 (Appendix A).

7.4.2 Flocculants

Flocculants are commercial products used to increase the rate of sedimentation in a SCP by increasing aggregation of fine sediments. Flocculants can be used to enhance removal of suspended sediment, particularly in situations where the sediment-laden water cannot be detained long enough to allow particles to settle (i.e., when turbidity levels are high and adequate detention times cannot be provided). Flocculants used will be:

- Non-acutely toxic to fish, aquatic organisms, wildlife, and plants;
- Biodegradable;
- Legal for use in Canada; and
- Accompanied with a Safety Data Sheet containing toxicity information confirming that the product is not toxic to aquatic life.

Written approval from a BC ENV Environmental Protection Mining Team Statutory Decision Maker is required prior to the use of settling aids. The approval request must describe the 96 Hour LC50 concentration, as well as details of the settling aid addition rate (and control method), mixing conditions, and conditioning time/facilities (BC MOE 2015b). Flocculants will be used to prevent damage to sensitive water resources such as streams or whenever turbidity control is required and will only be used after all appropriate physical BMPs have been implemented. The use of flocculants is soil-type dependent and requires a screening process to determine the best chemical for each specific location. If flocculants will

be used, the written manufacturer's instructions describing correct use of the product (e.g., dosage and settling time recommendations), site preparation, application, inspection, maintenance, and storage, will be followed.

The site EM or Environmental Staff will monitor water quality and flocculant dosage for discharge compliance with applicable water quality guidelines where water is being discharged to a watercourse.

7.4.3 Culverts

Cross-drain culverts will be constructed along access and haul road alignments to carry ditchwater from one side of the road to the other. Culverts that pass surface runoff beneath the roads can be combined with Check Dams and Collection Ditches. Spacing of culverts along road alignments is dependent on both the grade and skew of the road, and the erosion hazard level. Culverts will be spaced at intervals necessary to minimize erosion of the roadside ditchline (BC MOF 2022).

The guidance in Table 7-2 can be used by site staff to determine the maximum spacing for cross-drain culverts between established watercourses.

Table 7-2: Culvert Spacing Guidance

Erosion Hazard	**Slight**	**Moderate**	**High**
More than 50% by Soil Type	**Hardpan, Rock, Course Gravels**	**Fine Gravels**	**Sands, Silts, Clays**
Road Gradient			
0-3%	350 m	300 m	200 m
3-6%	300 m	200 m	150 m
6-9%	250 m	150 m	100 m
9-12%	200 m	100 m	75 m
12%+	150 m	100 m	100 m + rock line the ditch

Source: BC Ministry of Forests, 2022.

7.4.4 Diversion Ditches and Structures

Diversion ditches (DD) will be constructed upgradient of disturbed areas to intercept clean surface water runoff and convey it around areas to be disturbed to avoid excessive sheet flow. All DDs will discharge through a stabilized outlet designed to handle the expected runoff velocities and volumes from the ditch without scouring. Each DD type will provide a minimum freeboard of 0.3 m between the top of flow and the ditch crest.

Two types of DD may be required: Type 1 (DD1) ditch in soil and Type 2 (DD2) ditch in rock. Whether ditch cross section type DD1 or DD2 is built will depend on site conditions during construction. Dimensions for the two types of diversion ditches are presented in Table 7-3.

Table 7-3: Recommended Diversion Ditch Dimensions

Dimension	DD1	DD2
Bottom width (mm)	500	500
Side slopes	2H:1V	0.5H:1V
Minimum Depth (mm)	500	500

Notes:

1. *V-shaped diversion ditches may also be constructed; design criteria will be provided in design reports and drawings.*
2. *Riprap size shall be selected to resist maximum allowable flow velocity within the ditch*

Type 1 DDs (DD1) are best installed with filter fabric to be placed along the base and sides of the ditch prior to placement of riprap. Fabric is placed continuously to maintain intimate contact with the base soil. Fabric is installed so that upstream strips overlap downstream strips by a minimum of 500 mm or as per recommended by manufacturer. Riprap will be placed so as to form a dense, uniform, well-graded mass with few voids. As an alternative to riprap, the DDs may be lined with a bituminous geomembrane HDPE liner, used conveyor belting, check dams, or other equivalent along with a monitoring, surveillance, and contingency program.

DDs will be inspected and maintained regularly as per Section 11. Typical diversion ditch designs are shown on Drawing C3803 (Appendix A).

7.4.5 Collection Ditches

A runoff collection ditch (CD) intercepts contact water runoff from disturbed areas and diverts it to a stabilized area where it can be effectively managed. CDs are used within construction areas to collect runoff and convey it to appropriate sediment control measures. Where fine grained soils are exposed, appropriate erosion protection materials will be installed based on the estimated magnitude of flow and flow velocity. General locations and conditions may include:

- Below disturbed slopes to divert sediment-laden water to control facilities;
- At or near the perimeter of the construction area to prevent sediment-laden runoff from leaving the site; and
- Below disturbed areas before stabilization to prevent erosion if stabilization measures cannot be implemented immediately.

CDs may be either temporary or permanent structures. Two types of CDs may be required: Type 1 (CD1) ditch in soil and Type 2 (CD2) ditch in rock. Whether ditch cross section type CD1 or CD2 is built will depend on site conditions. Dimension for the two types of CDs are presented in Table 7-4. Each CD type will provide a minimum freeboard of 0.5 m between the top of flow and the ditch crest.

Table 7-4: Recommended Collection Ditch Dimensions

Dimensions	**CD1**	**CD2**
Bottom width (mm)	500	500
Side slopes	2H:1V	0.5H:1V
Minimum Depth (mm)	500	500

Notes:

1. *V-shaped collection ditches may also be constructed; design criteria will be provided in design reports and drawings.*
2. *Riprap size shall be selected to resist maximum allowable flow velocity within the ditch*

Type 1 CD (CD1) are best installed with filter fabric to be placed along the base and sides of the ditch prior to placement of riprap. Fabric is placed continuously to maintain intimate contact with the base soil. Fabric will be installed so that upstream strips overlap downstream strips by a minimum of 500 mm. Riprap will be placed so as to form a dense, uniform, well-graded mass with few voids, and some hand placement may be necessary to obtain good size distribution. As an alternative to riprap, the collection ditches may be lined with a bituminous geomembrane or HDPE liner, used conveyor belting or check dams will be used along with a monitoring, surveillance, and contingency program.

CDs will be inspected and maintained regularly as per Section 11. Typical CD designs are shown on Drawing C3803 (Appendix A).

7.4.6 Rock Check Dams

Rock check dams are small dams constructed across swales, drainage ditches, and waterways to avoid erosion by reducing flow velocity. Rock check dams accomplish this by interrupting the flow of water to form small ponds, thereby flattening the surface of the water, and reducing the velocity of flow (Government of Alberta 2011). The obstructions induce infiltration and reduce erosion potential. Check dams are also used to distribute flows across a swale to avoid preferential paths and guide flows towards vegetation.

Rock Check Dams along the centreline of Collection or Diversion Ditches should form an asymmetrical triangle with the bottom of the ditch. Dam slopes of 3H:1V downstream and 2H:1V upstream are typical; however, the check dams will be field-fit based on site conditions and as approved by a CPESC. The rock check dams will be spaced such that top of the middle of each downstream check dam is at the same elevation as the base of the previous dam - dam spacing and rock size will be determined by the supervising engineer based on hydraulic conditions and gradient (Toronto and Region Conservation Authority 2019). Rock Check Dams should be installed on all ditches exceeding 6.0% grade. Rock Check Dam construction should start from the downstream end of the ditch and be constructed upstream from that point. A minimum 100 mm deep trench should be excavated for the entire footprint of the Rock Check Dam, and spoiled material must be removed from the site. Typical configurations for a rock check dam are shown on Drawing C3805 (Appendix A).

Rock Check Dams require regular maintenance and should be inspected regularly, as outlined in Section 11. It is important that rubble, litter, and leaves are removed from the upstream side of the dam. This is typically done when the sediment has reached a height of one-half of the original height of the dam.

7.4.7 Straw Bale Check Dams

Straw bale check dams are small, temporary dams constructed of straw bales as drop structures placed across channels to reduce a steep grade to intervals of flatter grades. Straw bale check dams are used for (Government of Alberta 2011):

- Small open channels that have a drainage area of ≤2 ha;
- Channels with grade of <5%; and
- Flow velocities of <0.3 m/s.

Straw bale check dams are recommended to be a maximum of one straw bale in height, or 0.5 m maximum; however, the configuration will be field-fit based on site conditions and as approved by a CPESC. Straw bales should be machine-made; weed free cereal crop straw such as wheat, oats, rye, or barley; tightly compacted and bound with two rows of wire or synthetic string; and show no signs of weathering and be no more than year old (Government of Alberta 2011).

Structures will be inspected with increased frequency during spring freshet and after significant rainfall events as per Section 11. Typical configurations for a straw bale check dam are shown on Drawing C3801 (Appendix A).

7.4.8 Energy Dissipators

Energy dissipators are pools used to dissipate the energy of fast flowing water and control erosion at the outlet of a ditch or a conduit passing water to minimize erosion of natural stream channels downstream. The energy dissipator will be set at zero grade and aligned straight with the direction of flow at the outlet and constructed flush with the surrounding grade.

These structures are used in conjunction with diversion of non-contact water around construction areas and with DDs and are typically located upstream of a receiving water body (e.g., stream, pond, lake, etc.). Typical configurations for a rock check dam are shown on Drawing C3804 (Appendix A).

7.4.9 Slope Drains

Slope drains consist of flexible tubing or conduit and are required to convey concentrated runoff from the top to the bottom of a cut or fill slope into the appropriate BMP when ditches are deemed impractical (i.e., at steep ditch gradients, or unfavourable side slopes for ditch construction). Additionally, slope drains may be used in conjunction with rock check dams at the inlet to reduce velocities and to drain collection ditches into stabilized outlets. The entrance section to the drains will be well-entrenched and stable so that surface water can enter freely, and the drain will extend downslope beyond the toe of the slope to a stable area. The minimum slope drain diameter will be sized according to the contributing drainage area summarized in Table 7-5.

Table 7-5: Recommended Slope Drain Sizing

Drainage Area (Hectare)	Pipe Diameter (mm)
0.2	300
0.6	450
1.0	530
1.4	600
2.0	900

Source: Government of Alberta (2011).

Typical configurations for a pipe slope drain are shown on C3805 (Appendix A). Slope drains will be inspected and maintained as per Section 11, Inspections will identify where any blocked or damaged parts will need to be cleaned, repaired, or removed and replaced. In particular, sediment should be removed from the upslope inflow area to prevent downslope sediment transport, which may cause plugging of the drainpipe and overtopping of the structure.

7.4.10 Slope Texturing /Surface Roughening

Slope texturing is a temporary soil stabilization measure that may be used on fresh cut or fill slopes with gradients of generally 3H:1V or steeper in cohesive soils. Exposed soils on a slope surface are roughened in the direction of water flow to minimize erosion and to entrap some sediments and can be used on slope subgrades that will not be immediately topsoiled, vegetated or stabilized by other means. Surface Roughening activities will also help to mitigate the effects of wind erosion.

The roughening will be carried out by a tracked machine moving up and down the slope surfaces to create grooves perpendicular to the slope, creating undulations on the soil surface, as shown on Drawing C3801 (Appendix A). The number of tracking passes will be minimized to avoid over compaction; surface roughening and tracking will not be used in areas with sandy silt soil types to minimize sloughing.

Alternative measures for slope texturing include grooved or serrated slopes (excavating shallow furrows across the width of the slope, perpendicular to the direction of the slope) or benched slopes (construction of narrow, flatter sections of soil on the slope, perpendicular to the direction of the slope) (Government of Alberta 2011). Benching is usually a permanent slope design feature and should only be designed by a qualified geotechnical engineer. These procedures are simple, inexpensive, and provide immediate short-term erosion control for bare soil where vegetative cover is not yet established. Slope texturing/surface roughening are to be used in conjunction with other erosion and sediment control measures such as temporary seeding, mulching, or covering with a rolled erosion control blanket to help control erosion during construction.

Final graded areas outside of construction and operation areas shall have the appropriate permanent surface protection in conformance with the requirements of the Vegetation Management Plan and the Reclamation and Closure Plan. Reclamation measures on final graded slopes outside of construction and operation areas could include placement of coarse woody debris in “rough and loose surface treatments”, which involves opening holes on the slope, dumping the material that is generated from the holes in mounds between the holes (Polster 2013), similar to the vegetation and cover trials using mounding or using coarse woody debris to create microsites for seedlings, as described in Section 4.2.5.1 (Lower Waste Stockpile) of BW Gold (2022).

For more details on activities resulting in fugitive dust by Project phases, refer to Section 6 Table 6-1 of the AQDMP. Activities resulting in fugitive dust include wind erosion from exposed TSF beach and stockpiles.

7.4.11 Filter Bags

Filter bags are generally constructed from a sturdy non-woven geotextile capable of capturing particles larger than 150 microns. Filter bags will be installed at the discharge end of pumped diversion pipelines, via fabric flange fittings, to remove fine grained materials before discharging to the environment, as needed. Filter bags are generally temporary sediment control measures. Filter bags are installed on flat, stable, non-erodible foundations, or in well vegetated areas. The pumping rate is specified by the manufacturer. Discharge from filter bags is routed to avoid erosion.

A smaller variety of filter bags, referred to as filter socks, can be installed on the discharge ends of gravity flow pipes, such as slope drains, to filter silt particles before discharging to the environment. Filter bags will be inspected regularly when in use for defects, rips, tears, sediment accumulation, and erosion of the surrounding area. Once the used bag is fully drained, the bag and its contents can be disposed of as solid waste. A typical filter bag plan and cross section is provided on Drawing C3802 (Appendix A).

7.4.12 Waterbars

Waterbars, shown on Drawing C3802 (Appendix A), are ridges or ridges and channels constructed diagonally across a sloping road or right-of-way to limit the accumulation of erosive volumes of water at pre-designed intervals. Waterbars reduce sheet flow and surface erosion of areas of exposed soil and/or roads by diverting runoff towards a stable vegetated area or diversion ditch. Configuration and spacing of waterbars will be field-fit based on slope grade, general erodibility of the surface, and anticipated flows. Waterbars will not direct runoff into a ditch that channels water toward a watercourse unless the ditch is adequately designed with check dams and armouring where appropriate. The crossing angle will be selected to provide a positive grade less than 2%.

The approximate spacing of waterbars is summarized in Table 7-6 and will be field-fit to locate the outlet in stable natural areas, where possible. Waterbars will be inspected as outlined in Section 11, and sediment will be removed from the flow and outlet areas as needed.

Table 7-6: Recommended Waterbar Spacing

Grade (%)	Waterbar Interval (m)
< 5	35
5 – 10	30
10 – 20	20
20 – 35	15
>35	7.5

Source: North Carolina Department of Environment and Natural Resources (2013).

If, during the periodic inspections, impacts to vegetated areas are observed (e.g., scour as a result of erosive volumes of water), adaptive management measures will be implemented, which may include installation of additional water bars.

7.4.13 Silt Retention Structures

Silt fences are temporary sediment control devices used to protect water quality in nearby watercourses from sediment present in stormwater runoff, by forcing low volumes of overland flow to pool, allowing sediment to settle out of suspension. Silt fences are typically installed downslope of erosion-susceptible terrain to prevent sediment-laden sheet flow from entering receiving waters. Intercepted drainage pools along the uphill side of the fence to promote sediment settling. Additionally, they help to mitigate effects of wind erosion. Drainage in contact with the fence is filtered through geotextile. The small pores of the silt fence will filter coarse particles (fine sand to coarse silt) and restrict water exfiltration rates. Barrier locations are field-fit based on-site features and conditions (e.g., soil types, climate, terrain features, sensitive areas, etc.), design plans, existing and anticipated drainage courses, and other available ESC measures. Typical barrier sites are catch points beyond the toe of fill, or on side slopes above waterways or drainage channels.

Silt fencing will be trenched according to Drawing C3801(Appendix A) for proper anchoring. The design criteria for silt fences includes:

- The size of the drainage area shall be no greater than 0.1 hectare per 30 m length of fence;
- Maximum flow path length above silt fence should be no greater than 30 m; and

- Maximum slope gradient above the silt fence should be no greater than 2H:1V.

Silt fences shall be inspected in conformance with Section 11 for damages, tears, clogging, or erosion of the surrounding areas. Damaged sections shall be repaired or replaced to maintain their functionality.

An alternative to a silt fence is a sediment retention berm, which is a small (approximately 600 mm high) berm that is constructed using random fill material (rock, wood chips, soil, topsoil, coarse woody debris). Sediment retention berms do not require removal of the underlying vegetation; however, voids along the base of the berm must be minimized.

For more details on activities resulting in fugitive dust by Project phases, refer to Section 6, Table 6-1 of the AQDMP. Activities resulting in fugitive dust include wind erosion from exposed TSF beach and stockpiles. Having Silt Retention Structures in place, will help to mitigate the effects of wind erosion.

7.4.14 Floating Silt Curtains

Floating silt curtains will be used in SCPs as needed to increase flow length, and in construction areas in low flow or standing water to allow disturbed sediment to be contained at the source. Silt curtains are vinyl barriers of varying lengths and heights, held in suspension by heavy duty float line and anchored using a ballast weight chain. Silt curtains are typically placed around a site or shoreline as close as possible to the disturbance area to allow sediment to be contained at the source.

The main purpose of the silt curtain is to allow displaced sediment enough time to settle back down to the bottom of the SCP or natural waterbody: the specific length of time required for the curtain to remain in position will vary depending on the type of sediment and/or silt to be contained, and the construction activities. Typical configurations for a turbidity curtain are shown on Drawing C3805 (Appendix A).

7.4.15 Temporary Seeding

Temporarily disturbed areas and exposed slopes with an observed risk to erosion and sediment transport will be seeded (as required at the direction of the EM) for initial soil stabilization using quick establishing weed-free seed mixes (native and approved non-native). The proposed seed mix will be comprised of the following species:

- Slender wheatgrass (*Elymus trachycaulus*);
- Rocky mountain fescue (*Festuca saximontana*);
- Tufted hairgrass (*Deschampsia caespitosa*); and
- Northern sweetvetch (*Hedysarum boreale*).

The purpose of temporary seeding is to stabilize the soil and reduce damage from wind and/or water until permanent stabilization is accomplished. Seeding is applicable to areas that are exposed with an observed risk to erosion and sediment transport and subject to erosion for more than 30 days, and is usually accompanied by surface preparation, fertilizer, and mulch; however, the timing of seeding is weather and season dependent and consequently this method is not applicable at all times.

Temporary seeding may be accomplished by hand or mechanical methods, or by hydraulic application (hydroseeding), which incorporates seed, water, fertilizer, and mulch into a homogeneous mixture (slurry) that is sprayed onto the soil. Selection of seeding methods will be site-specific

Fertilizer will not be used at the mine site with the exception of site-specific cases. In the case that fertilizer is proven to be an effective method for seed establishment or is for the purpose of reclamation research trials, BW Gold will seek consensus from Indigenous nations prior to use of fertilizer. A workplan

will be developed prior to use, detailing how the fertilizer will be applied and mitigations to avoid fertilizer entering waterbodies.

These mitigations along with conventional ESC measures such as silt fencing, straw bales, and multi-barrier approaches are the measures that will be used to ensure fertilizer runoff does not enter water bodies. For additional information on seeding soil stockpiles refer to Section 10.4 of the Soil Management Plan and for a description of permanent seeding mixes refer to Section 4.2.2.3 BW Gold (2022). The intended duration of time for temporary seeding will be site and activity specific.

For more details on activities resulting in fugitive dust by Project phases, refer to Section 6, Table 6-1 of the AQDMP. Activities resulting in fugitive dust include wind erosion from exposed TSF beach and stockpiles. Performing temporary seeding will help to mitigate the effects of wind erosion.

7.4.16 Mulching

Mulching is the application of a uniform protective layer of straw, wood fiber, wood chips, or other acceptable material on or incorporated into the soil surface of a seeded area to allow for the immediate protection of the seed bed. The purpose of mulching is to protect the soil surface from the forces of raindrop impact and overland flow, foster the growth of vegetation, increase infiltration, reduce evaporation, insulate the soil, and suppress weed growth. Mulching also helps to hold fertilizer, seed, and topsoil in place in the presence of wind, rain, and runoff, and reduces the need for watering. Mulching may be utilized in areas that have been seeded either for temporary or permanent cover.

There are two basic types of mulches: organic mulches and chemical mulches. Organic mulches likely to be used include straw, hay, wood fiber, wood chips, and bark chips. All organic mulches will be certified weed-free. This type of mulch is usually spread by hand or by machine (mulch blower) after seed, water, and fertilizer have been applied. Chemical mulches, also known as soil binders or tackifiers, are composed of a variety of synthetic materials. Chemical mulches are usually mixed with organic mulches as a tacking agent to aid in the stabilization process, and are not typically used as the sole control, except in cases where temporary dust and erosion control is required. The choice of materials for mulching will be based on soil conditions, season, type of vegetation, and the size of the area.

For more details on activities resulting in fugitive dust by Project phases, refer to Section 6, Table 6-1 of the AQDMP. Activities resulting in fugitive dust include wind erosion from exposed TSF beach and stockpiles. Mulching will help to mitigate the effects of wind erosion.

7.4.17 Rolled Erosion Control Product

Rolled erosion control products such as blankets, nets, and matting, are manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment, and protection of vegetation. Nets are made of high tensile material woven into an open net which overlays mulch materials. Blankets are made of interlocking fibers, typically held together by a biodegradable or photodegradable netting; blankets generally have lower tensile strength than nets but cover the ground more completely. Rolled erosion control products will be used when mulch cannot be adequately tacked and where immediate ground cover is required to prevent erosion damage and will be used to aid permanent vegetated stabilization of slopes 2:1 or greater. Typical configurations for rolled erosion control products are shown on Drawing C3804 (Appendix A).

An alternative to the high tensile material woven blanket is a hemp fibre erosion control blanket comprised of fibres that are 100% biodegradable and created without the use of polypropylene netting. The hemp fibre blankets can be used for slope protection (for slopes up to 1H:1V) and on culvert inlets and outlets.

The rolled erosion control products will be monitored and repaired as necessary until ground cover is established. Products will be inspected weekly at a minimum and before and after each significant rainfall event.

For more details on activities resulting in fugitive dust by Project phases, refer to Section 6, Table 6-1 of the AQDMP. Activities resulting in fugitive dust include wind erosion from exposed TSF beach and stockpiles. Having Rolled Erosion Control Product in place, will help to mitigate the effects of wind erosion.

7.4.18 Polyethylene Cover

Polyethylene sheets can be used to temporarily (less than two years) cover newly exposed soil (slopes and stockpiles) in situations when time does not permit other more permanent solutions to be applied. Soil that has high erosion potential will be covered immediately if a precipitation event is forecast. Strips of polyethylene should overlap each other in a configuration that prevents water from running underneath adjacent sheets. Runoff should be directed into an appropriate non-erodible or armoured drainage channel. Typical configurations for a cover on a stockpile are shown on Drawing C3805 (Appendix A).

For more details on activities resulting in fugitive dust by Project phases, refer to Section 6, Table 6-1 of the AQDMP. Activities resulting in fugitive dust include wind erosion from exposed TSF beach and stockpiles. Having Polyethylene Cover in place will help to mitigate the effects of wind erosion.

8.0 Plan Implementation

8.1 Training and Awareness

All staff and subcontractors responsible for the management, implementation, monitoring, and reporting of ESC measures will be experienced and will receive training specific to their roles in this plan prior to the commencement of their work. As indicated in Section 3 (Table 3-1), ESC measures will be installed/constructed based on plans and according to design specifications approved by and under the supervision of a CPESC. Environmental Staff (including persons designated as CPESC) will be responsible for tracking and reporting on environmental permit obligations through field-based monitoring programs and will provide training to staff and subcontractors responsible for the management and implementation of ESC measures.

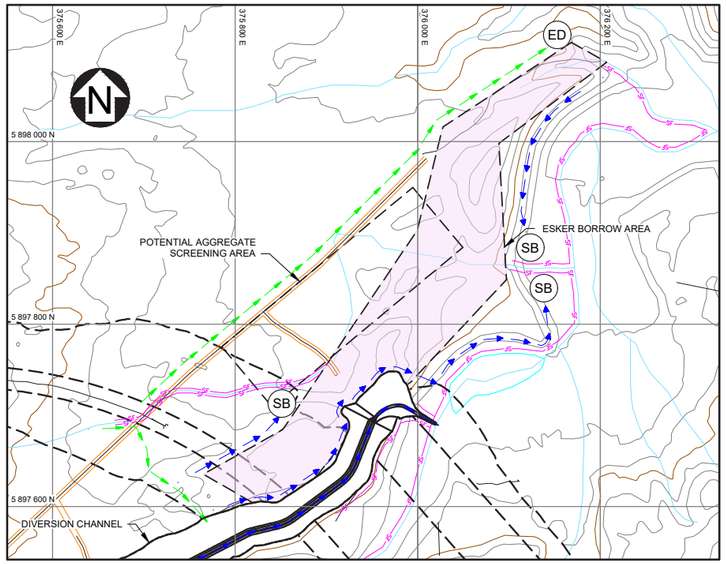
ESC refresher training will be provided annually or as needed to site staff involved in installation, monitoring, inspections and replacement of ESC measures.

8.2 Construction Sequencing

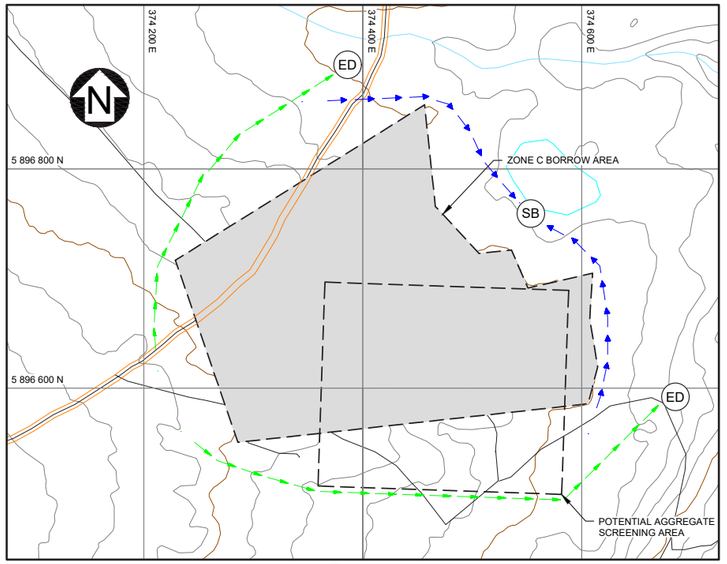
Construction activities will be performed in sequence to minimize the area of exposed soils. Earthworks crews will establish all sediment control measures during the initial stages of construction to minimize sediment loading to natural watercourses. An example of the planned order of construction activities for a cut and fill slope is as follows:

1. Install ESC measures as directed by the Environmental Monitor or the CM.
2. Clear and strip work areas as required and link directly all ESC measures associated with each construction stage and area.
3. Provide temporary erosion control measures for cut slopes.
4. Construct components to design lines and grades shown on Drawings.
5. Provide temporary erosion control measures for fill slopes.
6. Complete final stabilization and seeding of disturbed surfaces and slopes.
7. Reclaim temporary ESC measures.

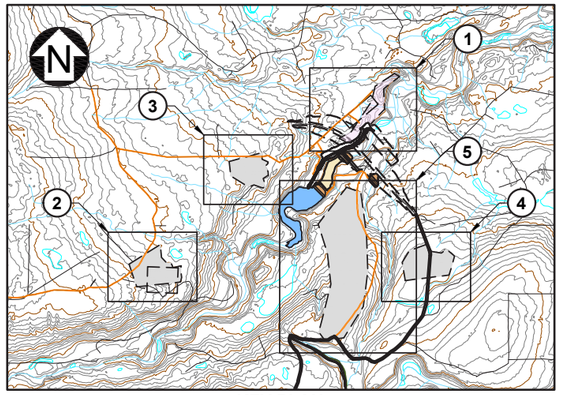
Detailed construction activities and the order in which they will be implemented for each activity or disturbance area will be provided on the drawings prior to construction or as otherwise required by the *Mines Act* Permit. The ESC measures will primarily be field-fit based on conditions encountered in the field, under the direction of the EM or Environmental Staff. Examples of how ESC measures may be implemented for construction of Main Dam C, the Water Management Pond, and Main Dam D are shown on Figures 8-1 through 8-7.



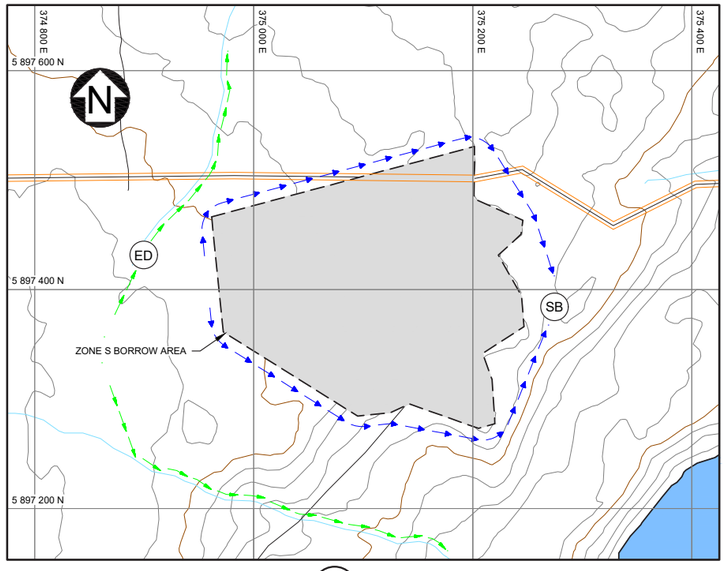
1 - FIG. **PLAN** SCALE A



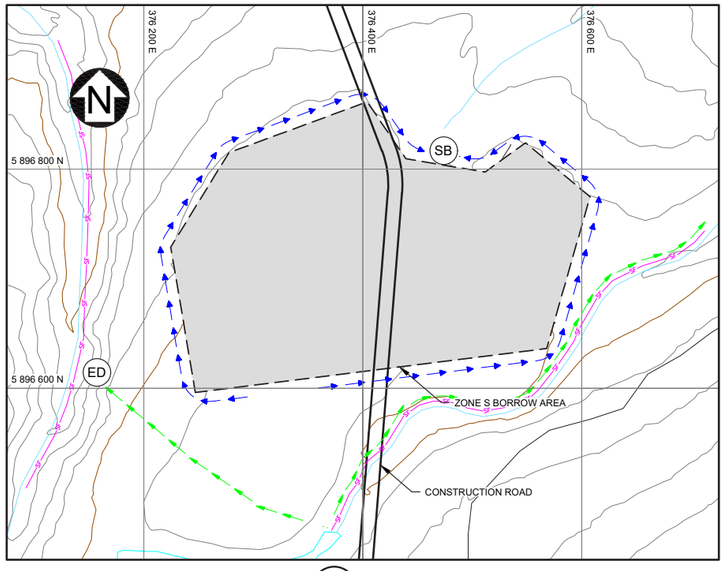
2 - FIG. **PLAN** SCALE B



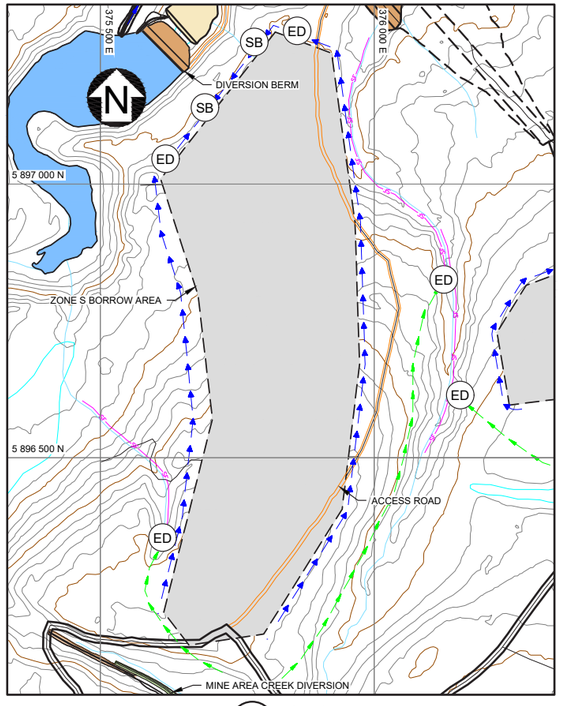
KEY PLAN
NTS



3 - FIG. **PLAN** SCALE B



4 - FIG. **PLAN** SCALE B



5 - FIG. **PLAN** SCALE C

LEGEND:

- FRESH WATER
- EMBANKMENT FILL
- ESKER BORROW (ESKER)
- BORROW AREA (ZONES S AND C)
- ACCESS ROAD
- EXISTING ACCESS TRAILS
- CONSTRUCTION ROAD

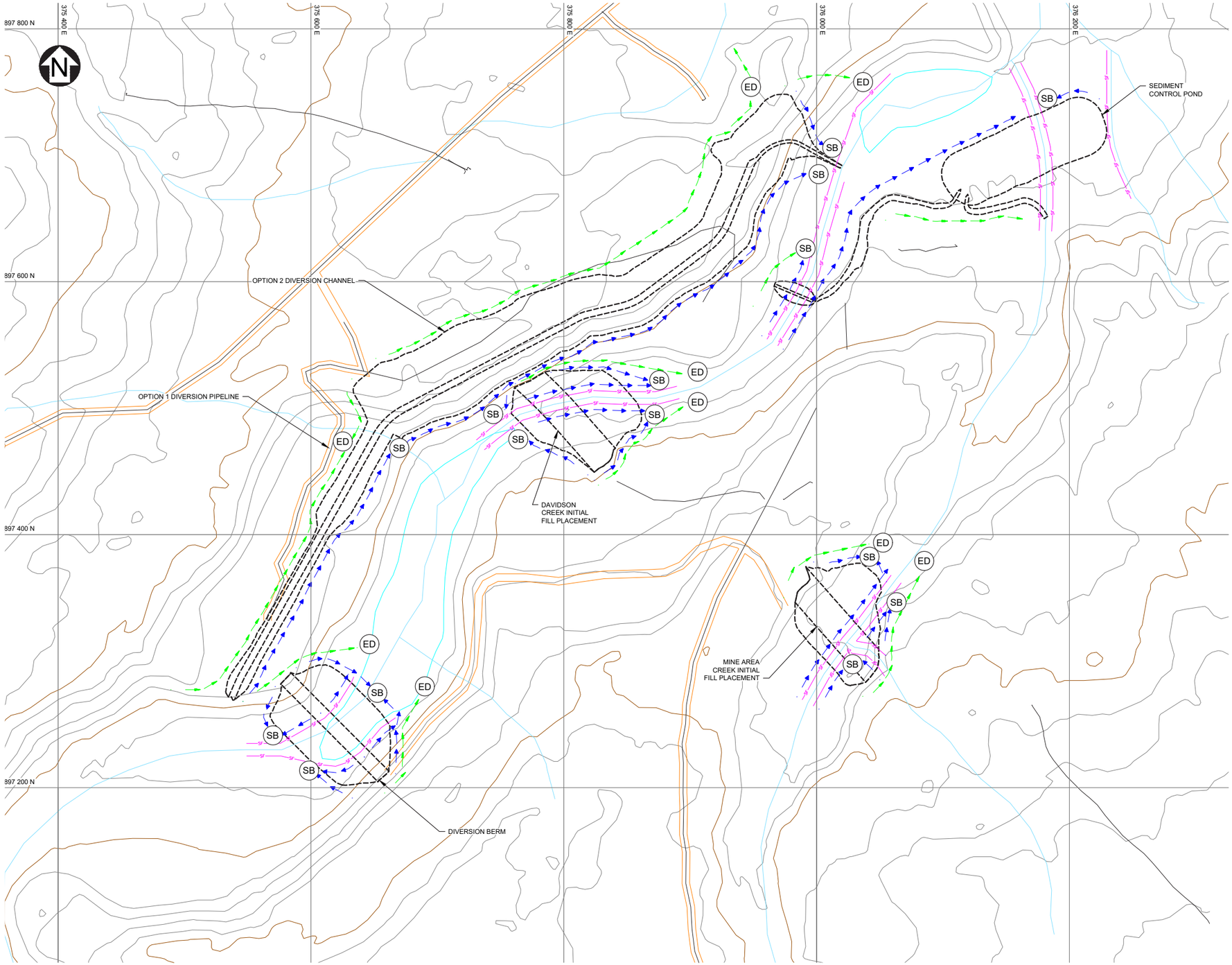
- CD — COLLECTION DITCH
- DD — DIVERSION DITCH
- SF — SILT FENCE
- ED — ENERGY DISSIPATER
- SB — SEDIMENT BASIN

FOR INFORMATION ONLY

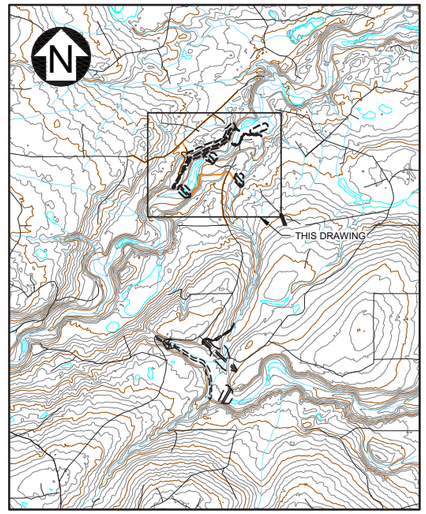
SCALE C: 100 50 0 100 200 300 400 500 m
SCALE B: 50 25 0 50 100 150 200 250 m
SCALE A: 60 30 0 100 200 300 m

Figure 8-1: Site Borrow Areas General Arrangement – Erosion and Sediment Control Plan

Source: Knight Piésold Consulting (2021).



PLAN
SCALE A



KEY PLAN
NTS

LEGEND:

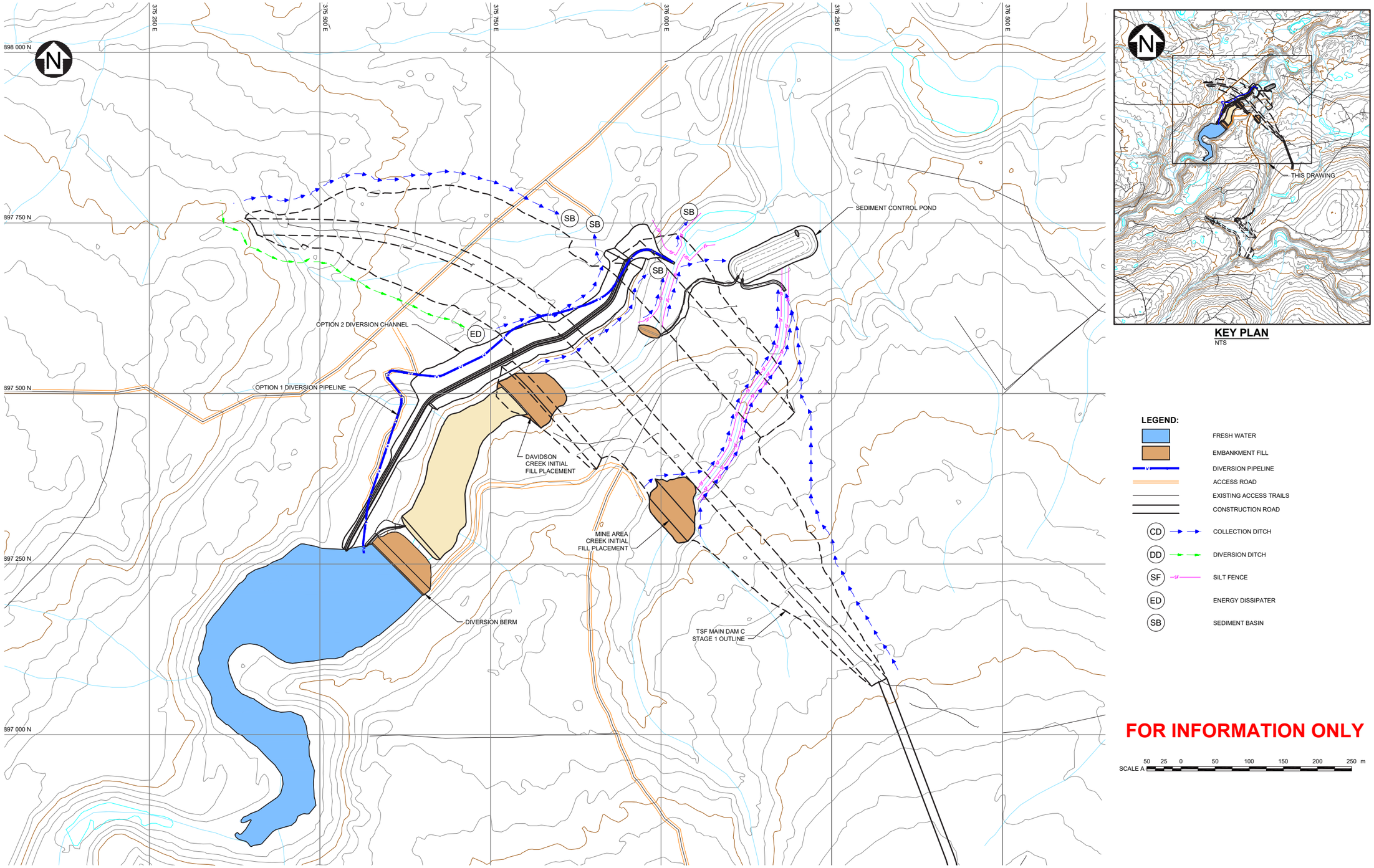
- ACCESS ROAD
- EXISTING ACCESS TRAILS
- CONSTRUCTION ROAD
- CD — COLLECTION DITCH
- DD — DIVERSION DITCH
- SF — SILT FENCE
- ED — ENERGY DISSIPATER
- SB — SEDIMENT BASIN

FOR INFORMATION ONLY

SCALE A 50 25 0 50 100 150 200 250 m

Figure 8-2: Main Dam C Site Establishment – Erosion and Sediment Control Plan

Source: Knight Piésold Consulting (2021).



KEY PLAN
NTS

LEGEND:

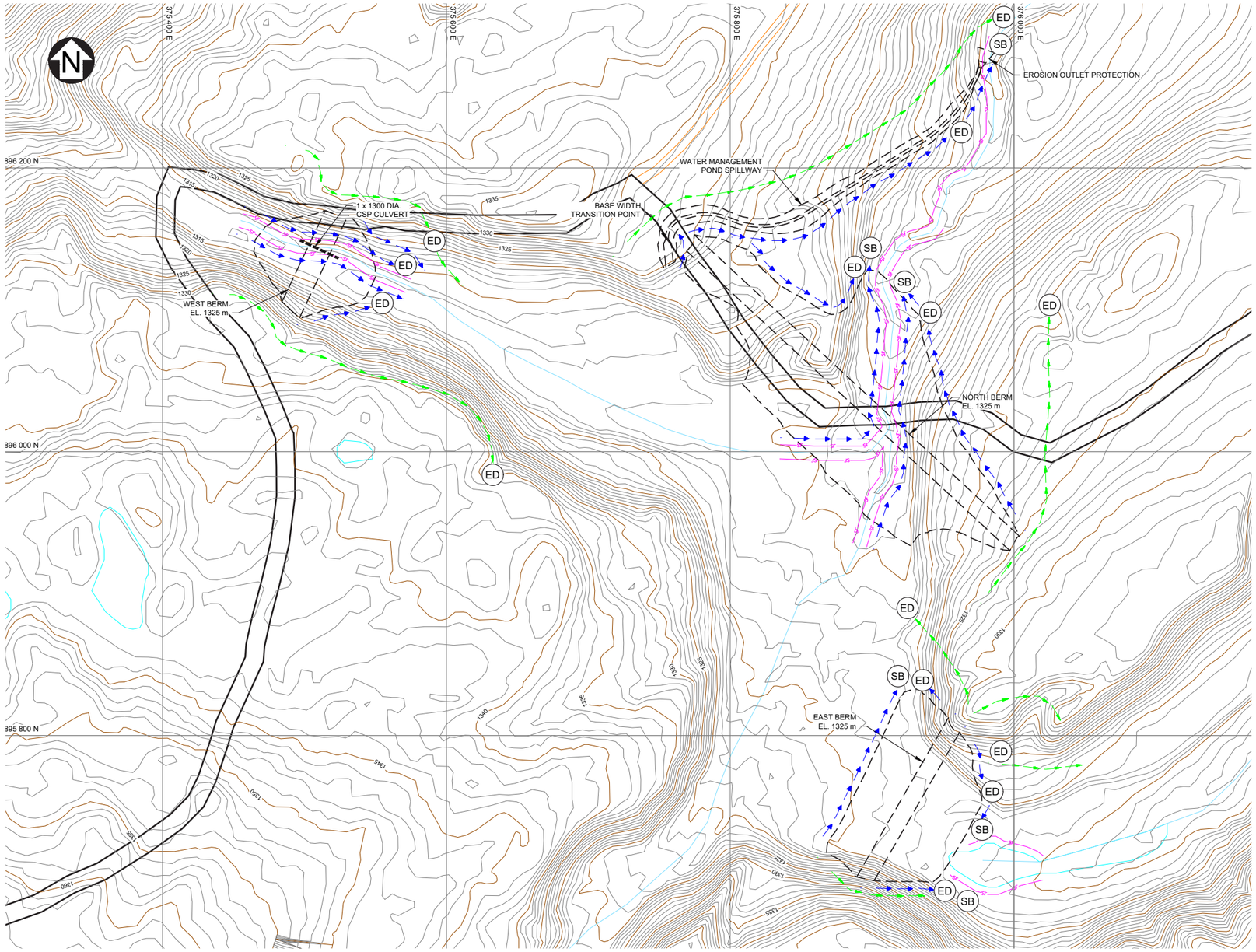
- FRESH WATER
- EMBANKMENT FILL
- DIVERSION PIPELINE
- ACCESS ROAD
- EXISTING ACCESS TRAILS
- CONSTRUCTION ROAD
- CD — COLLECTION DITCH
- DD — DIVERSION DITCH
- SF — SILT FENCE
- ED — ENERGY DISSIPATER
- SB — SEDIMENT BASIN

FOR INFORMATION ONLY

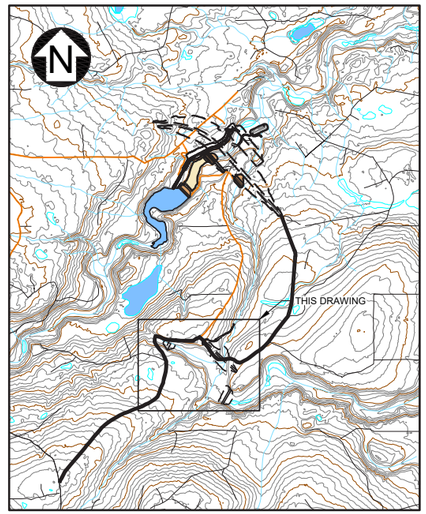
SCALE A 50 25 0 50 100 150 200 250 m

Figure 8-3: Main Dam C Stage 1 Construction – Erosion and Sediment Control Plan

Source: Knight Piésold Consulting (2021).



PLAN
SCALE A



KEY PLAN
NTS

LEGEND:

- FRESH WATER
- EMBANKMENT FILL
- ACCESS ROAD
- EXISTING ACCESS TRAILS
- CONSTRUCTION ROAD
- CD — COLLECTION DITCH
- DD — DIVERSION DITCH
- SF — SILT FENCE
- ED — ENERGY DISSIPATER
- SB — SEDIMENT BASIN

NOTES:

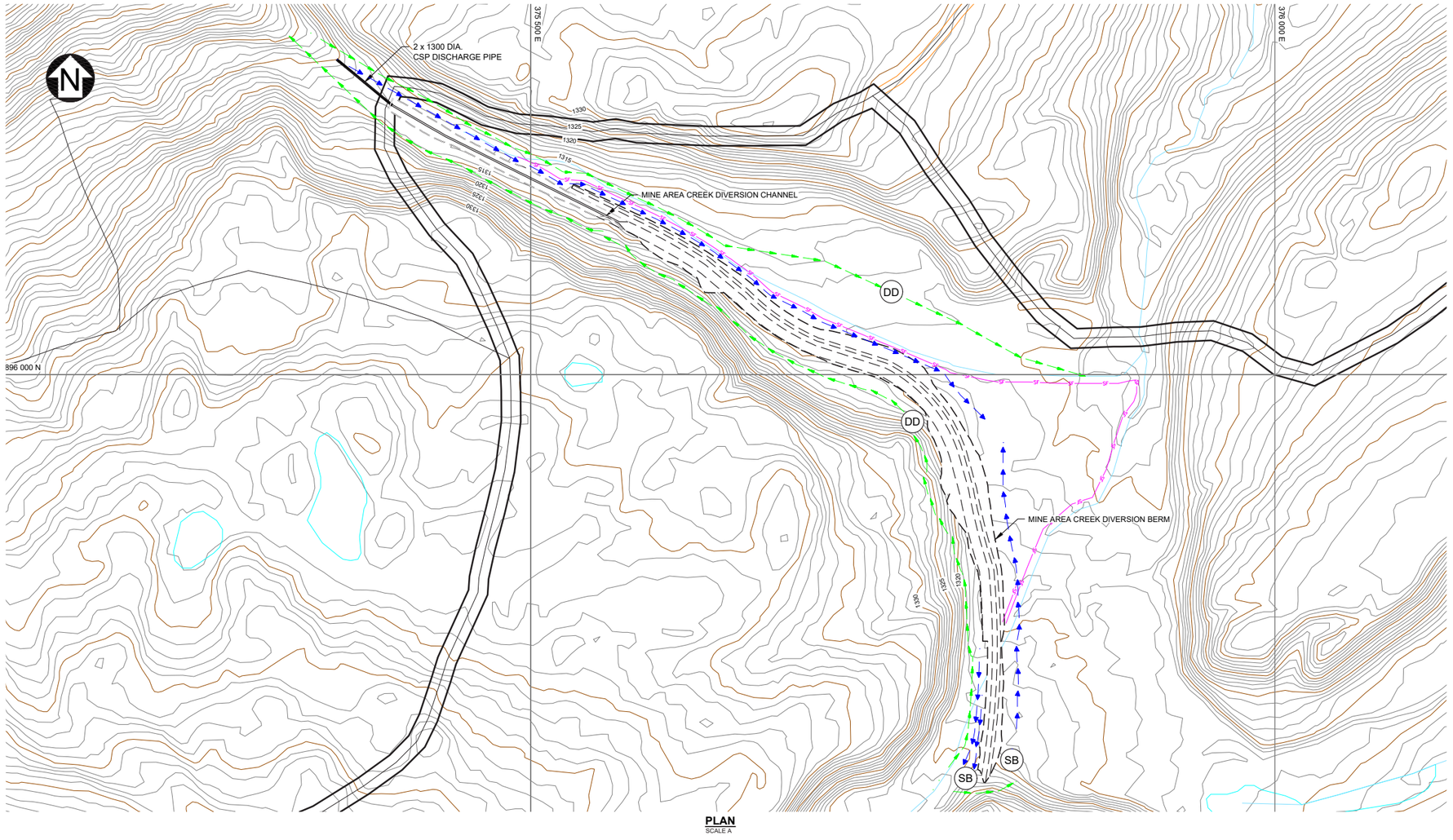
1. EXCAVATE ORGANICS AND UNSUITABLE MATERIALS TO ENGINEER APPROVED SUBGRADE.

FOR INFORMATION ONLY

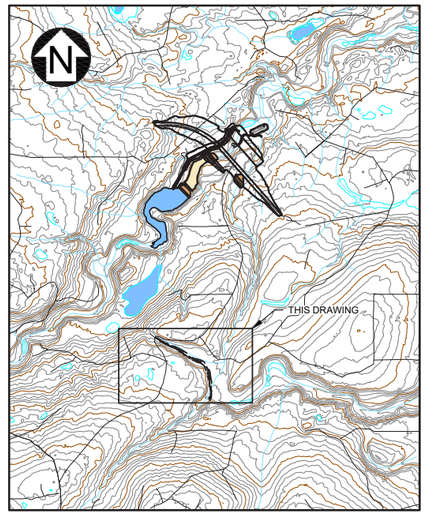
SCALE A 30 15 0 50 100 150 m

Figure 8-4: Tailings Storage Facility Water Management Pond – Erosion and Sediment Control Plan

Source: Knight Piésold Consulting (2021).



PLAN
SCALE A



KEY PLAN
NTS

LEGEND:

- ACCESS ROAD
- EXISTING ACCESS TRAILS
- CONSTRUCTION ROAD
- CD — COLLECTION DITCH
- DD — DIVERSION DITCH
- SF — SILT FENCE
- SB — SEDIMENT BASIN

FOR INFORMATION ONLY

30 15 0 50 100 150 m
SCALE A

Figure 8-5: Tailings Storage Facility Mine Area Creek Diversion – Erosion and Sediment Control Plan

Source: Knight Piésold Consulting (2021).

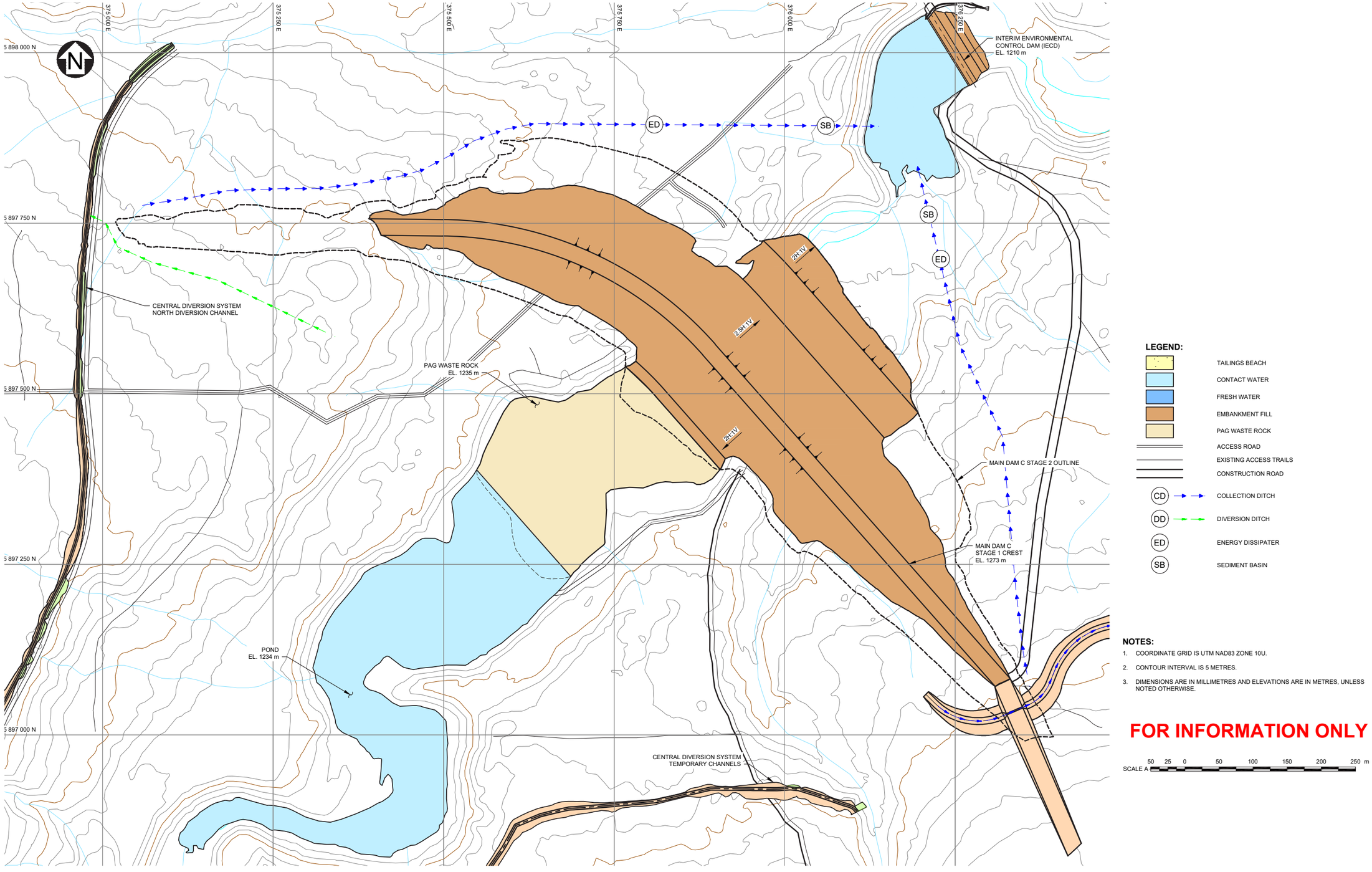


Figure 8-6: Main Dam C Stage 2 Construction (Year +1) – Erosion and Sediment Control Plan

Source: Knight Piésold Consulting (2021).

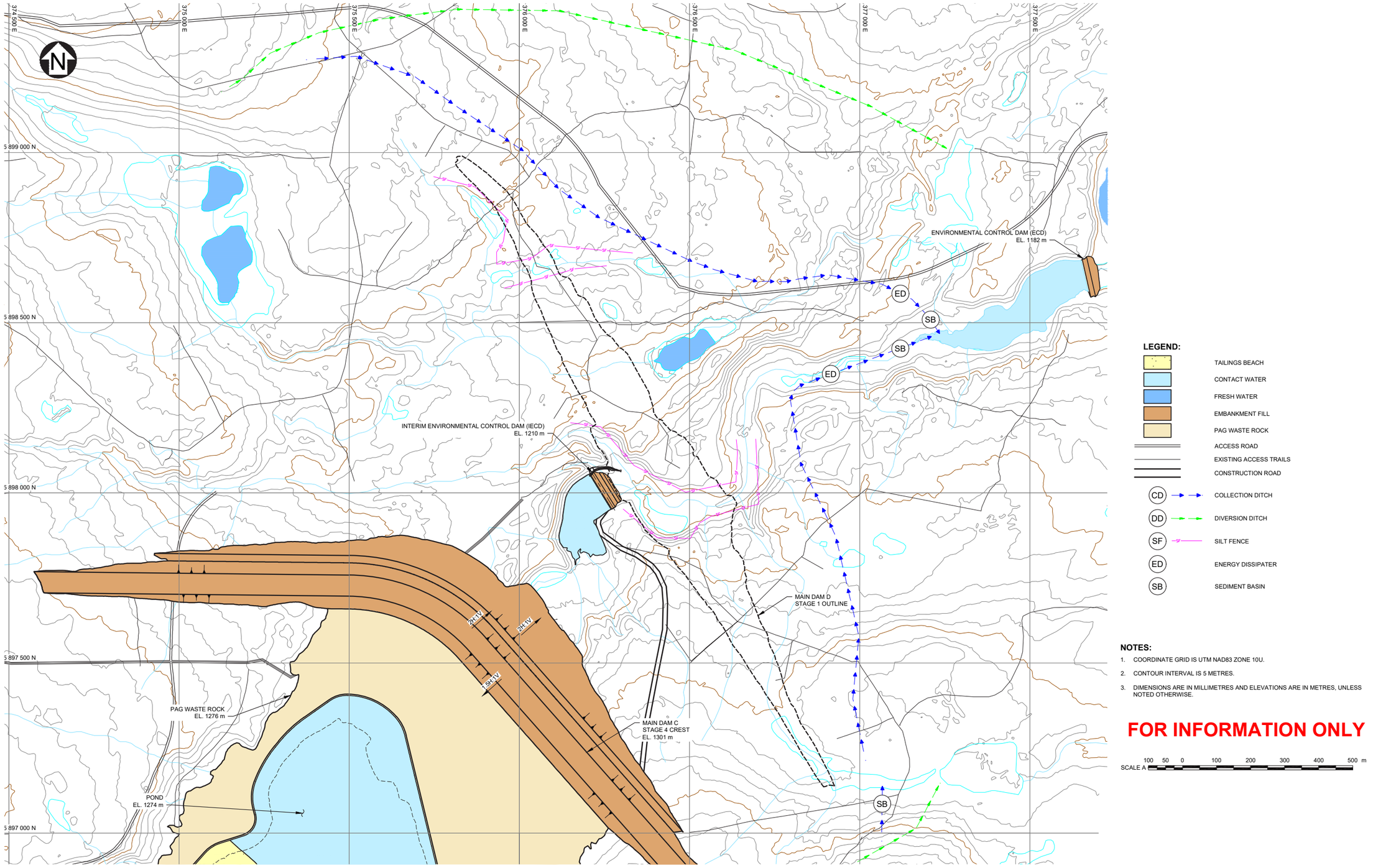


Figure 8-7: Main Dam D Stage 1 Construction (Year +5) – Erosion and Sediment Control Plan

Source: Knight Piésold Consulting (2021).

8.3 Example Implementation – Wind Erosion

Wind erosion is the detachment, transportation and redeposition of soil particles by wind. Wind erosion control measures consist of installing wind barriers or protective covers. Most BMPs that provide protection against water-based erosion will also protect against wind-based erosion.

The following BMPs discussed in previous sections of this plan for erosion induced by rainfall and runoff also mitigate the effects of wind erosion to minimize the risk to aquatic receiving environments:

- Slope texturing / surface roughening (Section 7.4.10): a rougher surface reduces wind speed at the soil surface so the wind is less able to move soil particles.
- Silt retention structures (Section 7.4.13): can be used to create wind breaks in areas with exposed slopes once construction is completed.
- Temporary seeding (Section 7.4.15): vegetation protects soil from wind erosion by reducing the wind speed at the soil surface.
- Mulching (Section 7.4.16): mulching also helps to hold fertilizer, seed, and topsoil in place in the presence of wind.
- Rolled erosion control products (Section 7.4.17): placed on final soil stockpiles or highly erodible areas; function by shielding bare soil and newly seeded areas against wind erosion and help to increase precipitation infiltration and decrease soil crusting and compaction.
- Polyethylene Cover (Section 7.4.18): can be used to temporarily (less than two years) cover newly exposed soil if high winds are forecast.

Measures outlined in Section 8.2 of the AQDMP will also be implemented, such as applying water in non-freezing and dry conditions to minimize fugitive dust and seeding topsoil stockpiles. Procedural BMPs for wind erosion during soil salvage, stockpiling, and placement are described in Table 9.1-3 of the Soil Management Plan. Measures described in the Reclamation and Closure Plan, such as placement of coarse woody debris to create microsites and restrict predators will also act to break the wind energy.

8.4 Example Implementation – Clear Span Bridge Replacement

Bridge activities such as construction, maintenance, or removal may negatively impact water quality, fish and wildlife populations and habitat, and riparian areas (Government of British Columbia, 2022). Bridges must be designed and constructed so that stormwater runoff from bridge decks, side slopes, and approaches is directed into a water retaining feature or vegetated area to remove suspended solids, dissipate velocity, and prevent sediment and other deleterious substances from entering watercourses. The CEMP provides measures for the protection of fish and fish habitat and must be implemented in conjunction with this SEPSCP for installation or replacement of clear span bridges: these measures include maintaining the natural rate of water flow upstream and downstream of the worksite during all phases of instream activity; instream activities must be conducted in the dry and the worksite must be isolated from water flowing in the stream channel; and measures must be taken to ensure that no harmful material (e.g. fuel and other hydrocarbons, soil, road fill, or sediment) which could adversely impact water quality, fish and other aquatic life, and/or fish habitat, be allowed to enter the wetted perimeter as a result of the project activities.

Under the WSA (Government of British Columbia, 2022), the following measures applicable to this SEPSCP must be implemented:

- All bridges must be designed and have the installation overseen by a Qualified Professional, and climate change impacts must be considered in the design process.
- The bridge must be designed to pass the 1 in 200-year maximum daily flow and consider passage of flood debris and ice.
- Every effort must be made to design a clear span bridge and avoid placing bridge components (e.g., piers, piles etc.) in the water.
- To be considered a clear span bridge, the superstructure, substructure, and road approaches must be located outside of the stream channel, including excavations required to support construction.
- The bridge must be designed so that stormwater from the deck, fill slopes, approaches, and ditches is directed to the surrounding vegetated areas to prevent sediment and other deleterious substances from entering the stream.
- Cross drains (culverts) must be planned back from the bridge approaches to minimize the amount of water directed into the approach ditches. Cross drain outlets and approach ditches near the bridge must be protected from erosion using riprap or vegetation.

The following BMP strategies must be implemented for working around streams to minimize erosion and sedimentation:

- The removal of material must not lead to stream channel instability or increase the risk of sedimentation into the watercourse.
- Any spoil materials must be placed in a location which ensures that sediment or debris does not enter the watercourse.
- All rock used in the works shall be clean and free of sediment producing material, durable, non-acid generating and suitably graded.
- Do not work in weather conditions likely to contribute to sediment production to the stream.
- Establish natural vegetation as part of the erosion control, including willow staking, and other plantings in the riparian area.
- Grade disturbed areas to a stable angle after work is completed and revegetate these areas to prevent surface erosion.
- Protect disturbed soil areas on the banks and areas adjacent to the stream from surface erosion.
- Remove any remaining sediment and erosion control measures.

The BMPs described in Section 7 of this SEPSCP must be implemented as needed:

- Cross-drain culverts (Section 7.4.3): divert flows out of ditches prior to the watercourse crossing.
- Diversion ditches (Section 7.4.4): divert ditch water out of ditches and across vegetated forest floor to allow natural filtration.
- Use rock check dams (Section 7.4.6) or straw bale check dams (Section 7.4.7) to slow water velocity and limit down-cutting within ditches.
- Install energy dissipators (Section 7.4.8) at the inlet and outlet of cross-drain diversion ditches or culverts.

- Install waterbars (Section 7.4.12) to limit the accumulation of erosive volumes of water at pre-designed intervals. Waterbars reduce sheet flow and surface erosion of areas of exposed soil and/or roads by diverting runoff towards a stable vegetated area or diversion ditch.
- Install silt retention structures (Section 7.4.13) along water's edge.

Additional BMPs specific to bridges and working in and around water, and typical examples BMP implementation, are provided in the Sediment and Erosion Control Field Guide (Forest Service British Columbia, no date).

9.0 Monitoring

9.1 Scheduled Monitoring

A performance-based approach will be used to assess the effectiveness of the SEPSCP during regularly scheduled monitoring of potentially impacted watercourses. Monitoring frequency will vary with site conditions and depending on the BMP implemented. Monitoring will occur:

- Daily during rain events (as defined in Table 9-2) and the snowmelt period at road stream crossings, contact and non-contact water management structures, snow dumps, and the TSF;
- Daily during each significant melt event or runoff-producing rainfall event for all other installed BMPs;
- Weekly during spring freshet; and
- Monthly outside of freshet and in open water periods.

Effectiveness will be determined by the extent to which certain performance metrics are being achieved. The Trigger Response Plan (TRP) specific to this SEPSCP provided in Appendix F will be implemented for managing significant rainfall events and for works in and around water. This TRP will be reviewed once A TRP for compliance with Condition 3.4 of EMA Permit 110652 will be developed separately for the Downstream Aggregate Borrow Area SCP discharge to Davidson Creek.

Table 9-1: Maximum Allowable Increase of TSS and Turbidity

Parameter	Background		
	Clear Waters (TSS <25 mg/L Turbidity <8-NTU)	**Turbid Waters (TSS 25-100 mg/L Turbidity 8-50 NTU)**	**Turbid Waters (TSS >100 mg/L Turbidity >50 NTU)**
TSS	Change from background of 25 mg/L at any one time for a duration of 24 hours Change from background of 5 mg/L at any one time for a duration of 30 days	Change from background of 10 mg/L at any time	Change from background of 10%
Turbidity	Change from background of 8 NTU at any one time for a duration of 24 hours Change from background of 2 NTU at any one time for a duration of 30 days	Change from background of 5 NTU at any time	Change from background of 10%

The monitoring frequency will depend on site conditions: an increase in contaminant concentrations in construction runoff in the receiving environment may trigger changes in the monitoring program (e.g., increased monitoring frequency, additional monitoring stations in the receiving waterbody both upstream (background) and downstream of the construction area) to identify sources and the requirement for additional BMPs.

Weekly water quality monitoring of potentially impacted watercourses during non-storm events is sufficient to meet the objectives of the plan: water quality monitoring frequency will be increased at the discretion of the EM based on construction site monitoring and inspections, with frequency commensurate with the risk, nature, location, and timing (seasonality) of the work.

BW Gold will engage suitably qualified individuals to supervise the construction activities, where deemed necessary, who will determine the validity of a result and whether it results from construction or other external factors. This would include further field-truthing upstream of the construction area to understand if a natural slide event, for instance, has caused the exceedance. The clarification above outlines how the Environmental Monitor/Staffs for BW Gold will use their experience to immediately undertake these validation techniques to ascertain the necessity to stop work and protect the receiving environment should there be trigger exceedances caused by the construction activities.

BW Gold will conduct visual monitoring of the Plant Site Sediment Control Pond daily while discharging to the Rapid Infiltration Basins and will conduct visual monitoring of the Rapid Infiltration Basins daily when there is effluent in the basins. Visual monitoring will include monitoring for adequate infiltration in the Rapid Infiltration Basins and monitoring for seepage, overland flow, and erosion in the area outside the Sediment Control Pond and Rapid Infiltration Basins. Daily inspections will be recorded and maintained on site for three years and will be made available to Ministry staff upon request.

9.2 Incident Monitoring

A TRP will also be implemented if signs of erosion that may adversely affect the receiving environment are noted on site during the construction or operations phases outside of regular monitoring events. Three levels of qualitative triggers have been defined: examples of each trigger level and roles and responsibilities for the implementation of subsequent actions are summarized in Table 9-2.

Incident reporting requirements are detailed in the Spill Contingency Plan.

Table 9-2: Erosion Incident Monitoring Triggers and Actions

Roles	Trigger – Minor	Trigger – Moderate	Trigger – Major
First person On the Scene (First Responders) will assess conditions to determine the initial Trigger to be applied.	Examples of Minor Triggers • Freshet Preparation. • Old and non-active erosion events. • Small Rills, non-active. • Equipment required is as per normal activities for maintenance and minor repairs. • Small, easily manageable erosion events. • Standing water in non-designated areas.	Examples of Moderate Triggers: • Active ditch erosion. • Existing Freshet Conditions. • 24-hr storm events >32 mm rain precipitation (2-Year return period). • Conditions that are active and have the potential to cause operational changes due to access restrictions or have potential for threats to infrastructure. • Standing water in non-designated areas that have potential for mobility or interfere with operations.	Examples of Major Triggers: • Slopes with active gullies and erosion channels where large volumes of sediment including rock is entrained. • Immediate threats to infrastructure. • Major sedimentation threats to water bodies. • 24-hr storm events >56 mm rain precipitation (10-Year return period). • Prolonged heavy rainfall events > 3 days. • Standing water in non-designated areas that have potential for mobility or interfere with operations in high risk/critical areas
First Responder - First person on the scene who discovered the event. **Project Engineer** - Personnel designated to perform inspections	1. Note areas where erosion event has occurred, notify Supervisor. 2. If possible redirect flows or correct event immediately. 3. Inspectors to note culverts that may be plugged and that may need attention to be ready for spring freshet flows. 4. Investigate source of erosion event as necessary to prevent repeats or to reduce/remove potential for larger event.	1. All Minor Response duties. 2. Provide immediate actions/assistance as necessary to minimize negative effects of erosion event if safe to do so. 3. Notify relevant personnel and contractors of event including location, potential for damage, proximity to water body, and safety aspects.	1. All Moderate Response duties. 2. Prevent entry by non-essential personnel and maintain a safe distance. 3. If safe to do so, minimize negative effects. 4. Release the scene to Mine Rescue upon their arrival as necessary.
EPC Contractor/Personnel	1. Provide assistance to First Responder/Inspector as necessary.	1. All Minor Response duties. 2. Determine level of effort required to mitigate the hazard and repair the damage. 3. Organize mitigations/repairs. 4. Notify Environmental Manager, if associated with water bodies or in receiving environment. 5. Notify Mine Manager if event associated inside the pit or with catch benches or with tailings storage facility. 6. Notify department superintendent/superintendent as necessary.	1. All Moderate Response duties. 2. Depending on gravity of situation, initiate Mine Emergency Response Procedures. 3. Ensure safety of the First Responder and safety of the crew by preventing non-essential personnel from entering area. 4. Notify Engineering and Environmental Departments. 5. Notify Project Engineer.
Environmental Monitor	1. Schedule inspections and designate inspectors in fall periods for freshet readiness in spring. 2. Share notes of inspections with EPC Contractor and Construction Manager as necessary. 3. Review SEPSCP and revise as necessary. 4. Ensure revisions are communicated to all affected departments.	1. Respond to notifications for further inspection. 2. If sedimentation into waterbody, perform up and downstream samples for water quality to determine compliance. Note: Full suite samples may be necessary. 3. Direct environmental/erosion controls that may have to take place to mitigate impacts, reduce environmental hazard. 4. Record event and mitigations for reporting purposes.	1. All Moderate Response duties. 2. Notify Environmental Manager 3. Prepare for and assist in receiving environment investigations and impact assessments.
Construction Manager	1. Schedule inspections and designate inspectors in fall periods for freshet readiness in spring. 2. Share notes of inspections with Environment Monitor as necessary.	1. Provide resources/guidance to event responders as necessary. 2. Determine if outside agencies are required to provide assistance. 3. Determine courses of action to prevent/mitigate damage to resources.	1. All Moderate Response duties. 2. Notify Environmental Manager 3. Notify Safety Lead 4. Notify Mine Manager
Environmental Manager	1. Duties as normal.	1. Report event to external agencies, Indigenous groups as necessary.	1. All Moderate Response duties. 2. Provide recommendations to senior management on risks, mitigations and impacts.
Mine Manager	1. Duties as normal.	1. Duties as normal.	1. Notify Corporate Executive as necessary. 2. Ensure all necessary funding and resources are provided in an efficient manner.

10.0 Reporting and Record Keeping

10.1 Reporting

Scheduled monitoring activities for this SEPSCP will be documented in internal weekly and monthly reports in accordance with the CEMP The reports will be prepared by the EM or Environmental Monitor(s) and will include the following information:

- Summaries of any environmental sampling conducted (e.g., date and time of each sample, weather conditions) ;
- Sampling results (e.g., receiving water results compared to Maximum Allowable Increase levels for any works in and around water, instrument calibration records, etc.); and
- Documentation of all non-compliance instances, including the level of exceedance, the duration of exceedance, the mitigation measures taken, verification of the reporting of the exceedance and any related communications with regulators regarding the exceedance event, and future measures to be taken to avoid or control further exceedances.

At the completion of the initial Construction phase, and after defined construction projects during Operation, the EM or Environmental Monitor(s) will prepare a section of the Completion Report prepared in accordance with the CEMP that includes the following information specific to this SEPSCP:

- Compliance summary for the nature and type of incidents and environmental impacts;;
- Assessment of the effectiveness of the BMPs based on the sampling results;
- Recommendations for improvements for environmental performance; and
- A brief description of ongoing activities at the site related to maintenance and monitoring of site areas.

Incident monitoring reporting is required to meet Condition 2.2 of Permit 110652: in the event of an emergency or condition that leads to an unauthorized discharge, the incident will immediately be reported to the Environmental Protection division of BC ENV.

Non-compliance notification and reporting are required to meet Condition 6 of Permit 110652: the Environmental Protection division of BC ENV must be notified immediately by email in the event that any discharges from the Downstream Aggregate Borrow Area SCP or the TSF Stage 1 SCP exceed discharge criteria. Notification must include the following information:

- Date of Non-compliance
- Location of Non-compliance
- Nature of Non-compliance
- Initial Response/Actions taken
- Monitoring conducted
- Future action items
- Contact information
- Monitoring data

Notification must be followed by submission of a report within 30 days that includes the results of any testing related to the non-compliance; potential causes; potential impacts to the receiving environment; and remedial actions that were implemented.

10.2 Record Keeping

Analytical monitoring data will be entered into an electronic database and have quality control checks completed upon receipt of results. Data will be entered into a standard format that allows for data reporting and analyses. Data and data comparisons will be stored in a single file format for each type of survey or monitoring activity.

11.0 Evaluation and Adaptive Management

11.1 Maintenance, Onsite Inspection, and Plan Review

Inspection and maintenance are vital to the performance of ESC measures; therefore, the success of the SEPSCP is dependent on monitoring of implemented BMPs. The Construction Personnel/Sub-Contractors and Environmental Monitor will inspect all erosion control measures weekly during spring freshet and monthly outside of freshet and in open water period, as well as after each significant runoff-producing rainfall event. Silt fences, sediment traps/basins, ditches, culverts, and sediment control ponds will be visually inspected for the following:

- Excess sediment build-up;
- Structural/physical integrity; and
- Anticipated wear and tear.

Immediate action will be taken by the Construction Personnel/Sub-Contractors when the need for maintenance or repair of ESC measures is identified for the ongoing performance of the measures. When applicable monitoring will include but not be limited to the following:

- New erosion control prescriptions will be developed, as needed based on encountered or anticipated erosion of disturbed soils, slopes, and ditches. Initial erosion will be inspected visually by searching for light surface material (litter or soil) movement, while sedimentation resulting from erosion will be determined by searching for deposition of soil particles at the bottom of slopes and depressions. Rilling, gullying, pedestalling, and unusual compaction are also indicators of erosion and will be recorded if and when observed.
- Sediment accumulation in ditches, check dams, and sumps will be identified, and maintenance actions will be recommended where needed.
- The physical integrity and stability of sediment pond components, including berms, outlet pipes, spillways, and downstream discharge channels.
- Sediment levels in sediment control ponds will be assessed monthly or prior to a predicted storm event to ensure that the minimum pond depth below the outlet pipe invert is present; sediment captured in traps will be removed in a timely manner.
- Revegetated areas will be monitored for evidence of wind and water erosion; remedial seeding and erosion-control measures will be applied when required.

Sediment removal and proper disposal will be performed as required. Sediment will be removed from the SCPs at a frequency required to maintain capacity to operate effectively up to a 1 in 10-year 24-hour storm event. Sediment removed from the SCPs will be disposed of in an authorized discharge location. The sediment material will be tested for the same suite of parameters as waste rock and overburden prior to disposal: this will include at a minimum an aqua regia digestible elemental scan at the onsite laboratory (as outlined in Section 7.1.7 of the ML/ARD Management Plan). Should sediments be identified to be potentially acid generating or metal leaching, they will be disposed in the TSF. When a cumulative volume of sediment (<100 m3) builds up from the various ESC features, one sample will be collected and undergo the proposed testing program.

The EM and Project Engineer will modify the SEPSCP when necessary, to reflect changing site conditions or new information which has been identified during construction. At a minimum, a SEPSCP Review Report will be prepared every three years, to meet Condition 3.6 of Permit 110652, that outlines whether the ESC measures have been implemented in accordance with the SEPSCP and whether the

SEPSCP is adequate to ensure water discharged from the SCPs meets TSS permit limits. The SEPSCP Review Report must also include any recommended improvements to ensure environmental protection.

11.2 Continuous Improvement

The design of ESC measures should be viewed as a flexible process that responds to new information obtained throughout the Construction Phase. Contingency strategies for the Project will be active and adaptive, with ongoing inspection, maintenance, and re-evaluation for all BMP control measures and surrounding site conditions. If monitoring identifies that BMPs are not functioning adequately, the following steps will be taken:

- Confirm control measure/feature installed correctly.
- Assess appropriate size or length/depth of control method with site circumstances.
- Determine if alternate BMP/control method or contingency measures are required.
- Assess if increased maintenance/inspections required.

An inventory of ESC materials will be kept on site to address problems that may arise. The inventory list will be updated regularly to reflect a more accurate estimate of the quantities that should be stocked on site. The materials will provide a spectrum of measures to address a broad range of site conditions and severity.

12.0 Plan Revision

The SEPSCP is a “living” document and it will be reviewed annually at a minimum through the ELoMC request for review. Changes to the SEPSCP, including additions or updates to site specific ESC prescriptions, mitigation measures or monitoring programs, will be driven largely by revisions to discipline-specific management plans. Proposed changes will be documented via the provision a change log document including rationale for changes, which will be provided at the same time (where possible) or following resubmission of the SEPSCP. Revised versions of the SEPSCP will be dated, version controlled, signed and filed with EMLI through Mine Space, the Environmental Assessment Office via and Aboriginal Groups via email and posted to BW Gold’s Project website in accordance with EAC Condition 42(c). Upon submissions of updated Management plans, reviewers will be invited to share and direct any comments, questions or concerns on the SEPSCP updates through the ELoMC. Regular presentations of implementation of management plans including the SEPSCP will also be provided to reviewers per the ELoMC annual schedule of topics/development of monthly meeting agendas.

13.0 Qualified Registered Professionals

This management plan has been prepared and reviewed by, or under the direct supervision of, the following qualified registered professionals:

Reviewer Role	Name	Signature	Date
Prepared by:	Stephanie Eagen, R.P.Bio. Senior Environmental Scientist Knight Piésold Ltd.		June 1, 2023
Reviewed by:	Carlos Penate, P.Eng. Senior Engineer - Mining Knight Piésold Ltd.		June 1, 2023

14.0 References

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

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Appendix A Erosion and Sediment Control BMPs

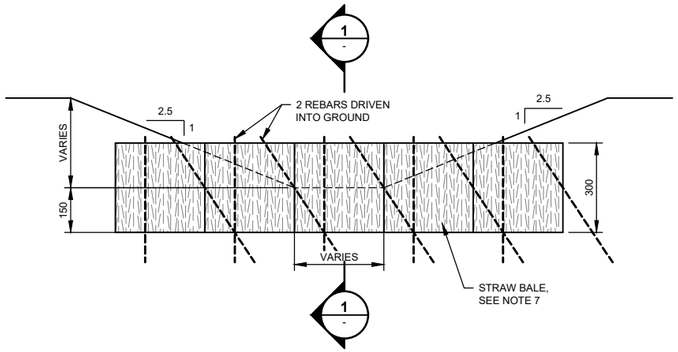
Drawing C3801 ESC – Typical Sections and Details – Sheet 1

Drawing C3802 ESC – Typical Sections and Details – Sheet 2

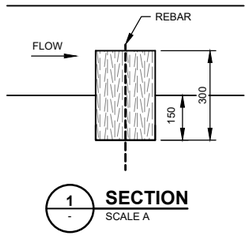
Drawing C3803 ESC – Typical Sections and Details – Sheet 3

Drawing C3804 ESC – Typical Sections and Details – Sheet 4

Drawing C3805 ESC – Typical Sections and Details – Sheet 5



STRAW BALE ON CHANNEL
SCALE A



SECTION
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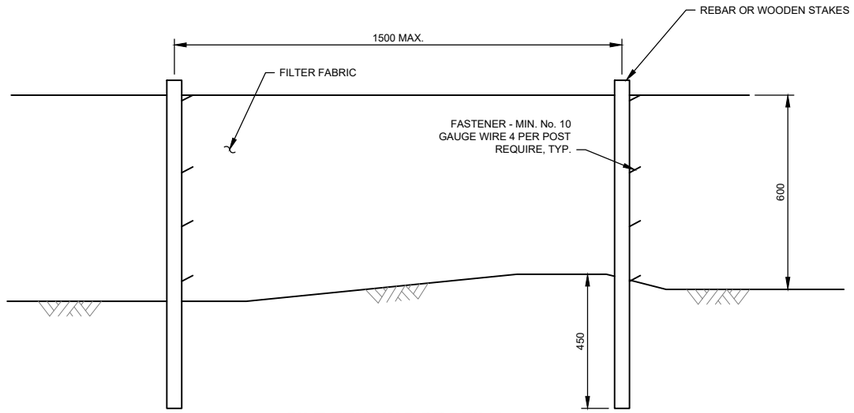

SILT FENCING PROFILE
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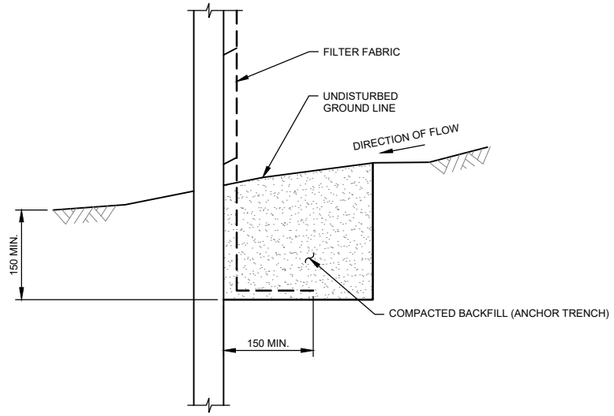

SILT FENCING - CROSS SECTION
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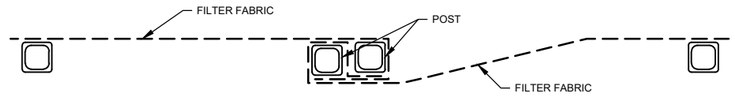

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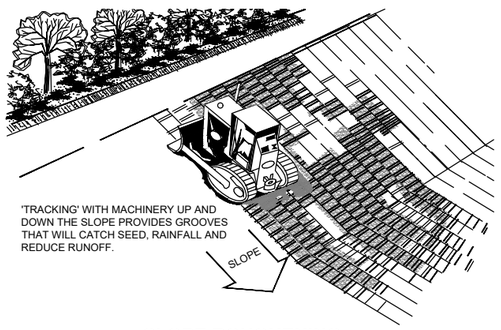

SLOPE ROUGHENING
NTS

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BEST MANAGEMENT PRACTICES (BMP) FOR SEDIMENT AND EROSION CONTROL WILL BE APPLIED DURING CONSTRUCTION AND OPERATION OF COLLECTION CHANNELS AND SEDIMENT CONTROL POND.
3. FOUNDATION PREPARATION SHALL CONSIST OF REMOVAL OF VEGETATION, MUD, DEBRIS, AND SOFT AND DELETERIOUS MATERIAL.
4. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
5. SITE GRADING SURFACE WATER RUNOFF TO BE DIRECTED TO THE COLLECTION CHANNELS AT ALL TIMES DURING SITE DISTURBANCE ACTIVITIES UNTIL FINAL STABILIZATION IS ACHIEVED.
6. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL MEASURES PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
7. STRAW BALE SHALL BE IMPLEMENTED ON COLLECTION CHANNELS WHEN REQUIRED BY THE CONTRACTOR. TYPE OF CHANNELS MAY INCLUDE NON-CONTACT RUNOFF, CONTACT RUNOFF, ACCESS ROAD, PERMANENT AND TEMPORARY CHANNELS.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE B 100 50 0 100 200 300 400 500 mm

SCALE A 200 100 0 200 400 600 800 1000 mm

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
45299

2021-02-04

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 1

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3801	0

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04FEB'21	ISSUED FOR PERMITTING	CAP	SKC		

REVISIONS

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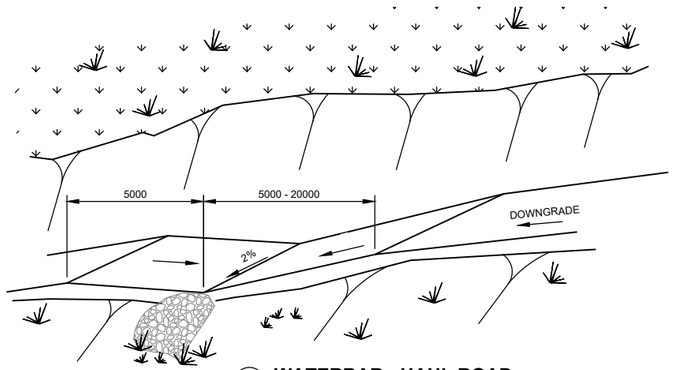
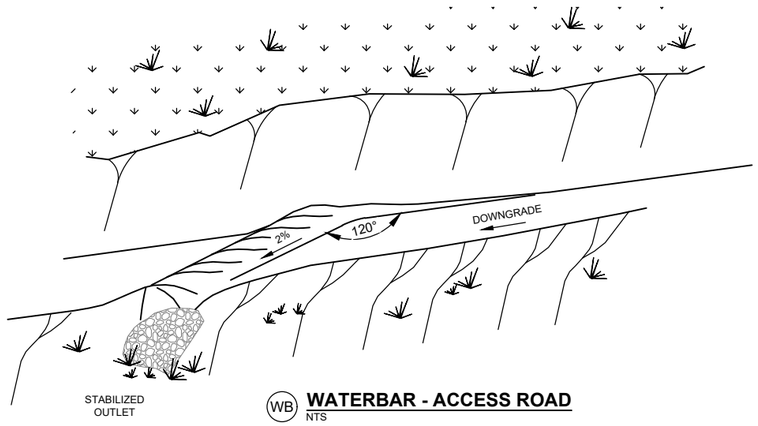


WB **WATERBAR - HAUL ROAD**
NTS



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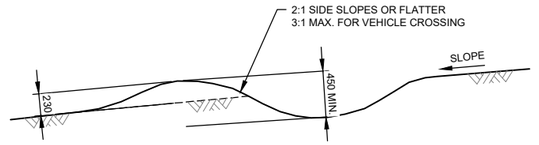

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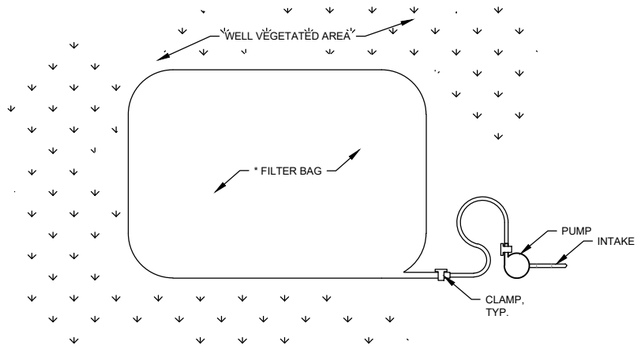

FB **FILTER BAG PLAN**
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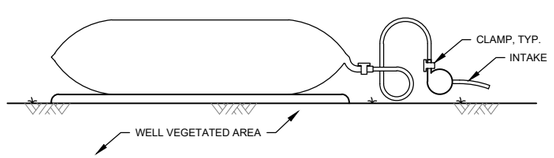

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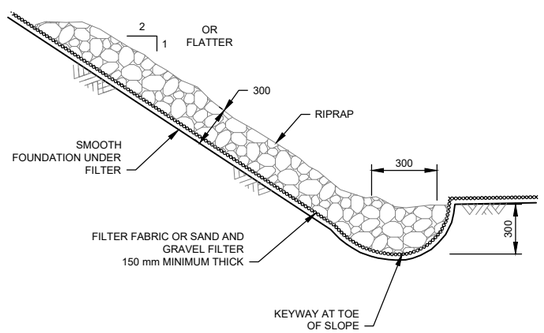
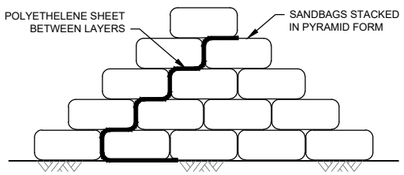


AS **ARMOURED SLOPE - TYPICAL**
NTS



DS **TEMPORARY STREAM DIVERSION STRUCTURE**
NTS

NOTES:

1. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
2. SURFACE WATER RUNOFF TO BE DIRECTED TO THE EROSION CONTROL BMPS AT ALL TIMES DURING SITE DISTURBANCE ACTIVITIES UNTIL FINAL STABILIZATION IS ACHIEVED.
3. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL BMPS PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
4. AN AREA IS CONSIDERED TO HAVE ACHIEVED FINAL STABILIZATION WHEN IT HAS A MINIMUM UNIFORM 70% VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER TO RESIST ACCELERATED SURFACE EROSION.
5. DIVERSION STRUCTURE TO CONSIST OF SANDBAGS OR U-SHAPED METAL PLATE.

DETAILED DESIGN
NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. RENATE ROJAS
45299

2021-02-04

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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 2

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3802	0

DRG. NO.	DESCRIPTION
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REFERENCE DRAWINGS

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REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04FEB'21	ISSUED FOR PERMITTING	CAP	SKC		

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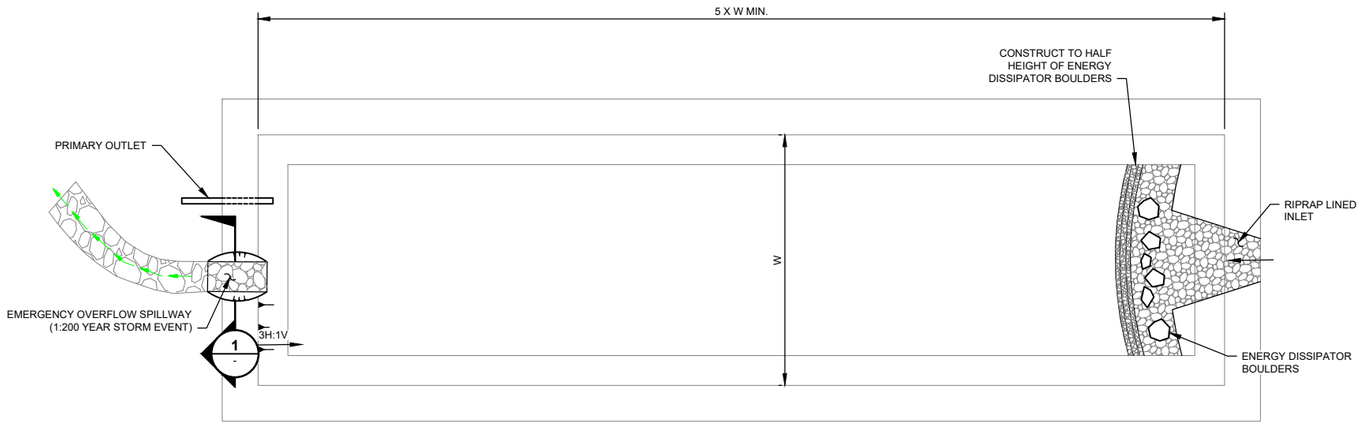
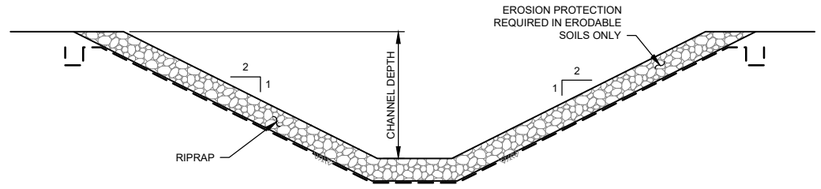
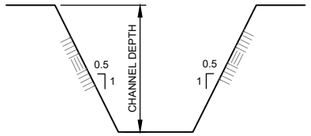


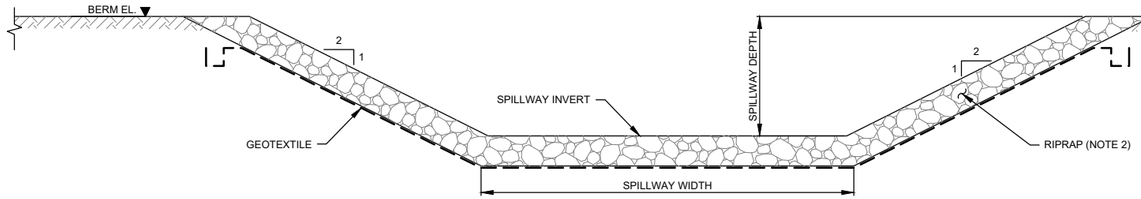
SP **SEDIMENT POND PLAN VIEW**
SCALE A



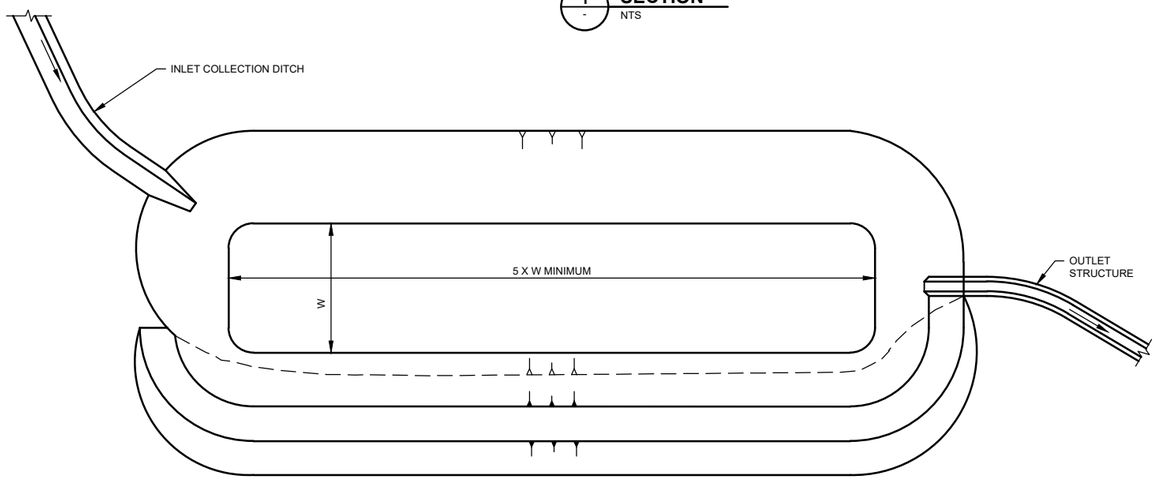
DD1 CD1 **DIVERSION / COLLECTION DITCH IN SOIL**
NTS



DD2 CD2 **DIVERSION / COLLECTION DITCH IN ROCK**
NTS



1 - **SECTION**
NTS



SB **SEDIMENT BASIN PLAN**
NTS

NOTES:

1. SEDIMENT POND LINING REQUIREMENTS SUBJECT TO ENGINEERS REVIEW OF FOUNDATION MATERIAL.
2. RIPRAP TO BE SPECIFIED FOR EACH INDIVIDUAL SEDIMENT POND DURING DETAILED DESIGN PHASE.
3. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS OTHERWISE NOTED.

DETAILED DESIGN
NOT FOR CONSTRUCTION

10000 5000 0 10000 20000 30000 40000 50000 mm
SCALE A

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PROVINCE OF BRITISH COLUMBIA
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2021-02-04

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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 3

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3803	0

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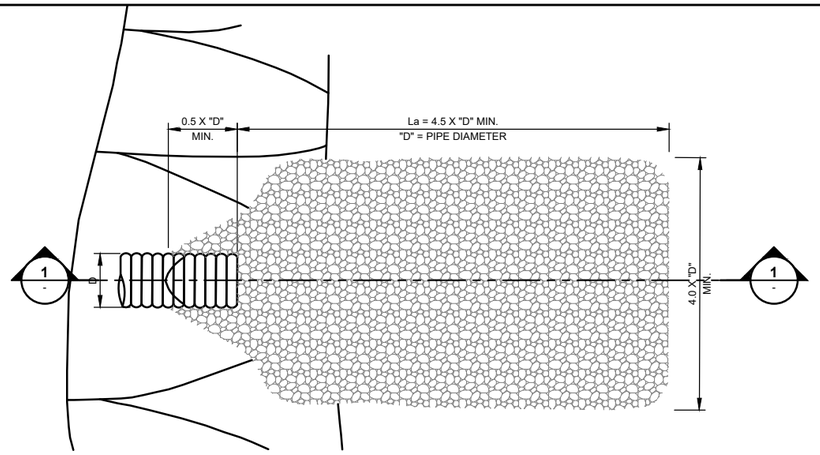
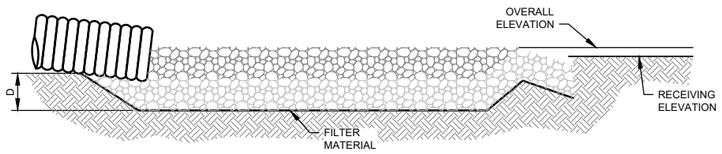
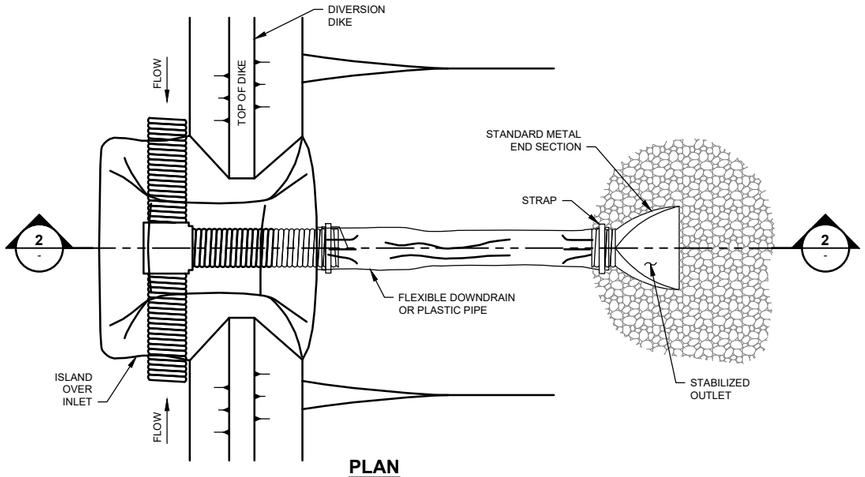


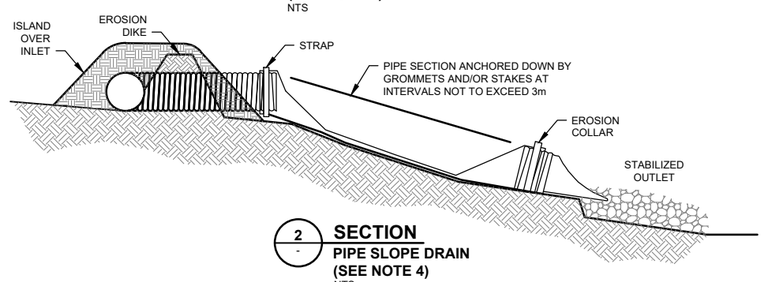
PLAN
ENERGY DISSIPATER FOR CULVERT OUTLET
(SEE NOTE 3)
NTS



1 **SECTION**
ENERGY DISSIPATER FOR CULVERT OUTLET
(SEE NOTE 1)
NTS



PLAN
PIPE SLOPE DRAIN
(SEE NOTE 2)
NTS



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PIPE SLOPE DRAIN
(SEE NOTE 4)
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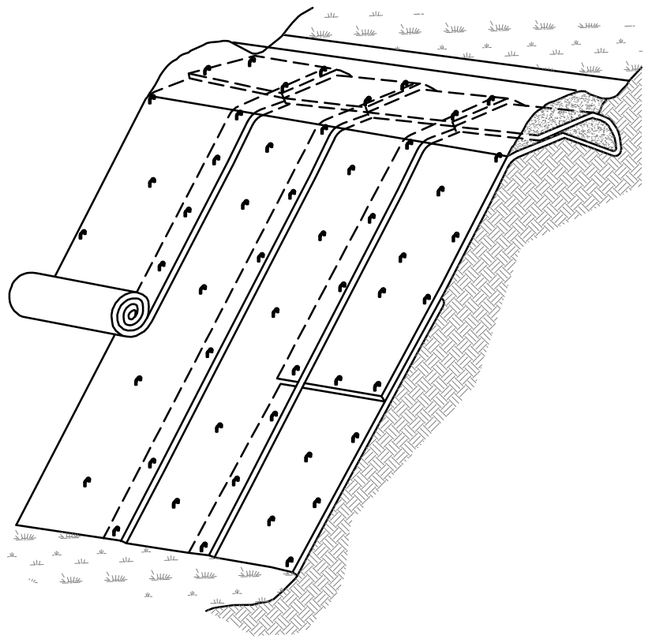

TYPICAL DETAIL
RECP (SEE NOTES 1 AND 5)
NTS

NOTES:

1. GOVERNMENT OF ALBERTA. 2011. EROSION AND SEDIMENT CONTROL MANUAL. ALBERTA TRANSPORTATION.
2. CITY OF PORTLAND. 2022. EROSION AND SEDIMENT CONTROL MANUAL. FINAL.
3. GRADE THE AREA TO FINAL DESIGN GRADES AND ELEVATIONS - ENERGY DISSIPATER SHALL BE CONSTRUCTED FLUSH WITH THE SURROUNDING GRADE AND SHALL BE DIRECTLY IN LINE WITH DIRECTION OF OUTLET FLOW. SUB-EXCAVATE ENERGY DISSIPATER LOCATION TO THICKNESS OF ENERGY DISSIPATER. ENERGY DISSIPATER (SPLASH PAD, APRON) SHALL BE SET AT ZERO GRADE AND ALIGNED STRAIGHT, WITH THE DIRECTION OF FLOW AT THE OUTLET ENERGY DISSIPATER SHALL BE DESIGNED TO ACCOMODATE A 10-YEAR PEAK RUNOFF OR THE DESIGN DISCHARGE OF THE UPSTREAM CHANNEL, PIPE, DRAIN, OR CULVERT, WHICHEVER IS GREATER.
4. PIPE SLOPE DRAINS MUST BE CONSTRUCTED FROM HEAVY-DUTY FLEXIBLE MATERIALS, SUCH AS NON-PERFORATED, CORRUGATED PLASTIC PIPE OR SPECIFICALLY DESIGNED FLEXIBLE TUBING ENSURE THE FLARED INLET AND OUTLET ARE KEYED INTO THE GROUND AND SECURED SO FLOWS DO NOT BYPASS OR POND AT THESE LOCATIONS. PROVIDE ENHANCED ARMORING AT THE BOTTOM OF ALL OUTLETS. PERFORM MAINTENANCE ON OUTLET STRUCTURE AND ARMORING TO REMOVE SEDIMENT BUILDUP AND FIX ANY DAMAGE.
5. RECP SHOULD BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS. SURFACE SHOULD BE SMOOTH AND FREE OF LARGE ROCKS, DEBRIS, OR OTHER DELETERIOUS MATERIALS.

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PERMIT NUMBER
1001011
EGBC PERMIT TO PRACTICE

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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 4

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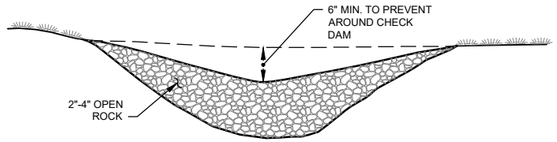

TYPICAL SECTION
ROCK CHECK DAM
(SEE NOTES 1 AND 4)
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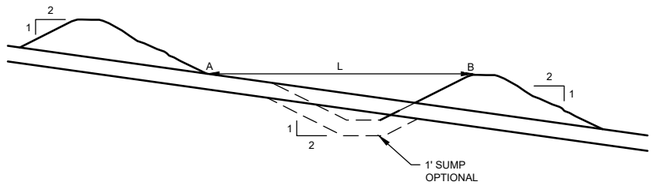

TYPICAL SECTION
SPACING BETWEEN CHECK DAMS
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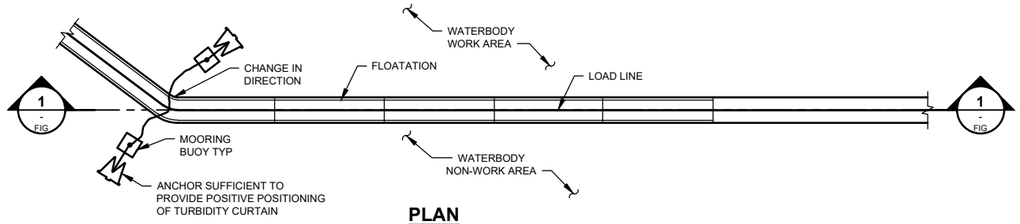
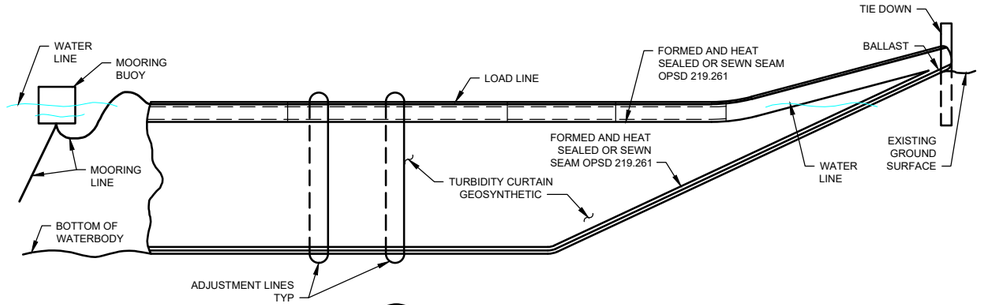
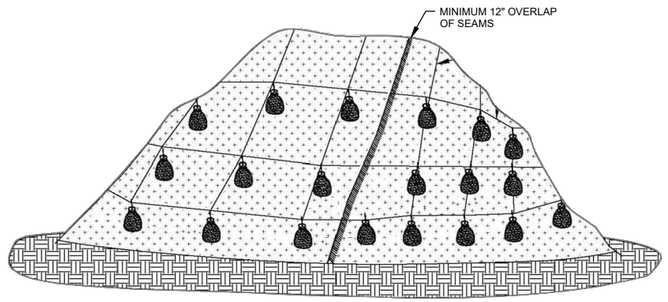


PLAN
TURBIDITY CURTAIN
(SEE NOTE 2)
NTS



1 - FIG **SECTION**
TURBIDITY CURTAIN
NTS



PLAN
POLYETHYLENE COVER
(SEE NOTE 3)
NTS

NOTES:

1. CLEAN WATER SERVICES. 2020. EROSION PREVENTION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL.
2. TORONTO AND REGION CONSERVATION AUTHORITY. 2019. EROSION AND SEDIMENT CONTROL GUIDE FOR URBAN CONSTRUCTION.
3. CLEAN WATER SERVICES (CWS). 2020.
4. CONSTRUCT ROCK CHECK DAMS SIZED TO STAY IN PLACE GIVEN THE EXPECTED DESIGN FLOW VELOCITY. BRIDGE ENTIRE DITCH OR SWALE WIDTH AND ENSURE THE CENTER OF THE DAM IS 6 INCHES LOWER THAN THE OUTER ENDS. REMOVE SEDIMENT ONCE IT REACHES ONE-THIRD THE DEPTH OF THE CHECK DAM.

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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 5

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3805	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
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REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

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REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
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XREF FILE(S): IMAGE FILE(S): Polyethylene Cover Rock Check Dam Turbidity Curtain

Appendix B Soil Loss Calculation

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

MEMORANDUM

Date:	December 8, 2022	**File No.:**	VA101-00457/37-A.01
		Cont. No.:	VA22-02237
To:	Mr. Ryan Todd		
Copy To:	Jack Love, Travis Desormeaux		
From:	Carlos Penate, Stephanie Eagen		
Re:	**Issues Tracking Table IDs 908, 909, 911, 916 – Surface Erosion Protection and Sediment Control Plan**		

1.0 INTRODUCTION AND PURPOSE

BW Gold LTD. (BW Gold) submitted a Joint *Mines Act / Environmental Management Act* Permits Application (the Application) for the Blackwater Gold Project (Project) in March 2022. Keefer Ecological Services Ltd. (Keefer), on behalf of Lhoosk'uz Dené Nation and Ulkatcho First Nation (LDN/UFN), has raised concerns about erosion risk and management during construction of the Project during the Application review phase.

Keefer's expressed concerns are related to Section 6.2 of the Surface Erosion Prevention and Sediment Control Plan (SEPSCP), submitted as Appendix 9-A of the Application (BW Gold, 2022), specifically the calculation of soil erosion potential. The LDN/UFN comments on Section 6.2 are documented in the Issues Tracking Table (ITT) as Comment IDs 908, 909, 911, and 916. The general theme of the concerns relate to:

- Timing of sharing of the soil erosion potential classification for the Project site with LDN/UFN for review
- How the soil erosion potential classification will be used to inform the selection of erosion and sediment control measures to be implemented

BW Gold has committed to providing the potential long-term average annual soil loss per hectare for disturbance areas on the Issued for Construction (IFC) drawings to LDN/UFN. IFC plans are commonly required in the post-permitting, pre-construction phase of the project, since not all information is available at the level of detail that would be required for construction during the permitting phase (British Columbia Ministry of Energy, Mines and Petroleum Resources (BC EMPR) and British Columbia Ministry of Environment and Climate Change Strategy (BC ENV), 2019). *Mines Act* permit conditions typically require that IFC drawings be submitted to the Chief Inspector of Mines a minimum of 60 days prior to commencing construction of facilities, such a waste rock dumps.

A hard target date for IFC drawing submission cannot be provided at this time due to the dynamic nature of the permitting and project development schedules; therefore, the purpose of this memo is to provide a site-wide estimate of potential annual soil loss to understand the expected overall performance of the surficial materials before and during construction activities. The soil loss calculation is one of several factors used by qualified professionals to design containment facilities, such as sediment and collection ponds: other factors include site layout and size, local topography, runoff coefficients, hydraulic lengths, time of concentration, and design flow (BC ENV, 2015a). In addition, as noted in Technical Guidance 3 (BC ENV, 2015b), the quantification of erosion potential is used to assist in designing erosion and sediment control

plans: several other variables will also be considered by the site Environmental Manager and Environmental Monitors to guide the selection and implementation of erosion and sediment control measures. These other variables include surface preparation and construction activities, volume and velocity of runoff from precipitation, size of the disturbance area, proximity to natural watercourses, timing and duration of construction activity, and whether the measures are designed to be temporary or permanent.

The IFC drawings will include relevant design information required to construct project facilities, but will not include the surface erosion and sediment control measurements presented in the SEPSCP (BW Gold, 2022). It will be the responsibility of the construction manager and all contractors to coordinate with the Environmental Manager and Environmental Monitors to ensure that appropriate erosion and sediment control measures are installed and maintained.

2.0 METHODOLOGY

2.1 OVERVIEW

The Revised Universal Soil Loss Equation for Application in Canada (RUSLEFAC) is used to estimate the potential long-term average annual soil loss per hectare (Wall et al., 2002).

The equation to estimate the potential, long-term average annual soil loss per hectare is:

$A = R \times K \times LS \times C \times P$

Where:

A = potential, long-term, average annual soil loss per hectare [tonnes/ha/year]

R = rainfall and runoff factor [MJ•mm/ha/hr]

K = soil erodibility factor [tonnes•hr/MJ/mm]

LS = slope factor [dimensionless]

C = crop/vegetation and management factor [dimensionless]

P = support practice factor [dimensionless]

Each one of the parameters is calculated based on the data available at the time of completion of this document, with estimated values and rationale presented in the following sections.

2.2 R - RAINFALL AND RUNOFF FACTOR

The rainfall and runoff factor (R) is a measure of the total annual erosive rainfall for a specific location, as well as the distribution of erosive rainfall throughout the year, and applies site-wide (Wall et al., 2002). The factor is affected by storm energy and intensity, the amount of rainfall, snowfall, and runoff that occurs during different seasons of the year, and snowmelt on top of frozen or partially frozen soil taken from isoerodent maps for western Canada (Wall et al., 2002).

An R factor of 425 was estimated based on the isoerodent map of British Columbia from RUSLEFAC Figure R-4 (Wall et al., 2002) included in Appendix A.

2.3 K – SOIL ERODIBILITY FACTOR

The soil erodibility factor (K) is a quantitative measure of a soil's inherent susceptibility/resistance to erosion and the soil's influence on runoff amount and rate. This factor is affected by soil texture and structure, organic matter content, permeability, and season of the year (Wall et al., 2002).

The following steps were used to estimate the K factor, with reference plots included in Appendix A:

- Surficial geology units were obtained from the surficial geology and landform map presented in the Dam Site Characterization Report (KP, 2021), Appendix A1, Figure A1.5, and included in Appendix B of this letter for reference.
- Grain size distribution curves from the different surficial material were obtained from the Dam Site Characterization Report (KP, 2021), Section 5.2 (included as Appendix 3-L of the Application).
- Correlation between surficial geology units and surficial materials based on soil composition was completed in order to assign a specific grain size distribution curve from a surficial material to a specific surficial geology unit. Typical grain size distribution curves for surficial geology units were used when no information was available for a direct correlation.
- An organic matter content of 2% was selected for the studied area when applicable: this number was considered adequate as it represents the average of the potential organic matter content that will be encountered throughout the project area. Selection of the upper and lower boundary conditions (0 – 4% organic matter content) won't significantly affect the final K values obtained.
- Soil structure and permeability values were assigned for each terrain unit based on soil composition and characteristics as per RUSLEFAC Figure K-1 (Wall et al., 2002). A summary of these values is presented in Table 2.1 and Table 2.2, respectively.

The K factor was estimated based on the soil erodibility nomograph from RUSLEFAC Figure K-1 (Wall et al., 2002) included in Appendix A and summarized in Table 2.3

Table 2.1 Soil Structure Code

Code	Soil Structure
1	Very Fine Granular
2	Fine Granular
3	Medium or Coarse Granular
4	Blocky, Platy, Massive

Table 2.2 Permeability Class

Class	Permeability
6	Very Slow
5	Slow
4	Slow to Moderate
3	Moderate
2	Moderate to Rapid
1	Rapid

The Fresh Water Supply System components fall outside the surficial geology and landform map presented in the Dam Site Characterization Report (KP, 2021); a site investigation will be implemented prior to the construction of this facility in Year 5 in order to estimate the K factor.

Table 2.3 Soil Erodibility Factor (K)

Surficial Geology Units		Assigned Surficial Material		%Silt and Very Fine Sand	%Sand	% Organic Material	Soil Structure	Permeability	K
Alluvium Floodplain	F, Fp	Alluvial Floodplains	Fp	36	54	3	2	4	0.031
Alluvium	F	Glaciofluvial	Gf	29	52	2	3	4	0.028
Fluvial Fan	Ff	Glaciofluvial	Gf	29	52	2	3	4	0.028
Organic Swamp	O	Topsoil	TS	0	0	100	1	6	0.100
Lake Deposit	L	Glaciolacustrine	GLU	54	24	2	1	5	0.042
Colluvium	C	Colluvium	C	25	39	2	2	5	0.027
Eolian Deposit	E	Eolian	E	80	20	2	2	4	0.074
Glaciofluvial Sands and Gravels (Terrace)	FGt	Glaciofluvial	GF	29	52	2	3	4	0.028
Glaciofluvial Sands and Gravels (Kame Deposits)	FGh								
Glaciofluvial Sands and Gravels (Esker)	FGr								
Glaciofluvial Sands and Gravels (Unidentified)	FG								
Glacial Till (Ablation Till)	M	Glacial Till[1]	GT	30	41	2	3	3	0.025
Glacial Till (Lodgment Till)	M								
Weathered Bedrock	D	Completely Weathered Bedrock	CWB	25	39	2	2	5	0.022

Note(s):

1. Glacial till (gt) values obtained from average between ablation and lodgement till.
2. Very fine sand material size 0.02 mm – 0.4 mm; sand material size 0.08 mm – 5 mm.

2.4 LS – SLOPE FACTOR

The slope length and slope steepness (LS) factor is a measure of the effects of slope angle, length and complexity on erosion (Wall et al., 2002). The LS factor represents a ratio of soil loss under given conditions to that at a site with a standard slope steepness of 9% and slope length of 22.13 m (Wall et al., 2002).

To provide a better understanding when using this factor, two scenarios were assumed:

1. Pre-construction, considering the current site conditions.
2. During construction, considering that proper surface erosion and sediment control measurements based on the SEPSCP (BW Gold, 2022) are in place, including any required surface water management facility such as diversion/collection channels and ponds.

The following steps were used to estimate the LS factor, with reference plots included in Appendix A:

- For Scenarios 1 and 2, the LS factor was estimated based on RUSLEFAC Tables LS-1 and LS-3 respectively (Wall et al., 2002), included in Appendix A of this letter as reference, with Table LS-1 assuming cover conditions and Table LS-3 assuming freshly prepared construction sites.
- The values obtained from this table correspond to the maximum length of 300 m available in Tables LS-1 and LS-3 of Wall et. Al, 2002, as they represent the most conservative approach. This option seemed reasonable based on the extensive area of the project and the difficulty to sub-divide/study this area considering a maximum 300 m length. Values were extrapolated for the different slope angle ranges when required, with plots included in Appendix A of this letter as reference.

The slope angles were selected from the slope angle map presented in the Updated Terrain Stability Mapping and Geohazard Assessment (KP, 2022), Appendix B, and presented in Appendix B of this memo for reference.

Table 2.4 Slope Factor (LS)

Slope Angle [% Gradient]	Slope Description	LS Scenario 1 (Pre-Construction)	LS (During Construction)
0 - 5 %	Plain	1.1	2.5
6 - 26 %	Gentle	14	29
27 - 49 %	Moderate	26	59
50 - 70 %	Moderately Steep	40	82
>70 %	Steep	40[1]	82[1]

Note(s):

1. Slopes higher than 70% not shown on table ls-1 and ls-3. Values have been assigned based on extrapolation and as per slope angles = 70%.

The Fresh Water Supply System components fall outside the slope angle map presented in the Updated Terrain Stability Mapping and Geohazard Assessment (KP, 2022); a site investigation will be implemented prior to the construction of this facility in Year 5 in order to estimate the LS factor for this area.

2.5 C – CROP/VEGETATION AND MANAGEMENT FACTOR

The cropping management (C) factor is used to determine the relative effectiveness of soil and crop management systems and is a ratio comparing the soil eroded under a specific crop and management system to continuous fallow conditions (Wall et al., 2002). Variables that reduce the C factor include surface cover (e.g., mulch to help control erosion) and tillage (surface roughness promote infiltration) (Wall et al., 2002).

The same scenarios mentioned in Section 2.4 were also considered to estimate the C factor, with reference tables included in Appendix A.

- For Scenario 1, the C factor is calculated based on the values from the undisturbed forest land in Table C-6 from Wall et al. (2002), considering an average of 75 to 100% of area covered by canopy of trees and undergrow.
- For Scenario 2, the C factor is calculated based on the values from the mechanically prepared woodlands sites in Table C-7 from Wall et al. (2002), considering excellent soil and average mulch cover conditions. This selection is considered representative and conservative of site conditions with proposed surface erosion measures to be implemented during construction (e.g., mulch, surface roughness, rolled erosion control products). Specific site preparations onsite will differ from those presented in Table C-7; therefore, the disked, raked, and bedded site preparation activity was assumed to be most similar to erosion control measures that will be used.

C factors of 0.001 for scenario 1 and 0.17 for scenario 2 were selected, with reference tables included in Appendix A.

2.6 P – SUPPORT PRACTICE FACTOR

The support practice factor (P) represents the ratio of soil loss with a specific support practice to the corresponding loss with up and down slope cultivation and planting (Wall et al. 2002). The lower the P value, the more effectively the practice helps to retain sediment close to the source (similar to the sediment control measures such as silt fences presented in the SEPSCP).

The same scenarios mentioned in Section 2.4 were also considered:

- For Scenario 1, the P factor was estimated based on the general P values from RUSLEFAC Table 6.2 (Wall et al., 2002) included in Appendix A. A value of 1 was assumed (no support practice) as this is the most conservative approach.
- For Scenario 2, the P factor was estimated based on the general P values from RUSLEFAC Table 6.1 (Wall et al., 2002) included in Appendix A. A value of 0.1 was assumed considering the use of surface water management facilities during this stage, with these structures managing and collecting runoff and maintaining them below erosive velocities.

2.7 AVERAGE ANNUAL SOIL LOSS

The potential average annual soil loss estimate is used to qualitatively rank an area into one of five soil erosion classes: the soil loss classes from Table 1.1 of Wall et al. (2022) are presented in Table 2.5.

Table 2.5 RUSLEFAC – Soil Loss Classes

Soil Erosion Class	Potential Soil Loss [tonnes/ha/year]
1 Very Low	<6
2 Low	6 – 11
3 Moderate	11 – 22
4 High	22 – 33
5 Severe	>33

The average annual soil loss (in tonnes/ha/year) for pre-construction or current conditions (no construction has taken place), and for conditions assumed after clearing and grubbing activities, are presented in Table 2.6 by surficial geology and slope. The results are presented graphically on average annual soil loss maps in Appendix B.

The potential annual average soil loss prior to construction, as shown in Table 2.6, is qualitatively rated as Very Low for all surficial geology and slope ratings, ranging from 0.01 tonnes/ha/year for Glaciofluvial Sands and Gravels, Glacial Till, and Weathered Bedrock in areas up to 5% gradient to 1.7 tonnes/ha/year for Organic Swamp in moderately steep and steep areas (greater than 6% gradient). During construction, the potential annual average soil loss is qualitatively rated as follows:

- Very Low for all surficial geology in areas up to 5% gradient, and for Alluvium, Fluvial Deposits, Colluvium, Glaciofluvial Sand and Gravels, Glacial Till and Weathered Bedrock in areas up to 26% gradient.
- Low for lake deposits in areas up to 26% gradient, Colluvium, Glacial Till and Weathered Bedrock in areas up to 49% gradient, and Fluvial Deposits in areas greater than 26% gradient.
- Moderate for Organic Swamps and Eolian Deposits in areas up to 26% gradient, Lake Deposits in areas up to 49% gradient, Alluvium and Glaciofluvial Sand and Gravels in areas greater than 26%, and Colluvium, Glacial Till and Weathered Bedrock in areas greater than 49% gradient.
- High for Eolian Deposits in areas up to 49% gradient, and Colluvium in areas greater than 49% gradient.
- Severe for Organic Swamp in areas greater than 26% gradient and Eolian Deposits in areas greater than 49% gradient.

Most of the proposed upper and lower waste stockpiles, open pit, and plant site overlies Glacial Till, whereas the tailings storage facility (TSF), and Interim and Environmental Control Dams overlie primarily Glaciofluvial Sands and Gravels (see Figure B1, Appendix B). Small areas of Organic Swamp are present within the footprint of the TSF Main Dam D and near the West Dam. The project facilities are located on plain (0 to 5%) and gently sloping (6% to 26%) areas (see Figure B2, Appendix B). The slope angle mapping indicates that the proposed Open Pit is in an area of gently sloping terrain oriented towards the north-northeast with localized areas of moderately sloped ground. The Low-Grade Ore Stockpile, Lower Waste Stockpile, Upper Waste Stockpile, topsoil stockpiles TS-1, TS-2, and TS-3 are in an area of flat to gently sloping terrain with localized areas of moderately sloped ground. The TSF is located predominantly in an area of flat to moderately sloped terrain except along the incised portions of Davidson Creek and

Creek 505659, where the ground is moderately steep with localized areas of steep terrain. The Plant Site is in an area with flat to gently sloping terrain.

Figure B3 and B4 in Appendix B illustrate the soil erosion class across the project area prior to construction, and the potential soil loss rating during construction with implementation of erosion and sediment control measures. The majority of the project facilities are in areas with Very Low and Low soil erosion class. Areas with a Moderate soil erosion class are within the footprint of the TSF.

It is expected the more sediment deposition/build-up in collection/sediment ponds could occur in areas with higher soil erosion classification, indicating a potential increase in the frequency of cleaning and maintenance of these facilities, and to maintain the required freeboard conditions within the facilities. Sediment removal and proper disposal will be performed as required.

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Table 2.6 Potential Average Annual Soil Loss (A)

Surficial Geology	Slope Gradient [%]							
	Scenario 1 (Pre-Construction)				Scenario 2 (During Construction)			
	0 – 5%	6 – 26%	27 – 49%	≥ 50%	0 – 5%	6 – 26%	27 – 49%	≥ 50%
	A [tonnes/ha/year]							
Alluvium	0.01	0.16	0.30	0.46	0.5	5.9	12	17
Fluvial Fan	0.01	0.10	0.19	0.29	0.5	6	12	17
Organic Swamp	0.05	0.60	1.11	1.70	2	21	43	59
Lake Deposit	0.02	0.25	0.46	0.71	1	9	18	25
Colluvium	0.01	0.13	0.24	0.37	0.5	5.6	11	16
Eolian Deposit	0.04	0.47	0.87	1.34	1	16	32	44
Glaciofluvial Sands and Gravels (Terrace)	0.01	0.17	0.31	0.48	1	5.9	12	17
Glaciofluvial Sands and Gravels (Kame Deposits)	0.01	0.17	0.31	0.48	1	5.9	12	17
Glaciofluvial Sands and Gravels (Esker)	0.01	0.17	0.31	0.48	1	5.9	12	17
Glaciofluvial Sands and Gravels (Unidentified)	0.01	0.17	0.31	0.48	1	5.9	12	17
Glacial Till (Ablation Till)	0.01	0.15	0.28	0.43	0.5	5	10.7	15
Glacial Till (Lodgment Till)	0.01	0.15	0.28	0.43	0.5	5	10.7	15
Weathered Bedrock	0.01	0.13	0.24	0.37	0.4	5	9	13

3.0 CONCLUSION

The potential estimated annual soil loss 'A' is considered a general tool to understand the expected overall performance of the soils before and during construction activities. The results of this analysis will be used by qualified professionals to help inform the design of surface water management facilities such as sediment control ponds; it should be noted that several other criteria are factored into the design of these structures: detailed designs for all water management facilities will be provided on IFC drawings. The potential estimated average annual soil loss will also inform the selection, implementation, maintenance, and monitoring and activities for all erosion and sediment control measures; for example, it is expected that sediment deposition/build-up in collection/sediment ponds will be higher in areas qualitatively ranked as High or Severe, indicating a higher frequency of cleaning and maintenance to maintain the required freeboard conditions.

The Environmental Manager and Environmental Monitors will use professional judgement to guide the selection and implementation of erosion and sediment control measures, based on erosion potential as well as site-specific factors such as local topography and drainage directions and patterns, proximity to natural watercourses, and the timing and duration of the site preparation and construction activities.

We trust that the information provided in this letter satisfies your requirements at this time. If you have any questions, please contact the undersigned.

Yours truly,
Knight Piésold Ltd.

Prepared:	Carlos Penate, M.Eng., P.Eng. Senior Engineer	Reviewed:	Stephanie Eagen, R.P. Bio. Specialist Environmental Scientist

Reviewed:

James Fogarty, P.Eng.
Senior Engineer

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Approval that this document adheres to the Knight Piésold Quality System:

Attachments:

Appendix A	Additional Calculations
Appendix B	Figures

References:

British Columbia Ministry of Energy, Mines and Petroleum Resources (BC EMPR) and British Columbia Ministry of Environment and Climate Change Strategy (BC ENV). 2019. Joint Application Information Requirements for Mines Act and Environmental Management Act Permits.

British Columbia Ministry of Environment (BC ENV). 2015a. Environmental Management Act Technical Guidance 7. Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining. Version 1.

British Columbia Ministry of Environment (BC ENV). 2015b. Environmental Management Act Technical Guidance 3. Developing a Mining Erosion and Sediment Control Plan. Version 1.

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Wall, G.J., Coote, D.R., Pringle, E.A., and Shelton, I.J. (editors). 2002. RUSLEFAC — Revised Universal Soil Loss Equation for Application in Canada: A Handbook for Estimating Soil Loss from Water Erosion in Canada. Research Branch, Agriculture and Agri-Food Canada. Ottawa. Contribution No. AAFC/AAC2244E. 117 pp.

APPENDIX A

Additional Calculations

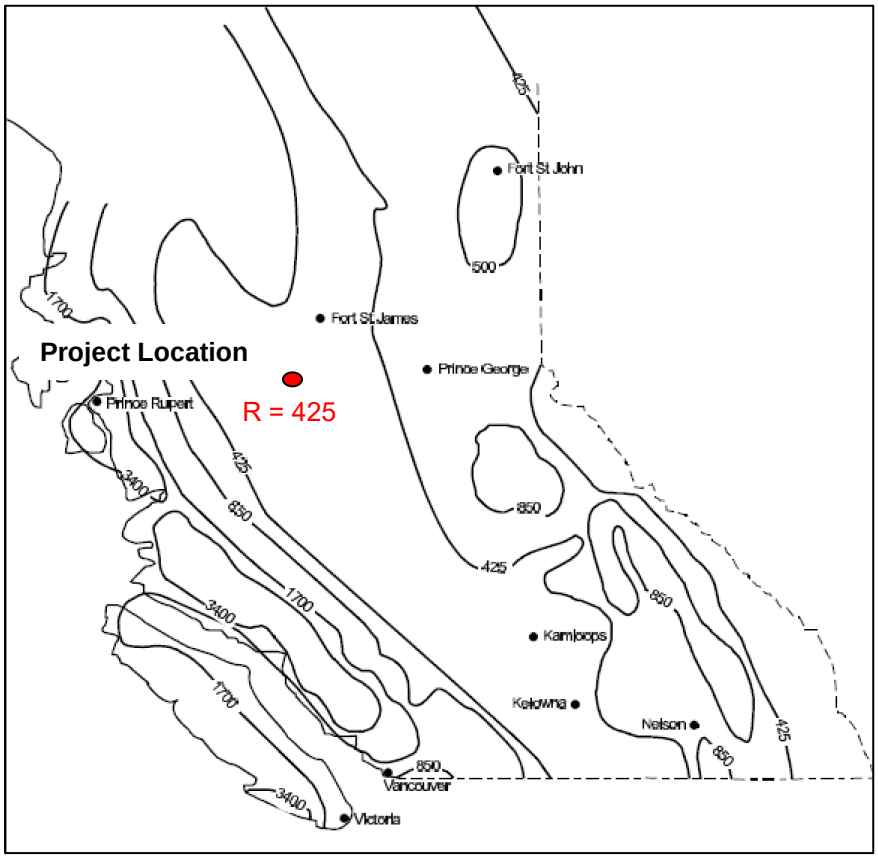
(Pages A-1 to A-19)

APPENDIX A
ADDITIONAL SOIL ERODIBILITY CALCULATIONS

1.0 GENERAL

The following sections provide the reference tables, figures and plots used to estimate the input parameters required for the Potential, Long-Term, Average Annual Soil value (A).

2.0 R - RAINFALL AND RUNOFF FACTOR



Note(s):

1. Ref. isoerodent map of British Columbia from Ruslefac figure R-4 (Wall et al., 2002).

Figure A.1 Isoerodent Map Showing R values for British Columbia

3.0 K – SOIL ERODIBILITY FACTOR

In the grain size distribution curve, the red lines represent the lower and upper boundary conditions expected for silt and very fine sand, and the green lines represent the lower and upper boundary conditions for sands. The grain size distribution curves were obtained from the Dam Site Characterization Report VA101-457/33-10 (KP, 2021a), Section 5.2, and the K factor was estimated based on the soil erodibility nomograph from RUSLEFAC Figure K-1 (Wall et al., 2002).

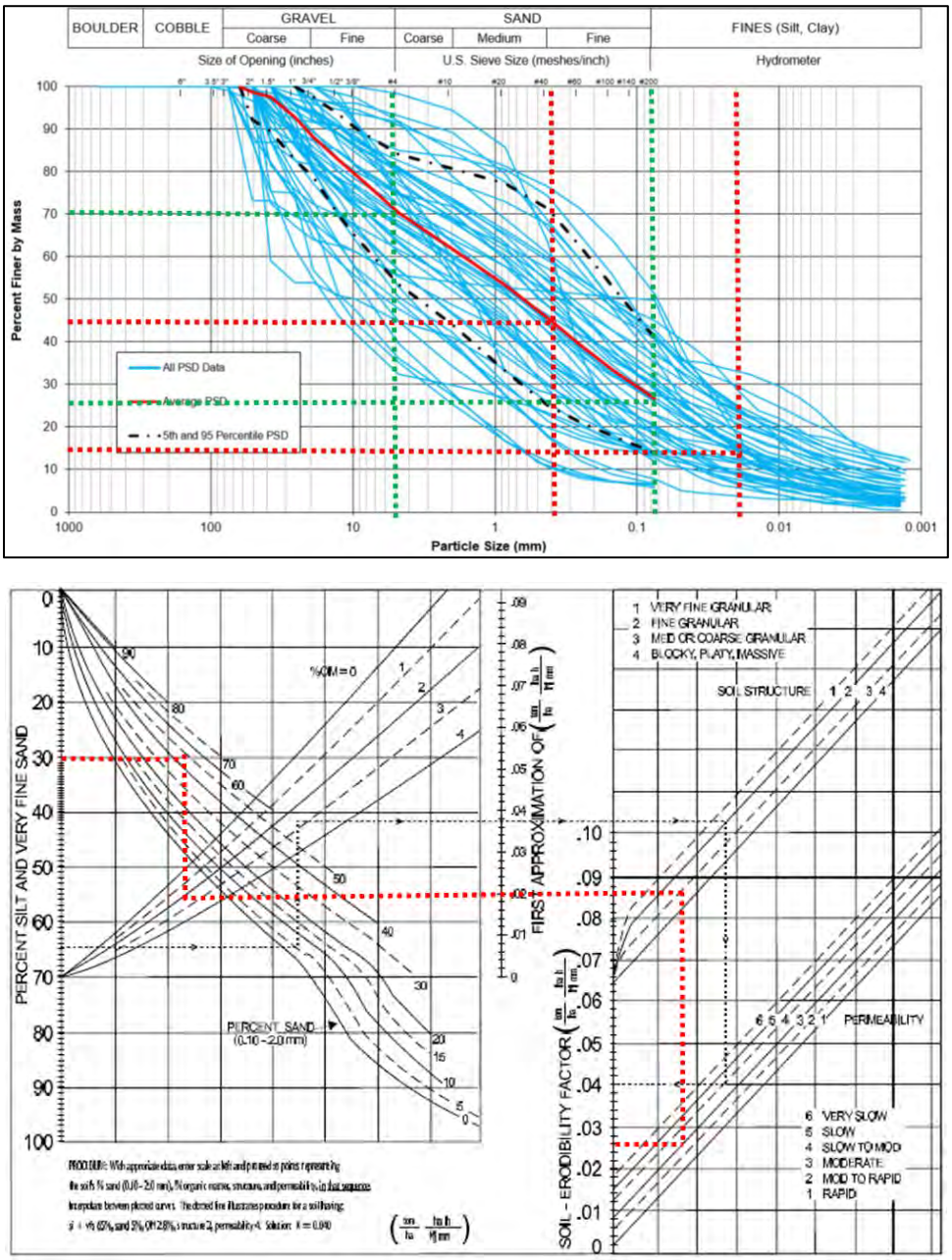


Figure A.2 Ablation Till (AT)

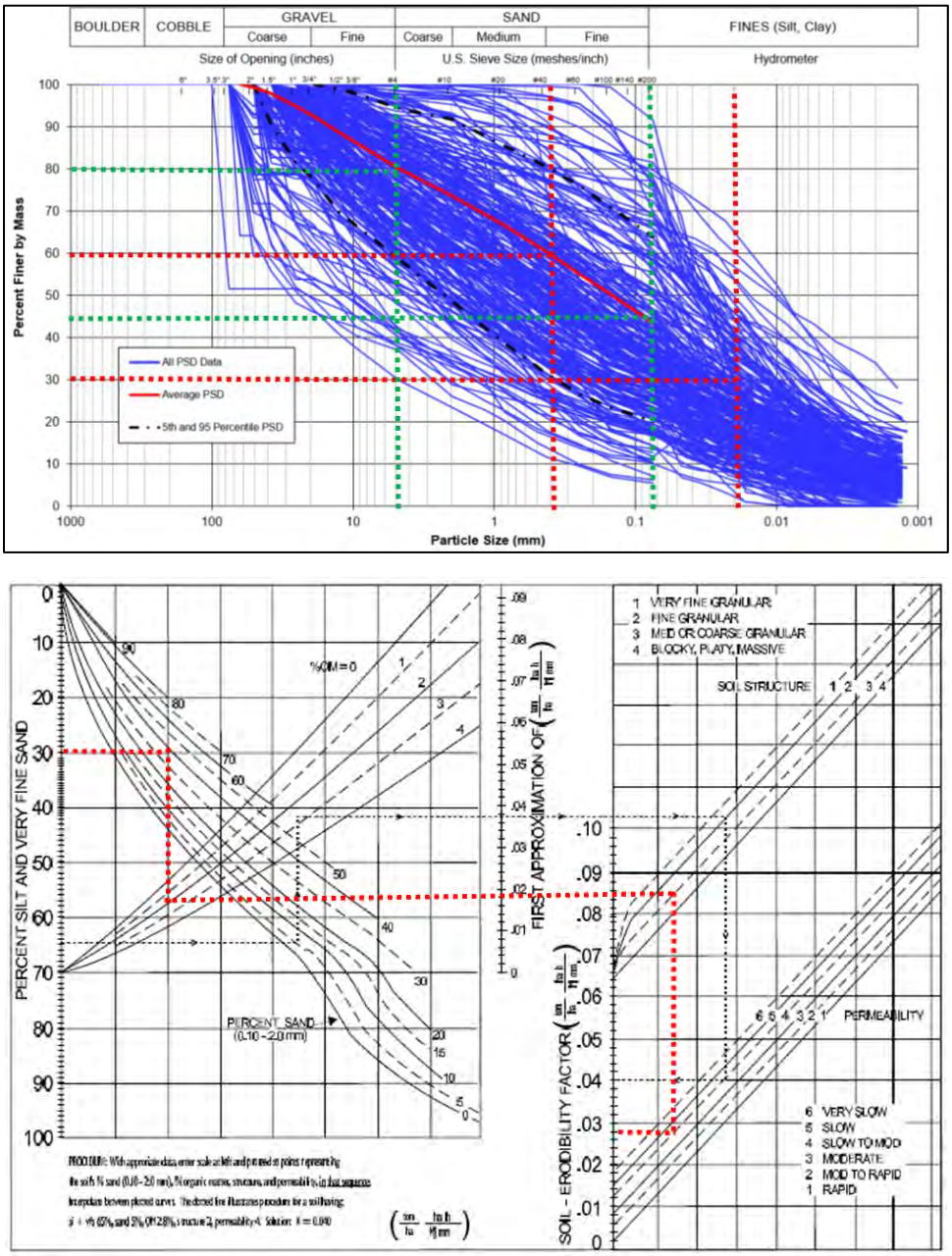


Figure A.3 Lodgment Till (LT)

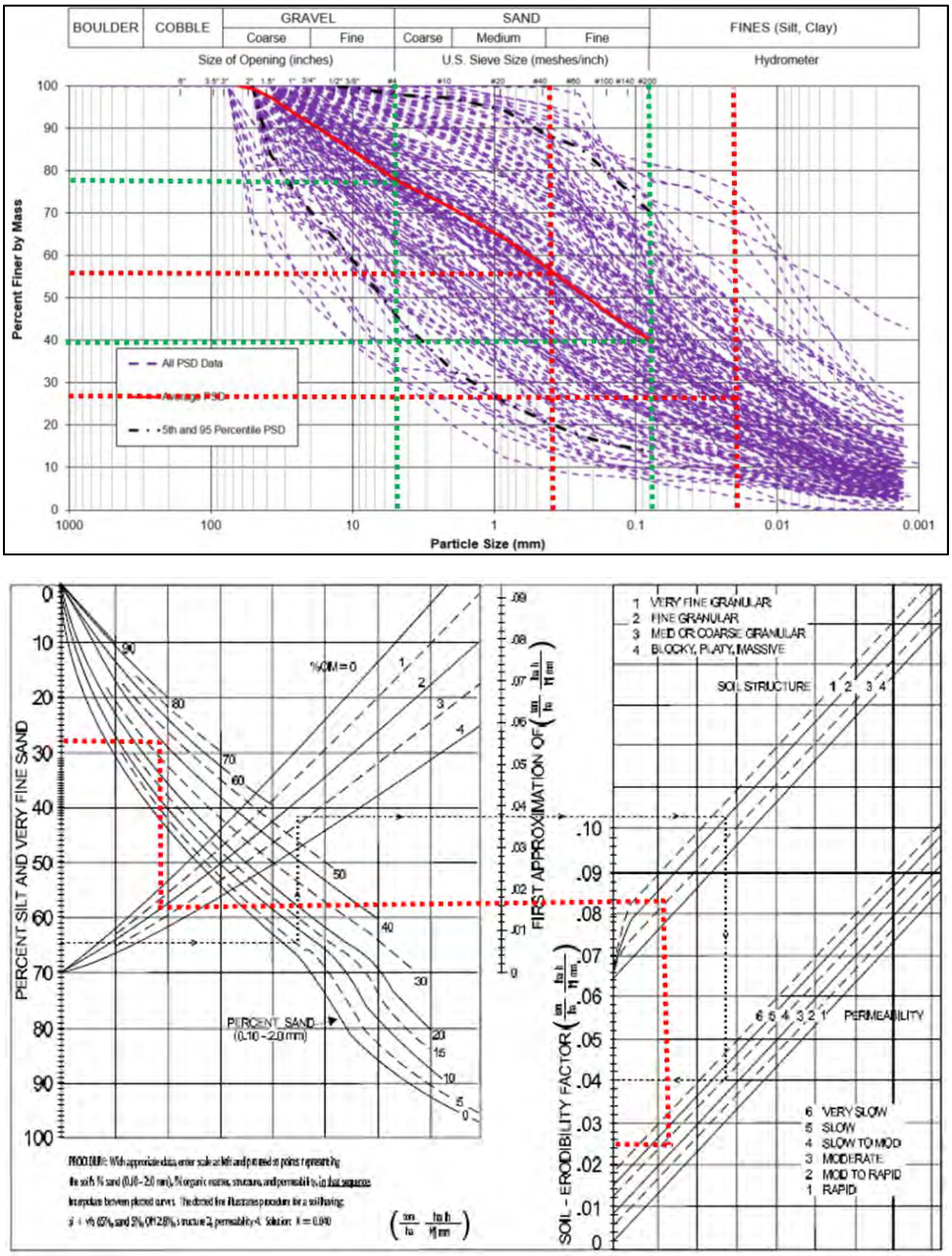


Figure A.4 Undifferentiated Till (UT)

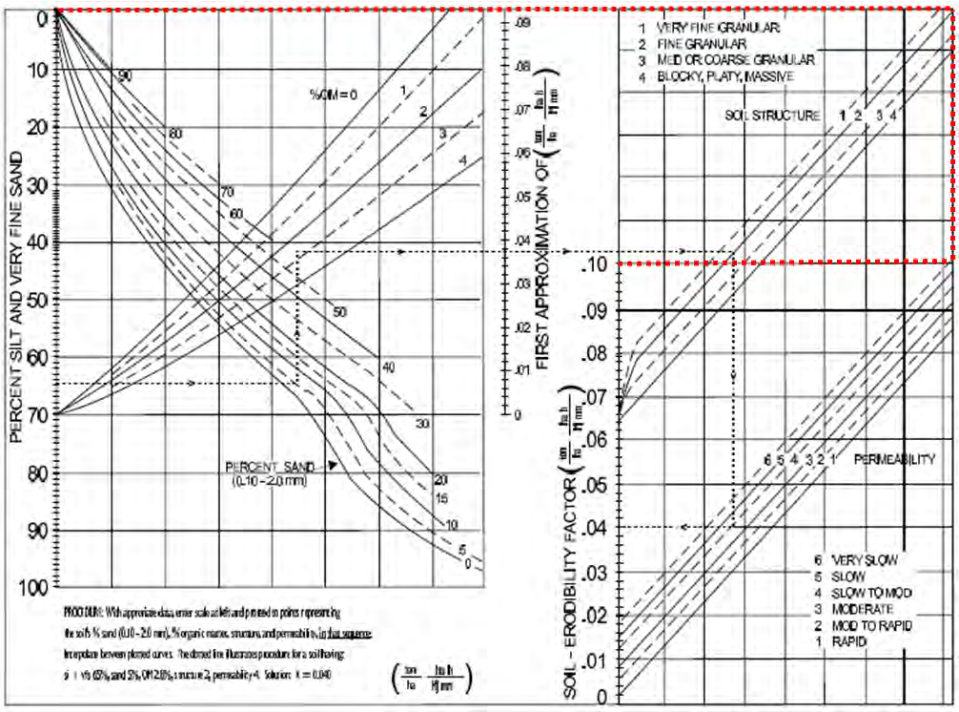


Figure A.5 Topsoil (TS)

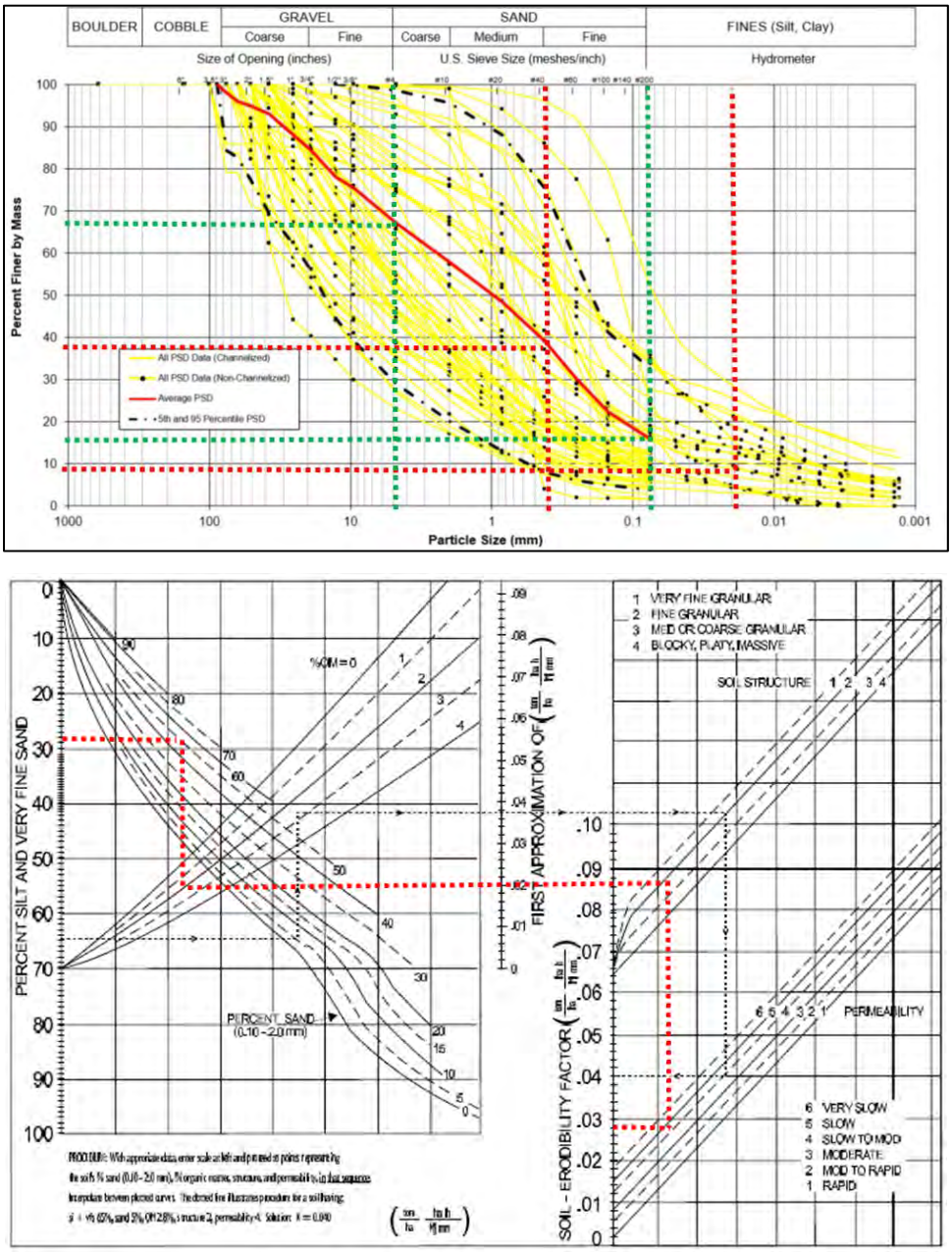


Figure A.6 Glaciofluvial (GF)

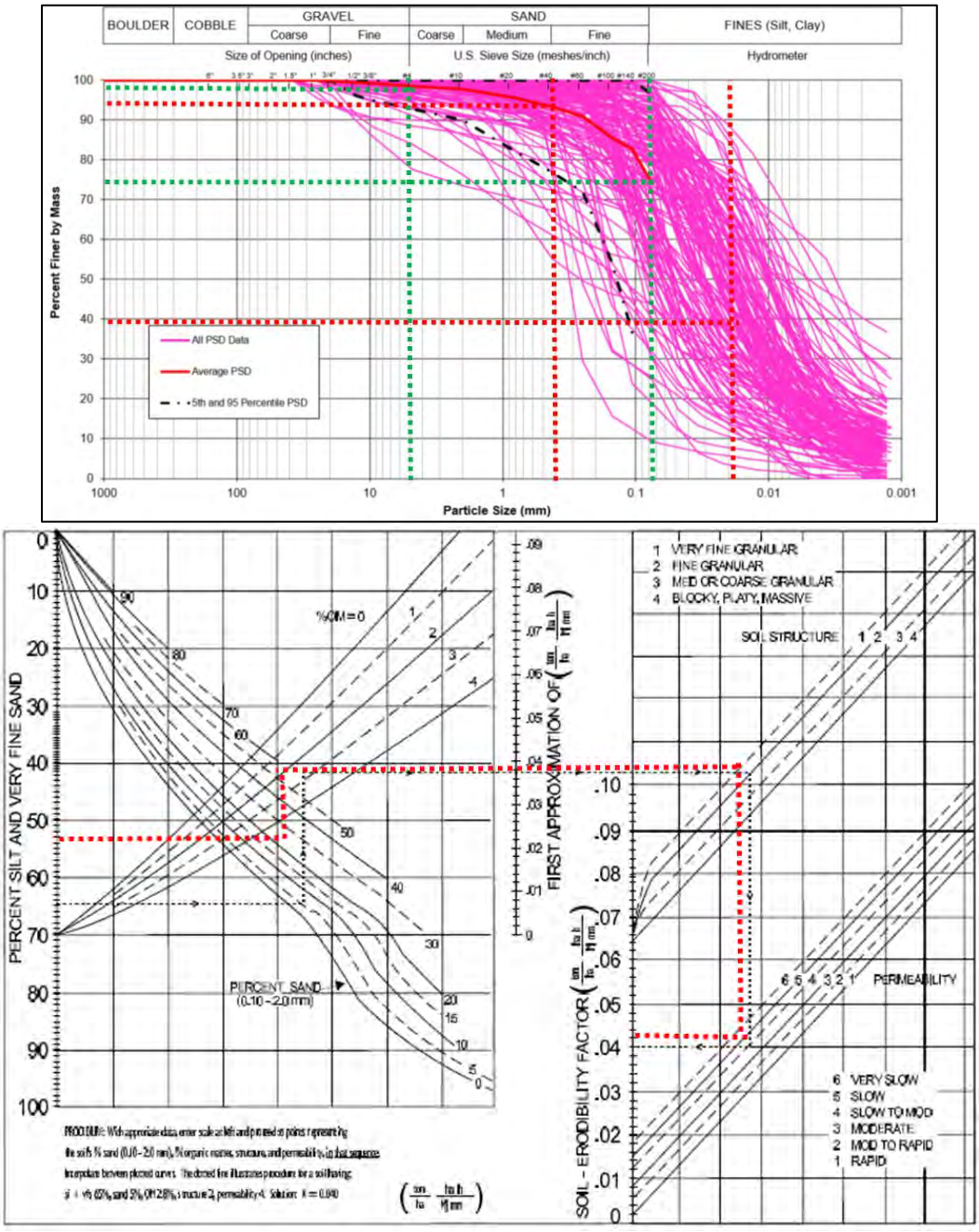


Figure A.7 Glaciolacustrine (GLU)

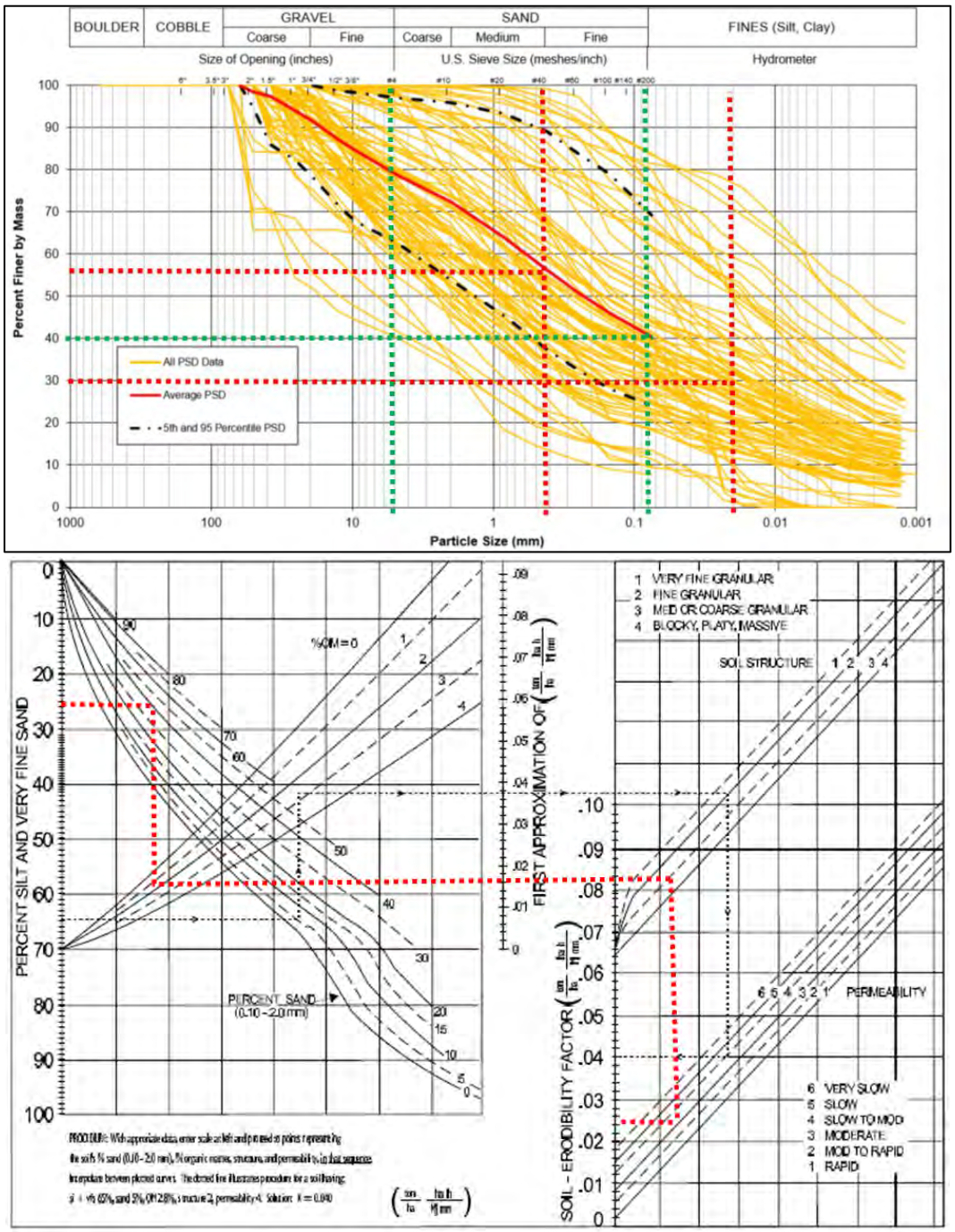


Figure A.8 Reworked Regolith (RR)

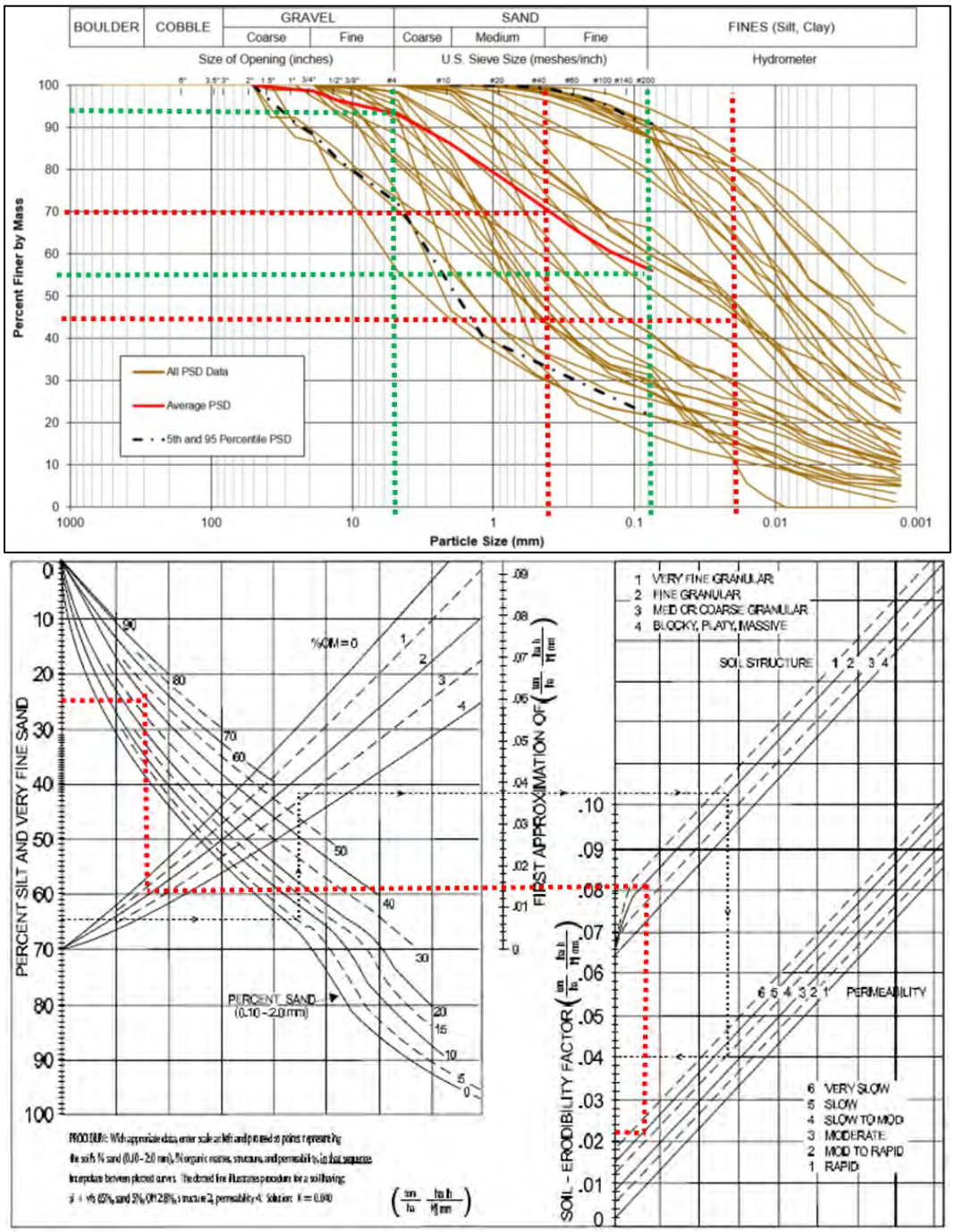


Figure A.9 Completely Weathered Rock (CWR)

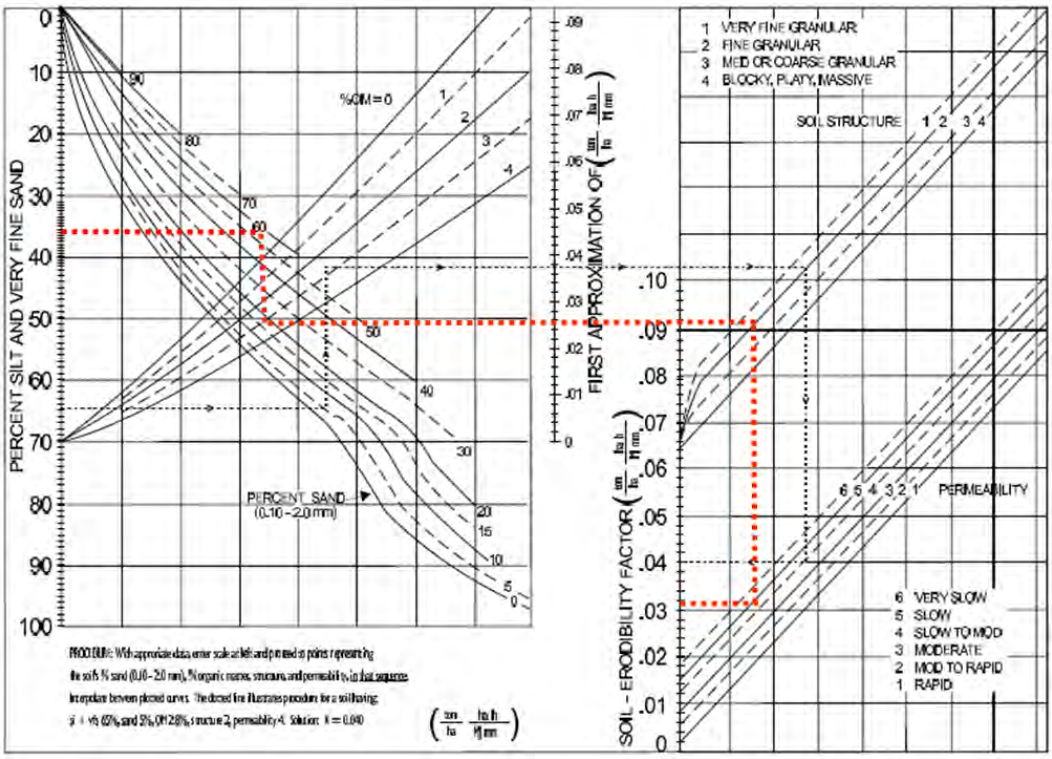


Figure A.10 Alluvial Floodplains (Af)

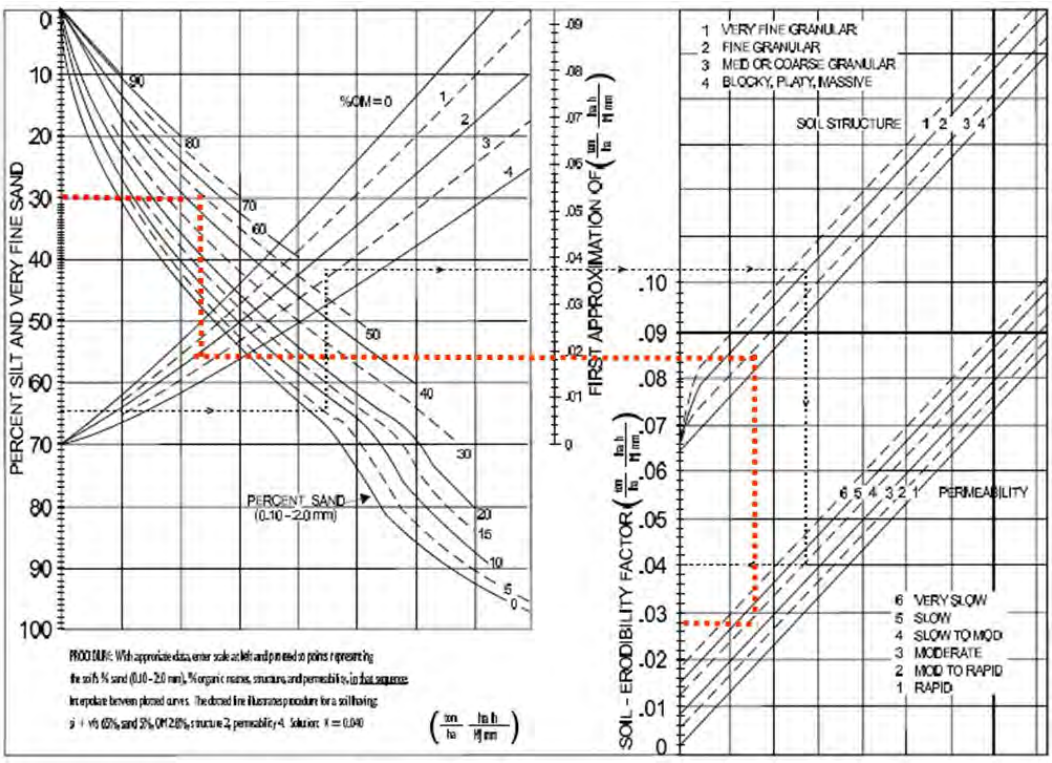


Figure A.11 Colluvial (C)

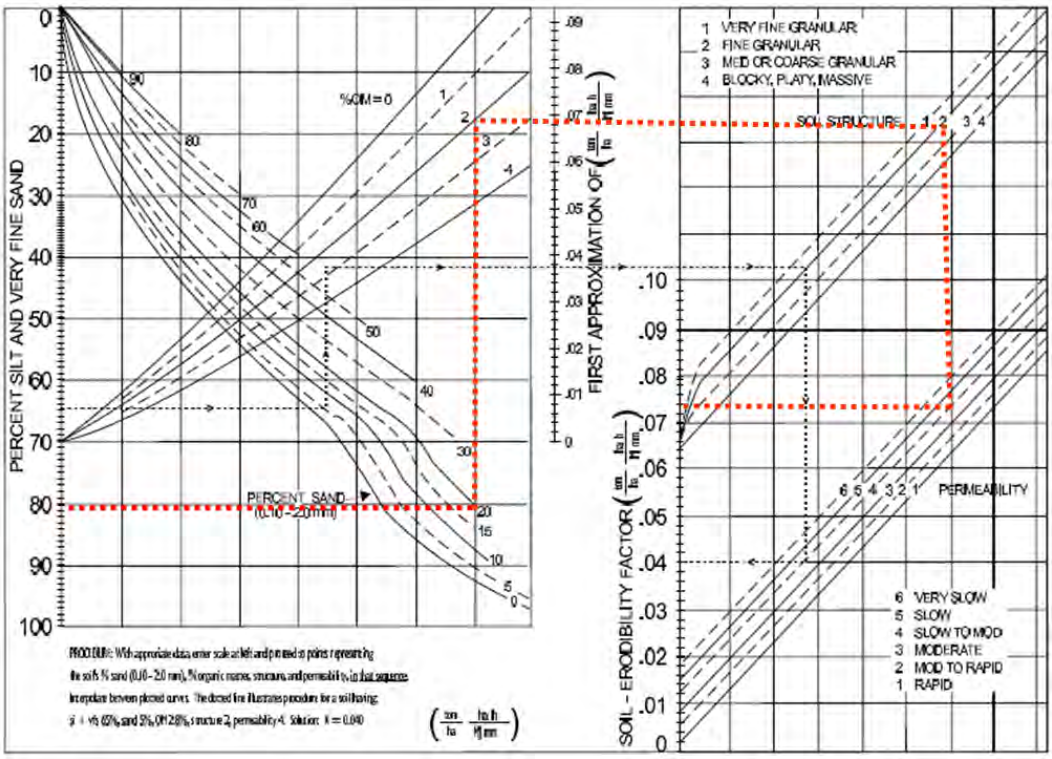


Figure A.12 Eolian (E)

Table A.1 Surficial Material K Values.

Surficial Material		% Silt and Very Fine Sand 0.02mm - 0.125mm	% Sand 0.08mm - 5mm"	% Organic Material	Soil Structure	Permeability	K
TS	Topsoil	0	0	100	1	6	0.100
GT	Glacial Till	30	41	2	3	3	0.025
AT	Ablation Till	30	45	2	3	3	0.026
LT	Lodgment Till	30	36	2	3	3	0.024
UT	Undifferentiated Till	28	38	2	3	3	0.024
GLU	Glaciolacustrine	54	24	2	1	5	0.042
GF	Glaciofluvial	29	52	2	3	4	0.028
Fp	Alluvial Floodplains	36	54	3	2	4	0.031
C	Colluvial	30	46	2	3	4	0.027
E	Eolian	80	20	2	2	4	0.074
RR	Reworked Regolith	26	40	2	3	3	0.024
CWB	Completely Weathered Bedrock	25	39	2	2	5	0.022
HWB	Highly Weathered Bedrock	-	-	-	-	-	-
IB	Intact Bedrock	-	-	-	-	-	-

4.0 LS – SLOPE FACTOR

Table LS-1. Values for topographic factor, LS, for low ratio of rill:inter-rill erosion, such as consolidated soil conditions with cover and rangeland (applicable to thawing soils where both inter-rill and rill erosion are significant)

Slope (%)	Slope length in meters											
	2	5	10	15	25	50	75	100	150	200	250	300
0.2	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
0.5	0.07	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09
1	0.11	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.16	0.16	0.17	0.17
2	0.18	0.20	0.22	0.23	0.25	0.28	0.29	0.30	0.32	0.33	0.35	0.35
3	0.23	0.27	0.31	0.33	0.36	0.41	0.44	0.47	0.50	0.53	0.55	0.57
4	0.27	0.33	0.39	0.42	0.47	0.55	0.60	0.64	0.70	0.74	0.78	0.81
5	0.31	0.39	0.47	0.52	0.59	0.70	0.77	0.83	0.92	0.99	1.05	1.10
6	0.35	0.45	0.54	0.61	0.70	0.84	0.94	1.02	1.14	1.24	1.32	1.39
8	0.41	0.55	0.69	0.78	0.92	1.15	1.31	1.43	1.63	1.79	1.92	2.03
10	0.48	0.66	0.84	0.96	1.15	1.47	1.69	1.87	2.15	2.38	2.57	2.74
12	0.61	0.86	1.11	1.29	1.57	2.03	2.37	2.64	3.07	3.42	3.72	3.99
14	0.70	1.01	1.33	1.56	1.91	2.52	2.96	3.31	3.89	4.36	4.77	5.12
16	0.79	1.16	1.54	1.82	2.25	3.00	3.55	4.00	4.74	5.33	5.85	6.31
20	0.96	1.44	1.96	2.34	2.94	4.00	4.79	5.44	6.51	7.39	8.16	8.85
25	1.15	1.77	2.45	2.96	3.77	5.22	6.31	7.23	8.74	10.01	11.12	12.11
30	1.33	2.08	2.92	3.56	4.57	6.42	7.84	9.03	11.01	12.68	14.15	15.47
40	1.64	2.64	3.78	4.67	6.08	8.72	10.76	12.50	15.43	17.91	20.12	22.11
50	1.91	3.13	4.55	5.66	7.45	10.83	13.47	15.73	19.57	22.85	25.77	28.43
60	2.15	3.56	5.22	6.54	8.67	12.71	15.91	18.65	23.34	27.36	30.95	34.23

Note(s):

1. Ref. table LS-1 from Ruslefac figure LS-1 (Wall et al., 2002).

Table A.2 Slope Factor (as per Table LS-1 of Wall, et al. (2002))

Table LS-3. Values for topographic factor, LS, for high ratio of rill:inter-rill erosion, such as highly disturbed soil conditions and freshly prepared construction sites, with little or no cover (not applicable to thawing soils)

Slope (%)	Slope length in meters											
	2	5	10	15	25	50	75	100	150	200	250	300
0.2	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
0.5	0.06	0.07	0.08	0.08	0.08	0.09	0.10	0.10	0.11	0.12	0.12	0.12
1	0.07	0.09	0.11	0.14	0.14	0.17	0.19	0.20	0.23	0.24	0.26	0.27
2	0.10	0.14	0.18	0.26	0.26	0.34	0.40	0.44	0.52	0.58	0.64	0.69
3	0.11	0.17	0.24	0.37	0.37	0.52	0.63	0.72	0.87	1.00	1.11	1.22
4	0.13	0.21	0.30	0.49	0.49	0.70	0.87	1.02	1.26	1.47	1.65	1.82
5	0.14	0.24	0.36	0.61	0.61	0.91	1.14	1.35	1.70	2.00	2.28	2.53
6	0.16	0.27	0.42	0.72	0.72	1.10	1.41	1.67	2.14	2.54	2.91	3.25
8	0.19	0.34	0.53	0.96	0.96	1.50	1.96	2.36	3.07	3.70	4.28	4.82
10	0.21	0.40	0.64	1.19	1.19	1.92	2.53	3.08	4.06	4.94	5.75	6.52
12	0.27	0.52	0.85	1.63	1.63	2.66	3.54	4.33	5.77	7.07	8.28	9.42
14	0.32	0.62	1.02	1.98	1.98	3.28	4.40	5.42	7.27	8.95	10.52	12.01
16	0.36	0.71	1.19	2.34	2.34	3.90	5.26	6.51	8.79	10.87	12.81	14.66
20	0.45	0.90	1.52	3.05	3.05	5.17	7.03	8.75	11.92	14.84	17.58	20.20
25	0.54	1.11	1.91	3.90	3.90	6.70	9.19	11.50	15.78	19.75	23.51	27.10
30	0.64	1.32	2.29	4.73	4.73	8.20	11.32	14.22	19.62	24.65	29.43	34.02
40	0.81	1.70	2.99	6.29	6.29	11.04	15.35	19.38	26.94	34.03	40.79	47.30
50	0.96	2.04	3.62	7.70	7.70	13.62	19.02	24.11	33.67	42.67	51.29	59.60
60	1.09	2.35	4.17	8.94	8.94	15.92	22.30	28.33	39.70	50.43	60.72	70.66

Note(s):

1. Ref. table LS-1 from Ruslefac figure LS-3 (Wall et al., 2002).

Table A.3 Slope Factor (as per Table LS-3 of Wall et al. (2002))

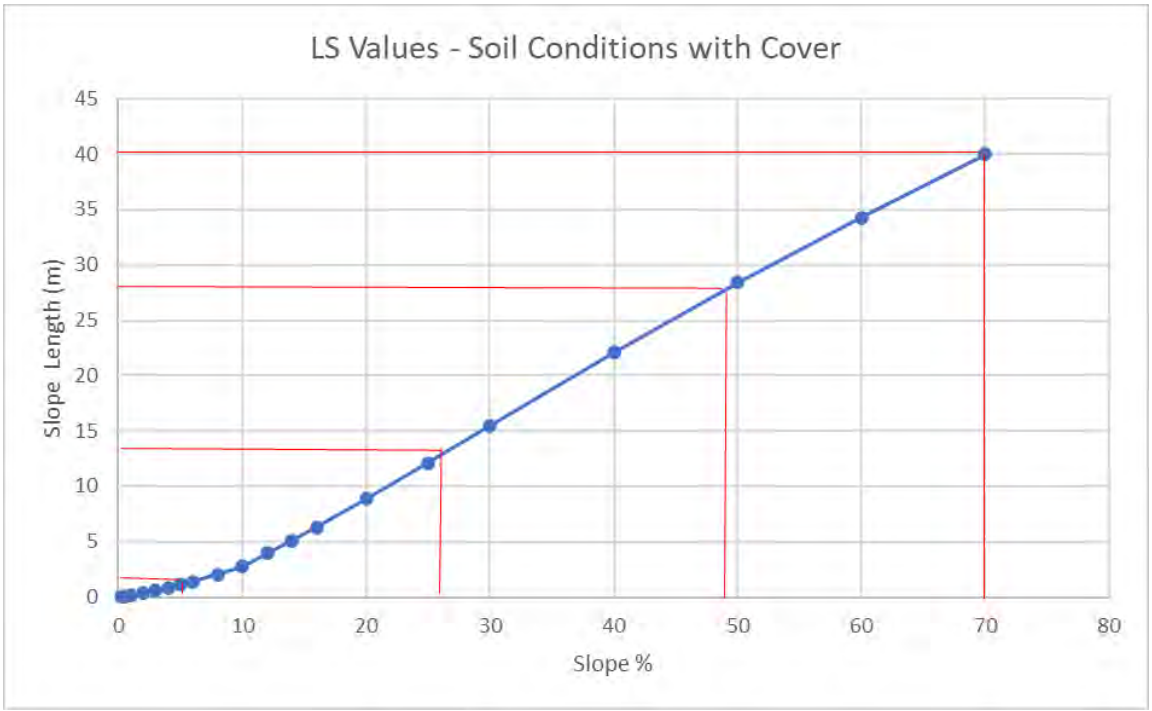


Figure A.13 Slope Factor as per Table LS-1 (Wall et al., 2002) and Lengths = 300m (Scenario 1)

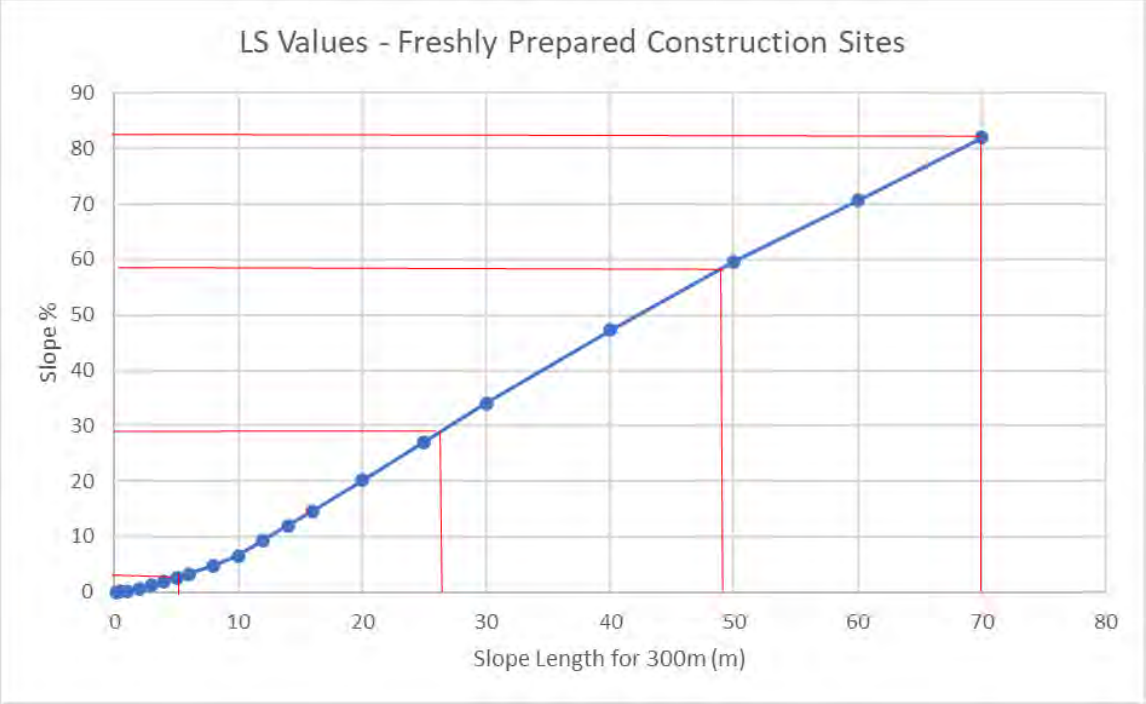


Figure A.14 Slope Factor as per Table LS-3 (Wall et al., 2002) and Lengths = 300m (Scenario 2)

5.0 C – CROP/VEGETATION AND MANAGEMENT FACTOR

Table A.4 Values for Undisturbed Forest Land (Pre-construction)

Percent of area covered by canopy of trees and undergrowth	Percent of area covered by duff at least 2 inches deep	C factor
100-75	100-90	0.0001-0.001
70-45	85-75	0.002-0.004
40-20	70-40	0.003-0.009

Note(s):

1. Ref. undisturbed forest land from Ruselfac table C-6 (Wall et al. 2002).

Table A.5 Values for Mechanical Prepared Woodland Sites (after Clearing and Grubbing)

Site Preparation	Mulch Cover (%)	Soil Condition and weed cover							
		Excellent		Good		Fair		Poor	
		NC	WC	NC	WC	NC	WC	NC	WC
Disked, raked, bedded	0	0.52	0.20	0.72	0.27	0.85	0.32	0.94	0.36
	10	0.33	0.15	0.46	0.20	0.54	0.24	0.60	0.26
	20	0.24	0.12	0.34	0.17	0.40	0.20	0.44	0.22
	40	0.17	0.11	0.23	0.14	0.27	0.17	0.30	0.19
	60	0.11	0.08	0.15	0.11	0.18	0.14	0.20	0.15
	80	0.05	0.04	0.07	0.06	0.09	0.08	0.10	0.09
burned	0	0.25	0.10	0.26	0.10	0.31	0.12	0.45	0.17
	10	0.23	0.10	0.24	0.10	0.26	0.11	0.36	0.16
	20	0.19	0.10	0.19	0.10	0.21	0.11	0.27	0.14
	40	0.14	0.09	0.14	0.09	0.15	0.09	0.17	0.11
	60	0.08	0.06	0.09	0.07	0.10	0.08	0.11	0.08
	80	0.04	0.04	0.05	0.04	0.05	0.04	0.06	0.05
drum chopped	0	0.16	0.07	0.17	0.07	0.20	0.08	0.29	0.11
	10	0.15	0.07	0.16	0.07	0.17	0.08	0.23	0.10
	20	0.12	0.06	0.12	0.06	0.14	0.07	0.18	0.09
	40	0.09	0.06	0.09	0.06	0.10	0.06	0.11	0.07
	60	0.06	0.05	0.06	0.05	0.07	0.05	0.07	0.05
	80	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04

NC - no live vegetation; WC - 75% cover of grass, weeds with average drop fall height of 20 inches

Note(s):

1. Ref. values from the mechanical prepared woodlands sites from Ruselfac table C-7 (Wall et al. 2002).

6.0 P – SUPPORT PRACTICE FACTOR

Table A.6 General P Values.

Support practice	P-value
No support practice	1.00
Cross slope farming	0.75
Contour farming (3-8% slopes)	0.50
Strip cropping, cross slope (3-8% slopes)[1]	0.38
Strip cropping, on contour (3-8% slopes)	0.25

[1] derived by interpolation

Note(s):

1. Ref. general P values from Ruslefac table 6.2 (Wall et al., 2002).

Table A.7 General P Values Additional Table.

Variable (practice)	Description and function	Effect on erosion	Management implications
Cross slope farming (P range 0.75-1.0)	Description - cultivation, planting done across slope Function - tillage, crop rows create ridges which act as small dams across slope - ridges redirect runoff, modify downslope flow pattern, reduce erosive capacity of runoff	Erosion reduction up to 25% - almost complete protection from storms of low to moderate intensity - little or no protection against severe storms (extensive runoff breakovers of ridges, rows) - effectiveness influenced by slope length, soil properties, crop management, tillage type, rainfall, snowmelt - stabilized (grass) waterways required to carry accumulated excess runoff from depressional areas downslope without causing rill or gully erosion - grass strips do not reduce upslope erosion but are effective in reducing or even preventing sediments from entering a drainage system - compatible with almost any type of cropping system - waterways diffuse or spread flow of water, which reduces runoff velocity, decreases erosive capability of runoff and allows sediment deposition within strip	- up and down slope tillage, planting promotes runoff, rill and gully development, erosion - cross slope tillage provides runoff barriers, increases infiltration, decreases runoff and erosion - rougher soil surfaces (e.g. ridged) provide better protection than smooth surfaces (soil loss decreases as ridge height increases) - closely grown stems of stiff vegetation (e.g.forages, grain) act like ridges Examples of ridge heights: HIGH - left by twisted shoven chisel plough, ridge tillage LOW - left after small grain drilling
Contour farming (P range 0.50-0.90)	Description - cultivation, planting is done following topographic contours of slope Function - ridges created along contour have a zero gradient - water flows uniformly over ridges along entire length	Erosion reduction 10 to 50 % - almost complete protection from storms of low to moderate intensity, more effective than cross slope farming - little or no protection against severe storms (extensive runoff breakovers of ridges, rows) - most effective on slopes 3 to 8% - most effective on ridges >15 cm - if ridges are not level water will flow along ridge to lowest point, and can create rills or gullies at this point - requires stabilized waterways (e.g. per-manent grass) on slopes greater than 8 % - combination of P practices required, or change in C practices	
Strip cropping (P range 0.25 - 0.90)	Description - crops grown in systematic arrangement of strips or bands (across slope or on contour) - alternating strips of close growing vegetation (grass or forage) with row crops either across slope or along contour - crops rotated between strips in systematic order, grass or legume covers a portion of slope year round Function - runoff diffused and reduced, infiltration increased at grass strip - soil eroded from annually cultivated crop strip filtered out within first several metres of adjacent downslope grass strip	Erosion reduction - 10 to 75 % - reduces erosion in the grass, legume strips - deposition occurs at upper edge of grass strips (infiltration increases, transport capacity decreases) - more effective than contouring alone - strip cropping factor accounts for soil movement leaving the field, but not for all movement and redistribution within	- strips of economically higher-return row or cereal crops in combination with erosion-resistant grasses, legumes can limit soil movement - strip width depends on: slope steepness and length, infiltration capacity and other properties of soil, crop management, precipitation characteristics - longer, steeper slopes should incorporate wider forage bands, narrower row crop bands
Terracing (P range 0.10-0.90)	Description - large soil ridges constructed across slope at regular intervals Function - divides slope into shorter lengths - runoff intercepted, collected, conveyed off field at nonerosive velocities - sediment trapped, deposited within field or in sediment traps	Erosion reduction - 10 to 90 % - reduces sheet, rill erosion on the terrace interval - causes deposition on the terrace channel if gradient is less than 1 % - soil losses from uniform grade vary exponentially with grade (soil loss increases as grade increases) - P factor considers both the benefit of localized deposition (i.e. close to source) and amount of soil deposited	- relatively expensive, permanent changes made to microtopography of slope

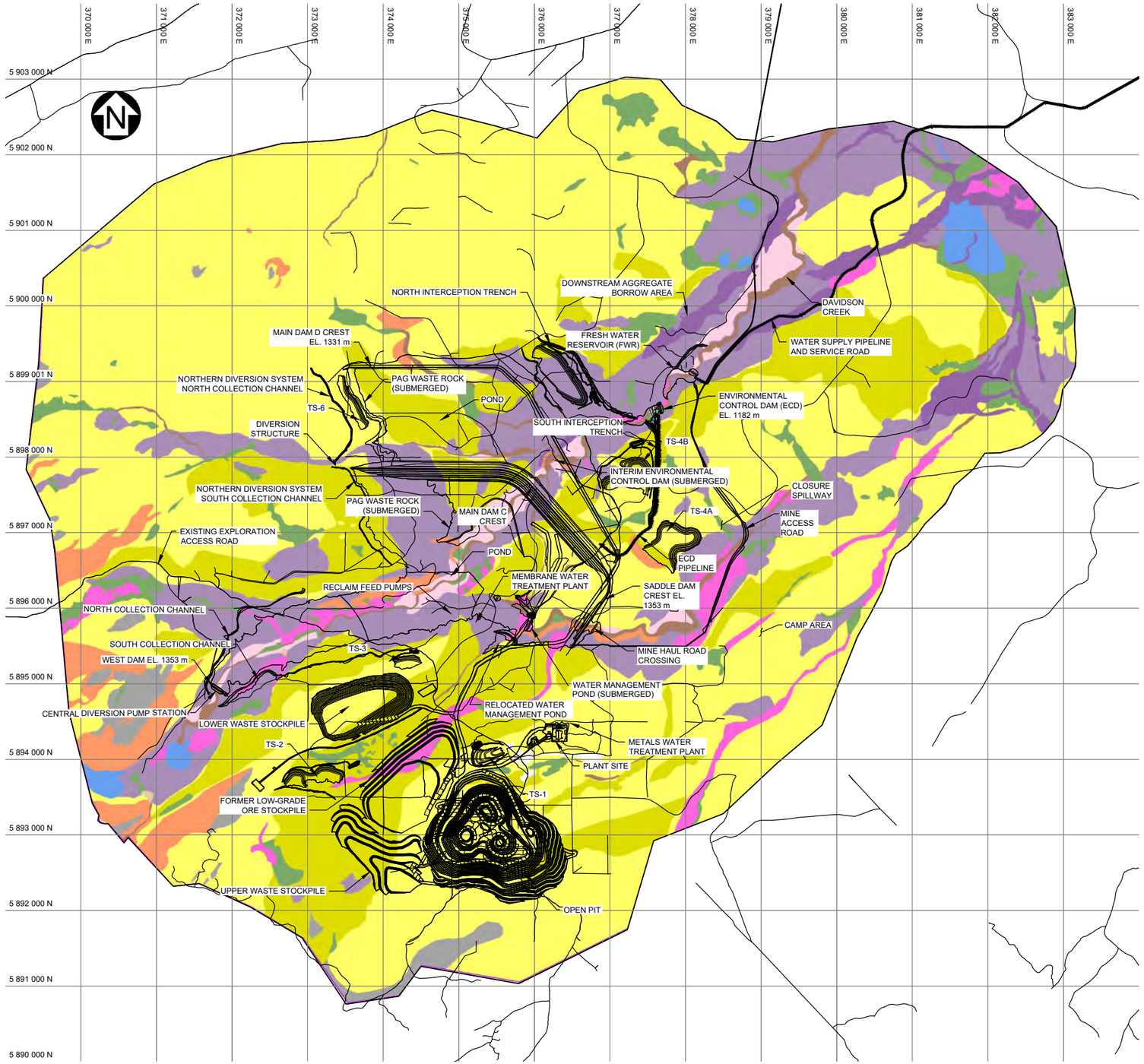
Note(s):

1. Ref. general P values from Ruslefac table 6.1 (Wall et al., 2002).

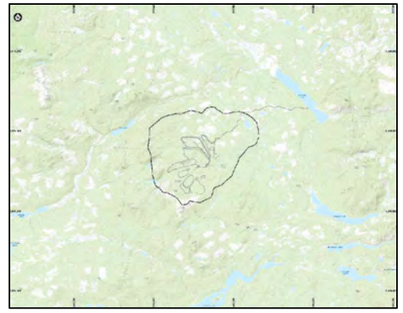
APPENDIX B

Figures

(Figure B1 to B4)



PLAN
SCALE A



KEY PLAN
NTS

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. SURFICIAL GEOLOGY AS PER DAM CHARACTERIZATION REPORT REV 1VA101-457/33-10

SURFICIAL GEOLOGY

A	ANTHROPOGENIIC MATERIAL
F, Fp	ALLUVIUM
Ft	FLUVIAL FAN
O	ORGANIC SWAMP
L	LAKE DEPOSIT
C	COLLUVIUM
E	EOLIAN DEPOSIT
FGt	GLACIOFLUVIAL SANDS AND GRAVELS (TERRACE)
FGk	GLACIOFLUVIAL SANDS AND GRAVELS (KAME DEPOSIT)
FGk	GLACIOFLUVIAL SANDS AND GRAVELS (ESKER)
FG	GLACIOFLUVIAL SANDS AND GRAVELS (UNDIFFERENTIATED)
M	GLACIAL TILL (ABLATION TILL)
M	GLACIAL TILL (LODGEMENT TILL)
D	WEATHERED BEDROCK

FOR INFORMATION ONLY

SCALE A 600 300 0 1000 2000 3000 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	07DEC'22	ISSUED WITH LETTER	CAP	ELG	SCE

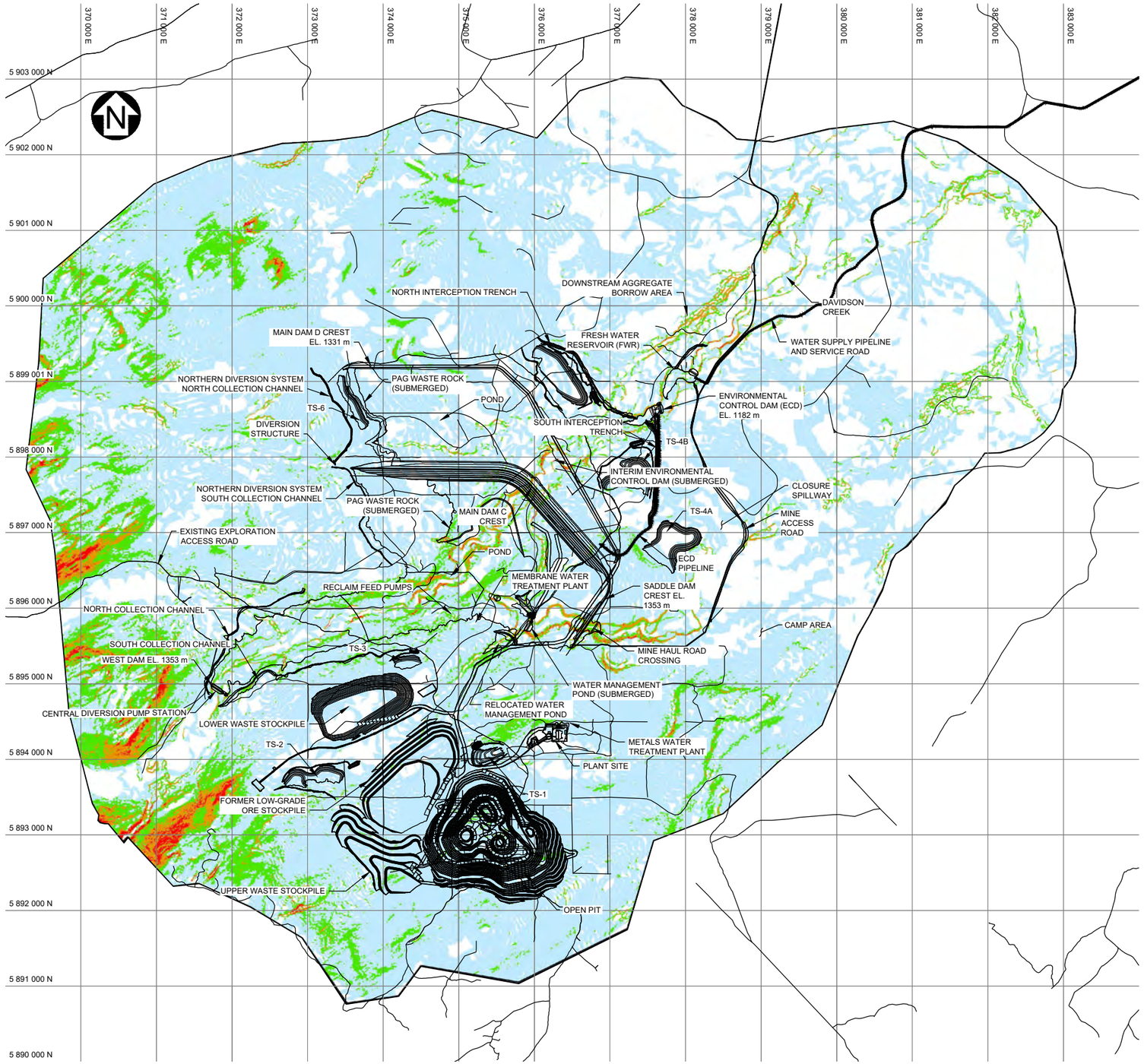
BW GOLD LTD.

BLACKWATER GOLD PROJECT

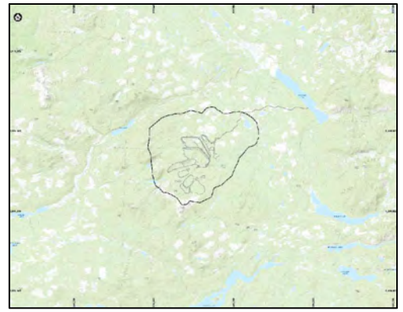
RUSLEFAC SOIL LOSS EQUATION
SOIL EROSION CLASS
SURFICIAL GEOLOGY MAP

Knight Piésold CONSULTING

P/A NO. VA101-457/37
REF NO. VA22-02237
FIGURE B1
REV 0



PLAN
SCALE A



KEY PLAN
NTS

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. SLOPE ANGLES AS PER AS PER UPDATED TERRAIN STABILITY MAPPING AND GEOHAZARD ASSESSMENT REPORT VA22-00586

LEGEND:

- 0 - 5% (PLAIN: 0 - 3 DEGREES)
- 6 - 26% (GENTLE: 4 - 15 DEGREES)
- 27 - 49% (MODERATE: 16 - 26 DEGREES)
- 50 - 70% (MODERATELY STEEP: 27 - 35 DEGREES)
- >70% (STEEP: >35 DEGREES)

FOR INFORMATION ONLY

SCALE A 600 300 0 1000 2000 3000 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	07DEC'22	ISSUED WITH LETTER	CAP	ELG	SCE

BW GOLD LTD.

BLACKWATER GOLD PROJECT

RUSLEFAC SOIL LOSS EQUATION SOIL EROSION CLASS SLOPE ANGLE MAP

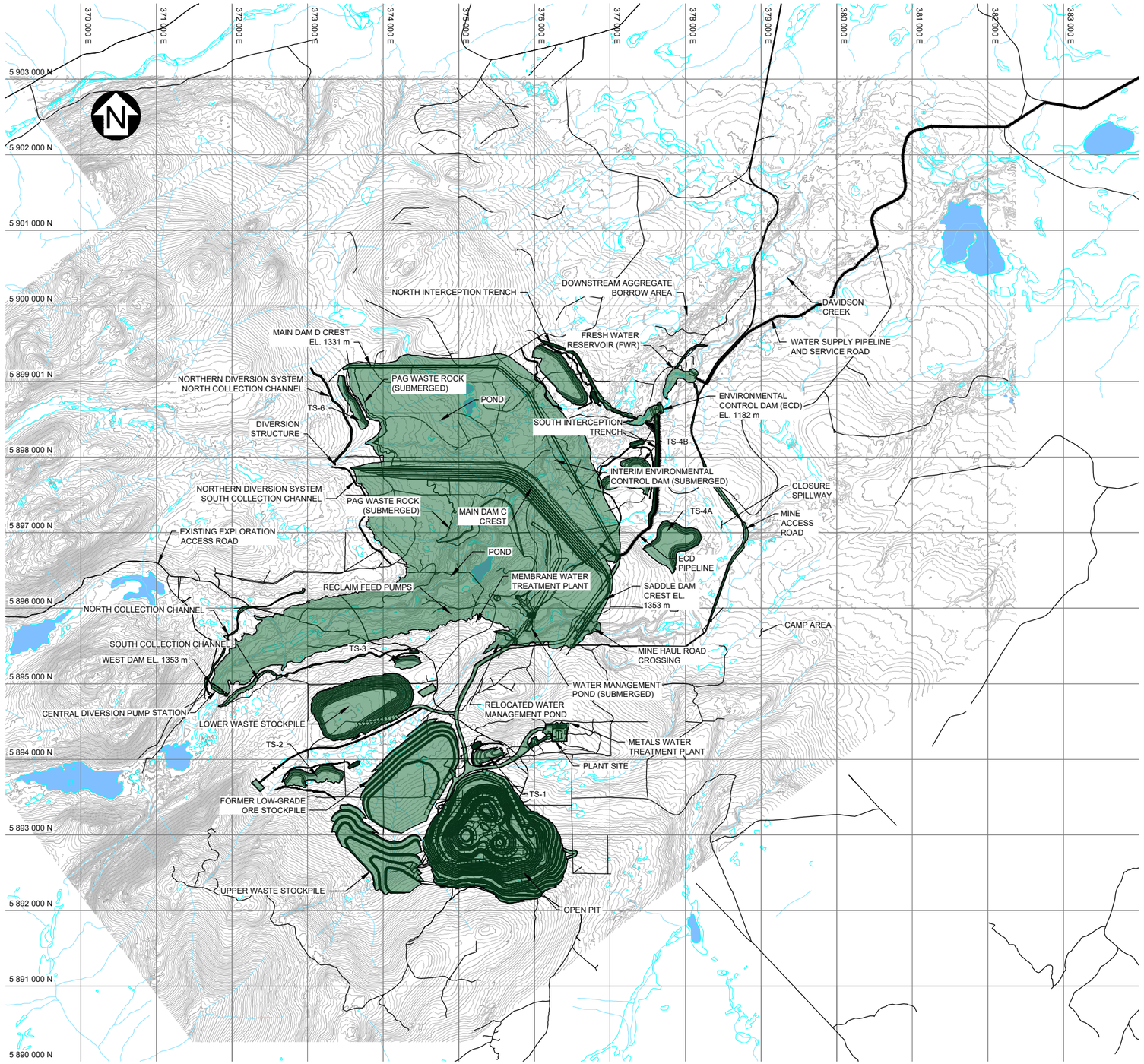
Knight Piésold CONSULTING

P/A NO. VA101-457/37

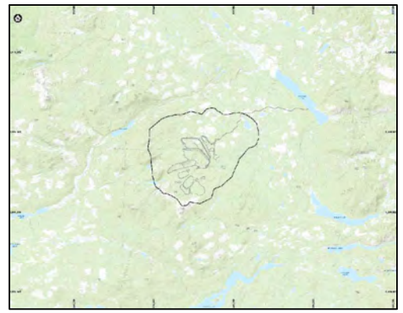
REF NO. VA22-02237

FIGURE B2

REV 0



PLAN
SCALE A



KEY PLAN
NTS

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. AREAS ARE BASED ON REVISED UNIVERSAL SOIL LOSS EQUATION FOR APPLICATION IN CANADA RUSLEFAC

LEGEND:

- SOIL EROSION CLASS - VERY LOW
- MELTWATER CHANNEL

FOR INFORMATION ONLY

SCALE A 600 300 0 1000 2000 3000 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	07DEC'22	ISSUED WITH LETTER	CAP	ELG	SCE

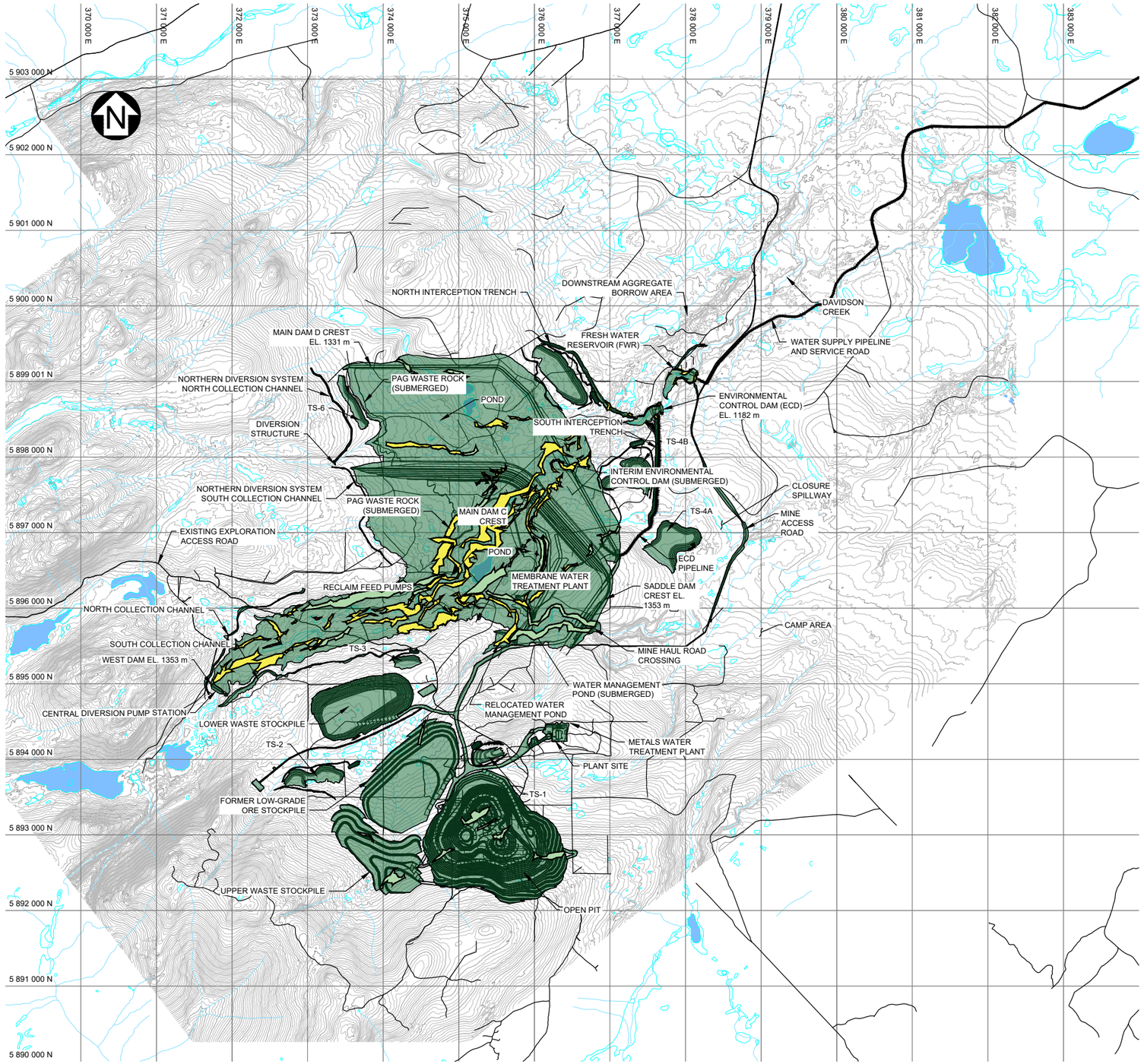
BW GOLD LTD.

BLACKWATER GOLD PROJECT

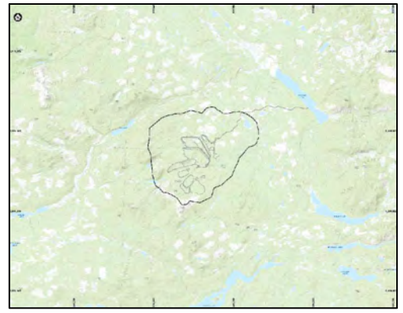
RUSLEFAC SOIL LOSS EQUATION
SOIL EROSION CLASS
PRE-CONSTRUCTION MAP

Knight Piésold CONSULTING

P/A NO. VA101-457/37
REF NO. VA22-02237
FIGURE B3
REV 0



PLAN
SCALE A



KEY PLAN
NTS

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. AREAS ARE BASED ON REVISED UNIVERSAL SOIL LOSS EQUATION FOR APPLICATION IN CANADA RUSLEFAC

LEGEND:

- SOIL EROSION CLASS - VERY LOW
- SOIL EROSION CLASS - LOW
- SOIL EROSION CLASS - MODERATE
- SOIL EROSION CLASS - SEVERE
- MELTWATER CHANNEL

FOR INFORMATION ONLY

SCALE A 600 300 0 1000 2000 3000 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	07DEC'22	ISSUED WITH LETTER	CAP	ELG	SCE

BW GOLD LTD.

BLACKWATER GOLD PROJECT

RUSLEFAC SOIL LOSS EQUATION
SOIL EROSION CLASS
DURING CONSTRUCTION MAP

Knight Piésold CONSULTING

P/A NO. VA101-457/37
REF NO. VA22-02237
FIGURE B4
REV 0

SAVED: M:\101\00457\37-A\acad\FIGS\B35, 12/7/2022 1:39:22 PM, EGUEVARRA, PRINTED: 12/7/2022 2:14:46 PM, B4, EGUEVARRA ACAD VERSION: 24.1S (LMS TECH)
XREF FILES): Topo 5m Contours; Hydro; Site C PAG Stages; YR23 Mine Objects; Site D Entrainment - YEAR 23 CLOSURE; West Dam - Stage 2; Topsoils; Environmental Control Dam; Fresh Water Reservoir; Central Diversion System - Collection Channels; Polishing Pond; Polishing Pond - Relocated

Appendix C Downstream Aggregate Borrow Area SCP Design

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

July 22, 2022

Knight Piésold Ltd.
Suite 1400 - 750 West Pender Street
Vancouver, British Columbia
Canada, V6C 2T8
T +1 604 685 0543
E vancouver@knightpiesold.com
www.knightpiesold.com

Mr. Alastair Tiver
Vice President Projects
BW Gold Ltd.
3085 - 595 Burrard Street
Vancouver, British Columbia
Canada, V7X 1L3

Dear Alastair,

RE: Issue Tracking Table ID 371 – Downstream Aggregate Borrow Area Water Management and Geotechnical Design

1.0 INTRODUCTION

1.1 REGULATORY CONTEXT

This letter responds to a comment provided by the Ministry of Energy, Mines, and Low Carbon Innovation (EMLI) Major Mines Office on June 1, 2022 with respect to the BW Gold Ltd. (BW Gold) Joint *Mines Act / Environmental Management Act* Permits Application (the Application) for the Blackwater Gold Project (Blackwater). The comment was received as part of the technical review phase. Response to the information request from BW Gold, prepared by Knight Piésold Ltd. (KP), is provided below.

An initial response to the comment, including permitting background and further response timeline, was provided in the letter *Issue Tracking Table ID 371 – Sediment Control Pond Designs – Information Requirement* (KP, 2022c).

1.2 EMLI COMMENT

The following comment was provided by EMLI reviewers to BW Gold on June 1, 2022 and is addressed by this information summary:

ID #371. The Application includes reference to the Downstream Aggregate Borrow Area Sediment Control Pond, the location and design for which cannot be found within the Application. Provide the location and design for the Downstream Aggregate Borrow Area Sediment Control Pond, and confirm that all other ponds and dams are included in the Application including, but not necessarily limited to, ponds and dams associated with the borrow areas identified in the comment above.

1.3 SCOPE OF LETTER

This letter describes the detailed design of the water management structures required to manage contact water for the Downstream Aggregate Borrow Area. It includes the design of runoff collection channels, sediment control pond (SCP), and erosion control Best Management Practices (BMPs) for the area and geotechnical assessment of the proposed SCP as well.

The Downstream Aggregate Borrow Area water management and geotechnical design was informed by findings of the associated supporting studies related to hydrometeorological characterization (KP, 2021b),

site geotechnical characterization (KP, 2021c), and the geological, geotechnical, and hydrogeological site conditions (KP, 2013a; KP, 2013b; KP, 2021d; KP, 2021e). The geotechnical assessments presented for the SCP in this letter must be read in conjunction with the modelling basis and material parameter justifications presented in the Supplemental Stability Assessment Report (KP, 2022a).

1.4 DESIGN DRAWINGS

This letter should be reviewed with reference to the following drawings, which are included in Appendix A:

- Drawing No. C3610: Water Management – Downstream Aggregate Borrow Area – Sediment Control Pond and Channels – General Arrangement
- Drawing No. C3611: Water Management – Downstream Aggregate Borrow Area – Sediment Control Pond and Channels – North Collection Channel – Plan, Profile, and Sections
- Drawing No. C3612: Water Management – Downstream Aggregate Borrow Area – Sediment Control Pond and Channels – South Collection Channel – Plan, Profile, and Sections
- Drawing No. C3613: Water Management – Downstream Aggregate Borrow Area – Sediment Control Pond and Channels – Cross Sections
- Drawing No. C3614: Water Management – Downstream Aggregate Borrow Area – Sediment Control Pond and Channels – Sediment Control Pond – Plan and Sections
- Drawing No. C3615: Water Management – Downstream Aggregate Borrow Area – Sediment Control Pond and Channels – Sediment Control Pond Spillway – Sections

This design summary letter and the design drawings were prepared to support the permit application for the Downstream Aggregate Borrow Area water management structures. The design drawings are considered to be ‘Detailed Design’ and are also labelled as ‘Not for Construction’ as is the standard for any drawing issued other than Issued for Construction (IFC) drawings. Further work will be required to prepare IFC drawings prior to construction of the Downstream Aggregate Borrow Area water management structures.

2.0 WATER MANAGEMENT DESIGN CRITERIA

2.1 OBJECTIVE

Surface contact water will be managed in a manner that allows for safe containment and control. Collection channels will be constructed surrounding the Downstream Aggregate Borrow Area to collect and convey contact surface runoff to the Downstream Aggregate Borrow Area SCP. The SCP is sized to safely manage storm event runoff while allowing for adequate suspended sediment settling time prior to release to the downstream environment. The emergency spillway from the collection pond will provide controlled release of flows to Davidson Creek for storms exceeding the 10-year event, up to the 200-year design event.

The general arrangement of the Downstream Aggregate Borrow Area water management systems is shown in on Drawing C3610. Detailed plans, sections, and details are included in the C3610 Drawing series in Appendix A.

2.2 GENERAL ARRANGEMENT

The Downstream Aggregate Borrow Area water management comprises the following components:

- Cut/fill erosion protection-lined collection channels
- Contact water SCP

- Primary outflow culvert
- Emergency spillway

Flow through the emergency spillway will be directed downslope to Davidson Creek; erosion protection measures and/or energy dissipation structures will be developed for controlled discharge.

2.3 DESIGN CRITERIA

The design criteria for the collection channels include the following:

- Designed as an open channel to pass the 1 in 10-year, 24-hr storm event with a minimum freeboard allowance equal to or greater than 300 mm above this design flow level.
- Designed to pass the 1 in 200-year, 24-hr storm event.
- Minimum channel slope of -0.5%.

The design criteria for the SCP are based on the British Columbia Ministry of Environment Sediment Control Pond Technical Guidance recommendations (ENV, 2015) and include the following:

- Provide controlled discharge of flows up to the 1 in 10-year, 24-hour precipitation event via a primary outlet located at sufficient distance from the inflow location to allow settling of sediments.
- Provide controlled discharge of flows up to the 1 in 200-year, 24-hour precipitation event through a broad crested rectangular weir spillway.
- Provide and maintain a minimum of 500 mm of freeboard above the flood level resulting from the 1 in 200-year, 24-hour precipitation event.
- The pond is assumed to be 0.5 m above the invert of the pond at the start of the 1 in 10-year precipitation event, and the water level is assumed to be at the spillway invert at the start of the 1 in 200-year, 24-hour precipitation event.

3.0 HYDROLOGIC INPUTS

3.1 CLIMATE DATA

3.1.1 RAINFALL

The estimated 24-hours precipitation events for a range of return periods are shown in Table 3.1. Values were obtained from the 2020 Hydrometeorology Report (KP, 2021b) and adjusted to include a 15% increase to consider the effects of climate change according to the recommendations of Engineers and Geoscientists of British Columbia (2018). The 1 in 10-year and 1 in 200-year, 24-hour precipitation events of 64 mm (56 mm x 1.15) and 110 mm (95 mm x 1.15), respectively, were selected for the collection channels.

Table 3.1 Estimated 24-hour Precipitation Depth (Without Considering Climate Change)

24-hour Precipitation (mm) for Return Periods (years)[1]					
2	**10**	**100**	**200**	**1000**	**PMP**
32	56	86	95	115	288

Note(s):
1. Source: Blackwater Gold Project – 2020 Hydrometeorology Report – Table 2.15 (KP, 2021b).

3.1.2 SNOWMELT

Snowmelt was considered based on values presented in the 2020 Hydrometeorology Report (KP, 2021b). The estimate assumes that the entire Downstream Aggregate Borrow Area will be covered entirely in snow at the time of the design storm event.

3.2 CATCHMENT AREAS

Catchment areas used for the sizing of the Downstream Aggregate Borrow Area collection channels and SCP are provided in Table 3.2 and shown on Figure 3.1, respectively.

Table 3.2 Downstream Aggregate Borrow Area Water Management Design Catchment Areas

Sub-Catchment	Area (ha)
Area N1	3.3
Area S1	5.5
Area S2	11.2
Area P1	3.3

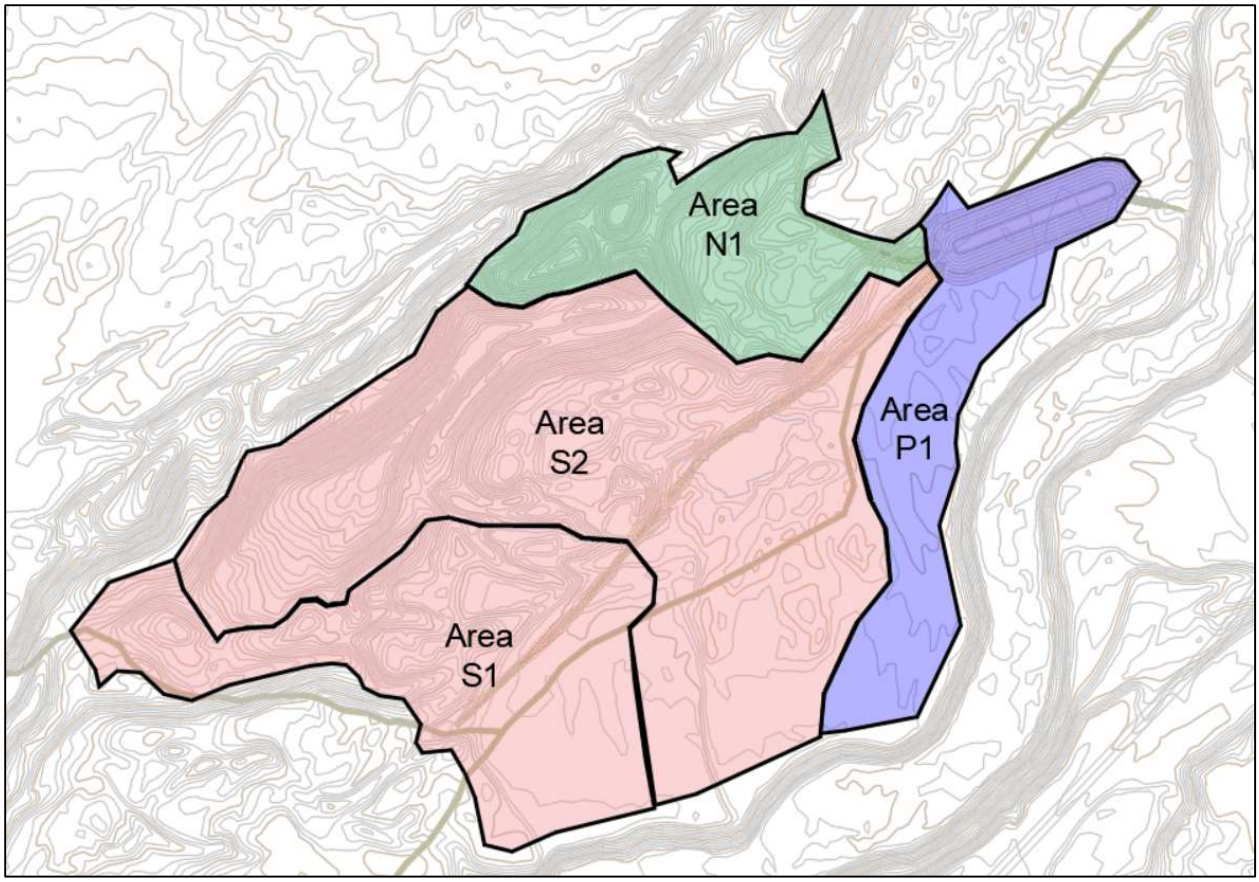


Figure 3.1 Downstream Aggregate Borrow Area Water Management Design Catchment Areas

3.2.1 SCS CURVE NUMBER

Group C hydrologic soil was chosen as representative of the disturbed area contributing to the Downstream Aggregate Borrow Area, and a curve number (CN) of 80 was selected for these surfaces.

Group C *soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr)* (USDA, 1999).

Group B hydrologic soil was chosen as representative of the undisturbed area upslope of the Downstream Aggregate Borrow Area and a CN of 70 was selected for these surfaces.

Group B *soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr)* (USDA, 1999).

3.3 RUNOFF ESTIMATION

Storm peak flow estimates were calculated using the rainfall-runoff modelling software HydroCAD®, and are based on the following input parameters:

- The 24-hour rainfall values plus snowmelt, as summarized in Section 3.1.
- The catchment areas summarized in Section 3.2.
- SCS curve numbers, defined in Section 3.2.1.
- SCS Type I rainfall distribution.
- SCS unit hydrograph.
- Time of concentration, calculated using SCS curve number/lag time method.

4.0 WATER MANAGEMENT CHANNELS

4.1 NORTH COLLECTION CHANNEL

The North Collection Channel will comprise a trapezoidal channel with 2H:1V side slopes lined with erosion protection, with a minimum design grade of 0.5%. The North Collection Channel conveys flows from the footprint of the Downstream Aggregate Borrow Area to the SCP. The North Collection Channel is shown on Drawing C3611 in Appendix A.

A summary of the North Collection Channel design parameters is presented in Table 4.1.

Table 4.1 North Collection Channel Key Design Parameters

Parameter	Unit	Value
Contribution		
Catchment N1	km^2	0.03
	m^3/s	0.14 (0.39)
Segment 1 (0+000 to 0+036)		
Design Storm	-	1:10-year, 24-hour
Length	m	35.72
Invert Inlet Elevation	m	1146.83
Invert Outlet Elevation	m	1145.4

Parameter	Unit	Value
Channel Slope	-	0.040
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0.5
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.26 (0.40)
Expected Freeboard	m	0.34 (0.20)
Outflow	m^3/s	0.10 (0.41)
Segment 2 (0+036 to 0+111)		
Design Storm	-	1:10-year, 24-hour
Length	m	74.87
Invert Inlet Elevation	m	1145.4
Invert Outlet Elevation	m	1145.03
Channel Slope	-	0.005
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0.5
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.25 (0.41)
Expected Freeboard	m	0.35 (0.19)
Outflow	m^3/s	0.15 (0.41)
Segment 3 (0+111 to 0+165)		
Design Storm	-	1:10-year, 24-hour
Length	m	54.41
Invert Inlet Elevation	m	1145.03
Invert Outlet Elevation	m	1143.94
Channel Slope	-	0.020
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0.5
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.18 (0.29)
Expected Freeboard	m	0.42 (0.31)
Outflow	m^3/s	0.14 (0.40)

4.2 SOUTH COLLECTION CHANNEL

The South Collection Channel will comprise a trapezoidal channel with 2H:1V side slopes lined with erosion protection, with a minimum design grade of 0.5%. The South Collection Channel conveys flows from the footprint of the Downstream Aggregate Borrow Area and surrounding undisturbed area to the Downstream Aggregate Borrow Area SCP. The South Collection Channel is shown on Drawing C3612 in Appendix A.

A summary of the South Collection Channel design parameters and details is presented in Table 4.2.

Table 4.2 South Collection Channel Key Design Parameters

Parameter	Unit	Value
Contribution		
Catchments S1 and S2	km^2	0.17
	m^3/s	0.50 (1.32)
Segment 1 (0+000 to 0+042)		
Design Storm	-	1:10-year, 24-hour
Length	m	42.24
Invert Inlet Elevation	m	1158.33
Invert Outlet Elevation	m	1156.01
Channel Slope	-	0.055
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0.5
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.15 (0.25)
Expected Freeboard	m	0.45 (0.35)
Outflow	m^3/s	0.17 (0.50)
Segment 2 (0+042 to 0+146)		
Design Storm	-	1:10-year, 24-hour
Length	m	103.37
Invert Inlet Elevation	m	1156.01
Invert Outlet Elevation	m	1151.88
Channel Slope	-	0.040
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0.5
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.17 (0.28)
Expected Freeboard	m	0.43 (0.32)
Outflow	m^3/s	0.17 (0.50)
Segment 3 (0+146 to 0+183)		

Parameter	Unit	Value
Design Storm	-	1:10-year, 24-hour
Length	m	37.08
Invert Inlet Elevation	m	1151.88
Invert Outlet Elevation	m	1151.02
Channel Slope	-	0.023
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0.5
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.24 (0.41)
Expected Freeboard	m	0.36 (0.19)
Outflow	m^3/s	0.17 (0.50)
Segment 4 (0+183 to 0+267)		
Design Storm	-	1:10-year, 24-hour
Length	m	84.03
Invert Inlet Elevation	m	1151.02
Invert Outlet Elevation	m	1146.40
Channel Slope	-	0.055
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0.5
Channel Lining D_{50}	mm	200
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.26 (0.45)
Expected Freeboard	m	0.34 (0.15)
Outflow	m^3/s	0.50 (1.35)
Segment 5 (0+267 to 0+441)		
Design Storm	-	1:10-year, 24-hour
Length	m	174.39
Invert Inlet Elevation	m	1146.40
Invert Outlet Elevation	m	1145.53
Channel Slope	-	0.005
Channel Side Slopes (H:V)	-	2:1
Base Width	m	1.5
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.27 (0.47)
Expected Freeboard	m	0.33 (0.13)

Parameter	Unit	Value
Outflow	m^3/s	0.50 (1.33)
Segment 6 (0+441 to 0+521)		
Design Storm	-	1:10-year, 24-hour
Length	m	79.64
Invert Inlet Elevation	m	1145.53
Invert Outlet Elevation	m	1143.95
Channel Slope	-	0.020
Channel Side Slopes (H:V)	-	2:1
Base Width	m	1.5
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.6
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.20 (0.36)
Expected Freeboard	m	0.40 (0.24)
Outflow	m^3/s	0.50 (1.33)

5.0 SEDIMENT CONTROL POND HYDRAULIC DESIGN

5.1 GENERAL

The Downstream Aggregate Borrow Area SCP will be constructed downstream of the Downstream Aggregate Borrow Area near Davidson Creek and has a total contributing catchment area of approximately 25 ha. The pond will receive inflows from the North and South Collection Channels. Water will be impounded by an earthfill structure that will be constructed using local cut/fill materials, riprap, riprap bedding and Zone S material. The SCP was designed with two outlets: a culvert discharge outlet (primary outlet) and an emergency spillway (secondary outlet). The Downstream Aggregate Borrow Area SCP is shown on Drawing C3614 in Appendix A.

The pond was designed with 0.5 m of dead storage at its base. The pond is entirely in cut and will have a base elevation of 1,139.5 masl, rising 4.5 m to a maximum containment elevation of 1,144 masl. The collection pond was designed to contain and convey the 1 in 10-year, 24-hour flood through the primary outlet. The pond secondary outlet, an emergency spillway at the east corner of the pond, was designed to pass the 1 in 200-year, 24-hour flood.

The pond will impound approximately 9,500 m^3 when the water level is at the spillway invert. Accordingly, the structure would be categorized as a minor dam (Low consequence) as defined by the BC Dam Safety Regulations (BC, 2016).

The Downstream Aggregate Borrow Area SCP design parameters are summarized in Table 5.1.

Table 5.1 Downstream Aggregate Borrow Area Sediment Control Pond Design Parameters

Parameter	Value
Base elevation (masl)	1,139.5
Maximum containment elevation (masl)	1,144
Primary outlet elevation (masl)	1,142
Spillway outlet elevation (masl)	1,143
Minimum freeboard (m)	0.5
Internal slopes (H:V)	3:1
Impounded volume at spillway invert (m^3)	9,500

5.2 PRIMARY OUTLET

The Downstream Aggregate Borrow Area SCP primary outlet was designed for the 1 in 10-year, 24-hr flood. The outlet peak discharge is 0.10 m^3/s, passed through a 350 mm (12") diameter culvert with an invert elevation at 1,142.0 masl and a slope of 0.5%.

Settling Velocity

A settling velocity of $5x10^{-5}$ m/s was estimated for particle sizes of 10 microns or greater at a water temperature of 0°C, based on the following:

- $Vs = (g/18\mu)(S.G. - 1)\ D^2$
- Vs = Settling Velocity = $5x10^{-3}$ cm/s = $5x10^{-5}$ m/s
- g = acceleration of gravity = 981 cm/s^2
- μ = kinematic viscosity = 0.01787 cm^2/s (at 0°C)
- S.G. = Specific Gravity = 2.7
- D = (Stokes) diameter (cm) of a non-interacting particle measured = 0.001 cm

The design settling velocity was chosen to provide an appropriate balance between pond size, function, and physical constraints. The potential to increase the pond size to accommodate a lesser settling velocity is limited by real world limits to settling fines in a high runoff environment, such that the ability to settle out particles finer than 10 microns may not be possible even with a substantially larger pond, without the use of settling aids. The sediment pond is expected to function well under normal conditions to meet the discharge targets for total suspended solids (TSS), but it is recognized that the use of flocculants may be required after heavy precipitation events when TSS concentrations are elevated with increased finer grained soils containing particle sizes less than 10 microns.

5.3 EMERGENCY SPILLWAY

The Downstream Aggregate Borrow Area SCP emergency spillway was designed for the 1 in 200-year, 24-hour flood. The spillway peak flow was calculated to be approximately 1.3 m^3/s, assuming the primary outlet system is not operational during the design storm event and the initial water level is at the spillway invert.

6.0 SEDIMENT CONTROL POND GEOTECHNICAL ASSESSMENT

6.1 SEEPAGE ASSESSMENT

6.1.1 METHODOLOGY AND POND CONDITIONS

Steady-state seepage analyses were carried out using SEEP/W®, a two-dimensional finite element seepage analysis software package (Geo-Slope, 2021) for modelling groundwater flux. The seepage analyses were carried out on the maximum pond water level (at the spillway invert) model configurations to evaluate seepage flow paths within the underlying foundation materials to define the estimated phreatic surface elevation for slope stability modelling. The Downstream Aggregate Borrow Area SCP is designed entirely in cut with internal erosion protection incorporated in the lining system. There are no fill berms that require the potential for internal erosion to be evaluated.

A three-dimensional steady-state regional scale numerical model was developed using MODFLOW-USG to simulate the baseline hydrogeological conditions and potential effects of mine development, including the estimate of seepage rates, travel times, and discharge locations. The regional scale groundwater modelling is presented in the Numerical Groundwater Modelling Report (KP, 2021f) with the estimated seepage rates, travel times, and discharge locations presented therein. The calibrated hydraulic conductivity values determined during baseline numerical groundwater model calibration were incorporated into the material parameter selection for the purpose of developing the two-dimensional seepage models used to define piezometric conditions for the stability analyses presented in this report.

6.2 STABILITY ASSESSMENT

6.2.1 METHODOLOGY LOADING CONDITIONS

Stability analyses were carried out using SLOPE/W®, a two-dimensional limit equilibrium stability analysis software package (Geo-Slope, 2021), to investigate the stability of each structure under both static and seismic loading conditions. The Morgenstern-Price method was used to estimate the Factor of Safety (FoS) for all models. The analyses comprised checking the stability of selected dam stages for each of the following cases:

- **Normal operations (static, long-term)** – Natural ground (pillar) slope was evaluated with a pond elevation consistent with the expected maximum normal operating conditions. Piezometric pressures incorporated into the stability analysis were based on a coupled seepage analysis and resulting estimated phreatic conditions.
- **Post-construction (static, short term)** – Downstream and excavated slopes were evaluated for the stockpile ponds, if appropriate, with no pond to represent the end of construction, prior to filling, condition.
- **Pseudo-static** – Downstream slope was evaluated with a 0.021g horizontal seismic load from the peak ground acceleration (PGA) for the 1/475-year Maximum Design Earthquake (MDE), (KP, 2021a).
- **Sensitivity analysis** – Sensitivity analyses were conducted to assess sensitivity to assumptions related to the effective strength of near surface foundation materials.

6.2.2 ACCEPTANCE CRITERIA

A summary of the loading conditions and minimum target FoS values is presented in Table 6.1 below.

Table 6.1 Recommended Minimum Target FoS [after EMPR (2016) and CDA (2013, 2019)]

Loading Condition	Recommended Minimum Target FoS
Long term (steady state seepage, normal reservoir level)	1.5
During or at end of construction	1.3
Pseudo-static	1.0

Note(s):

1. Analysis typically completed for downstream slope; however, some modelling scenarios may consider the upstream slope prior to impoundment filling.

6.3 FOUNDATION CONDITIONS

A summary of the foundation conditions at the Downstream Aggregate Borrow Area SCP was developed based on available geotechnical and hydrogeological information from site investigation programs completed from 2012 to 2021. The associated drillholes and test pits are listed in Table 6.2. The reference sites are located in the general vicinity of the SCP footprint within about 400 to 500 m. None were completed within the actual SCP footprints.

Table 6.2 Stockpile Site Investigation Summary

SCP	Drillhole Sites	Test Pit Sites
Downstream Aggregate Borrow Area	GT13-04, GT13-06, MW12-09	TP13-178, TP13-180

The deglaciation model map (Clague, 2018) and the terrain and landform maps (KP, 2019) indicate that the surficial material at the Downstream Aggregate Borrow Area SCP footprint is predominantly ice contact glaciofluvial sediments (mainly sand and gravel) which are typically greater than 5 m thick with younger fluvial sediments near the Davidson Creek. Glaciofluvial sands and gravels are common along the valley flanks, occurring as kames, terrace, and eskers. A large among of glacial meltwater was channeled along northeast sub-glacial meltwater channels producing these glaciofluvial deposits that are broadly aligned with the modern creek valleys.

Information from 2 test pits, 2 geotechnical drillholes, and 1 monitoring well were used to provide an assessment of the foundation conditions at the Downstream Aggregate Borrow Area SCP. Drillhole GT13-06 is located downstream, to the north, and drillholes GT13-04 and MW12-09 are located upstream, to the south. All the drillholes are within 500 m of the proposed SCP.

The 2 test pits within the vicinity of the SCP shows about 0.2 m of topsoil observed as brown, fibrous, moist, organic material with trace silt and sand overlying the glaciofluvial material observed as fine to coarse sand and subrounded and rounded gravel, some cobbles, trace clay and silt, light brown, non-plastic, compact, and moist. Drillhole GT13-04, GT13-06, and MW12-09 intercepted surficial glaciofluvial material observed as fine to coarse sand and gravel, subrounded to rounded, with trace cobbles, yellowish to light brown, non-plastic, and massive. Glacial till material, observed as silt with sand and gravel was intercepted below the surficial glaciofluvial material.

There is no bedrock exposure at the Downstream Aggregate Borrow SCP area. Bedrock elevation is expected to be deeper than 50 m based on drillholes in the general area (GT13-04 and GT13-06).

The two test pits did not intercept any groundwater. Groundwater tables at the Downstream Aggregate Borrow SCP area are expected at the level of Davidson Creek elevation (approximately 1,132 masl).

Additional ground truthing and geotechnical investigations are recommended prior to Issued for Construction (IFC) design and construction to verify ground conditions at the Downstream Aggregate Borrow SCP area.

6.4 MATERIAL PARAMETERS

Detailed descriptions of the material types and behavioural characteristics of the foundation materials considered in the seepage and stability assessments are not included in this letter report. Please refer to the Supplemental Stability Assessment Report (KP, 2022a) for more details.

6.5 MODELLED SECTIONS

The Downstream Aggregate Borrow Area SCP will be constructed downstream of the Downstream Aggregate Borrow Area near Davidson Creek. A layout plan showing the pond arrangement and the section used for stability analyses is included as Figure 6.1.

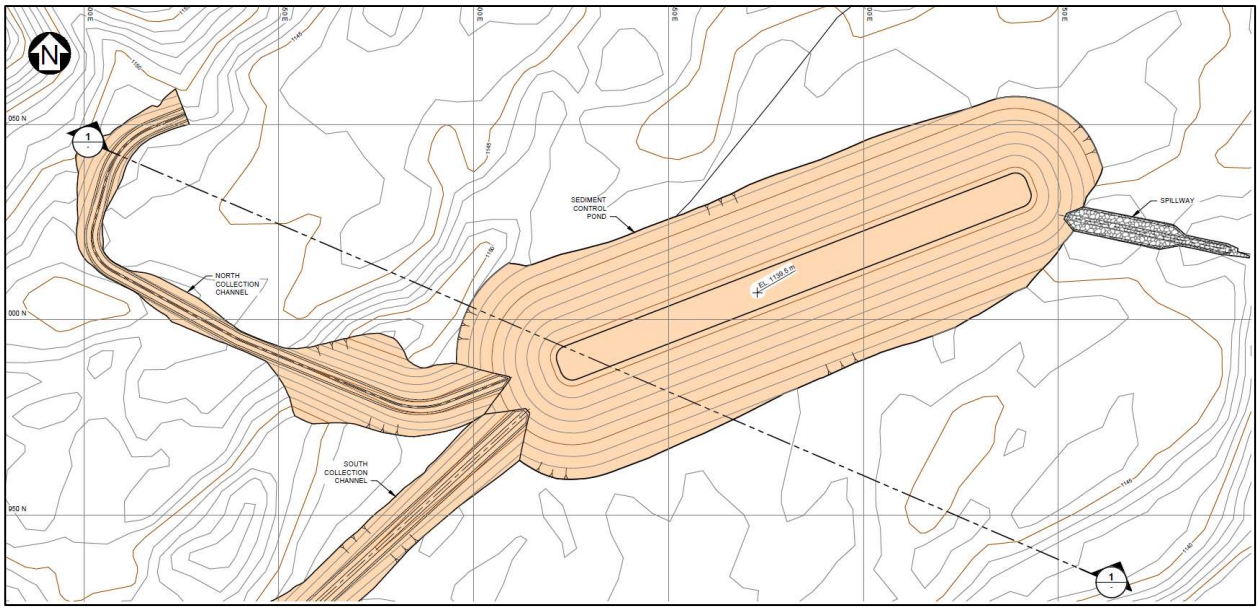


Figure 6.1 Downstream Aggregate Borrow Area SCP – Plan and Section for Geotechnical Analyses

6.6 HYDRAULIC CONDITIONS

For the post-construction (static, short term) analyses, a simplified representation of the groundwater phreatic surface was drawn in consideration of the elevation of Davidson Creek near the Downstream Aggregate Borrow Area. The phreatic surface was drawn at 1,132 masl through the model with an approximate groundwater depth at the pond centerline of 6.4 mbgs.

For the long-term (static) and pseudo-static analyses of the west natural ground pillar, estimated phreatic surfaces from the seepage analyses were used to define the piezometric pressures incorporated into the stability analyses. Boundary conditions were defined for the maximum normal seepage analyses as follows:

- Maximum operating pond water levels at the SCP spillway invert.
- Groundwater levels equal to the elevation of Davidson Creek near the modelled section.
- Potential seepage faces are applied to the natural ground surface. Potential seepage faces are modelled with water rate set to a constant of 0.

6.7 STABILITY ANALYSIS RESULTS

The results of the limit equilibrium stability analyses for the sediment control pond cut slopes are summarized in Table 6.3 and shown on the associated figures included in Appendix B. Sensitivity analyses were also carried out while considering a range in the effective strength of the foundation materials of ±5°, and the results are included on the associated figures in Appendix B.

Table 6.3 Downstream Aggregate Borrow Area Sediment Control Pond Stability Analysis Results

Loading Condition	Slope	Geometry		Estimated FoS	Recommended Minimum Target FoS [1]
		Ground Elevation at Cut Crest	Pond Elevation		
		(masl)	(masl)		
Long-term (static)	Pillar	1,150.1	1,143	2.3	1.5
Post-construction (static)	West Cut	1,150.1	None	2.3	1.3
	East Cut	1,147.5		3.0	
Pseudo-static	Pillar	1,150.1	1,143	2.1	1.0

Note(s):

1. Minimum factors of safety based on the requirements outlined in The Application of Dam Safety Guidelines to Mining Dams (CDA, 2019) and the HSRC Guidance Document (EMPR, 2016).

6.8 SUMMARY AND CONCLUSIONS

The geotechnical analyses of the Downstream Aggregate Borrow Area SCP were completed using available information from geotechnical and hydrogeological site investigations from 2012 to 2021 (KP, 2013a; KP, 2013b; KP, 2021d; KP, 2021e). The stability analyses confirm that the SCP designs meets the required FoS for the applicable loading conditions.

7.0 BEST MANAGEMENT PRACTICES

Erosion control BMPs reduce erosion by stabilizing exposed soil or by reducing surface runoff flow velocities. There are generally two types of erosion control BMPs:

- Source control BMPs for protection of exposed surfaces
- Conveyance BMPs for control of runoff

In addition to the downslope spillway erosion control measures, additional erosion control BMPs may be implemented prior to and during construction to minimize erosion and sediment discharge into surrounding areas. Descriptions of BMPs to be used at the site are provided below.

Vegetation Management and Re-vegetation

Natural vegetation is one of the best and most cost-effective methods of reducing the potential for erosion and sedimentation. Vegetation keeps soil secure and ground cover reduces raindrop velocities. In order to

preserve vegetation, a “no-entry” vegetation buffer will be maintained to prevent excess clearing, particularly around water bodies, prior to clearing vegetation from surrounding areas. If preserving natural vegetation is not a viable option, cleared areas that will not include infrastructure will be re-vegetated as soon as practical after construction activities have ended.

Mulching

Mulching is the application of a uniform protective layer of straw, wood fiber, wood chips, or other acceptable material on or incorporated into the soil surface of a seeded area to allow for the immediate protection of the seed bed. The purpose of mulching is to protect the soil surface from the forces of raindrop impact and overland flow, foster the growth of vegetation, increase infiltration, reduce evaporation, insulate the soil, and suppress weed growth. Mulching also helps to hold fertilizer, seed, and topsoil in place in the presence of wind, rain, and runoff, and reduces the need for watering. Mulching may be utilized in areas that have been seeded either for temporary or permanent cover.

There are two basic types of mulches: organic mulches and chemical mulches. Organic mulches likely to be used include straw, hay, wood fiber, wood chips, and bark chips. This type of mulch is usually spread by hand or by machine (mulch blower) after seed, water, and fertilizer have been applied. Chemical mulches, also known as soil binders or tackifiers, are composed of a variety of synthetic materials. Chemical mulches are usually mixed with organic mulches as a tacking agent to aid in the stabilization process, and are not used as mulch alone, except in cases where temporary dust and erosion control is required. The choice of materials for mulching will be based on soil conditions, season, type of vegetation, and the size of the area.

Mulching is not planned as part of the early works activities; however, it may be implemented for improved re-vegetation for sediment and erosion control if required in specific challenging areas.

Rolled Erosion Control Products

Rolled Erosion Control Products (RECPs) are geosynthetic or organic materials composed of two layers of coarse mesh that contain a central layer of permeable fibres in between. These products take the form of flexible sheet materials that are often composed of organic materials that decompose over time. When intended for long-term use, RECPs are made from UV-stable synthetics such as polypropylene.

RECPs are used to cover un-vegetated cut or fill slopes in order to provide erosion control when seeding or mulching alone is unsuccessful. RECP sheets must be anchored with special stakes or rocks and must be in direct, tight contact with the soil surface in order to perform effectively.

Slope Roughening

Cut and fill slopes will be roughened with tracked machinery or by other means, to reduce runoff velocity, increase infiltration, reduce erosion, and to aid in the establishment of vegetative cover with seed. Roughening will typically be carried out by a tracked machine moving up and down the slope, creating undulations on the soil surface. This procedure is simple, inexpensive, and provides immediate short-term erosion control for bare soil, where vegetative cover is not yet established. Compared to hard, compacted smooth surfaces a rough soil surface provides more favorable moisture conditions, which will aid in seed germination. Slope roughening works best on flat to moderately sloped areas.

Re-contouring

Re-contouring the soil surface can also reduce the effect of erosion by shortening the length of the accumulation and movement of water as well as decreasing its slope. Creating undulations or troughs will

also reduce overland water movement velocity. These types of improvements are beneficial as they are easily planned and constructed on site. However, both surface roughening and re-contouring are only temporary erosion control methods and more permanent structures are needed over time.

Silt Fencing

Silt fencing is a perimeter control type BMP used to intercept sheet flow runoff and used in conjunction with other BMPs. Typical silt fencing comprises a geotextile fabric anchored to posts driven into the ground. Silt fencing promotes sediment control by filtering water that passes through the fabric and increases short term retention time, allowing suspended sediments to settle.

Silt fences will be placed parallel to slope contours to maximize ponding efficiency when required. Barrier locations are informally chosen based on site features and conditions (e.g., soil types, terrain features, sensitive areas, etc.), design plans, existing and anticipated drainage courses, and other available erosion and sediment controls. Typical barrier sites are catch points beyond the toe of fill or on side slopes above waterways or drainage channels. Silt fences will not be used for wide low-flow, low-velocity drainage ways, for concentrated flows, in continuous flow streams, for flow diversion, or as check dams. Silt fencing will be installed in backfilled trenches for proper anchoring.

All silt fences will be inspected and maintained, as required, following major rainfall events. Proper installation and frequent maintenance are required for effective sediment control.

Straw Bale

A straw bale barrier consists of straw bales placed end to end along a level contour in a channel and then staked to hold them in place. The straw bale barrier detains and filters stormwater runoff, creating a small pond behind the barrier where sedimentation occurs. Straw bales, along with silt fences, will significantly reduce sediment accumulation in sediment control ponds and basins.

8.0 OPERATIONAL AND MONITORING REQUIREMENTS

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

The specific operational and monitoring requirements presented in this letter for the water management facilities must be read in conjunction with the general monitoring and operational requirements presented in the Stockpiles Geotechnical and Water Management Design Report (KP, 2022b).

The primary maintenance requirements include:

- Applying sediment and erosion control BMPs as required.
- Periodic removal of sediment from bottom of pond as required.
- Periodic maintenance to address any other requirements identified during regular visual inspections.

The SCP and all erosion control measures will be monitored periodically and after each significant runoff-producing rainfall event.

The following monitoring activities will typically be performed for the SCP at the frequencies prescribed below:

- Daily record of the elevation of the pond in addition to continuous monitoring.
- Weekly visual inspection of sediment buildup within dead storage.
- Weekly visual inspection of the surface drainage ditches, outlet pipe, and spillway for erosion, blockage and/or damage to delineate any corrective maintenance requirements.

Silt fences, ditches, and culverts, will be visually inspected monthly for the following:

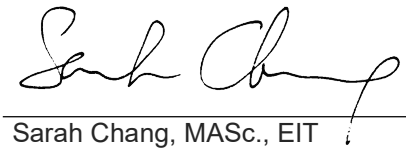
- Excess sediment build-up
- Structural/physical integrity
- Visible wear and tear

Every effort should be made to comply with the minimum target monitoring frequencies specified above. However, the schedule can be modified should circumstances temporarily preclude monitoring at the desired frequency.

9.0 CLOSURE

We trust this meets your needs at this time. Please contact the undersigned with any questions.

Yours truly,
Knight Piésold Ltd.

Prepared:		Prepared:	
	Sarah Chang, MASc., EIT Project Engineer		Jordan Priest, EIT Junior Engineer
Reviewed:		Reviewed:	
	Daniel Fontaine, P.Eng. Specialist Engineer | Associate		Carlos Penate, M.Eng., P.Eng. Senior Engineer

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Approval that this document adheres to the Knight Piésold Quality System:

Attachments:

Appendix A	Design Drawings
Appendix B	Slope Stability Figures

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Copy To: Klaus Popelka, Ryan Todd, Nicole Bishop (ERM)

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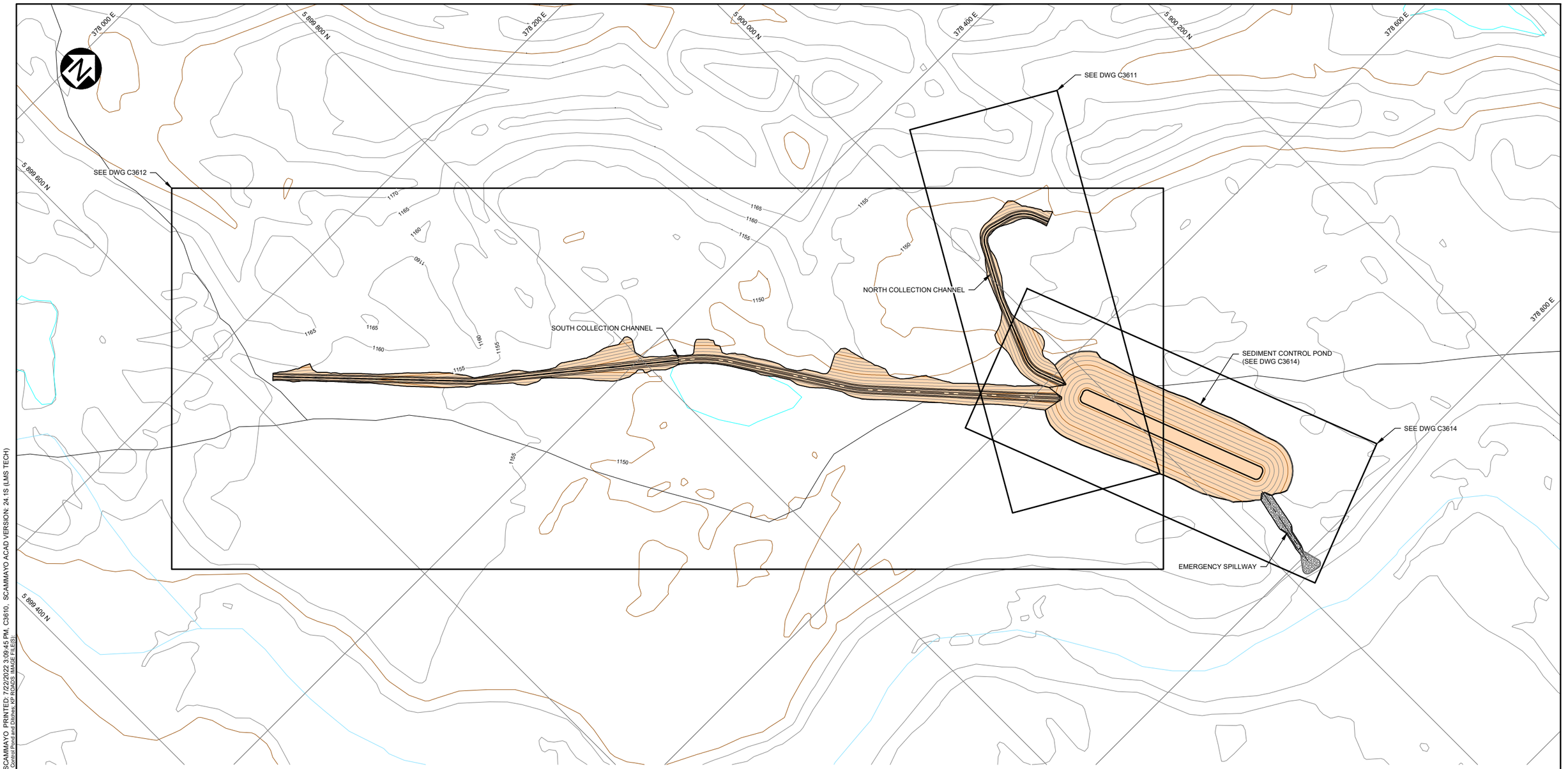
APPENDIX A

Design Drawings

C3610 Rev 0	C3612 Rev 0	C3614 Rev 0
C3611 Rev 0	C3613 Rev 0	C3615 Rev 0



PLAN
SCALE A

SCALE A 25 12.5 0 25 50 75 100 125 m

LEGEND:

CUT AREAS

NOTES:

1. CONTOUR INTERVAL IS 5 METRES.
2. FOR GENERAL NOTES SEE DWG. G0006.

DETAILED DESIGN
NOT FOR CONSTRUCTION

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EGBC PERMIT TO PRACTICE

DRG. NO.	DESCRIPTION
C3615	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - SEDIMENT CONTROL POND SPILLWAY - SECTIONS
C3614	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - SEDIMENT CONTROL POND - PLAN AND SECTIONS
C3613	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - COLLECTION CHANNELS - CROSS-SECTIONS
C3612	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND & CHANNELS - SOUTH COLLECTION CHANNEL - PLAN, PROFILE & SECT.
C3611	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND & CHANNELS - NORTH COLLECTION CHANNEL - PLAN, PROFILE & SECT.
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	22JUL'22	ISSUED FOR PERMITTING	SKC2	SKC	CR	DDF

REVISIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PEÑATE ROJAS
45299
2022-07-22

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
DOWNSTREAM AGGREGATE BORROW AREA
SEDIMENT CONTROL POND AND CHANNELS
GENERAL ARRANGEMENT

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3610	0

SAVED: M:\1\101\00457\33\Acad\DWGS\C3610\C3610_7-22-2022 2:54:21 PM, SCAMMAYO PRINTED: 7/22/2022 3:09:45 PM, C3610, SCAMMAYO ACAD VERSION: 24.1S (LMS TECH)
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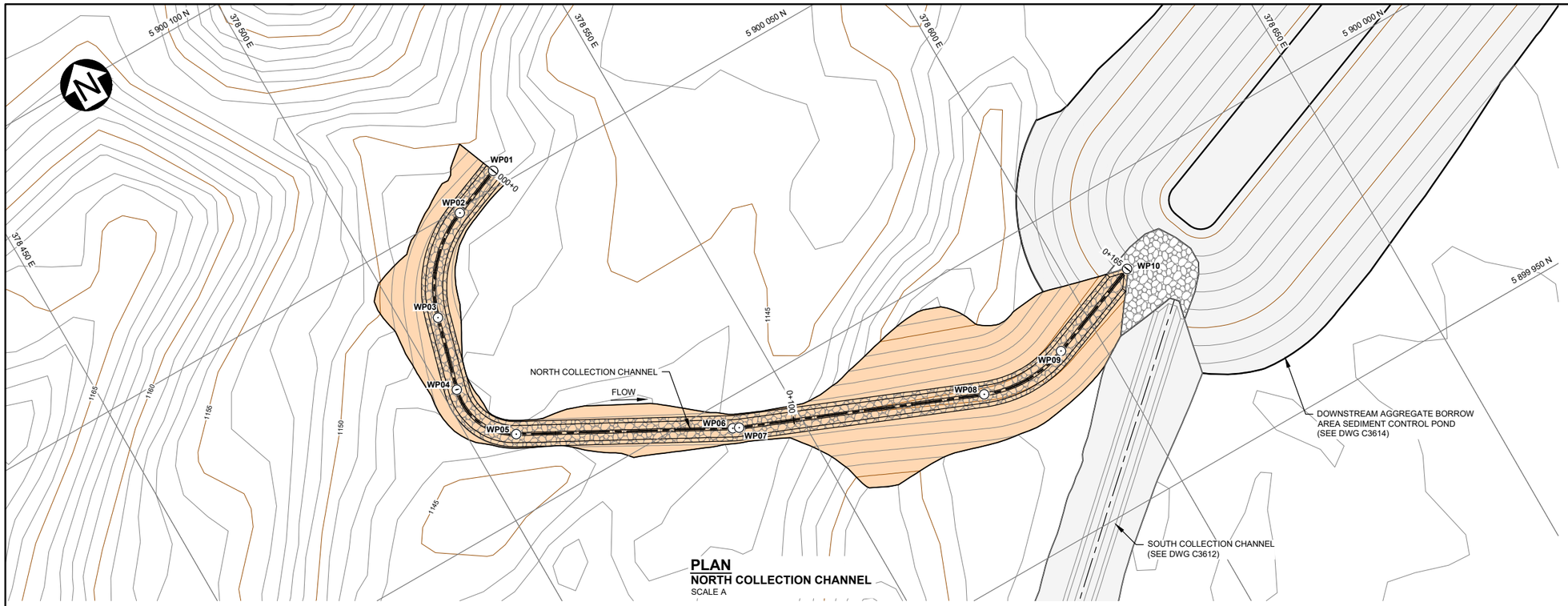
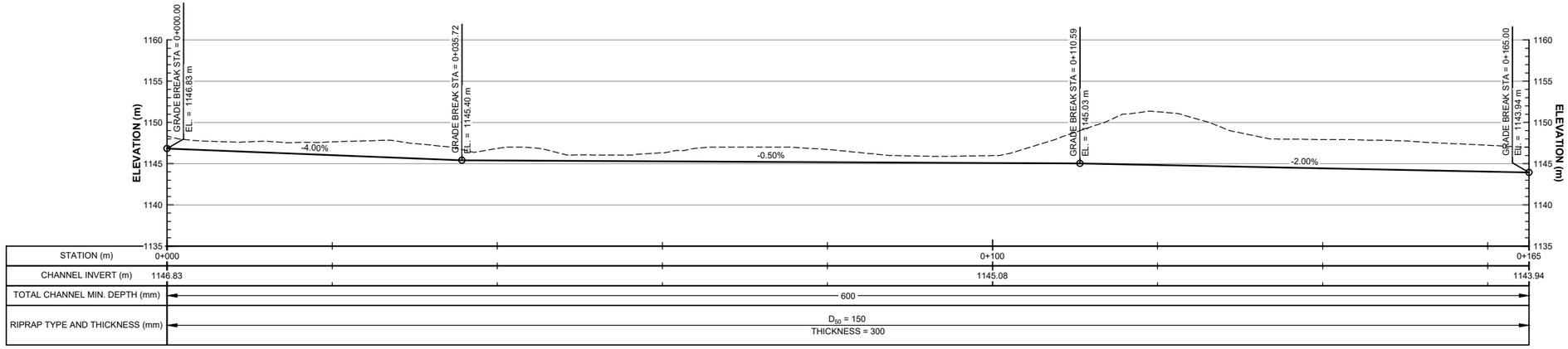


PLAN
NORTH COLLECTION CHANNEL
SCALE A

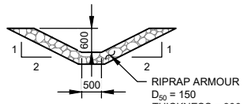
NORTH COLLECTION CHANNEL WORK POINTS			
WORK POINT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)
WP01	378,526.0	5,900,052.6	1,146.8
WP02	378,517.7	5,900,049.3	1,146.5
WP03	378,505.7	5,900,036.0	1,145.7
WP04	378,502.4	5,900,024.0	1,145.4
WP05	378,507.3	5,900,012.5	1,145.3
WP06	378,539.2	5,899,995.2	1,145.1
WP07	378,540.2	5,899,994.8	1,145.1
WP08	378,578.6	5,899,979.1	1,144.6
WP09	378,593.3	5,899,979.0	1,144.3
WP10	378,608.8	5,899,985.3	1,143.9

LEGEND:
- CUT AREAS
- RIPRAP
- WORK POINT

NOTES:
1. CONTOUR INTERVAL IS 1 METRES.
2. ALL DIMENSION ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. FOR GENERAL NOTES SEE DWG. G0006.



PROFILE
NORTH COLLECTION CHANNEL
SCALE B



TYPICAL SECTION
NORTH COLLECTION CHANNEL
0+000 TO 0+165
SCALE C

DETAILED DESIGN
NOT FOR CONSTRUCTION

1.5 0.75 0 2.5 5.0 7.5 m
SCALE C

6 3 0 10 20 30 m
SCALE B

8 4 0 10 20 30 40 m
SCALE A

KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
1001011
EGBC PERMIT TO PRACTICE

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C.A. PENATE ROJAS
45299
2022-07-22

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BLACKWATER GOLD PROJECT

WATER MANAGEMENT
DOWNSTREAM AGGREGATE BORROW AREA
SEDIMENT CONTROL POND AND CHANNELS
NORTH COLLECTION CHANNEL
PLAN, PROFILE AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3611	0

REFERENCE DRAWINGS	
C3613	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - COLLECTION CHANNELS - CROSS-SECTIONS
C3610	WATER MANAGEMENT - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - GENERAL ARRANGEMENT
G0006	TECHNICAL NOTES

DRG. NO.	DESCRIPTION

REVISIONS							
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	22JUL'22	ISSUED FOR PERMITTING	SKC2	SKC	CR	DDF

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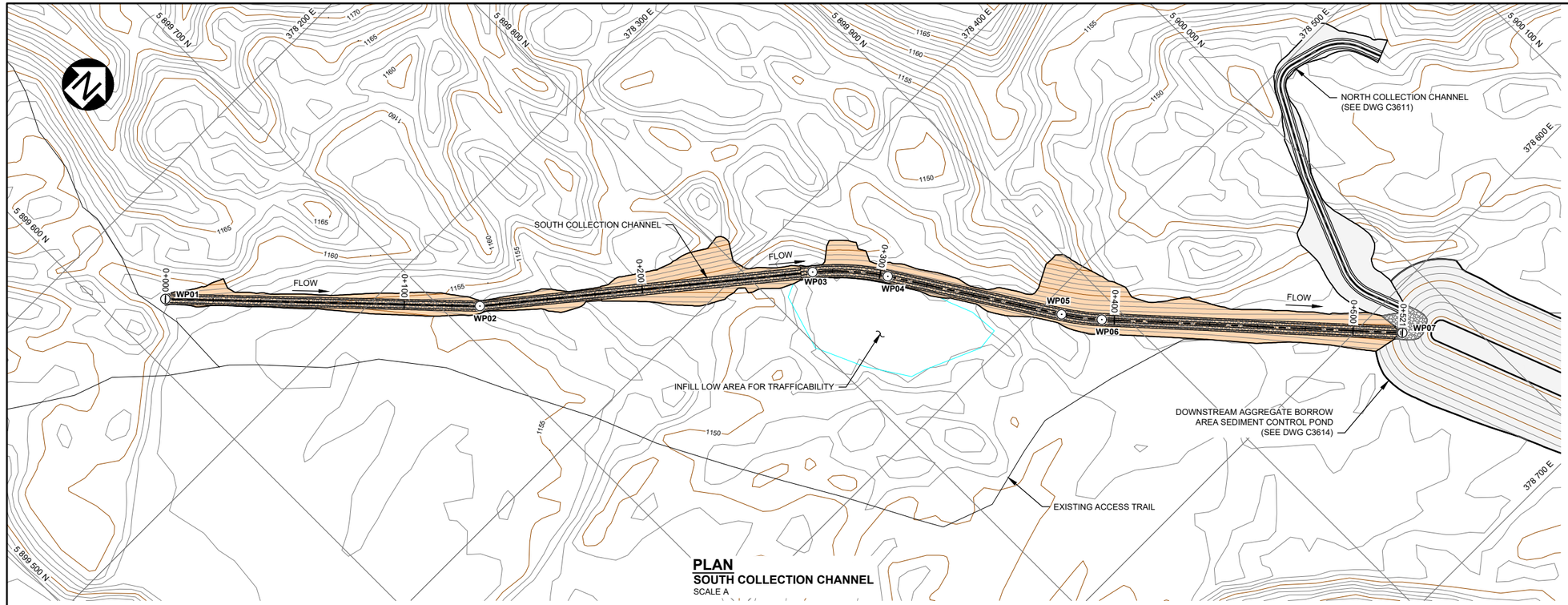


PLAN
SOUTH COLLECTION CHANNEL
SCALE A

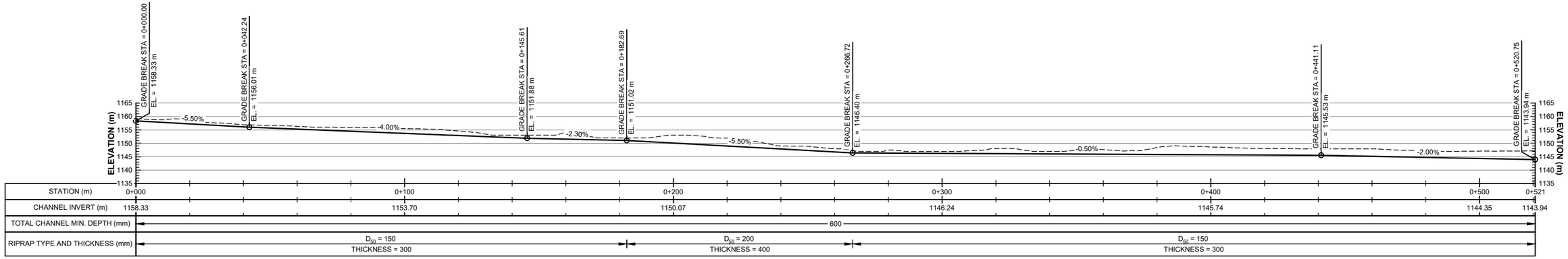
SOUTH COLLECTION CHANNEL WORK POINTS			
WORK POINT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)
WP01	378,238.2	5,899,621.1	1,158.3
WP02	378,333.4	5,899,712.0	1,152.4
WP03	378,421.8	5,899,820.6	1,146.4
WP04	378,445.3	5,899,841.6	1,146.2
WP05	378,508.0	5,899,881.8	1,145.8
WP06	378,521.5	5,899,892.2	1,145.8
WP07	378,614.4	5,899,977.2	1,143.9

LEGEND:

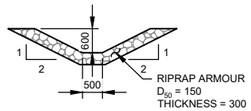
- CUT AREAS
- RIPRAP
- WORK POINT

NOTES:

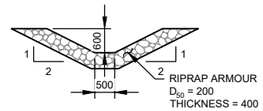
1. CONTOUR INTERVAL IS 1 METRES.
2. ALL DIMENSION ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. FOR GENERAL NOTES SEE DWG. G0006.



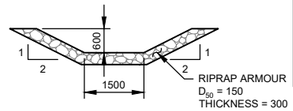
PROFILE
SOUTH COLLECTION CHANNEL
SCALE B



TYPICAL SECTION
SOUTH COLLECTION CHANNEL
0+000 TO 0+183
SCALE C



TYPICAL SECTION
SOUTH COLLECTION CHANNEL
0+183 TO 0+267
SCALE C



TYPICAL SECTION
SOUTH COLLECTION CHANNEL
0+297 TO 0+521
SCALE C

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1.5 0.75 0 2.5 5.0 7.5 m
SCALE C

15 7.5 0 25 50 75 m
SCALE B

20 10 0 20 40 60 80 100 m
SCALE A

DETAILED DESIGN
NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C.A. PENATE ROJAS
45299
2022-07-22

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BLACKWATER GOLD PROJECT

WATER MANAGEMENT
DOWNSTREAM AGGREGATE BORROW AREA
SEDIMENT CONTROL POND AND CHANNELS
SOUTH COLLECTION CHANNEL
PLAN, PROFILE AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3612	0

REFERENCE DRAWINGS	
C3613	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - COLLECTION CHANNELS - CROSS-SECTIONS
C3610	WATER MANAGEMENT - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - GENERAL ARRANGEMENT
G0006	TECHNICAL NOTES
DRG. NO.	DESCRIPTION

REVISIONS							
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	22JUL'22	ISSUED FOR PERMITTING	SKC2	SKC	CR	DDF

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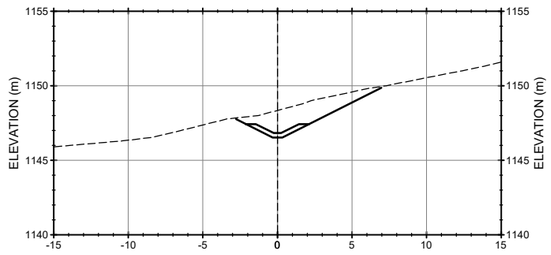

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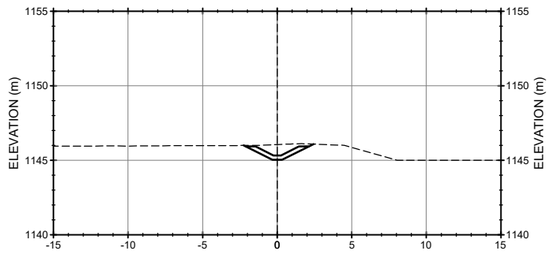

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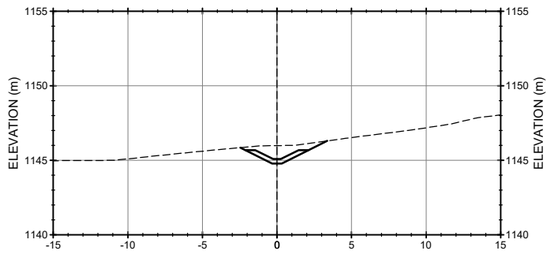

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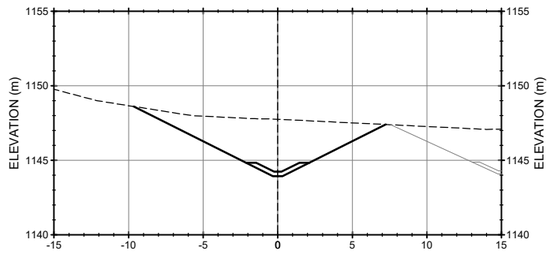

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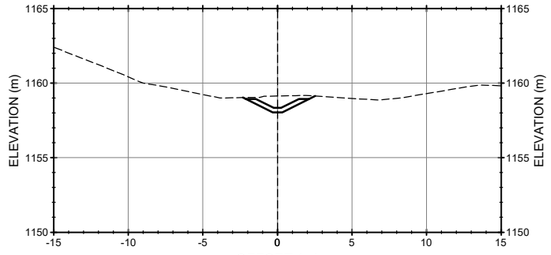
CROSS SECTIONS
NORTH COLLECTION CHANNEL
SCALE A



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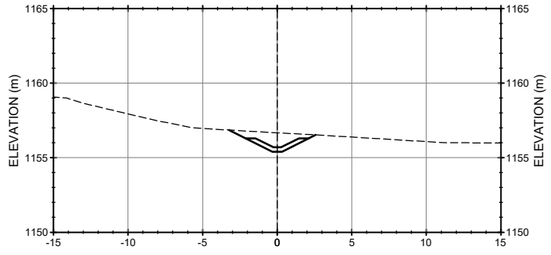

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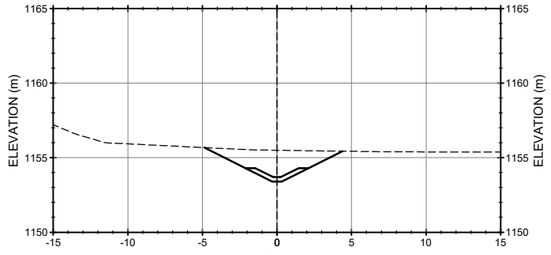

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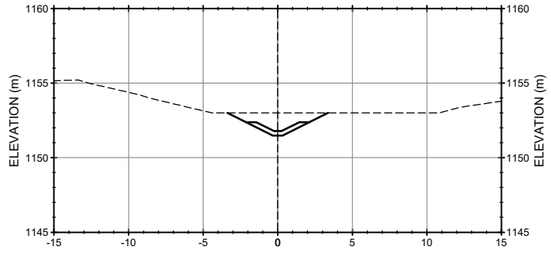

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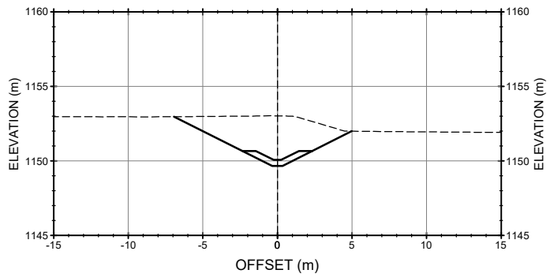

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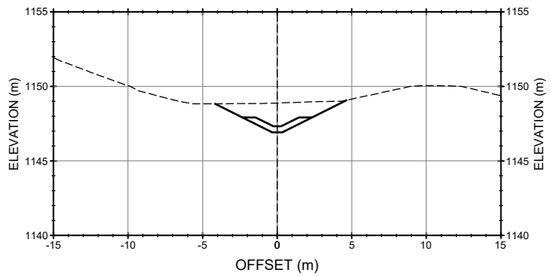

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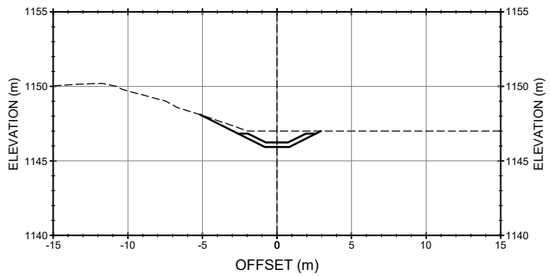

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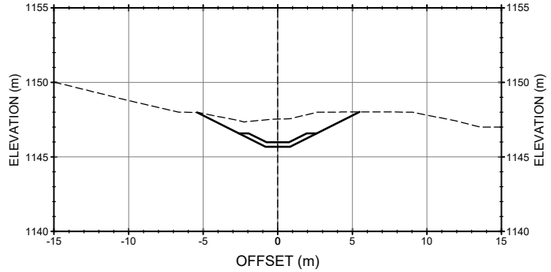

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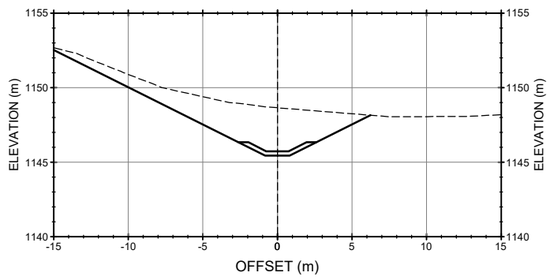

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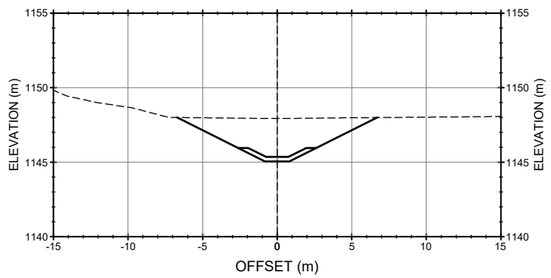

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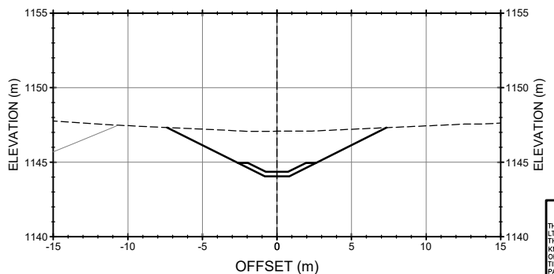

0+500.00

CROSS SECTIONS
SOUTH COLLECTION CHANNEL
SCALE A

NOTES:
1. FOR GENERAL NOTES SEE DWG. G0006.

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— 1001011 —
EGBC PERMIT TO PRACTICE

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE A 4 2 0 4 8 12 16 20 m

DRG. NO.	DESCRIPTION
C3612	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND & CHANNELS - SOUTH COLLECTION CHANNEL - PLAN, PROFILE & SECT.
C3611	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND & CHANNELS - NORTH COLLECTION CHANNEL - PLAN, PROFILE & SECT.
C3610	WATER MANAGEMENT - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - GENERAL ARRANGEMENT

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	22JUL'22	ISSUED FOR PERMITTING	SKC2	SKC	CR	DDF

REVISIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C.A. PENATE ROJAS
45299
2022-07-22

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
DOWNSTREAM AGGREGATE BORROW AREA
SEDIMENT CONTROL POND AND CHANNELS
COLLECTION CHANNELS
CROSS-SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3613	0

SAVED: M:\101\00457\33\A\Acad\DWGS\C3613\C3613, 7/22/2022 2:53:57 PM , SCAMMAYO PRINTED: 7/22/2022 3:07:24 PM, C3613, SCAMMAYO ACAD VERSION: 24.1S (LMS TECH)
XREF FILE(S): IMAGE FILE(S):

POND AND SPILLWAY WORK POINTS			
POINT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)
WP01	378626.4	5899984.7	1139.5000
WP02	378622.5	5899986.4	1139.5000
WP03	378621.4	5899989.2	1139.5000
WP04	378623.1	5899993.1	1139.5000
WP05	378737.9	5900037.4	1139.5000
WP06	378741.8	5900035.6	1139.5000
WP07	378742.8	5900032.8	1139.5000
WP08	378741.1	5900029.0	1139.5000
WP09	378750.2	5900026.8	1142.2832
WP10	378752.4	5900026.4	1143.0014
WP11	378794.2	5900017.8	1142.7881
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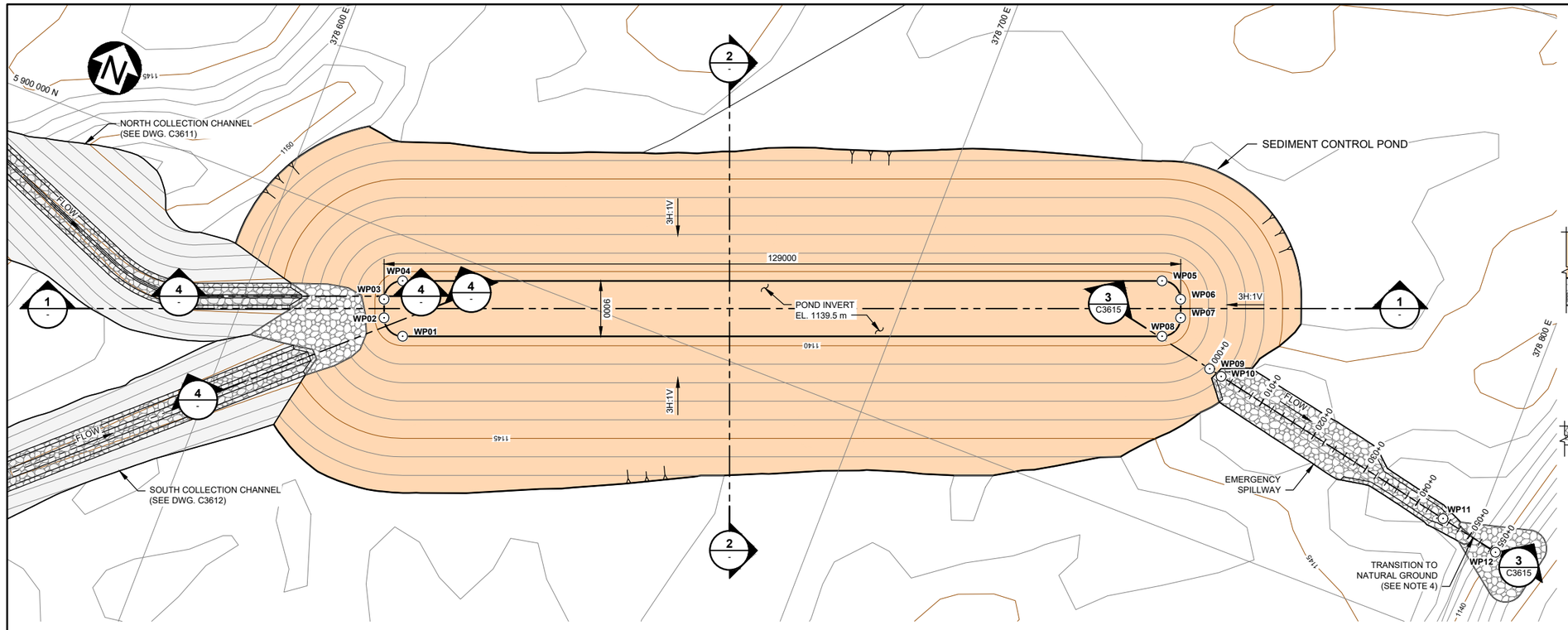
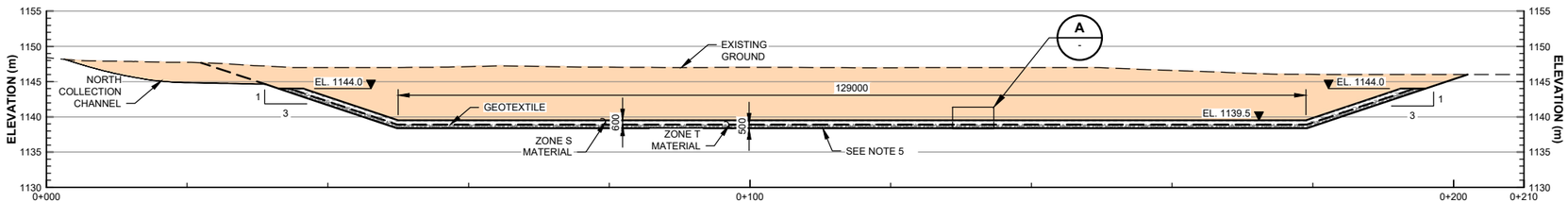
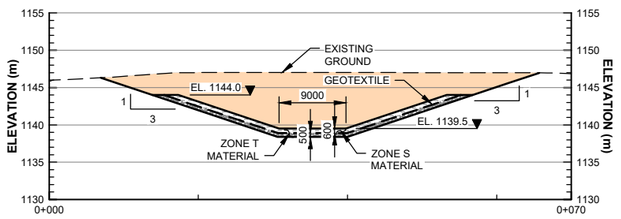


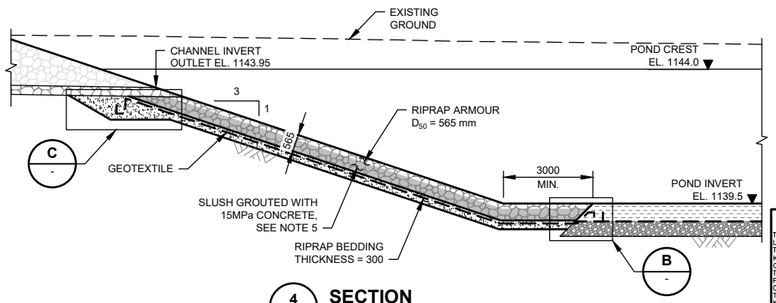
PLAN
SEDIMENT CONTROL POND
SCALE A



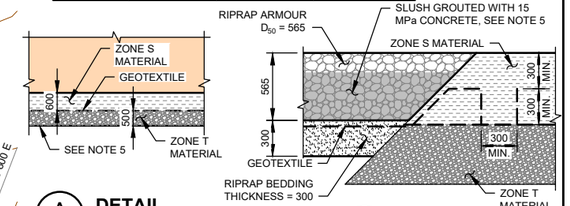
1 SECTION
SEDIMENT CONTROL POND
SCALE A



2 SECTION
SEDIMENT CONTROL POND
SCALE A

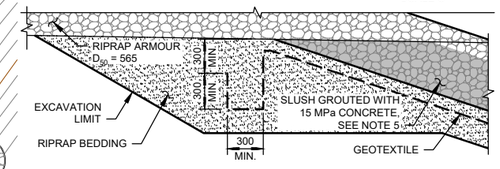


4 SECTION
SEDIMENT CONTROL POND
EROSION INLET PROTECTION
SCALE B



A DETAIL
SCALE B

B DETAIL
ANCHOR TRENCH
SCALE C



C DETAIL
ANCHOR TRENCH
SCALE C

LEGEND:

- CUT AREAS
- RIPRAP
- GRAVEL / ZONE T (TRANSITION ZONE)
- GLACIAL TILL / ZONE S (SEAL ZONE)
- RIPRAP BEDDING (ZONE RB)
- NON-WOVEN GEOTEXTILE
- WORK POINT

NOTES:

1. CONTOUR INTERVAL IS 1 METRES.
2. ALL DIMENSION ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. FOR GENERAL NOTES SEE DWG. G0006.
4. FIELD ENGINEER TO DETERMINE APPROPRIATE TRANSITION FROM SPILLWAY TO RECEIVING ENVIRONMENTWITH RIPRAP PROTECTION EXTENDED A MINIMUM OF 3 METRES DOWNSTREAM OF DISCHARGE PIPE.
5. SUBGRADE TO BE INSPECTED AND APPROVED BY THE ENGINEER PRIOR TO FILL PLACEMENT.

SCALE C 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE B 2 1 0 2 4 6 8 10 m
SCALE A 8 4 0 10 20 30 40 m

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EGBC PERMIT TO PRACTICE

DETAILED DESIGN
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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
45299
2022-07-22

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

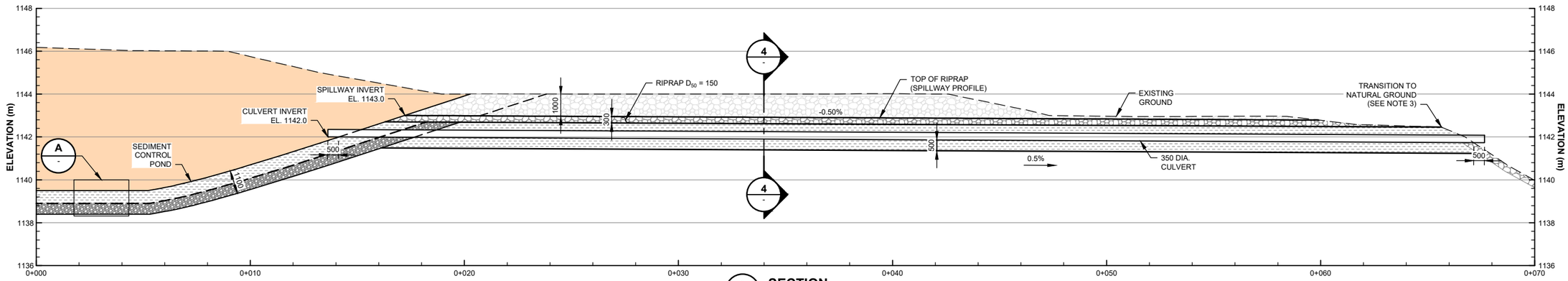
WATER MANAGEMENT
DOWNSTREAM AGGREGATE BORROW AREA
SEDIMENT CONTROL POND AND CHANNELS
SEDIMENT CONTROL POND
PLAN AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3614	0

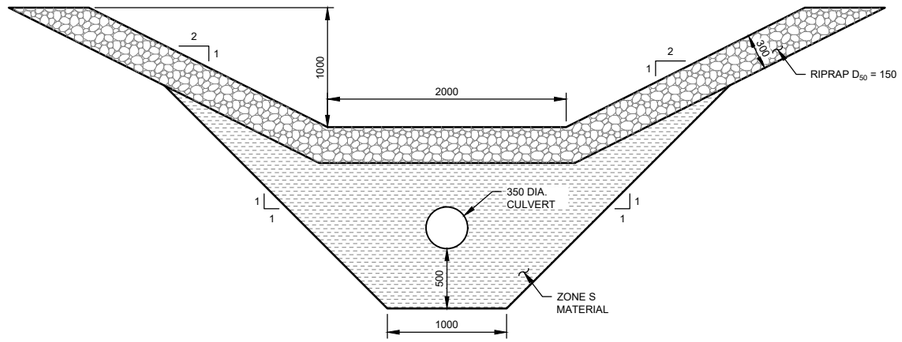
REFERENCE DRAWINGS	
C3615	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - SEDIMENT CONTROL POND SPILLWAY - SECTIONS
C3610	WATER MANAGEMENT AGGREGATE SCREENING AREA - SEDIMENT CONTROL POND AND CHANNELS - GENERAL ARRANGEMENT
G0006	TECHNICAL NOTES

DRG. NO.	DESCRIPTION

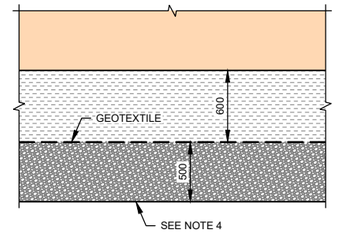
REVISIONS							
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	22JUL'22	ISSUED FOR PERMITTING	SKC2	ABN	ER	DDF



3 / C3714 SECTION
SEDIMENT CONTROL POND SPILLWAY
SCALE A



4 / - SECTION
POND SPILLWAY
SCALE B



A / - DETAIL
SCALE B

LEGEND:

- CUT AREAS
- RIPRAP
- GRAVEL / ZONE T (TRANSITION ZONE)
- GLACIAL TILL / ZONE S (SEAL ZONE)
- NON-WOVEN GEOTEXTILE

NOTES:

1. ALL DIMENSION ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. FOR GENERAL NOTES SEE DWG. G0006.
3. FIELD ENGINEER TO DETERMINE APPROPRIATE TRANSITION FROM SPILLWAY TO RECEIVING ENVIRONMENTWITH RIPRAP PROTECTION EXTENDED A MINIMUM OF 3 METRES DOWNSTREAM OF DISCHARGE PIPE.
4. SUBGRADE TO BE INSPECTED AND APPROVED BY THE ENGINEER PRIOR TO FILL PLACEMENT.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE B 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE A 2 1 0 2 4 6 8 10 m

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
45299
2022-07-22

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BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
DOWNSTREAM AGGREGATE BORROW AREA
SEDIMENT CONTROL POND AND CHANNELS
SEDIMENT CONTROL POND SPILLWAY
SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3615	0

DRG. NO.	DESCRIPTION
C3614	WM - DOWNSTREAM AGGREGATE BORROW AREA - SEDIMENT CONTROL POND AND CHANNELS - SEDIMENT CONTROL POND - PLAN AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	22JUL'22	ISSUED FOR PERMITTING	SKC2	ABN	CR	DDF

REVISIONS

SAVED: M:\101\00457\33\A\Acad\DWGS\C3615\C3615, 7/22/2022 2:52:24 PM, ANASIRI PRINTED: 7/22/2022 2:57:50 PM, C3615, ANASIRI ACAD VERSION: 24.1S (LMS TECH)
XREF FILE(S): IMAGE FILE(S):

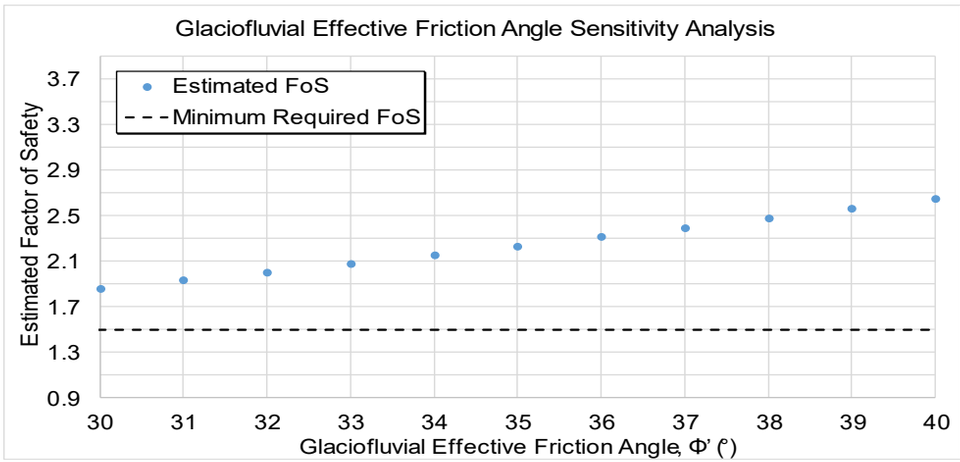
APPENDIX B

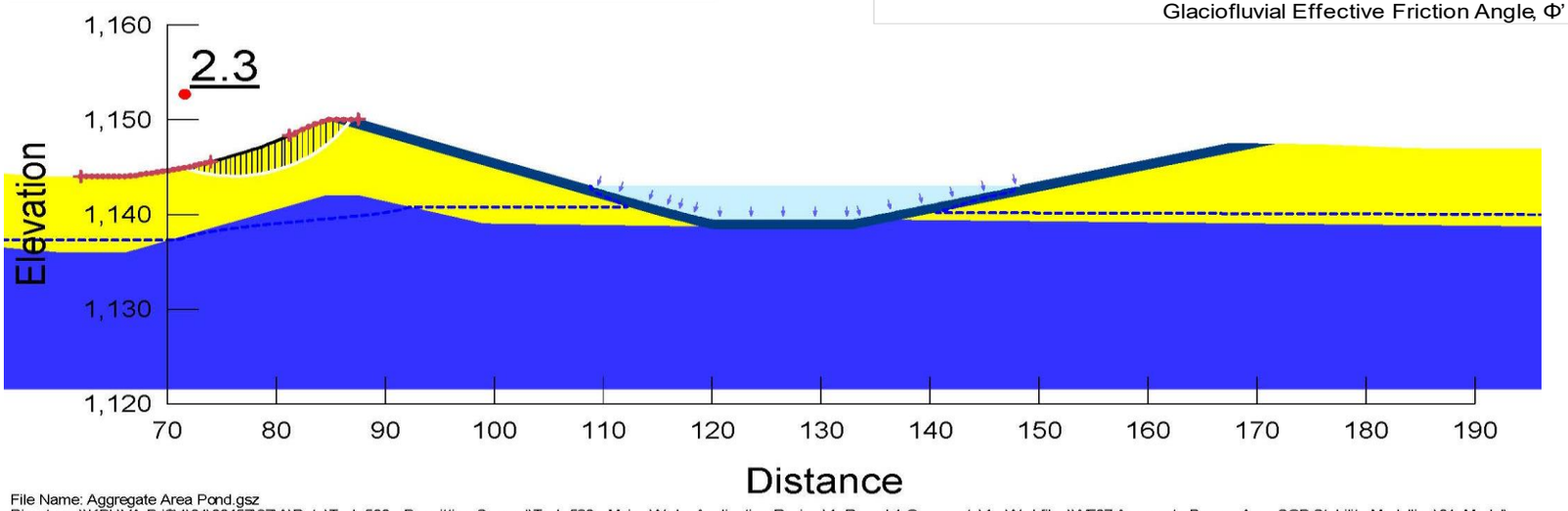
Slope Stability Figures

(Figures B1.1 to B1.4)

Name: Long-Term Static
Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Slip Surface Option: Entry and Exit
Optimize Critical Slip Surface Location: No
Horz Seismic Coef.:
PWP Conditions from Parent Analysis: Aggregate Area Pond Seepage [(last)]

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Friction Angle (°)
	Glacial (Lodgement) Till	Mohr-Coulomb	23	35
	Glaciofluvial (Channelized)	Mohr-Coulomb	23	35
	Zone S	Mohr-Coulomb	21	35





File Name: Aggregate Area Pond.gsz
Directory: \\KPL\VA-Prj$\1\01\00457\37\A\Data\Task 500 - Permitting Support\Task 520 - Major Works Application Review\4- Round 1 Comments\4 - Workfiles\WF07 Aggregate Borrow Area SCP Stability Modelling\01_Model\

NOTES:

1. CRITICAL SLIP SURFACE IS DISPLAYED. THE MINIMUM FACTOR OF SAFETY IS 1.5 (CDA, 2019)
2. STABILITY ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021)
3. GROUND WATER LEVEL MODELLED AT THE ELEVATION OF NEARBY DAVIDSON CREEK AT 1,132 masl .
4. POND WATER LEVEL MODELLED AT THE PROPOSED SPILLWAY CREST ELEVATION OF 1,143 masl.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22JUL'22	ISSUED WITH LETTER	IJP	DDF

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BLACKWATER GOLD PROJECT

DS AGGREGATE BORROW AREA SCP - PILLAR LONG-TERM STATIC STABILITY ANALYSIS SEEP/W PREDICTED PHREATIC SURFACE

Knight Piésold CONSULTING

P/A NO. VA101-457/37

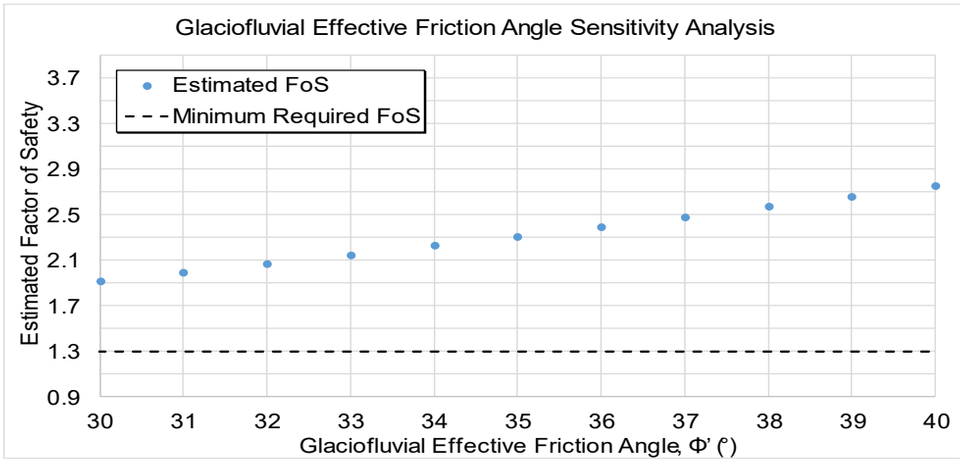
REF. NO. VA22-01349

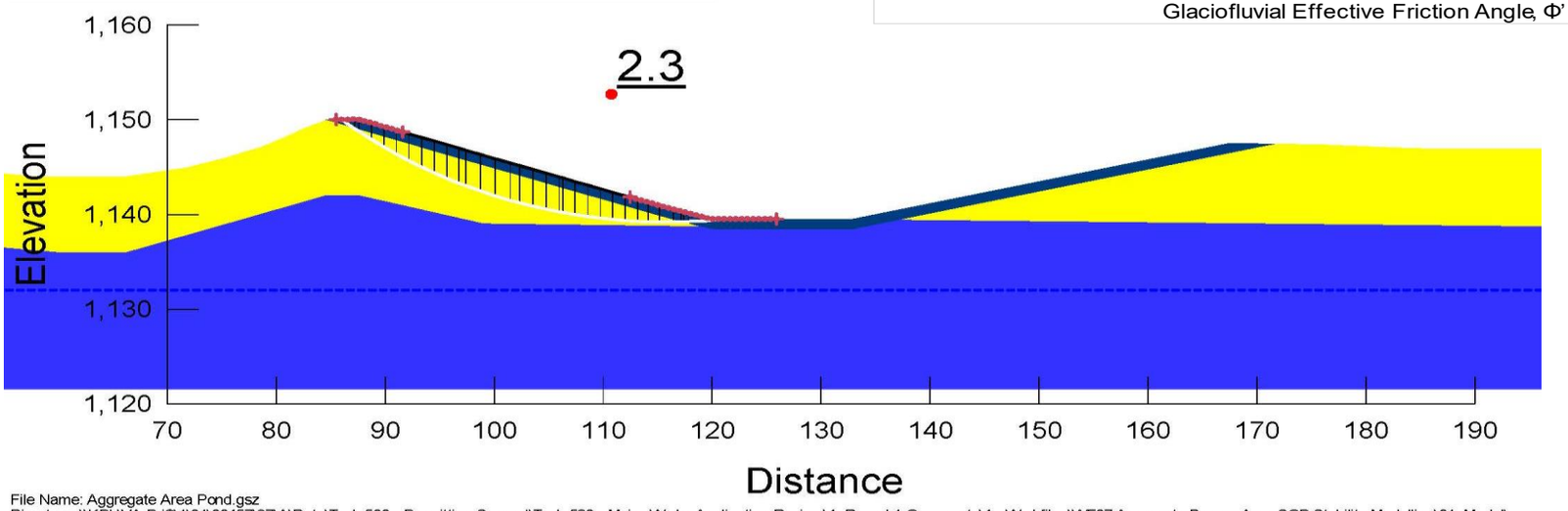
FIGURE B1.1

REV 0

Name: West Post-Construction
Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Slip Surface Option: Entry and Exit
Optimize Critical Slip Surface Location: No
Horz Seismic Coef.:
PWP Conditions from: Piezometric Line

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Friction Angle (°)
	Glacial (Lodgement) Till	Mohr-Coulomb	23	35
	Glaciofluvial (Channelized)	Mohr-Coulomb	23	35
	Zone S	Mohr-Coulomb	21	35





File Name: Aggregate Area Pond.gsz
Directory: \\KPL\VA-Prj$\1\01\00457\37\A\Data\Task 500 - Permitting Support\Task 520 - Major Works Application Review\4- Round 1 Comments\4 - Workfiles\WF07 Aggregate Borrow Area SCP Stability Modelling\01_Model\

NOTES:

1. CRITICAL SLIP SURFACE IS DISPLAYED. THE MINIMUM FACTOR OF SAFETY IS 1.3 (CDA, 2019)
2. STABILITY ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021)
3. GROUND WATER LEVEL MODELLED AT THE ELEVATION OF NEARBY DAVIDSON CREEK AT 1,132 masl .

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22JUL'22	ISSUED WITH LETTER	IJP	DDF

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BLACKWATER GOLD PROJECT

DS AGGREGATE BORROW AREA SCP - WEST CUT POST-CONSTRUCTION STABILITY ANALYSIS MANUAL PREDICTED PHREATIC SURFACE

Knight Piésold CONSULTING

P/A NO. VA101-457/37

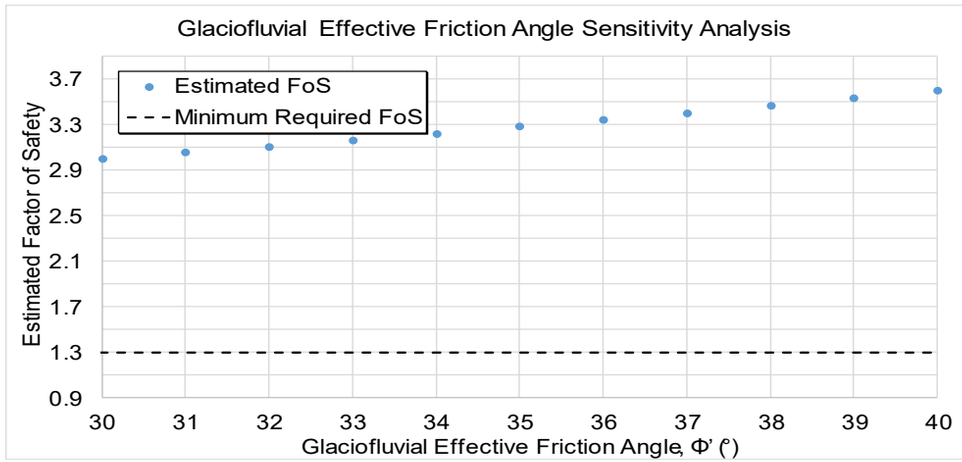
REF. NO. VA22-01349

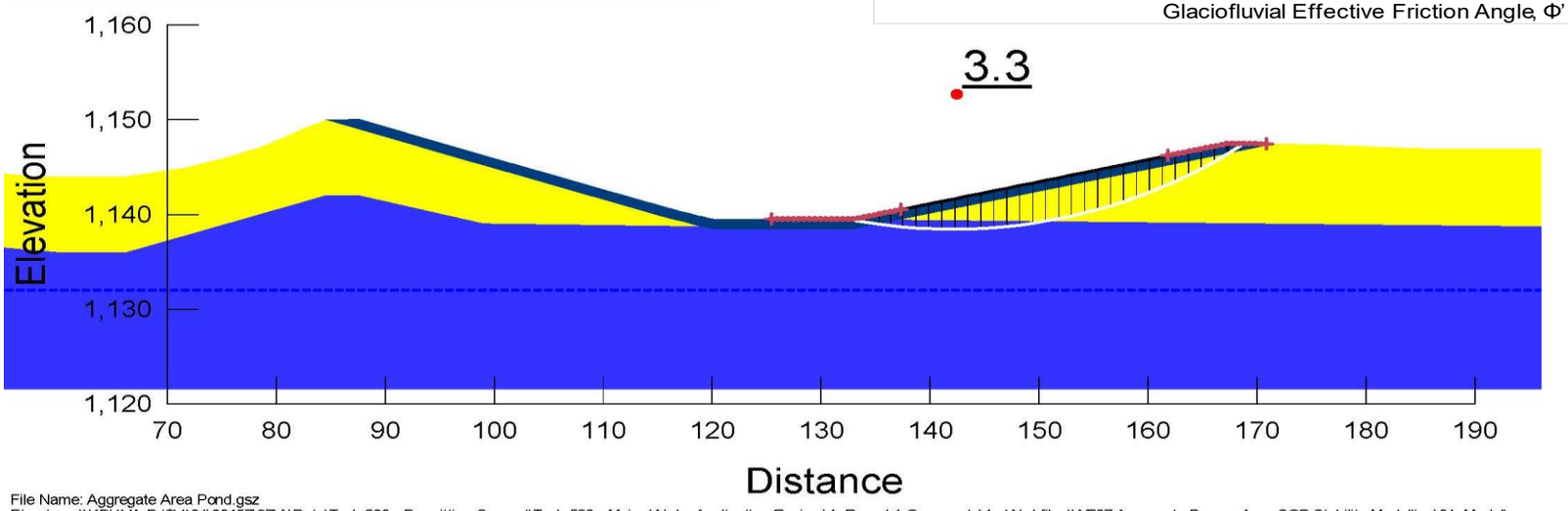
FIGURE B1.2

REV 0

Name: East Post-Construction
Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Slip Surface Option: Entry and Exit
Optimize Critical Slip Surface Location: No
Horz Seismic Coef.:
PWP Conditions from: Piezometric Line

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Friction Angle (°)
	Glacial (Lodgement) Till	Mohr-Coulomb	23	35
	Glaciofluvial (Channelized)	Mohr-Coulomb	23	35
	Zone S	Mohr-Coulomb	21	35





File Name: Aggregate Area Pond.gsz
Directory: \\KPL\VA-Prj$\1\01\00457\37\A\Data\Task 500 - Permitting Support\Task 520 - Major Works Application Review\4- Round 1 Comments\4 - Workfiles\WF07 Aggregate Borrow Area SCP Stability Modelling\01_Model\

NOTES:

1. CRITICAL SLIP SURFACE IS DISPLAYED. THE MINIMUM FACTOR OF SAFETY IS 1.3 (CDA, 2019)
2. STABILITY ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021)
3. GROUND WATER LEVEL MODELLED AT THE ELEVATION OF NEARBY DAVIDSON CREEK AT 1,132 masl .

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22JUL'22	ISSUED WITH LETTER	IJP	DDF

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BLACKWATER GOLD PROJECT

DS AGGREGATE BORROW AREA SCP - EAST CUT POST-CONSTRUCTION STABILITY ANALYSIS MANUAL PREDICTED PHREATIC SURFACE

Knight Piésold CONSULTING

P/A NO. VA101-457/37

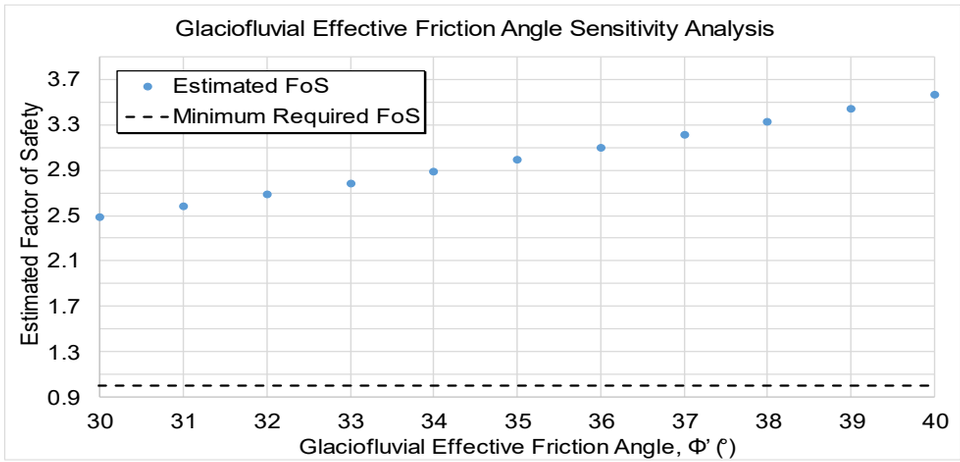
REF. NO. VA22-01349

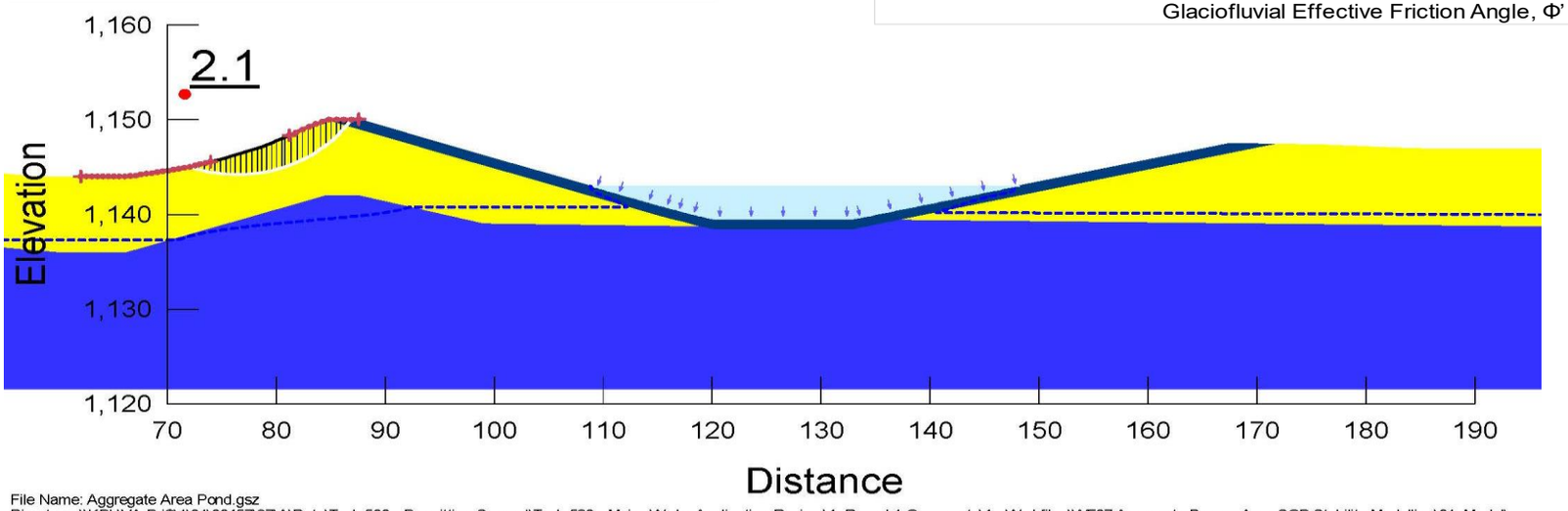
FIGURE B1.3

REV 0

Name: PGA=0.021g
Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Slip Surface Option: Entry and Exit
Optimize Critical Slip Surface Location: No
Horz Seismic Coef.: 0.021
PWP Conditions from Parent Analysis: Aggregate Area Pond Seepage [(last)]

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Friction Angle (°)
	Glacial (Lodgement) Till	Mohr-Coulomb	23	35
	Glaciofluvial (Channelized)	Mohr-Coulomb	23	35
	Zone S	Mohr-Coulomb	21	35





File Name: Aggregate Area Pond.gsz
Directory: \\KPL\VA-Prj$\1\01\00457\37\A\Data\Task 500 - Permitting Support\Task 520 - Major Works Application Review\4- Round 1 Comments\4 - Workfiles\WF07 Aggregate Borrow Area SCP Stability Modelling\01_Model\

NOTES:

1. CRITICAL SLIP SURFACE IS DISPLAYED. THE MINIMUM FACTOR OF SAFETY IS 1.0 (CDA, 2019)
2. STABILITY ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021)
3. GROUND WATER LEVEL MODELLED AT THE ELEVATION OF NEARBY DAVIDSON CREEK AT 1,132 masl .
4. POND WATER LEVEL MODELLED AT THE PROPOSED SPILLWAY CREST ELEVATION OF 1,143 masl.
5. HORIZONTAL SEISMIC COEFFICIENT OF 0.021g APPLIED.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22JUL'22	ISSUED WITH LETTER	IJP	DDF

BW GOLD LTD.

BLACKWATER GOLD PROJECT

DS AGGREGATE BORROW AREA SCP - PILLAR PSEUDO-STATIC STABILITY ANALYSIS SEEP/W PREDICTED PHREATIC SURFACE

Knight Piésold CONSULTING

P/A NO. VA101-457/37

REF. NO. VA22-01349

FIGURE B1.4

REV 0

Appendix D Camp Site SCP Design

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

August 30, 2022

Knight Piésold Ltd.
Suite 1400 - 750 West Pender Street
Vancouver, British Columbia
Canada, V6C 2T8
T +1 604 685 0543
E vancouver@knightpiesold.com
www.knightpiesold.com

Mr. Alastair Tiver
Vice President Projects
BW Gold Ltd.
3085 - 595 Burrard Street
Vancouver, British Columbia
Canada, V7X 1L3

Dear Alastair,

RE: Issue Tracking Table ID 371, 2156, and 2157 – Camp Site Water Management and Geotechnical Design Rev 1

1.0 INTRODUCTION

1.1 REGULATORY CONTEXT

This letter responds to Round 1 and additional Round 2 comments provided by the Ministry of Energy, Mines, and Low Carbon Innovation (EMLI) Major Mines Office on June 1 and August 10, 2022, respectively, with respect to the BW Gold Ltd. (BW Gold) Joint *Mines Act / Environmental Management Act* Permits Application (the Application) for the Blackwater Gold Project (Blackwater). The comments were received as part of the technical review phase. Response to the information request from BW Gold, prepared by Knight Piésold Ltd. (KP), is provided below.

1.2 RESPONSE HISTORY

Initial response to the Round 1 comment provided on June 1, 2022 (ID# 371) were provided in the letters *Issue Tracking Table ID 371 – Sediment Control Pond Designs – Information Requirement* (KP, 2022d), which included permitting background and further response timeline, and *Issue Tracking Table ID 371 – Camp Site Water Management and Geotechnical Design* (KP, 2022e), which included the revision 0 design.

No previous responses have been provided for the additional Round 2 comments provided by EMLI on August 10, 2022 (ID# 2156 and 2157).

This response includes revised designs superseding the revision 0 design (KP, 2022e) and addresses details of the additional Round 2 comments provided on August 10, 2022.

1.3 EMLI COMMENT

The following comment was provided by EMLI reviewers to BW Gold on June 1, 2022 and is addressed by this information summary:

ID# 371. The Application includes reference to the Downstream Aggregate Borrow Area Sediment Control Pond, the location and design for which cannot be found within the Application. Provide the location and design for the Downstream Aggregate Borrow Area Sediment Control Pond and confirm that all other ponds and dams are included in the Application including, but not necessarily limited to, ponds and dams associated with the borrow areas identified in the comment above.

The following comments were provided by EMLI reviewers to BW Gold on August 10, 2022 and are addressed by this information summary:

ID# 2156. The document, "Issue Tracking Table ID 371 – Camp Site Water Management and Geotechnical Design," provides the analyses and design for the Camp Site Sediment Control Pond. Section 3.5.6 of the JAIR requires "…an assessment of geohazards that could influence the water management structures and an explanation of how geohazards are managed in the design…" Reviewers were unable to locate this information within the Application. Provide an assessment of geohazards that could influence the Camp Site Sediment Control Pond and an explanation of how geohazards are managed in the design if required.

ID# 2157. Section 7.5 of the document, "Issue Tracking Table ID 371 – Camp Site Water Management and Geotechnical Design," states, "A layout plan showing the pond arrangement and the section used for stability analyses is included as Figure 6.1." Figure 7.1 provides a section line, which is oblique to the upper cut-slope of the sediment control pond basin. Clarify if the section line shown on Figure 7.1 is the section line used for analysis and demonstrate that the section analyzed is the critical section of analysis of the facility.

1.4 SCOPE OF LETTER

This letter describes the revision 1 detailed design of the water management structures required to manage contact and non-contact water for the operations camp site area beginning during construction of the project in approximately Year -2 and throughout the mine operations period. The camp facilities are described in Section 3.5.11.7 of the Application, which indicates that the operations camp pad will be cleared, grubbed, and levelled in approximately Year -2. The operations camp will be constructed thereafter and will become the primary camp facility, eventually replacing the existing 250-person exploration camp.

The water management design includes the design of runoff diversion and collection channels, sediment control pond (SCP), and erosion control Best Management Practices (BMPs) for the area and geotechnical and geohazard assessments of the proposed SCP.

The camp site water management and geotechnical design was informed by findings of the associated supporting studies related to hydrometeorological characterization (KP, 2021b), site geotechnical characterization (KP, 2021e), and the geological, geotechnical, and hydrogeological site conditions (KP, 2013a; KP, 2013b; KP, 2021c; KP, 2021d). The geotechnical assessments presented for the SCP in this letter must be read in conjunction with the modelling basis and material parameter justifications presented in the Supplemental Stability Assessment Report (KP, 2022a).

1.5 DESIGN DRAWINGS

This letter should be reviewed with reference to the following drawings, which are included in Appendix A:

- Drawing No. C3620: Water Management – Camp Site – General Arrangement
- Drawing No. C3621: Water Management – Camp Site – Collection Channels – Plan, Profiles, and Sections
- Drawing No. C3622: Water Management – Camp Site – Collection Channels – Sections
- Drawing No. C3623: Water Management – Camp Site – Diversion Channel – Plan, Profiles, and Sections
- Drawing No. C3624: Water Management – Camp Site – Diversion Channel – Sections
- Drawing No. C3625: Water Management – Camp Site – Diversion Channel – Stilling Basin – Details and Sections

- Drawing No. C3626: Water Management – Camp Site – Sediment Control Pond – Plan and Sections
- Drawing No. C3627: Water Management – Camp Site – Sediment Control Pond Spillway – Sections and Details

This design summary letter and the design drawings were prepared to support the permit application for the camp site water management structures. The design drawings are considered to be 'Detailed Design' and are also labelled as 'Not for Construction' as is the standard for any drawing issued other than Issued for Construction (IFC) drawings.

Further work will be required to prepare IFC drawings prior to construction of the water management structures, which will include the verification of the current design presented in this letter to optimize the design and avoid potential unidentified interferences with any facilities around the camp site area. Potential changes may include realignment of channels, pond, and inclusion of culvert crossings, where required.

2.0 WATER MANAGEMENT DESIGN CRITERIA

2.1 OBJECTIVE

The water management components were designed for the available operations camp site configuration. Detailed plans, sections, profiles, and details are included in the C3620 Drawing series in Appendix A. Surface contact water will be managed in a manner that allows for safe containment and control. Collection channels will be constructed east and west of the camp site to collect and convey contact surface runoff to the Camp Site SCP. The SCP is sized to safely manage storm event runoff while allowing for adequate suspended sediment settling time prior to release to the downstream environment.

Non-contact water will be collected and conveyed in a diversion channel upslope (south) of the camp site to the west to reduce the overall catchment contributing to the SCP. Flows from the diversion channel and through the SCP primary outlet and emergency spillway will be released to the Creek 146920 (also referred to elsewhere as the southern tributary of Creek 505659). Stilling basins are designed for the outlets of the diversion channel and emergency spillway to reduce flow velocity, dissipate energy, and minimize erosion potential.

2.2 GENERAL ARRANGEMENT

The following are specific design features of the Camp Site water management components:

- Cut/fill glacial till and erosion protection-lined earthfill collection and diversion channels
- Contact water SCP
- Primary outflow culvert
- Emergency spillway
- Erosion protection-lined stilling basins for the diversion channel and SCP emergency spillway outlets

2.3 DESIGN CRITERIA

The design criteria for the collection and diversion channels includes the following:

- Designed as an open channel to pass the 1 in 10-year, 24-hr storm event with a minimum freeboard allowance of 300 mm above the design flow level and to pass the 1 in 200-year, 24-hr storm event with no minimum freeboard requirement.
- Designed to pass the 1 in 200-year, 24-hr storm event with a minimum freeboard allowance equal to or greater than 500 mm above this design flow level through the spillway.

- A minimum channel slope of -0.5%.

The design criteria for the stilling basins includes the following:

- Provide energy dissipation and controlled discharge of flows up to the 1 in 200-year, 24-hour precipitation event.

The design criteria for the sediment control pond are based on the British Columbia Ministry of Environment Sediment Control Pond Technical Guidance recommendations (ENV, 2015) and include the following:

- Provide runoff storage from the 1 in 10-year, 24-hour precipitation event with a controlled discharge through a 200 mm pipe.
- Provide controlled discharge of flows up to the 1 in 200-year, 24-hour precipitation event through a broad crested rectangular weir spillway.
- Provide and maintain a minimum of 500 mm of freeboard above the flood level resulting from the 1 in 200-year, 24-hour precipitation event.
- The pond is assumed to have a starting water level of 0.5 m when the 1 in 10-year, 24-hour precipitation event occurs and a starting water level equal to the water level resulting from the 1 in 10-year, 24-hour precipitation event when the 1 in 200-year, 24-hour precipitation event occurs.
- Sediments will remain in the pond until it is decommissioned or until it requires pumping and/or dredging to maintain the minimum operating depth of 0.5 m above pond invert.

3.0 HYDROLOGIC INPUTS

3.1 CLIMATE DATA

3.1.1 RAINFALL

The estimated 24-hours precipitation events for a range of return periods are shown in Table 3.1. Values were obtained from the 2020 Hydrometeorology Report (KP, 2021b) and adjusted to include a 15% increase to consider the effects of climate change according to the recommendations of Engineers and Geoscientists of British Columbia (2018). The 1 in 10-year and 1 in 200-year, 24-hour precipitation events of 64 (56 X 1.15) and 110 (95 x 1.15) mm respectively, were selected for the collection channels.

Table 3.1 Estimated 24-hour Precipitation Depth (Without Considering Climate Change)

24-hour Precipitation (mm) for Return Periods (years)[1]					
2	**10**	**100**	**200**	**1000**	**PMP**
32	56	86	95	115	288

Note(s):

1. Source: Blackwater Gold Project – 2020 Hydrometeorology Report – Table 2.15 (KP, 2021b).

3.1.2 SNOWMELT

Snowmelt was considered based on values presented in the 2020 Hydrometeorology Report (KP, 2021b). The estimate conservatively assumes that the entire Camp Site area and its diverted catchment areas will be covered entirely in snow at the time of the design storm event.

3.2 CATCHMENT AREAS

Catchment areas used for the sizing of the Camp Site collection and diversion channels and SCP are provided in Table 3.2 and shown on Figure 3.1, respectively.

Table 3.2 Camp Site Water Management Design Catchments Areas

Sub-Catchment	Area (Ha)
Area O	0.2
Area W	5.7
Area E	2.8
Area D	27.3

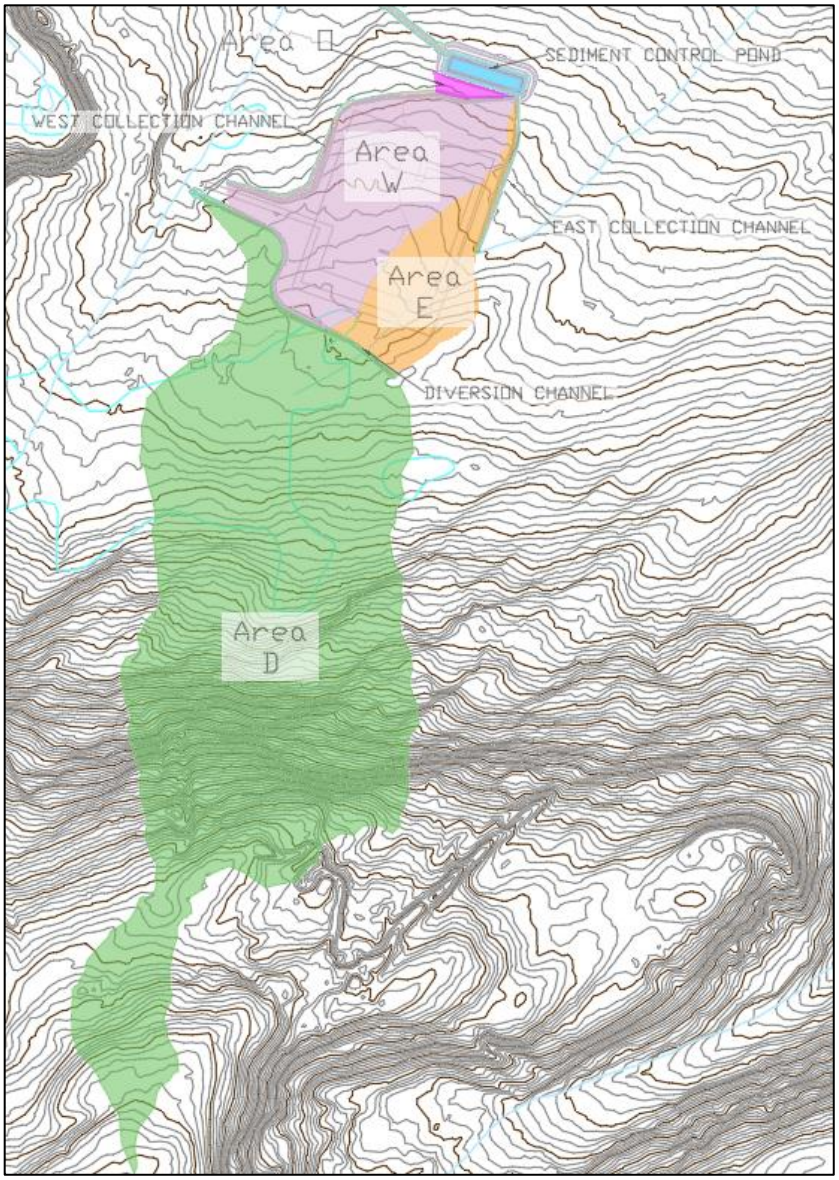


Figure 3.1 Camp Site Water Management Design Catchment Areas

3.3 SOIL CONSERVATION SERVICE CURVE NUMBER

Group C hydrologic soil was chosen as representative of the area around the Camp Site and a curve number (CN) of 91 was selected.

Group C *soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr)* (USDA, 1999).

Group B hydrologic soil is chosen as representative of the undisturbed area upslope of the Camp Site and a CN of 66 was selected.

Group B *soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr)* (USDA, 1999).

3.4 DESIGN RUNOFF FLOWS

Storm peak flow estimates were calculated using the rainfall-runoff modelling software HydroCAD® (HydroCAD, 2020), and are based on the following input parameters:

- The catchment areas summarized in Section 3.2
- The 24-hour rainfall values summarized in Section 3.1.1
- An SCS Type I rainfall distribution
- The time of concentration was calculated using SCS curve number/lag time method
- An SCS curve numbers defined in Section 3.3
- An SCS unit hydrograph

4.0 WATER MANAGEMENT CHANNELS

4.1 WEST COLLECTION CHANNEL

Erosion protection-lined, trapezoidal channels with 2H:1V side slopes with a minimum 0.5% grade were selected for the West Collection Channel design. The collection channel conveys flows along the west and north sides of the camp site to the Camp Site SCP. The West Collection Channel is shown on Drawings C3621 and C3622 in Appendix A.

The collection channel design parameters and details are summarized in Table 4.1.

Table 4.1 West Collection Channel Key Design Parameters

Parameter	Unit	Value
Contribution		
Catchment Area W	km^2	0.06
	m^3/s	0.40 (0.81)
Segment 1 (0+000 to 0+226.27)		
Design Storm	-	1 in 10-year, 24-hr
Length	m	226.27
Invert Inlet Elevation	m	1,263.61
Invert Outlet Elevation	m	1,258.58
Channel Slope	-	0.023
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.8
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.35 (0.46)
Expected Freeboard	m	0.45 (0.34)
Outflow	m^3/s	0.31 (0.61)
Segment 2 (0+226.27 to 0+457.26)		
Design Storm	-	1 in 10-year, 24-hr
Length	m	230.99
Invert Inlet Elevation	m	1,258.58
Invert Outlet Elevation	m	1,256.98
Channel Slope	-	0.007
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.8
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.49 (0.65)
Expected Freeboard	m	0.31 (0.15)
Outflow	m^3/s	0.40 (0.81)

Note(s):

1. Values in brackets are based on the 1 in 200-year, 24-hour design storm event.

4.2 EAST COLLECTION CHANNEL

Erosion protection-lined, trapezoidal channels with 2H:1V side slopes with a minimum 0.5% grade were selected for the East Collection Channel design. The collection channel conveys flows along the east side of the camp site to the Camp Site SCP. The East Collection Channel is shown on Drawings C3621 and C3622 in Appendix A.

The collection channel design parameters and details are summarized in Table 4.2.

Table 4.2 East Collection Channel Key Design Parameters and Details

Parameter	Unit	Value
Contribution		
Catchment Area E	km^2	0.03
	m^3/s	0.22 (0.43)
Segment 1 (0+000 to 0+212.09)		
Design Storm	-	1 in 10-year, 24-hr
Length	m	212.09
Invert Inlet Elevation	m	1,264.37
Invert Outlet Elevation	m	1,256.98
Channel Slope	-	0.035
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.7
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.29 (0.37)
Expected Freeboard	m	0.41 (0.33)
Outflow	m^3/s	0.22 (0.43)

Note(s):
1. Values in brackets are based on the 1 in 200-year, 24-hour design storm event.

4.3 DIVERSION CHANNEL

Erosion protection-lined, trapezoidal channels with 2H:1V side slopes with a minimum 0.5% grade were selected for the Diversion Channel design. The diversion channel conveys flows from upslope of the camp site to the southern tributary of Creek 505659 (also referred to as Creek 146920). The Diversion Channel is shown on Drawings C3623 and C3624 in Appendix A.

The diversion channel design parameters and details are summarized in Table 4.3.

Table 4.3 Diversion Channel Key Design Parameters

Parameter	Unit	Value
Contribution		
Catchment Area D	km^2	0.27
	m^3/s	0.23 (0.81)
Segment 1 (0+000 to 0+056.98)		
Design Storm	-	1 in 10-year, 24-hr
Length	m	56.98
Invert Inlet Elevation	m	1,270.42
Invert Outlet Elevation	m	1,268.60
Channel Slope	-	0.032
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.8
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.14 (0.24)
Expected Freeboard	m	0.66 (0.56)
Outflow	m^3/s	0.03 (0.13)
Segment 2 (0+056.98 to 0+162.77)		
Design Storm	-	1 in 10-year, 24-hr
Length	m	105.79
Invert Inlet Elevation	m	1,268.60
Invert Outlet Elevation	m	1,267.95
Channel Slope	-	0.006
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.8
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.40 (0.64)
Expected Freeboard	m	0.40 (0.16)
Outflow	m^3/s	0.22 (0.79)
Segment 3 (0+162.77 to 0+400.77)		
Design Storm	-	1 in 10-year, 24-hr
Length	m	238.00
Invert Inlet Elevation	m	1,267.95
Invert Outlet Elevation	m	1,262.64
Channel Slope	-	0.025
Channel Side Slopes (H:V)	-	2:1
Base Width	m	0

Parameter	Unit	Value
Channel Lining D_{50}	mm	150
Total Channel Design Depth	m	0.8
Minimum Required Freeboard	m	0.3 (0)
Maximum Water Height in Channel	m	0.31 (0.51)
Expected Freeboard	m	0.49 (0.29)
Outflow	m^3/s	0.23 (0.81)

Note(s):
1. Values in brackets are based on the 1 in 200-year, 24-hour design storm event.

5.0 STILLING BASINS

The stilling basin design parameters and details for the Diversion Channel and emergency spillway outlets are summarized in Table 5.1 and Table 5.2, respectively. The Diversion Channel and emergency spillway stilling basins are shown on Drawings C3625 and C3627, respectively, in Appendix A.

Table 5.1 Diversion Channel Stilling Basin Design Parameters and Details

Parameter	Value
Design storm	1 in 200-year, 24-hr
Inlet invert elevation (masl)	1,262.64
Inlet velocity (m/s)	1.59
Basin Lining D_{50}	150
Basin invert elevation (masl)	1,262.04
Lining invert elevation (masl)	1,261.74
Basin Length (m)	6.0
Internal slopes (H:V)	2:1
Apron Length (m)	Min. 3.0
Outlet apron elevation (masl)	1,262.20
Outlet velocity (m/s)	0.68
Maximum water elevation (masl)	1,261.82

Table 5.2 Emergency Spillway Stilling Basin Design Parameters and Details

Parameter	Value
Design storm	1 in 200-year, 24-hr
Inlet invert elevation (masl)	1,251.48
Inlet velocity (m/s)	1.55
Basin Lining D_{50}	200
Basin invert elevation (masl)	1,250.88
Lining invert elevation (masl)	1,250.48
Basin Length (m)	6.0
Internal slopes (H:V)	2:1
Apron Length (m)	Min. 3.0
Outlet apron elevation (masl)	1,251.10
Outlet velocity (m/s)	0.68
Maximum water elevation (masl)	1,251.32

6.0 POND

6.1 GENERAL

The Camp Site SCP will be constructed downslope, to the north, of the camp site and has a total contributing catchment area of approximately 8.6 Ha. The pond will receive inflows from the East and West Collection Channels. Water will be impounded by an earthfill structure that will be constructed using local cut/fill materials, riprap, and Zone S material. The pond is designed with two outlets: a culvert discharge outlet (primary outlet) and an emergency spillway (secondary outlet), and a single, erosion protection lined, inlet. The Camp Site SCP is shown on Drawings C3626 and C3627 in Appendix A.

The pond is designed with 0.5 m of dead storage at its base. It will have a base elevation of 1,254.3 masl and will rise 3.5 m to a crest elevation of 1,257.8 masl. The crest width is 5 m, and the pond has interior slopes of 3H:1V and exterior slopes of 2.5H:1V. The collection pond is designed to contain and convey the 1 in 10-year, 24-hr flood through the primary outlet. The pond secondary outlet, an emergency spillway at the northwest corner of the pond, is designed to pass the 1 in 200-yr, 24-hr flood.

The Camp Site SCP berm maximum fill height is approximately 2.9 meters, and the pond will impound approximately 3,200 m^3 when the water level is at the spillway invert. Accordingly, the structure is categorized as a minor dam as defined by the BC Dam Safety Regulations (BC, 2016).

The Camp Site SCP design parameters are summarized in Table 6.1.

Table 6.1 Camp Site Sediment Control Pond Design Parameters

Parameter	Value
Invert elevation (masl)	1,254.3
Crest elevation (masl)	1,257.8
Maximum fill height (m)	2.9
Primary outlet (culvert) invert elevation (masl)	1,255.0
Secondary outlet (emergency spillway) invert elevation (masl)	1,256.7
Minimum freeboard (m)	0.5
Crest width (m)	5
Internal slopes (H:V)	3:1
External slopes (H:V)	2.5:1
Pond length at invert (m)	95
Pond width at invert (m)	15
Impounded volume at secondary outlet invert (m^3)	3,200

6.2 PRIMARY OUTLET

The Camp Site SCP primary outlet is designed for the 1 in 10-year, 24-hr flood. The outlet peak discharge is 0.06 m^3/s and will be passed through a 200 mm (8") diameter culvert.

Settling Velocity

A settling velocity of $5x10^{-5}$ m/s was estimated for particle sizes of 10 microns or greater at a water temperature of 0°C, based on the following:

- $Vs = (g/18\mu)(S.G. - 1)\ D^2$
- Vs = Settling Velocity = $5x10^{-3}$ cm/s = $5x10^{-5}$ m/s
- g = acceleration of gravity = 981 cm/s^2
- μ = kinematic viscosity = 0.01787 cm^2/s (at 0°C)
- S.G. = Specific Gravity = 2.7
- D = (Stokes) diameter (cm) of a non-interacting particle measured = 0.001 cm

The design settling velocity was chosen to provide an appropriate balance between pond size, function, and physical constraints. The potential to increase the pond size to accommodate a lesser settling velocity is limited by real world limits to settling fines in a high runoff environment, such that the ability to settle out particles finer than 10 microns may not be possible even with a substantially larger pond, without the use of settling aids. The sediment pond is expected to function well under normal conditions to meet the discharge targets for total suspended solids (TSS), but it is recognized that the use of flocculants may be required after heavy precipitation events when TSS concentrations are elevated with increased finer grained soils containing particle sizes less than 10 microns.

6.3 SECONDARY OUTLET (EMERGENCY SPILLWAY)

The Camp Site SCP emergency spillway is designed for the 1 in 200-year, 24-hr flood. The spillway peak flow was calculated to be approximately 0.8 m^3/s.

7.0 SEDIMENT CONTROL POND GEOTECHNICAL ASSESSMENT

7.1 SEEPAGE ASSESSMENT

7.1.1 METHODOLOGY AND POND CONDITIONS

Steady-state seepage analyses were carried out using SEEP/W®, a two-dimensional finite element seepage analysis software package (Geo-Slope, 2021) for modelling groundwater flux. The seepage analyses were carried out on the maximum pond water level (at the spillway invert) model configurations to evaluate seepage flow paths within the berm and underlying foundation materials to define the estimated phreatic surface elevation for slope stability modelling and to evaluate the potential for internal erosion.

A three-dimensional steady-state regional scale numerical model was developed using MODFLOW-USG to simulate the baseline hydrogeological conditions and potential effects of mine development, including the estimate of seepage rates, travel times, and discharge locations. The regional scale groundwater modelling is presented in the Numerical Groundwater Modelling Report (KP, 2021f) with the estimated seepage rates, travel times, and discharge locations presented therein. The calibrated hydraulic conductivity values determined during baseline numerical groundwater model calibration were incorporated into the material parameter selection for the purpose of developing the two-dimensional seepage models used to define piezometric conditions for the stability analyses presented in this report.

7.1.2 ACCEPTANCE CRITERIA

The recommended factor of safety (FoS) against internal erosion should be at least 3 (Fell et al, 2005). An exit gradient of 0.3 at the downstream toe is approximately equivalent to a FoS against initiation of internal erosion of approximately 3.

7.2 STABILITY ASSESSMENT

7.2.1 METHODOLOGY LOADING CONDITIONS

Stability analyses were carried out using SLOPE/W®, a two-dimensional limit equilibrium stability analysis software package (Geo-Slope, 2021), to investigate the stability of the proposed structure under both static and seismic loading conditions. The Morgenstern-Price method was used to estimate the Factor of Safety (FoS) for all models. The analyses comprised checking the stability of the structure for each of the following cases:

- **Normal operations (static, long-term)** – Downstream slope was evaluated with a pond elevation consistent with the expected maximum normal operating conditions. Piezometric pressures incorporated into the stability analysis were based on a coupled seepage analysis and resulting estimated phreatic conditions.
- **Post-construction (static, short term)** – Downstream and excavated slopes were evaluated for the stockpile ponds, if appropriate, with no pond to represent the end of construction, prior to filling, condition.
- **Pseudo-static** – Downstream slope was evaluated with a 0.021g horizontal seismic load from the peak ground acceleration (PGA) for the 1/475-year Maximum Design Earthquake (MDE), (KP, 2021a).
- **Sensitivity analysis (static, long-term)** – Sensitivity analyses were conducted to assess sensitivity to assumptions related to the effective strength of near surface foundation materials.

7.2.2 ACCEPTANCE CRITERIA

A summary of the loading conditions and minimum target FoS values are summarized in Table 7.1 below.

Table 7.1 Recommended Minimum Target FoS [after EMPR (2016) and CDA (2013, 2019)]

Loading Condition	Recommended Minimum Target FoS
Long term (steady state seepage, normal reservoir level)	1.5
During or at end of construction	1.3
Pseudo-static	1.0

Note(s):

1. Analysis typically completed for downstream slope; however, some modelling scenarios may consider the upstream slope prior to impoundment filling.

7.3 FOUNDATION CONDITIONS

A summary of the foundation conditions at the Camp Site SCP was developed based on available geotechnical and hydrogeological information from site investigation programs completed from 2012 to 2021. The associated drillhole and test pit sites are listed in Table 7.2. The reference sites are in the general vicinity of the SCP footprint, located approximately 400 to 500 m away.

Table 7.2 Stockpile Site Investigation Summary

SCP	Drillhole Sites	Test Pit Sites
Camp Site	MW13-04, TW13-02, RCH089	TP12-127, TP12-126

The deglaciation model map (Clague, 2018) and the terrain and landform maps (KP, 2019) indicate that the surficial material is predominantly glacial till (ablation and lodgement) at the proposed Camp Site SCP footprint. A localized northeast trending glaciofluvial (undifferentiated sands and gravels) is located to the southeast within the proposed camp building footprint.

Information from 2 test pits, 2 monitoring wells, and 1 condemnation drillholes were used to provide an assessment of the foundation conditions at the Camp Site SCP. Drillhole MW13-04 is drilled within the proposed camp area (south of the SCP) while the other sites are located upstream to the north within 500 m of the proposed SCP.

The 2 test pits show topsoil thickness at 0.1 m consisting of soft dark brown organic material. Glacial till sequences typically greater than 5 m consisting of ablation till underlies the topsoil where it was observed as mainly silty fine to coarse sand, some subrounded to subangular gravel, light to medium compact, and moist. Drillhole MW13-04 also intercepted glacial till material (undifferentiated sandy silt with some gravel) with a thin lense of brown sand from 1.5 to 1.7 mbgs where the screen zone was installed.

There is no bedrock exposure at the Camp SCP area. Bedrock elevation is expected to be deeper than 100 m based on the condemnation drillholes completed in the area.

No groundwater was encountered in the two test pits to the north however monitoring well MW13-04 to the south indicates a near surface groundwater level at approximately 0.8 m below ground surface based on measurements from July 2013. Monitoring well TW13-02 to the north indicated flowing artesian conditions where it intercepted a confined aquifer water producing interval (silt, sand and gravel) from 42 to 48 mbgs.

7.4 MATERIAL PARAMETERS

Detailed descriptions of the material types and behavioural characteristics of the foundation materials considered in the seepage and stability assessments are not included in this letter report. Please refer to the Supplemental Stability Assessment Report (KP, 2022a) for more details.

7.5 MODELLED SECTIONS

The Camp Site SCP will be constructed downslope, to the north, of the camp site area. A layout plan showing the pond arrangement and the representative (i.e. critical) section used for stability analyses is included as Figure 7.1. The stability analysis section was selected based on the maximum berm height, steepest downstream slope, and representative (i.e. perpendicular to) internal slope. This section is updated from the one included in Figure 7.1 of the revision 0 design letter (KP, 2022e) to capture the critical internal slope.

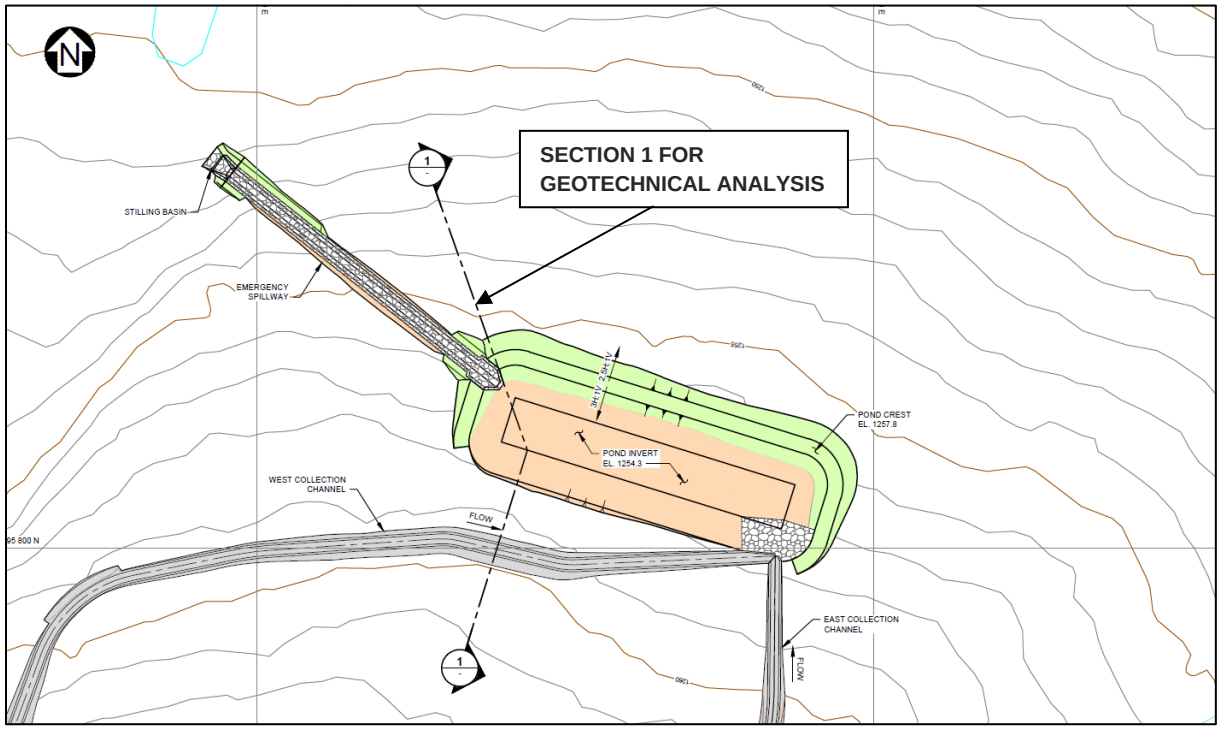


Figure 7.1 Camp Site SCP – Plan and Section for Geotechnical Analyses

7.6 HYDRAULIC BOUNDARY CONDITIONS

For the post-construction (static, short term) analyses, a simplified representation of the groundwater phreatic surface was drawn in consideration of the groundwater level measured from nearby hydrogeological installations. The phreatic surface was drawn as a subdued reflection of surface topography 0.8 mbgs with an approximate groundwater elevation at the pond centreline of 1,252.4 masl.

For the long-term (static) and pseudo-static analyses, estimated phreatic surfaces from the seepage analyses were used to define the piezometric pressures incorporated into the stability analyses. Boundary conditions were defined for the maximum normal seepage analyses as follows:

- Maximum operating pond water levels at the SCP spillway invert.

- Groundwater levels at the ground surface at the model extents.
- Potential seepage faces are applied to the downstream berm face. Potential seepage faces are modelled with water rate set to a constant of 0.

7.7 SEEPAGE ANALYSIS RESULTS

The estimated factors of safety against internal erosion are summarized in Table 7.3 and the xy-gradient at the berm toe is presented on Figure B1.1 in Appendix B.

Table 7.3 Camp Site Sediment Control Pond Seepage Analysis Results

Location	Geometry			XY-Gradient	Estimated FoS
	Crest Elevation (masl)	Toe Elevation (masl)	Pond Elevation (masl)		
Toe of Berm	1,257.8	1,254.9	1,256.7	0.20	5.0
[1] Recommended Minimum Target FoS					3.0

Note(s):

1. Minimum factor of safety based on the recommendations outlined in the Geotechnical Engineering of Dams (Fell et al, 2005).

7.8 STABILITY ANALYSIS RESULTS

The results of the limit equilibrium stability analyses for the sediment control pond berms are summarized in Table 7.4 and shown on the associated figures included in Appendix B. Sensitivity analyses were also carried out while considering a range in the effective strength of the foundation materials of ±5°, and the results are included on the associated figures in Appendix B.

Table 7.4 Camp Site Sediment Control Pond Stability Analysis Results

Loading Condition	Slope	Geometry		Estimated FoS	Recommended Minimum Target FoS [1]
		Crest Elevation (masl)	Pond Elevation (masl)		
Long-term (static)	Downstream	1,257.8	1,256.7	1.7	1.5
Post-construction (static)	Upstream	1,257.8	None	2.5	1.3
	Cut-slope	1,257.8		2.1	
Pseudo-static	Downstream	1,257.8	1,256.7	1.6	1.0

Note(s):

1. Minimum factors of safety based on the requirements outlined in The Application of Dam Safety Guidelines to Mining Dams (CDA, 2019) and the HSRC Guidance Document (EMPR, 2016).

7.9 SUMMARY AND CONCLUSIONS

The geotechnical analyses of the Camp Site SCP were completed using information from geotechnical and hydrogeological data collected from 2012 to 2021 (KP, 2013a; KP, 2013b; KP, 2021c; KP, 2021d) and reference to the deglaciation model map (Clague, 2018) along with the reference maps and terrain and landform maps provided in Appendix A1 and Appendix C1, respectively, of Appendix 3-L (KP, 2021e). The seepage and stability analyses confirm that the SCP design meets the required FoS for internal erosion and the static and pseudo-static stability loading conditions, respectively.

8.0 GEOHAZARD ASSESSMENT AND MANAGEMENT

8.1 GENERAL

Terrain stability maps and the associated slope angle maps for the Project showing the latest layout are included in Appendices A and B, respectively, of the letter titled *Updated Terrain Stability Mapping and Geohazard Assessment* (KP, 2022b). General details of the Project terrain stability and geohazard assessment are also included in that letter.

8.2 ASSESSMENT

The proposed camp site area is located east of TSF C and north of the proposed plant site area. The footprint of the proposed camp site area is shown on Sheet 2 of the maps included in Appendices A and B of the *Updated Terrain Stability Mapping and Geohazard Assessment* (KP, 2022b), which is included as Appendix 3-X1 of the Application.

The slope angle mapping indicates that the proposed camp site is in an area of gently sloping terrain oriented towards the northeast. The terrain stability maps indicate the area is ‘stable’, having a ‘negligible’ to ‘low’ likelihood of landslides. No evidence of geohazards that could influence the proposed camp site area were identified.

8.3 TEMPORARY MITIGATION MEASURES

Terrain Stability Assessments (TSAs) should be undertaken in mapped areas of potentially unstable and unstable terrain during construction where earthworks and/or vegetation clearance are planned. The TSAs should adopt a risk-based approach to determine the extent of any necessary temporary mitigation measures and should address the possible enhanced likelihood of erosion as well as landsliding as a result of the vegetation clearance and earthworks.

The types of temporary mitigation measures for terrain instability could include additional control of surface and subsurface water, adjustment to construction methods and activity sequencing, adjustment to cut and fill design slope angles, and temporary support/stabilization (e.g. buttressing, soil nailing, rock bolting, etc.)

9.0 BEST MANAGEMENT PRACTICES

Erosion control BMPs reduce erosion by stabilizing exposed soil or by reducing surface runoff flow velocities. There are generally two types of erosion control BMPs:

- Source control BMPs for protection of exposed surfaces
- Conveyance BMPs for control of runoff

In addition to the Diversion Channel and spillway stilling basins and SCP inlet erosion protection, additional erosion control BMPs may be implemented prior to and during construction to minimize erosion and sediment discharge into surrounding areas. Descriptions of BMPs to be used at the site are provided below.

Vegetation Management and Re-vegetation

Natural vegetation is one of the best and most cost-effective methods of reducing the potential for erosion and sedimentation. Vegetation keeps soil secure and ground cover reduces raindrop velocities. In order to preserve vegetation, a “no-entry” vegetation buffer will be maintained to prevent excess clearing, particularly around water bodies, prior to clearing vegetation from surrounding areas. If preserving natural

vegetation is not a viable option, cleared areas that will not include infrastructure will be re-vegetated as soon as practical after construction activities have ended.

Mulching

Mulching is the application of a uniform protective layer of straw, wood fiber, wood chips, or other acceptable material on or incorporated into the soil surface of a seeded area to allow for the immediate protection of the seed bed. The purpose of mulching is to protect the soil surface from the forces of raindrop impact and overland flow, foster the growth of vegetation, increase infiltration, reduce evaporation, insulate the soil, and suppress weed growth. Mulching also helps to hold fertilizer, seed, and topsoil in place in the presence of wind, rain, and runoff, and reduces the need for watering. Mulching may be utilized in areas that have been seeded either for temporary or permanent cover.

There are two basic types of mulches: organic mulches and chemical mulches. Organic mulches likely to be used include straw, hay, wood fiber, wood chips, and bark chips. This type of mulch is usually spread by hand or by machine (mulch blower) after seed, water, and fertilizer have been applied. Chemical mulches, also known as soil binders or tackifiers, are composed of a variety of synthetic materials. Chemical mulches are usually mixed with organic mulches as a tacking agent to aid in the stabilization process, and are not used as mulch alone, except in cases where temporary dust and erosion control is required. The choice of materials for mulching will be based on soil conditions, season, type of vegetation, and the size of the area.

Mulching is not planned as part of the early works activities; however, it may be implemented for improved re-vegetation for sediment and erosion control if required in specific challenging areas.

Rolled Erosion Control Products

Rolled Erosion Control Products (RECPs) are geosynthetic or organic materials composed of two layers of coarse mesh that contain a central layer of permeable fibres in between. These products take the form of flexible sheet materials that are often composed of organic materials that decompose over time. When intended for long-term use, RECPs are made from ultraviolet-stable synthetics such as polypropylene.

RECPs are used to cover un-vegetated cut or fill slopes in order to provide erosion control when seeding or mulching alone is unsuccessful. RECP sheets must be anchored with special stakes or rocks and must be in direct, tight contact with the soil surface in order to perform effectively.

Slope Roughening

Cut and fill slopes will be roughened with tracked machinery or by other means, to reduce runoff velocity, increase infiltration, reduce erosion, and to aid in the establishment of vegetative cover with seed. Roughening will typically be carried out by a tracked machine moving up and down the slope, creating undulations on the soil surface. This procedure is simple, inexpensive, and provides immediate short-term erosion control for bare soil, where vegetative cover is not yet established. Compared to hard, compacted smooth surfaces a rough soil surface provides more favorable moisture conditions, which will aid in seed germination. Slope roughening works best on flat to moderately sloped areas.

Re-contouring

Re-contouring the soil surface can also reduce the effect of erosion by shortening the length of the accumulation and movement of water as well as decreasing its slope. Creating undulations or troughs will also reduce overland water movement velocity. These types of improvements are beneficial as they are

easily planned and constructed on site. However, both surface roughening and re-contouring are only temporary erosion control methods and more permanent structures are needed over time.

Silt Fencing

Silt fencing is a perimeter control type BMP used to intercept sheet flow runoff and used in conjunction with other BMPs. Typical silt fencing comprises a geotextile fabric anchored to posts driven into the ground. Silt fencing promotes sediment control by filtering water that passes through the fabric and increases short term retention time, allowing suspended sediments to settle.

Silt fences will be placed parallel to slope contours to maximize ponding efficiency when required. Barrier locations are informally chosen based on site features and conditions (e.g., soil types, terrain features, sensitive areas, etc.), design plans, existing and anticipated drainage courses, and other available erosion and sediment controls. Typical barrier sites are catch points beyond the toe of fill or on side slopes above waterways or drainage channels. Silt fences will not be used for wide low-flow, low-velocity drainage ways, for concentrated flows, in continuous flow streams, for flow diversion, or as check dams. Silt fencing will be installed in backfilled trenches for proper anchoring.

All silt fences will be inspected and maintained, as required, following major rainfall events. Proper installation and frequent maintenance are required for effective sediment control.

Straw Bale

A straw bale barrier consists of straw bales placed end to end along a level contour in a channel and then staked to hold them in place. The straw bale barrier detains and filters stormwater runoff, creating a small pond behind the barrier where sedimentation occurs. Straw bales, along with silt fences, will significantly reduce sediment accumulation in sediment control ponds and basins.

10.0 OPERATIONAL AND MONITORING REQUIREMENTS

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

The specific operational and monitoring requirements presented in this letter for the water management facilities must be read in conjunction with the general monitoring and operational requirements presented in the Stockpiles Geotechnical and Water Management Design Report (KP, 2022c).

The primary maintenance requirements include:

- Applying sediment and erosion control BMPs as required.
- Periodic removal of sediment from bottom of pond as required.
- Periodic maintenance to address any other requirements identified during regular visual inspections.

The SCP and all erosion control measures will be monitored periodically and after each significant runoff-producing rainfall event.

The following monitoring activities will typically be performed for the SCP at the frequencies prescribed below:

- Daily record of the elevation of the pond in addition to continuous monitoring.
- Weekly visual inspection of sediment buildup within dead storage.
- Weekly visual inspection of the surface drainage ditches, outlet pipe, and spillway for erosion, blockage and/or damage to delineate any corrective maintenance requirements.

Silt fences, ditches, and culverts, will be visually inspected monthly for the following:

- Excess sediment build-up
- Structural/physical integrity
- Visible wear and tear

Every effort should be made to comply with the minimum target monitoring frequencies specified above. However, the schedule can be modified should circumstances temporarily preclude monitoring at the desired frequency.

11.0 CLOSURE

We trust this meets your needs at this time. Please contact the undersigned with any questions.

Yours truly,
Knight Piésold Ltd.

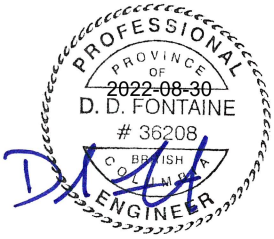
Prepared:

Jordan Priest, EIT
Junior Engineer

Reviewed:

2022-08-30

Carlos Penate, M.Eng., P.Eng.
Senior Engineer



Reviewed:

Daniel Fontaine, P.Eng.
Specialist Engineer | Associate

KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
1001011
EGBC PERMIT TO PRACTICE

Approval that this document adheres to the Knight Piésold Quality System: DDF

Attachments:

Appendix A Design Drawings
Appendix B Geotechnical Analyses Figures

References:

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Knight Piésold Ltd. (KP, 2013b). Blackwater Gold Project – 2013 Site Investigation Report, KP Ref. No. VA101-457/6-4 Rev. 0, dated November 7, 2013. Appendix 3-V4 of the Joint Mines Act/Environmental Management Act Permits Application.

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Knight Piésold Ltd. (KP, 2021c). Blackwater Gold Project – 2019 Site Investigation Report, KP Ref. No. VA101-457/31-1 Rev. 0, dated May 19, 2021. Appendix 3-D of the Joint Mines Act/Environmental Management Act Permits Application.

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Knight Piésold Ltd. (KP, 2021e). Blackwater Gold Project – Dam Site Characterization Report, KP Ref. No. VA101-457/33-10 Rev. 1, dated November 17, 2021. Appendix 3-L of the Joint Mines Act/Environmental Management Act Permits Application.

Knight Piésold Ltd. (KP, 2021f). Blackwater Gold Project – Numerical Groundwater Modelling Report, KP Ref. No. VA101-457/33-20 Rev. 1, dated November 24, 2021. Appendix 5-F of the Joint Mines Act/Environmental Management Act Permits Application.

Knight Piésold Ltd. (KP, 2022a). Blackwater Gold Project – Supplemental Stability Assessment Report, KP Ref. No. VA101-457/36-3 Rev. 1, dated April 13, 2022. Appendix 3-Z of the Joint Mines Act/Environmental Management Act Permits Application.

Knight Piésold Ltd. (KP, 2022b). Blackwater Gold Project – Updated Terrain Stability Mapping and Geohazard Assessment, File No.: VA101-457/37-A.01, KP Ref. No. VA22-00586, dated April 14, 2022. Appendix 3-X1 of the Joint Mines Act/Environmental Management Act Permits Application.

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Knight Piésold Ltd. (KP, 2022d). Issue Tracking Table ID 371 – Sediment Control Pond Designs – Information Requirement, File No.: VA101-457/37-A.01, KP Ref. No. VA22-01158, dated June 24, 2022.

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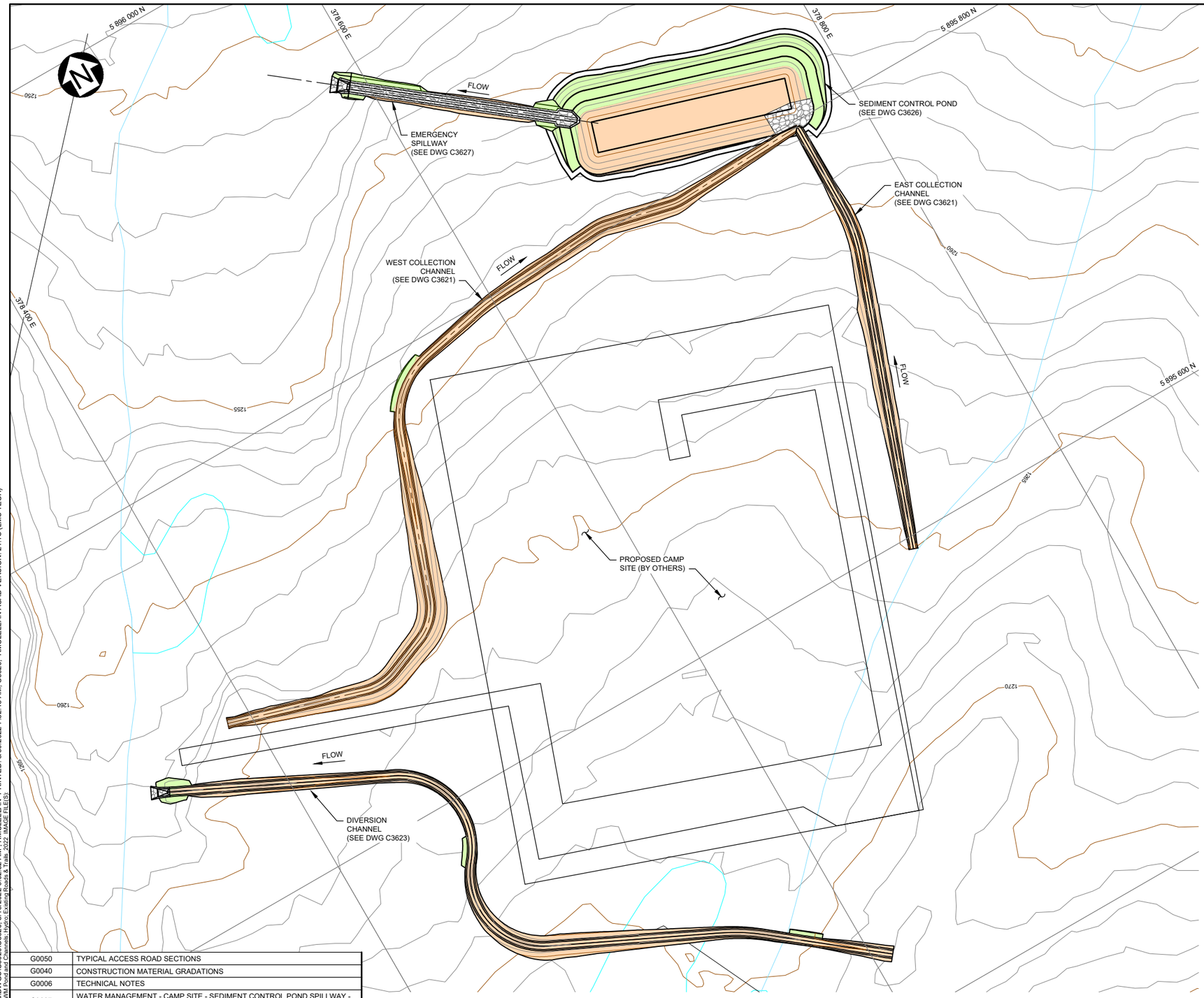
Copy To: Klaus Popelka, Ryan Todd, Nicole Bishop (ERM)

/jsp

APPENDIX A

Design Drawings

C3620 Rev 1
C3621 Rev 1
C3622 Rev 1
C3623 Rev 1
C3624 Rev 1
C3625 Rev 1
C3626 Rev 1
C3627 Rev 1



PLAN
SCALE A

KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
1001011
EGBC PERMIT TO PRACTICE

LEGEND:

- FILL AREAS
- CUT AREAS
- RIPRAP

NOTES:

1. FOR GENERAL NOTES SEE DWG G0006.
2. CHANNEL FILL AREAS TO COMPRISE OF ZONE G MATERIAL FROM LOCAL EXCAVATIONS OR EXTERNAL BORROW SOURCE, SEE DWG G0040 FOR FILL SPECIFICATIONS.
3. TYPICAL ACCESS ROAD DETAILS SHOWN ON DWG G0050.
4. ROAD CROSSING DETAILS TO BE DEFINED.

DETAILED DESIGN
NOT FOR CONSTRUCTION

20 10 0 20 40 60 80 100 m
SCALE A

DRG. NO.	DESCRIPTION
G0050	TYPICAL ACCESS ROAD SECTIONS
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES
C3627	WATER MANAGEMENT - CAMP SITE - SEDIMENT CONTROL POND SPILLWAY - SECTIONS AND DETAIL
C3626	WATER MANAGEMENT - CAMP SITE - SEDIMENT CONTROL POND - PLAN AND SECTIONS
C3623	WATER MANAGEMENT - CAMP SITE - DIVERSION CHANNEL - PLAN, PROFILE AND SECTIONS
C3621	WATER MANAGEMENT - CAMP SITE - COLLECTION CHANNELS - PLAN, PROFILES AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	30AUG'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF
0	21JUL'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF

REVISIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PEÑATE ROJAS
15299
2022-08-30

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
CAMP SITE
GENERAL ARRANGEMENT

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3620	1

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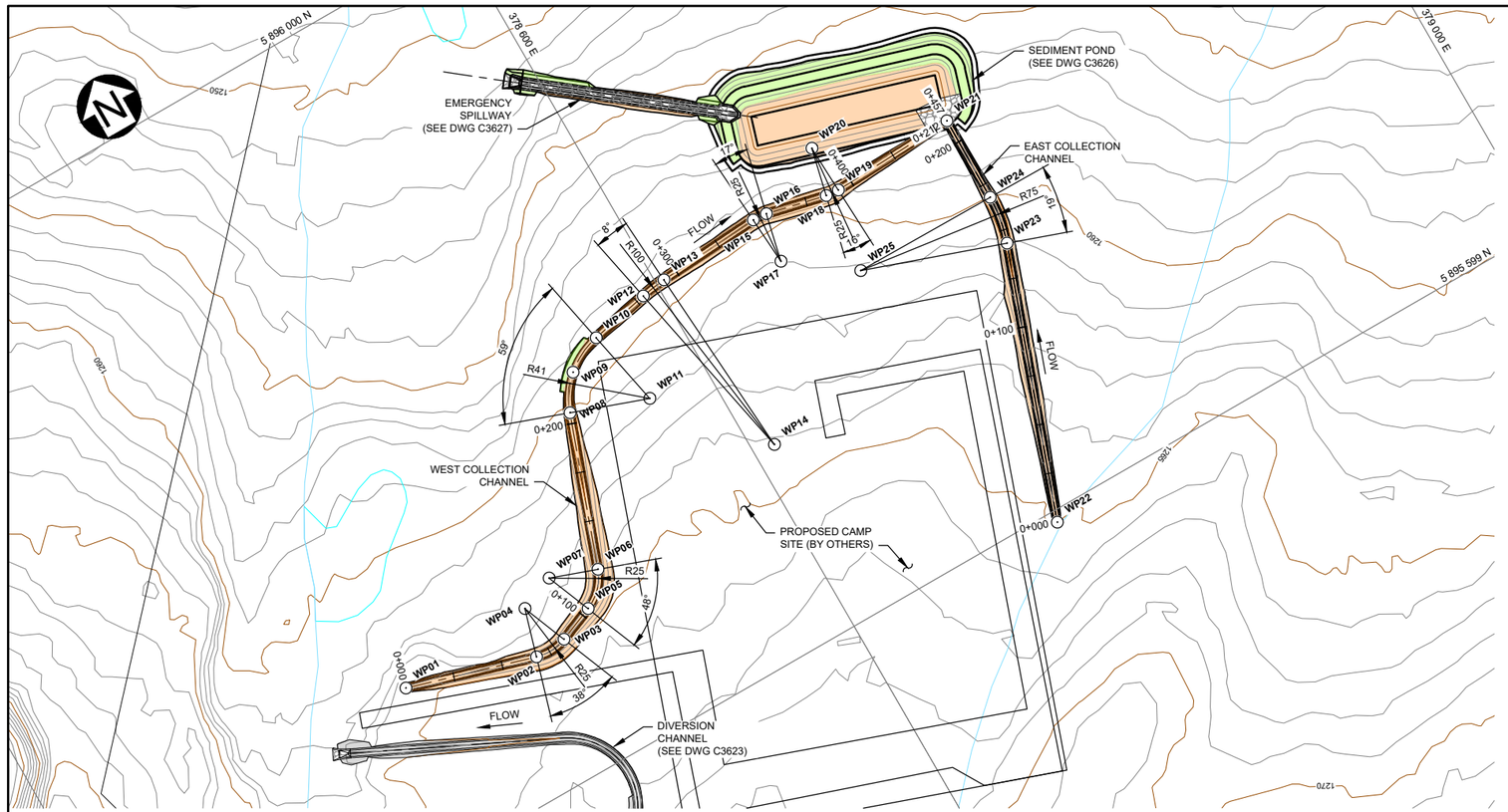

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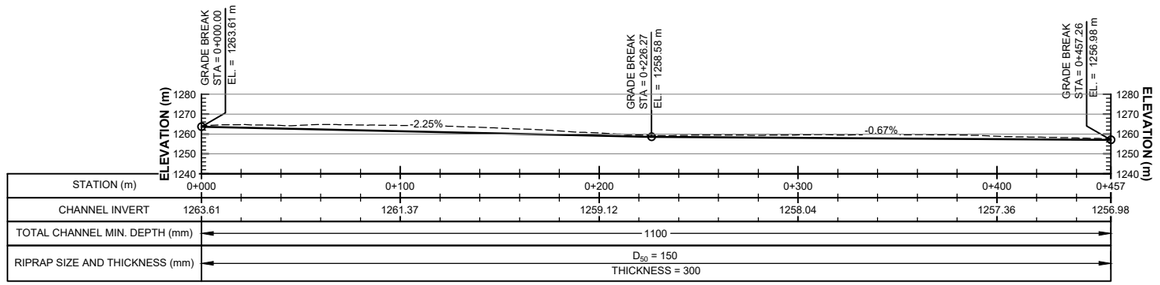

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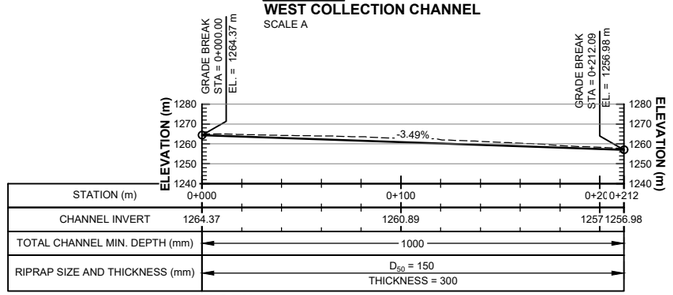

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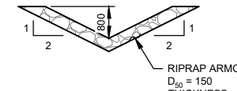

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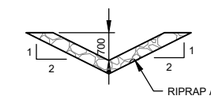

TYPICAL SECTION
EAST COLLECTION CHANNEL
0+000 TO 0+212
SCALE B

WEST COLLECTION CHANNEL WORK POINTS

POINT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)	STATION (m)
WP01	378388.5	5895686.0	1263.6	0+000.0
WP02	378453.5	5895666.7	1262.1	0+067.8
WP03	378469.9	5895667.4	1261.7	0+084.6
WP04	378460.6	5895690.6	N/A	N/A
WP05	378488.2	5895674.8	1261.3	0+104.3
WP06	378502.4	5895689.5	1260.8	0+125.3
WP07	378478.9	5895698.0	N/A	N/A
WP08	378529.7	5895764.9	1258.5	0+205.5
WP09	378541.2	5895781.8	1258.5	0+226.3
WP10	378560.0	5895791.1	1258.4	0+247.4
WP11	378568.1	5895751.0	N/A	N/A
WP12	378591.1	5895797.4	1258.2	0+279.2
WP13	378604.2	5895799.2	1258.1	0+292.4
WP14	378611.0	5895699.4	N/A	N/A
WP15	378658.3	5895802.9	1257.7	0+346.7
WP16	378665.7	5895802.3	1257.7	0+354.0
WP17	378660.0	5895777.9	N/A	N/A
WP18	378696.4	5895795.1	1257.5	0+385.6
WP19	378703.1	5895794.5	1257.4	0+392.4
WP20	378702.1	5895819.5	N/A	N/A
WP21	378767.9	5895797.3	1257.0	0+457.2

EAST COLLECTION CHANNEL WORK POINTS

POINT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)	STATION (m)
WP22	378715.0	5895594.2	1264.4	0+000.0
WP23	378763.3	5895728.7	1259.4	0+143.0
WP24	378767.6	5895753.0	1258.5	0+167.8
WP25	378692.6	5895753.7	N/A	N/A
WP21	378767.9	5895797.3	1257.0	0+212.1

LEGEND:

- FILL AREAS
- CUT AREAS
- RIPRAP

NOTES:

1. FOR GENERAL NOTES SEE DWG G0006.
2. CHANNEL FILL AREAS TO COMPRISE OF ZONE G MATERIAL FROM LOCAL EXCAVATIONS OR EXTERNAL BORROW SOURCE, SEE DWG G0040 FOR FILL SPECIFICATIONS.
3. TYPICAL ACCESS ROAD DETAILS SHOWN ON DWG G0050.
4. ROAD CROSSING DETAILS TO BE DEFINED.

DETAILED DESIGN
NOT FOR CONSTRUCTION

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G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES
C3627	WATER MANAGEMENT - CAMP SITE - SEDIMENT CONTROL POND SPILLWAY - SECTIONS AND DETAILS
C3626	WATER MANAGEMENT - CAMP SITE - SEDIMENT CONTROL POND - PLAN AND SECTIONS
C3623	WATER MANAGEMENT - CAMP SITE - DIVERSION CHANNEL - PLAN, PROFILE AND SECTIONS

REFERENCE DRAWINGS

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1	30AUG'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF
0	21JUL'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF

REVISIONS

KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
35299
2022-08-30

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
CAMP SITE
COLLECTION CHANNELS
PLAN, PROFILES, AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
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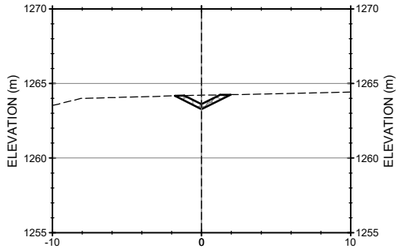

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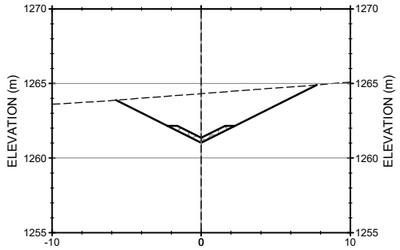

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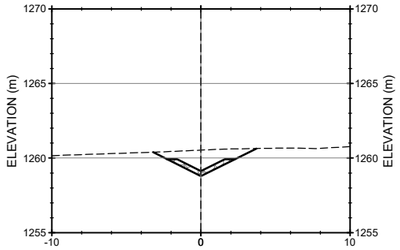

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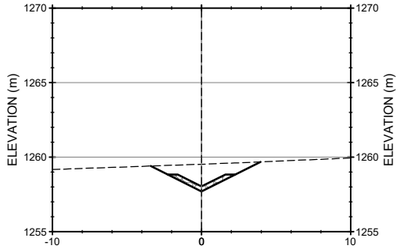

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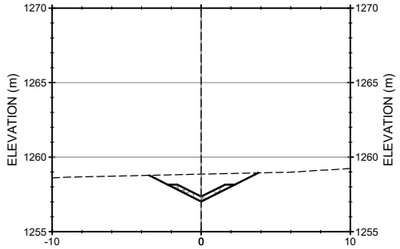

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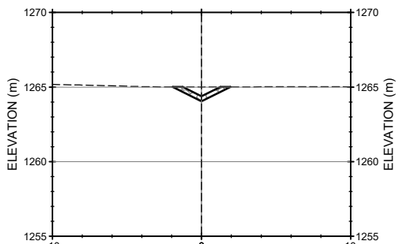

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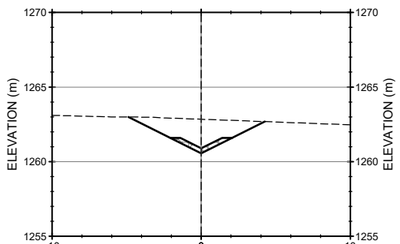

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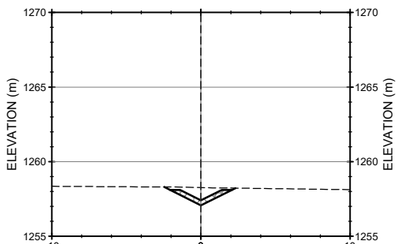

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CROSS SECTIONS
EAST COLLECTION CHANNEL
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KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
1001011
EGBC PERMIT TO PRACTICE

LEGEND:

RIPRAP

NOTES:

1. FOR GENERAL NOTES SEE DWG G0006.
2. CHANNEL FILL AREAS TO COMPRISE OF ZONE G MATERIAL FROM LOCAL EXCAVATIONS OR EXTERNAL BORROW SOURCE, SEE DWG G0040 FOR FILL SPECIFICATIONS.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE A 4 2 0 4 8 12 16 20 m

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
35299
2022-08-30

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
CAMP SITE
COLLECTION CHANNELS
SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3622	1

DRG. NO.	DESCRIPTION
G0050	TYPICAL ACCESS ROAD SECTIONS
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES
C3621	WATER MANAGEMENT - CAMP SITE - COLLECTION CHANNELS - PLAN, PROFILES, AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	30AUG'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF
0	21JUL'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF

REVISIONS

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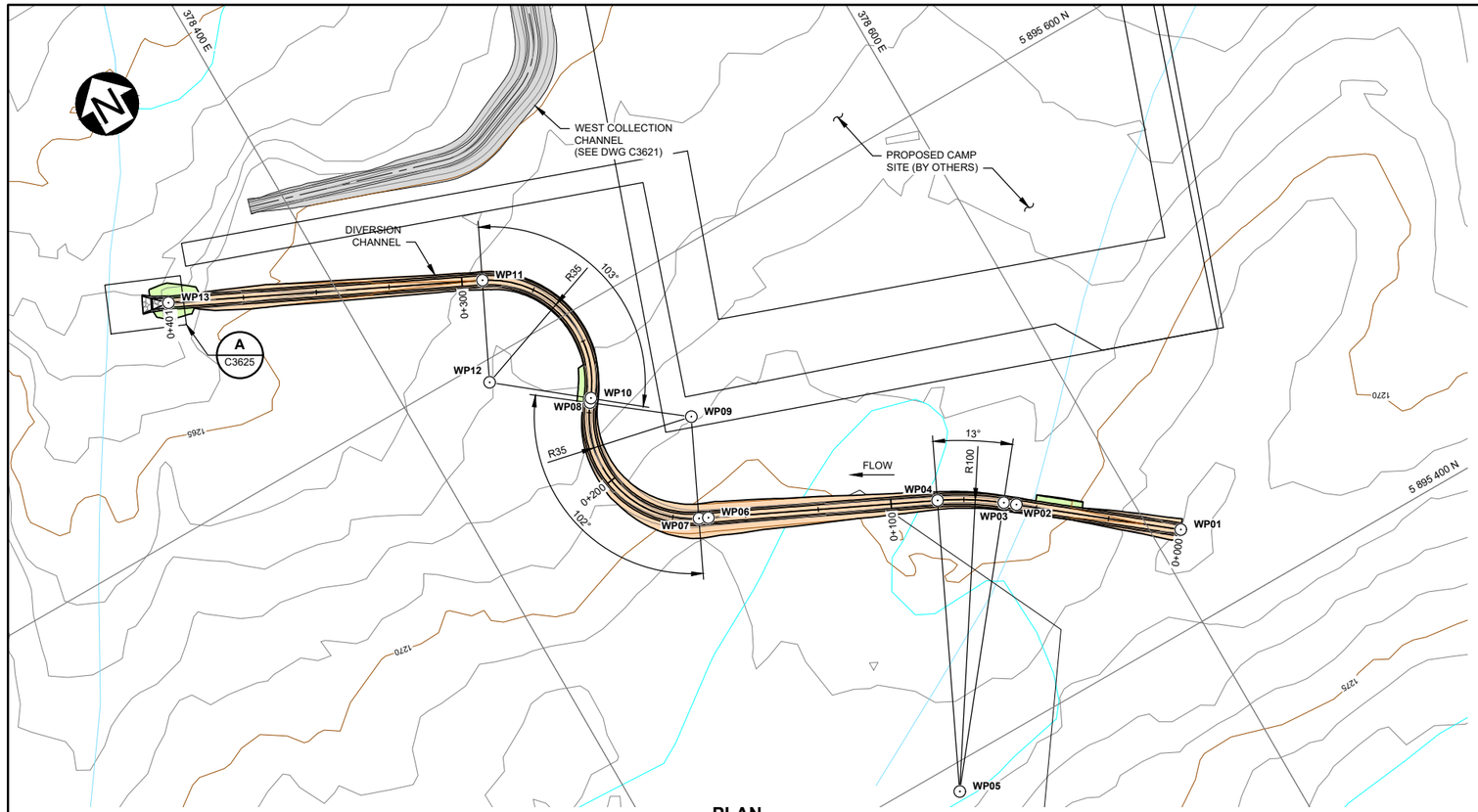

PLAN
SCALE A

DIVERSION CHANNEL WORK POINTS				
POINT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)	STATION (m)
WP01	378609.3	5895430.8	1270.4	0+000.0
WP02	378564.8	5895466.4	1268.6	0+057.0
WP03	378561.4	5895469.1	1268.6	0+061.4
WP04	378542.2	5895481.2	1268.5	0+084.1
WP05	378498.9	5895391.0	N/A	N/A
WP06	378471.2	5895515.2	1268.0	0+162.8
WP07	378468.3	5895516.6	1267.9	0+166.0
WP08	378455.8	5895569.7	1266.5	0+228.4
WP09	378483.4	5895548.2	N/A	N/A
WP10	378456.9	5895570.8	1266.5	0+230.0
WP11	378444.9	5895624.4	1265.1	0+293.0
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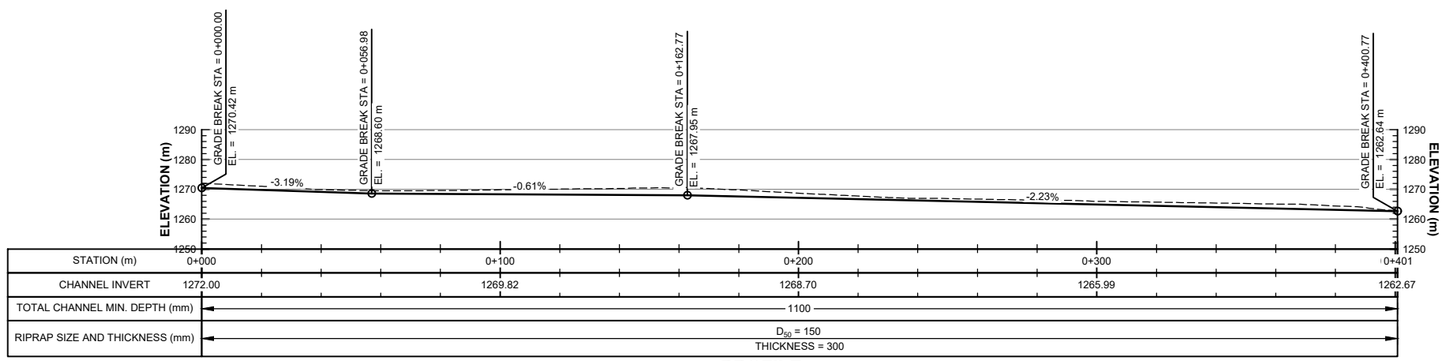

PROFILE
DIVERSION CHANNEL
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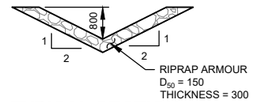

TYPICAL SECTION
DIVERSION CHANNEL
0+000 TO 0+401
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KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
1001011
EGBC PERMIT TO PRACTICE

LEGEND:
- FILL AREAS
- CUT AREAS
- RIPRAP

NOTES:
1. FOR GENERAL NOTES SEE DWG G0006.
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3. TYPICAL ACCESS ROAD DETAILS SHOWN ON DWG G0050.
4. ROAD CROSSING DETAILS TO BE DEFINED.

DETAILED DESIGN
NOT FOR CONSTRUCTION

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SCALE A 20 10 0 20 40 60 80 100 m

DRG. NO.	DESCRIPTION
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES
C3625	WATER MANAGEMENT - CAMP SITE - DIVERSION CHANNEL - STILLING BASIN - DETAILS AND SECTIONS
C3621	WATER MANAGEMENT - CAMP SITE - COLLECTION CHANNELS - PLAN, PROFILES AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	30AUG'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF
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REVISIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. RENATE ROJAS
#35299
2022-08-30

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
CAMP SITE
DIVERSION CHANNEL
PLAN, PROFILES, AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3623	1

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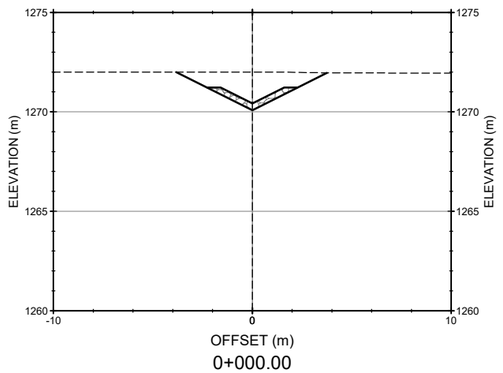

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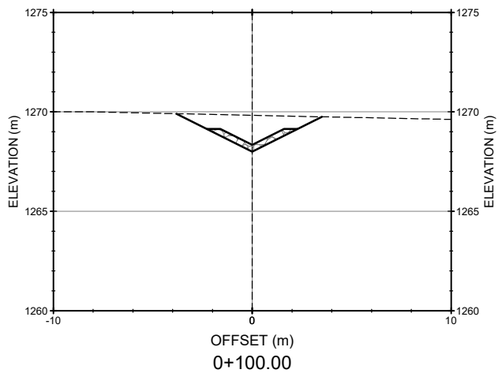

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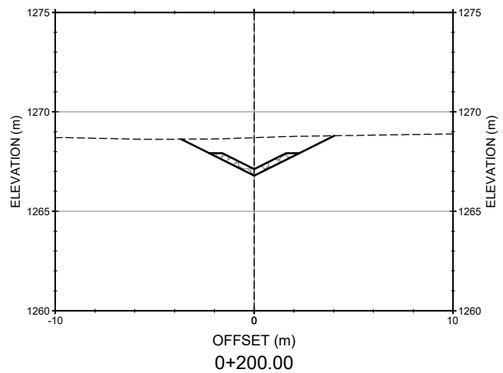

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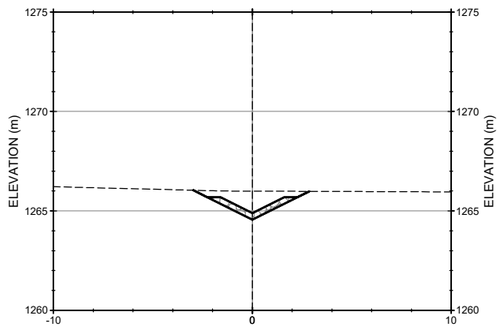

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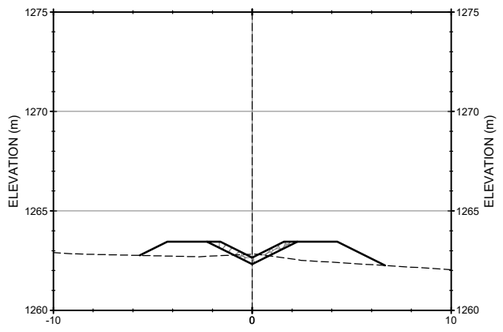

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CROSS SECTIONS
DIVERSION CHANNEL
SCALE A

LEGEND:

RIPRAP

NOTES:

1. FOR GENERAL NOTES SEE DWG G0006.
2. CHANNEL FILL AREAS TO COMPRISE OF ZONE G MATERIAL FROM LOCAL EXCAVATIONS OR EXTERNAL BORROW SOURCE, SEE DWG G0040 FOR FILL SPECIFICATIONS.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE A 3 1.5 0 5 10 15 m

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EGBC PERMIT TO PRACTICE

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
15299
ENGINEER
2022-08-30

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT CAMP SITE DIVERSION CHANNEL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3624	1

DRG. NO.	DESCRIPTION
G0050	TYPICAL ACCESS ROAD SECTIONS
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES
C3623	WATER MANAGEMENT - CAMP SITE - DIVERSION CHANNEL - PLAN, PROFILE, AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	30AUG'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF
0	21JUL'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF

REVISIONS

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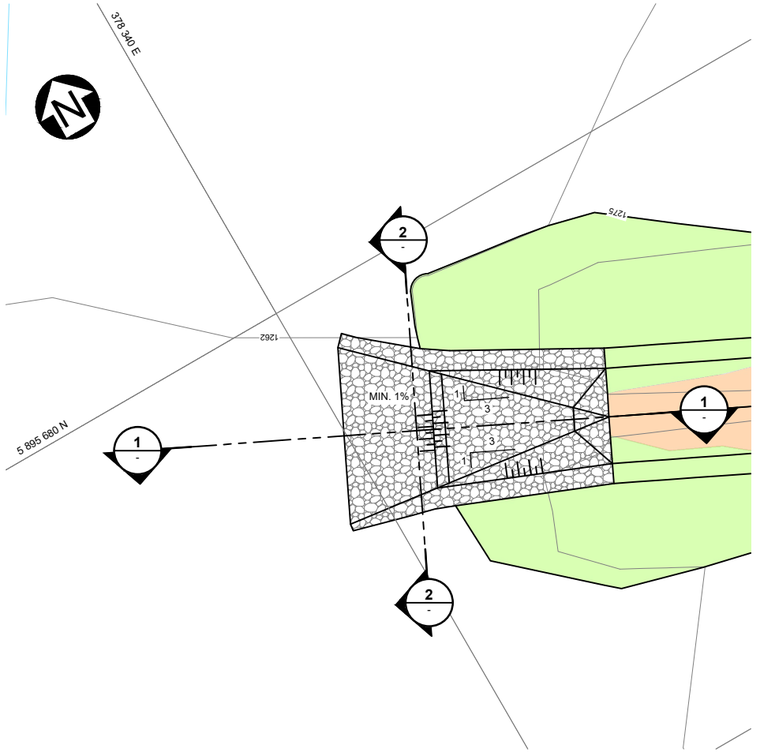
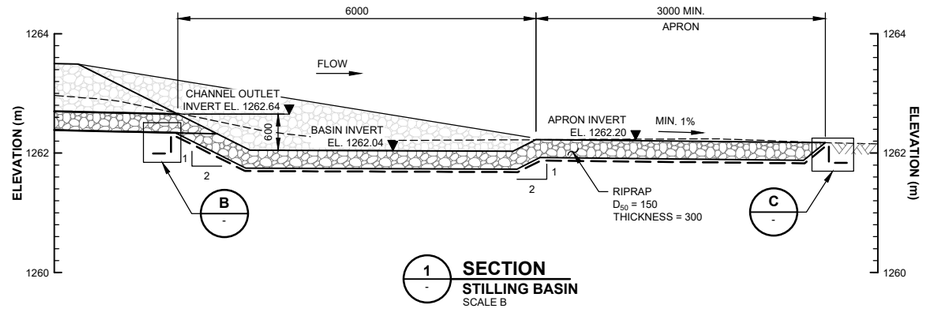
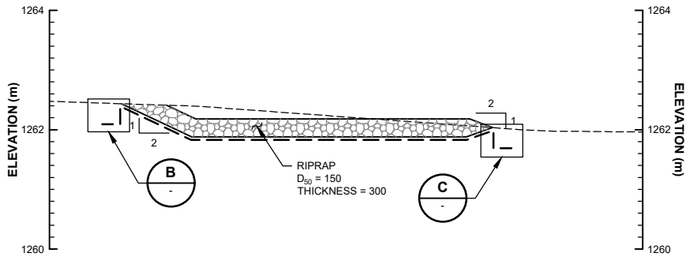


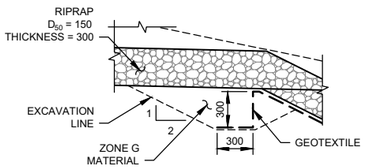
A C3623 **DETAIL**
STILLING BASIN
SCALE A



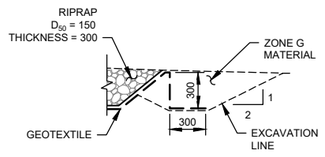
1 - **SECTION**
STILLING BASIN
SCALE B



2 - **SECTION**
STILLING BASIN APRON
SCALE B



B - **DETAIL**
GEOTEXTILE ANCHOR
SCALE C



C - **DETAIL**
GEOTEXTILE ANCHOR
SCALE C

LEGEND:

- FILL AREAS
- CUT AREAS
- RIPRAP
- GENERAL FILL / ZONE G
- GEOTEXTILE

NOTES:

1. FOR GENERAL NOTES SEE DWG G0006.
2. CHANNEL FILL AREAS TO COMPRISE OF ZONE G MATERIAL FROM LOCAL EXCAVATIONS OR EXTERNAL BORROW SOURCE, SEE DWG G0040 FOR FILL SPECIFICATIONS.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE C 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE B 1 0.5 0 1 2 3 4 5 m
SCALE A 2 1 0 2 4 6 8 10 m

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
15299
2022-08-30

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BLACKWATER GOLD PROJECT

WATER MANAGEMENT
CAMP SITE
DIVERSION CHANNEL
STILLING BASIN
DETAILS AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3625	1

DRG. NO.	DESCRIPTION
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES
C3623	WATER MANAGEMENT - CAMP SITE - DIVERSION CHANNEL - PLAN, PROFILE AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

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1	30AUG'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF
0	21JUL'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF

REVISIONS

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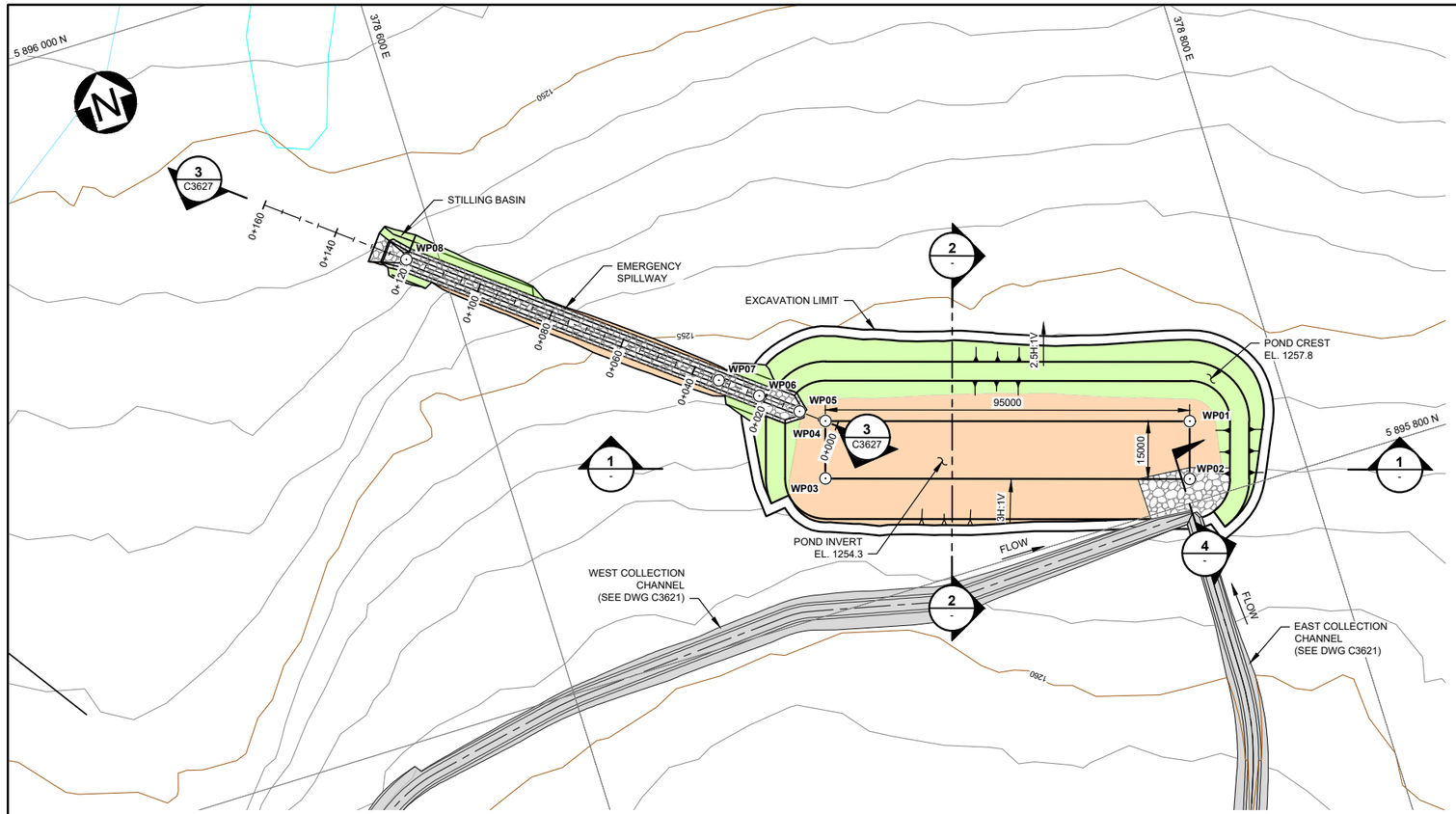
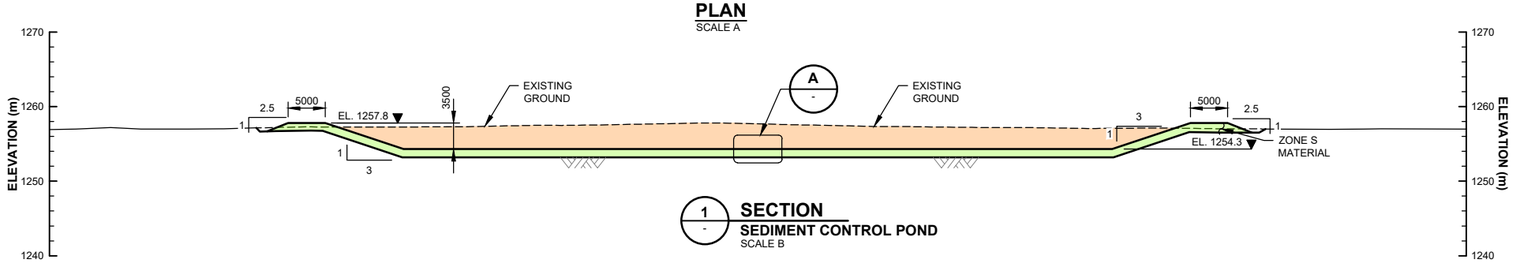
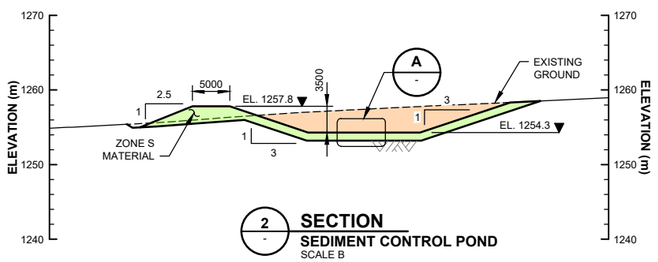


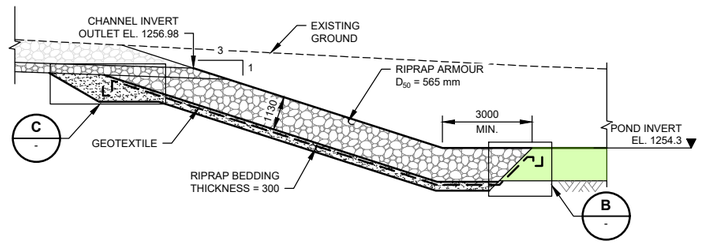
PLAN
SCALE A



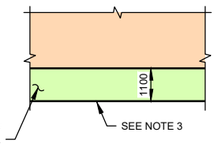
1 SECTION
SEDIMENT CONTROL POND
SCALE B



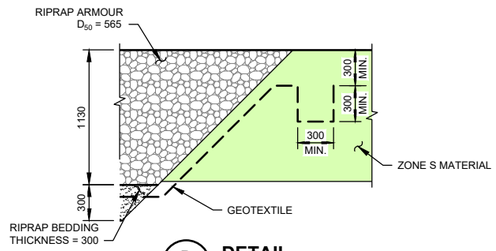
2 SECTION
SEDIMENT CONTROL POND
SCALE B



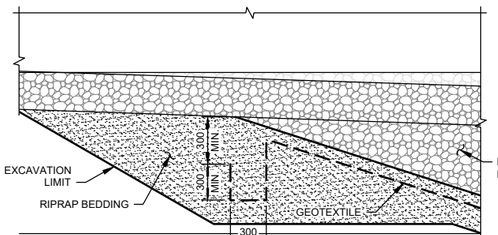
4 SECTION
SEDIMENT CONTROL POND
EROSION INLET PROTECTION
SCALE C



A DETAIL
SCALE C



B DETAIL
ANCHOR TRENCH
SCALE C



C DETAIL
ANCHOR TRENCH
SCALE C

SEDIMENT CONTROL POND WORK POINTS			
POINT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)
WP01	378774.4	5895820.4	1254.3
WP02	378769.9	5895806.1	1254.3
WP03	378679.2	5895834.3	1254.3
WP04	378683.6	5895848.6	1254.3

SPILLWAY WORK POINTS				
POINT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)	STATION (m)
WP05	378677.9	5895853.0	1256.7	0+010.3
WP06	378669.1	5895860.0	1256.7	0+021.7
WP07	378660.2	5895867.0	1254.7	0+033.0
WP08	378591.6	5895921.1	1251.5	0+120.4

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LEGEND:
- FILL AREAS
- CUT AREAS
- RIPRAP
- RIPRAP BEDDING (ZONE RB)
- GEOTEXTILE

NOTES:
1. FOR GENERAL NOTES SEE DWG G0006.
2. FILL MATERIAL SPECIFICATIONS ARE SHOWN ON DWG G0040.
3. SUBGRADE TO BE INSPECTED AND APPROVED BY THE FIELD ENGINEER PRIOR TO FILL PLACEMENT.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE D: 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE C: 2 1 0 2 4 6 8 10 m
SCALE B: 8 4 0 10 20 30 40 m
SCALE A: 10 5 0 10 20 30 40 50 m

DRG. NO.	DESCRIPTION
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES
C3627	WATER MANAGEMENT - CAMP SITE - SEDIMENT CONTROL POND SPILLWAY - SECTIONS
C3621	WATER MANAGEMENT - CAMP SITE - COLLECTION CHANNELS - PLAN, PROFILES, AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	30AUG'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF
0	21JUL'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF

REVISIONS

ACCEPTED
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS OF BRITISH COLUMBIA
C.A. PEÑATE ROJAS
#45299
PROVINCE OF BRITISH COLUMBIA
ENGINEER
2022-08-30

Knight Piésold CONSULTING

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BLACKWATER GOLD PROJECT

WATER MANAGEMENT
CAMP SITE
SEDIMENT CONTROL POND
PLAN AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3626	1

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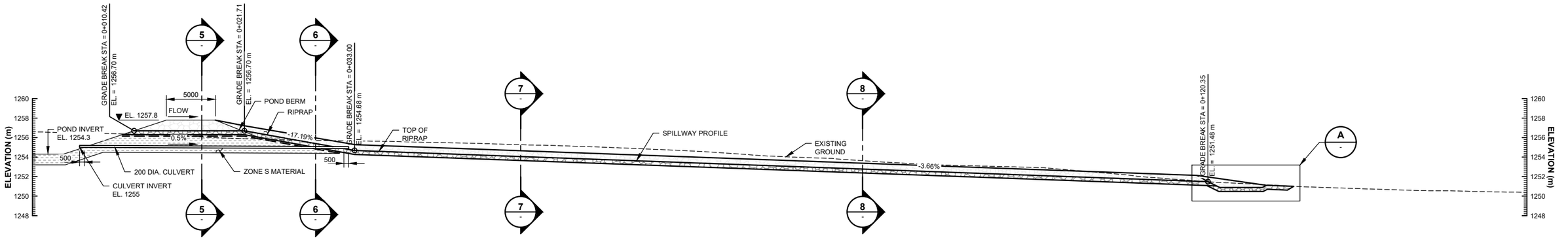
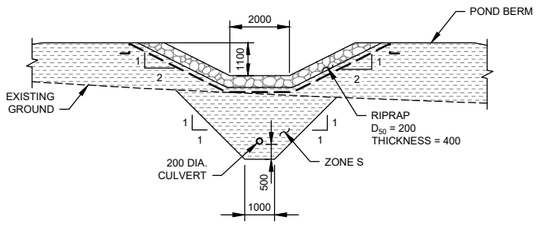
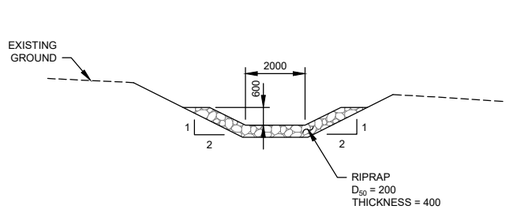


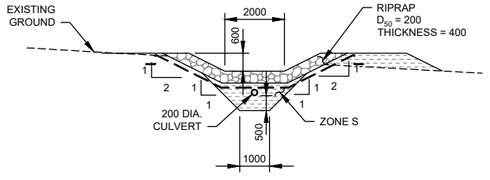
3 C3626 **SECTION**
SEDIMENT POND SPILLWAY
SCALE A



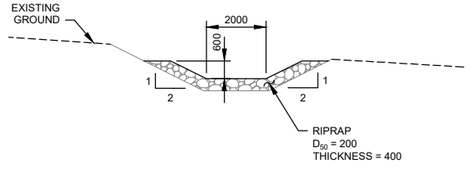
5 - **SECTION**
POND SPILLWAY
SCALE B



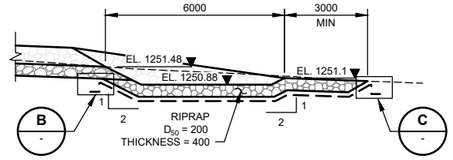
7 - **SECTION**
POND SPILLWAY
SCALE B



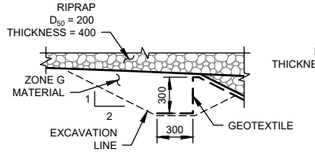
6 - **SECTION**
POND SPILLWAY
SCALE B



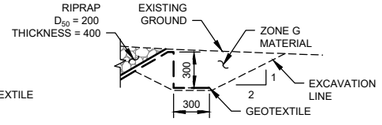
8 - **SECTION**
POND SPILLWAY
SCALE B



A - **DETAIL**
STILLING BASIN
SCALE B



B - **DETAIL**
GEOTEXTILE ANCHOR
SCALE C



C - **DETAIL**
GEOTEXTILE ANCHOR
SCALE C

LEGEND:

- GLACIAL TILL / ZONE S (SEAL ZONE)
- RIPRAP
- GENERAL FILL / ZONE G
- NON-WOVEN GEOTEXTILE

NOTES:

1. FOR GENERAL NOTES SEE DWG G0006.
2. CHANNEL FILL AREAS TO COMPRISE ZONE G MATERIAL FROM LOCAL EXCAVATIONS OR EXTERNAL BORROW SOURCE, SEE DWG G0040 FOR FILL SPECIFICATIONS.
3. FIELD ENGINEER TO DETERMINE APPROPRIATE TRANSITION FROM SPILLWAY TO RECEIVING ENVIRONMENT.
4. EXCAVATE ORGANICS AND UNSUITABLE MATERIAL TO ENGINEER APPROVED SUBGRADE.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE C: 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE B: 1 0.5 0 1 2 3 4 5 m
SCALE A: 2 1 0 2 4 6 8 10 m

KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
35299
2022-08-30

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
CAMP SITE
SEDIMENT CONTROL POND SPILLWAY
SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3627	1

DRG. NO.	DESCRIPTION
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES
C3626	WATER MANAGEMENT - CAMP - SEDIMENT CONTROL POND - PLAN AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
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0	21JUL'22	ISSUED FOR PERMITTING	JSP	RMM	CAP	DDF

REVISIONS

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XREF FILE(S): IMAGE FILE(S):

APPENDIX B

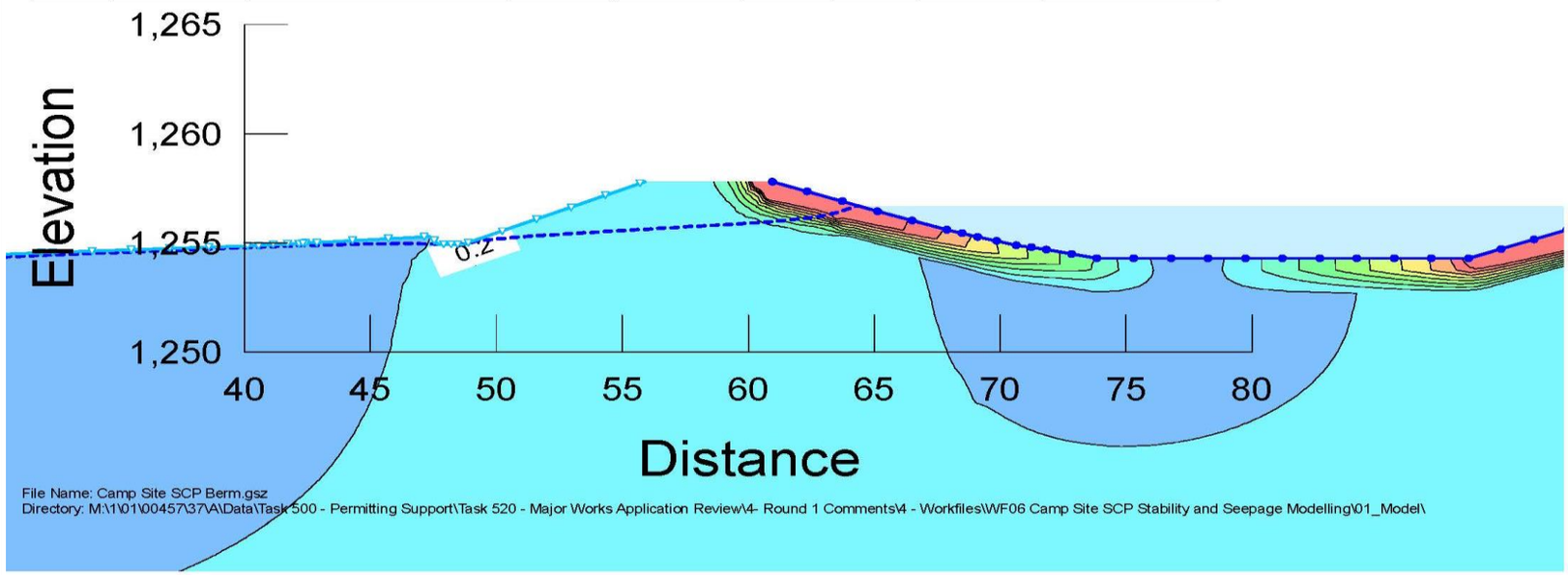
Geotechnical Analyses Figures

(Figures B1.1 to B1.5)

Name: Camp Site SCP Seepage
Kind: SEEP/W
Analysis Type: Steady-State

Color	Name	Category	Kind	Parameters
	Downstream (1,252.80 masl)	Hydraulic	Water Total Head	1,252.8 m
	Pond (1256.7 masl)	Hydraulic	Water Total Head	1,256.7 m
	Potential Seepage Face	Hydraulic	Water Flux	0 m/sec
	Upstream (1,261.05 masl)	Hydraulic	Water Total Head	1,261.05 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky'/Kx' Ratio	Volumetric Water Content	Compressibility (/kPa)
	Glacial (Ablation) Till	Saturated Only			2e-07	0.4	0.08	5e-05
	Zone S	Saturated / Unsaturated	Zone S	Zone S		1		



NOTES:

1. RESULTANT PHREATIC SURFACE SHOWN AS DASHED BLUE LINE. RESULTANT XY-GRADIENT AT DOWNSTREAM TOE LABELLED. MAXIMUM ALLOWABLE XY-GRADIENT AT TOE ~0.30 (FELL ET AL. 2005).
2. SEEPAGE ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021).
3. DOWNSTREAM BOUNDARY CONDITION OUTSIDE EXTENTS OF PRESENTED FIGURE.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	30AUG'22	ISSUED WITH LETTER	JSP	DDF

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BLACKWATER GOLD PROJECT

**CAMP SITE SCP SEEPAGE ANALYSIS
MAXIMUM OPERATING WL 1256.7 masl
(SEEP/W PREDICTED PHREATIC SURFACE)**

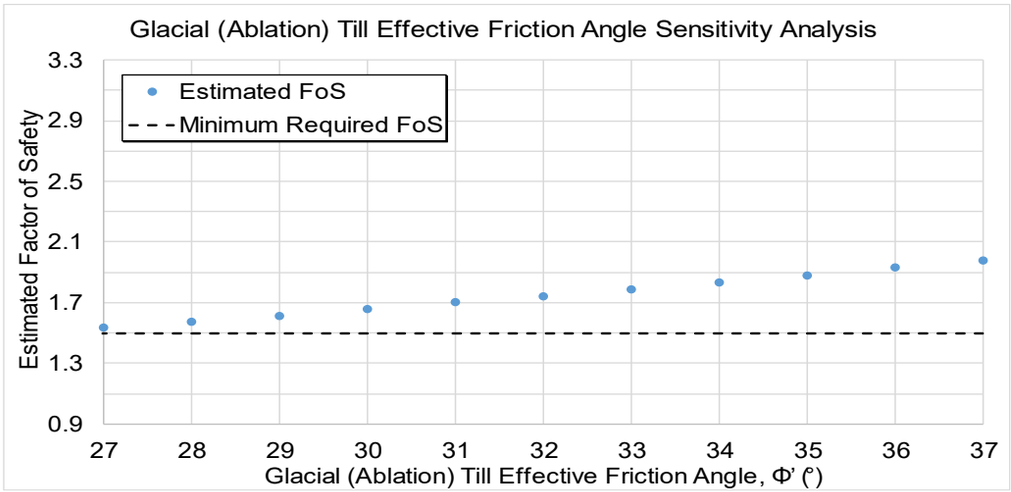
Knight Piésold CONSULTING

P/A NO. VA101-457/37

REF. NO. VA22-01471

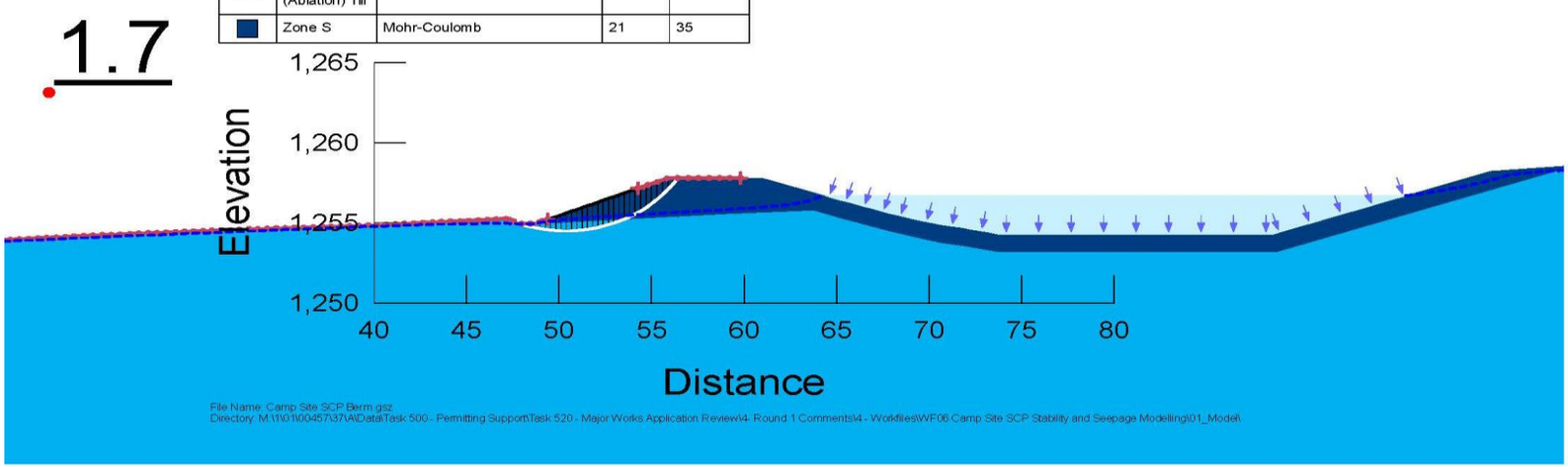
FIGURE B1.1

REV 1



Name: 1. Static
Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Slip Surface Option: Entry and Exit
Optimize Critical Slip Surface Location: No
Horz Seismic Coef.:
PWP Conditions from Parent Analysis: Camp Site SCP Seepage [(last)]

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Friction Angle (°)
	Glacial (Ablation) Till	Mohr-Coulomb	23	32
	Zone S	Mohr-Coulomb	21	35



NOTES:

1. CRITICAL SLIP SURFACE IS DISPLAYED. THE MINIMUM FACTOR OF SAFETY IS 1.5 (CDA, 2019).
2. STABILITY ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	30AUG'22	ISSUED WITH LETTER	JSP	DDF

BW GOLD LTD.

BLACKWATER GOLD PROJECT

CAMP SITE SCP
LONG TERM STATIC STABILITY ANALYSIS
(SEEP/W PREDICTED PHREATIC SURFACE)

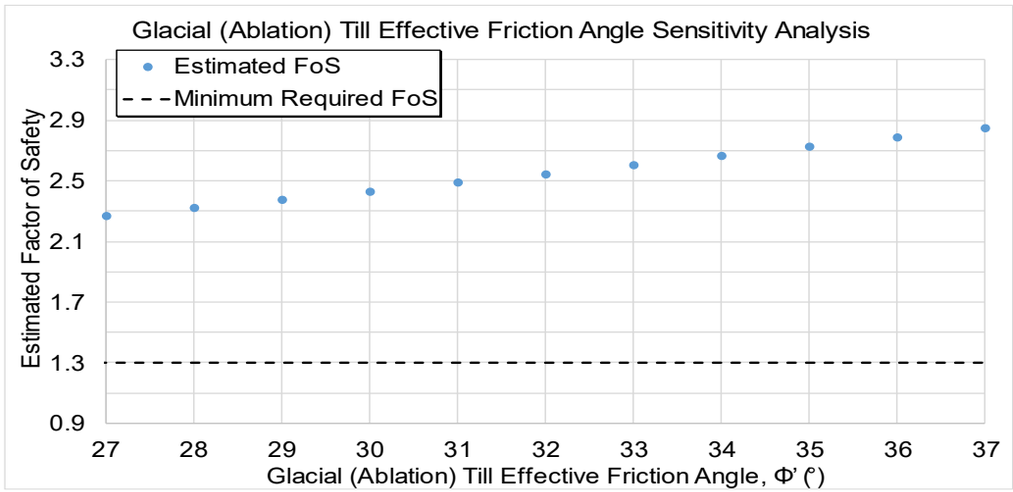
Knight Piésold CONSULTING

P/A NO. VA101-457/37

REF. NO. VA22-01471

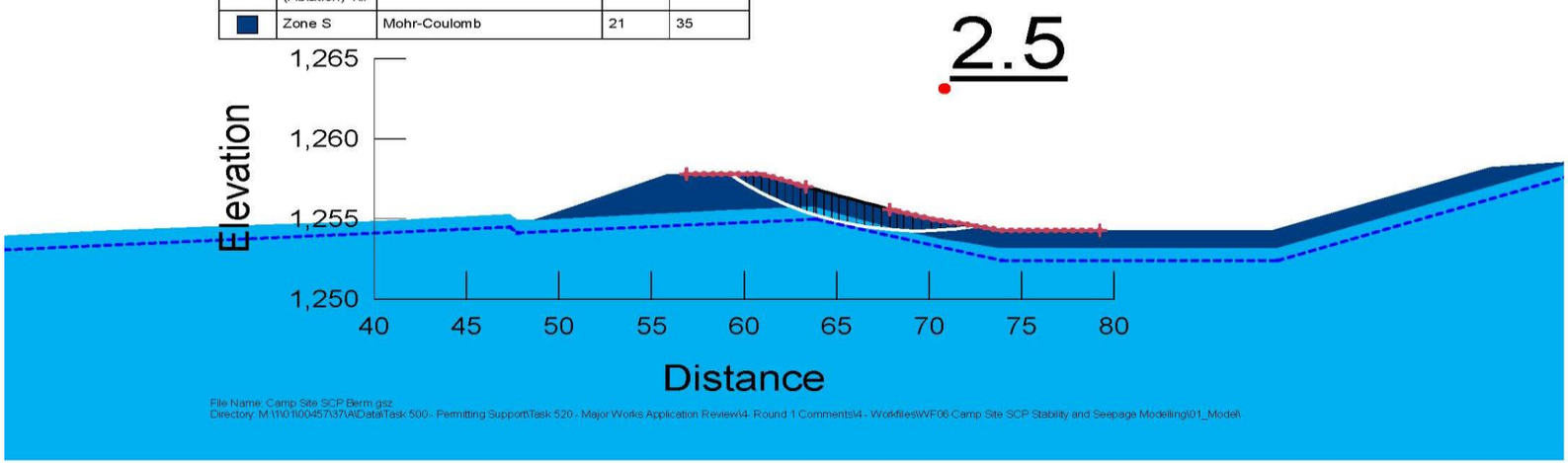
FIGURE B1.2

REV 1



Name: North Post-Construction
Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Slip Surface Option: Entry and Exit
Optimize Critical Slip Surface Location: No
Horz Seismic Coef.:
PWP Conditions from: Piezometric Line

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Friction Angle (°)
	Glacial (Ablation) Till	Mohr-Coulomb	23	32
	Zone S	Mohr-Coulomb	21	35



NOTES:

1. CRITICAL SLIP SURFACE IS DISPLAYED. THE MINIMUM FACTOR OF SAFETY IS 1.3 (CDA, 2019).
2. STABILITY ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	30AUG'22	ISSUED WITH LETTER	JSP	DDF

BW GOLD LTD.

BLACKWATER GOLD PROJECT

CAMP SITE SCP
POST-CONSTRUCTION STABILITY ANALYSIS
(MANUAL PREDICTED PHREATIC SURFACE)

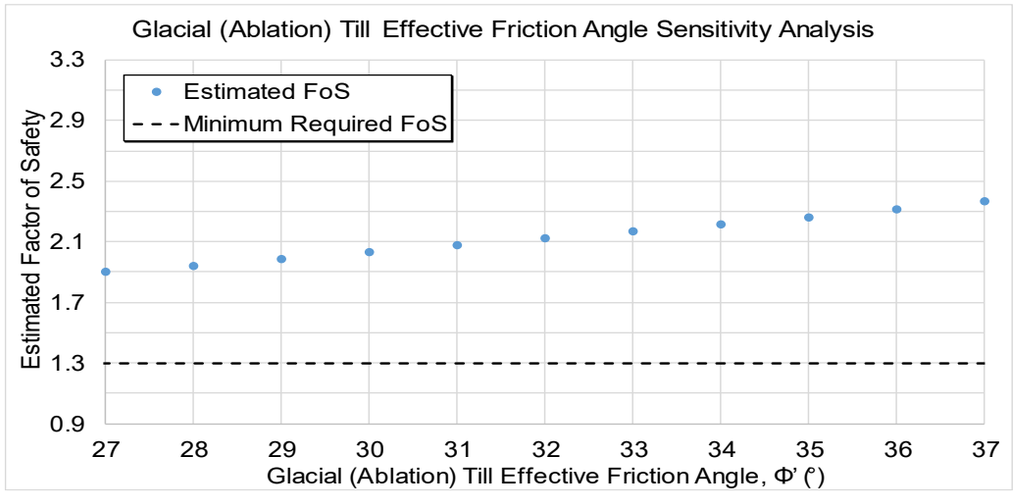
Knight Piésold CONSULTING

P/A NO. VA101-457/37

REF. NO. VA22-01471

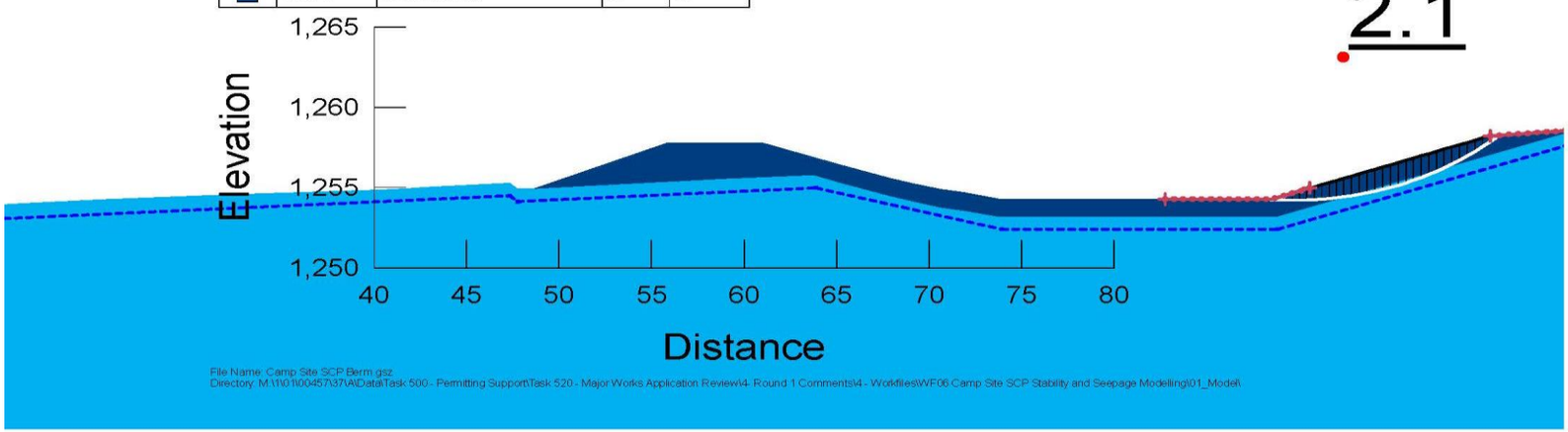
FIGURE B1.3

REV 1



Name: South Post-Construction
Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Slip Surface Option: Entry and Exit
Optimize Critical Slip Surface Location: No
Horz Seismic Coef.:
PWP Conditions from: Piezometric Line

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Friction Angle (°)
	Glacial (Ablation) Till	Mohr-Coulomb	23	32
	Zone S	Mohr-Coulomb	21	35



NOTES:

1. CRITICAL SLIP SURFACE IS DISPLAYED. THE MINIMUM FACTOR OF SAFETY IS 1.3 (CDA, 2019).
2. STABILITY ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	30AUG'22	ISSUED WITH LETTER	JSP	DDF

BW GOLD LTD.

BLACKWATER GOLD PROJECT

CAMP SITE SCP - CUT-SLOPE
POST-CONSTRUCTION STABILITY ANALYSIS
(MANUAL PREDICTED PHREATIC SURFACE)

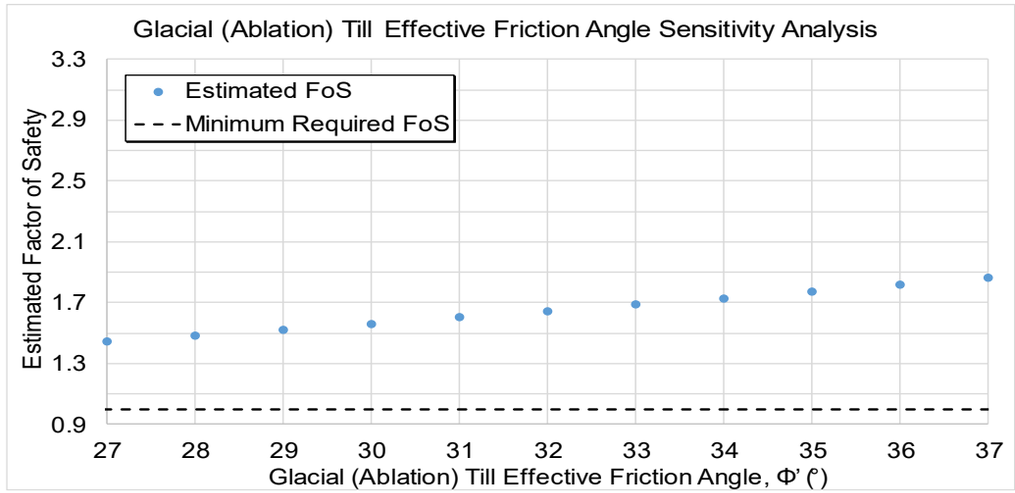
Knight Piésold CONSULTING

P/A NO. VA101-457/37

REF. NO. VA22-01471

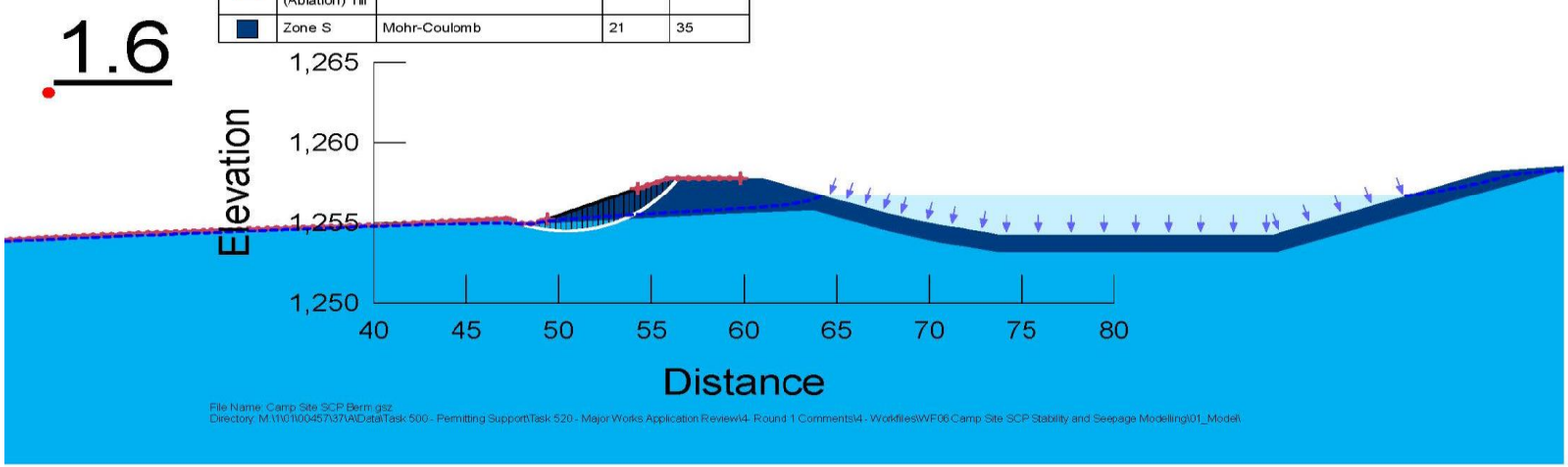
FIGURE B1.4

REV 1



Name: 2. PGA=0.021
Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Slip Surface Option: Entry and Exit
Optimize Critical Slip Surface Location: No
Horz Seismic Coef.: 0.021
PWP Conditions from Parent Analysis: Camp Site SCP Seepage [(last)]

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Friction Angle (°)
	Glacial (Ablation) Till	Mohr-Coulomb	23	32
	Zone S	Mohr-Coulomb	21	35



NOTES:

1. CRITICAL SLIP SURFACE IS DISPLAYED. THE MINIMUM FACTOR OF SAFETY IS 1.0 (CDA, 2019).
2. STABILITY ANALYSIS COMPLETED WITH GEOSTUDIO 2021 R4 (GEO-SLOPE, 2021).
3. HORIZONTAL SEISMIC COEFFICIENT OF 0.021g APPLIED.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	30AUG'22	ISSUED WITH LETTER	JSP	DDF

BW GOLD LTD.

BLACKWATER GOLD PROJECT

CAMP SITE SCP
PSEUDO-STATIC STABILITY ANALYSIS
(SEEP/W PREDICTED PHREATIC SURFACE)

Knight Piésold CONSULTING

P/A NO. VA101-457/37

REF. NO. VA22-01471

FIGURE B1.5

REV 1

Appendix E Plant Site SCP Design

Prepared for
BW Gold Ltd.
3083-595 Burrard Street
Vancouver, BC
Canada, V7X 1L3

Prepared by
Knight Piésold Ltd.
Suite 1400 - 750 West Pender Street
Vancouver, British Columbia
Canada, V6C 2T8

VA101-457/33-11

BLACKWATER GOLD PROJECT
EARLY WORKS EROSION AND SEDIMENT CONTROL PLAN

Rev	Description	Date
0	Issued in Final	February 4, 2021
1	Issued with Updates	December 1, 2021
2	Issued with Updated Design Information	March 25, 2022

Knight Piésold CONSULTING

Management System Certified by:
bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

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ABBREVIATIONS

Artemis	Artemis Gold Inc.
Blackwater Gold Project	the Project
BMP	best management practice
BW Gold	Blackwater Gold Ltd.
CEMP	Construction Environmental Management Plan
CD	collection ditch
DD	diversion ditch
EA	Environmental Assessment
EM	Environmental Monitor
ENV	Ministry of Environment and Climate Change Strategy
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
FSR	Forest Service Road
IDF	inflow design flood
KP	Knight Piésold Ltd.
masl	metres above sea level
MDMER	Metal and Diamond Mining Effluent Regulations
NTUs	nephelometric turbidity units
PMP	Probable Maximum Precipitation
RIB	Rapid Infiltration Basin
RUSLE	Revised Universal Soil Loss Equation
RUSLEFAC	Revised Universal Soil Loss Equation for Applications in Canada
SCP	sediment control pond
TARP	Trigger Action Response Plan
TSF	Tailings Storage Facility
TSS	total suspended solids
USLE	Universal Soil Loss Equation

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW AND PURPOSE

BW Gold Ltd. (BW Gold), a wholly owned subsidiary of Artemis Gold Inc. (Artemis), is developing the Blackwater Gold Project (the Project) located approximately 110 km southwest of Vanderhoof in central British Columbia. The Project is a large gold-silver deposit, which is proposed to be developed as a conventional truck-shovel open pit mine with a gold processing plant. Project access is via the Kluskus Forest Service Road (FSR), which joins Highway 16 west of Vanderhoof, Kluskus-Ootsa FSR and the Mine Access Road.

The Project underwent a coordinated provincial and federal environmental assessment (EA) that was initiated in 2012 and ended successfully in 2019 with the issuance of a provincial Environmental Assessment Certificate and federal Decision Statement. Condition 13 of EA Certificate #M19-01 Schedule B Table of Conditions requires that the proponent develop measures to address erosion and sediment control during construction, while Condition 29 requires the proponent to develop a plan to avoid sedimentation in waterbodies during construction and maintenance of the transmission line. BW Gold applied for a *Mines Act* Permit and *Environmental Management Act* Permit for the early works construction activities through a joint application; this application requires a description of Best Management Practices (BMPs) for the plant site sediment and erosion control structures and road works. BW Gold received *Mines Act* Permit M-246 approving the Early Works Program on June 22, 2021 and *Environmental Management Act* Permit 110602 on June 24, 2021.

This Erosion and Sediment Control Plan (ESCP) has been developed to support site preparation and grading activities proposed as part of the early work activities at the site. This plan should be read in conjunction with the Construction Environmental Management Plan (ERM, 2021) and all summary letters and design drawings prepared to support the early works activities.

1.2 OBJECTIVES AND SCOPE

This ESCP has been developed to proactively manage water, erosion, and sedimentation throughout the early works phases of the project. The ESCP adheres to the following guidance documents:

- *Technical Guidance 3 – Environmental Management Act – Developing a Mining Erosion and Sediment Control Plan* (B.C. Ministry of Environment, 2015a).
- *Technical Guidance 7 – Environmental Management Act – Assessing the Design, Size and Operation of Sedimentation Ponds Used in Mining* (Ministry of Environment, 2015b).
- *Developing Management Plans for Mines in British Columbia – Erosion and Sediment Control Plan* (B.C. Ministry of Energy, Mines and Petroleum Resources, 2020).
- *Dam Safety Guidelines 2007 (2013 Edition)* (Canadian Dam Association, 2013).
- *Revised Universal Soil Loss Equation for Application in Canada. A Handbook for Estimating Soil Loss from Water Erosion in Canada* (Wall et al., 2002).
- *Health, Safety and Reclamation Code for Mines in British Columbia* (B.C. Ministry of Energy, Mines, and Low Carbon Innovation, 2021).
- *Forest Road Engineering Guidebook* (B.C. Ministry of Forests, 2002).

The intent of this document is to outline strategies and design objectives, with appropriate flexibility, to allow the facilities to be field-fit to suit the conditions encountered during early works activities (i.e., an adaptive management approach). The ESCP describes BMPs that will be implemented prior to and during early works construction activities – it is not meant to be prescriptive. Specific measures to be implemented for each work area will be presented on detailed design drawings prepared for construction. The overall objective of the ESCP is to manage contact water within the project footprint, so as to prevent runoff from potentially impacting adjacent watercourses.

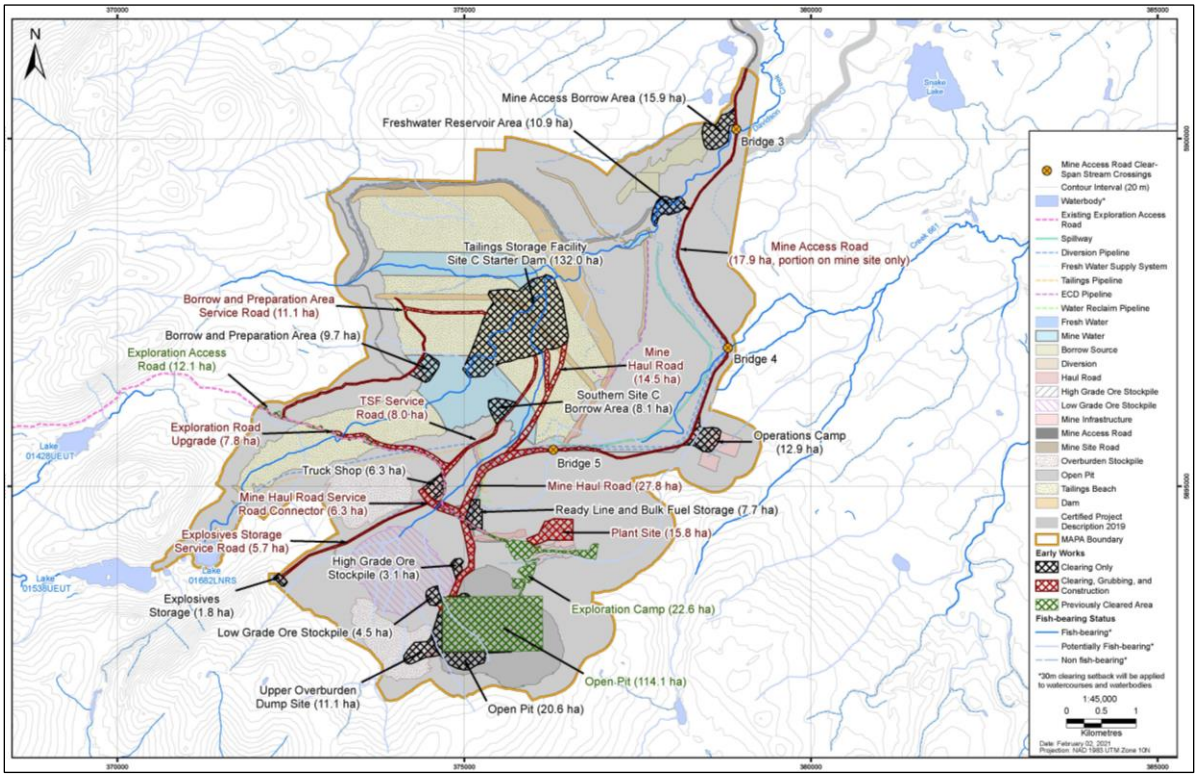
The term “contact water” is used to describe water that has come into contact with mine facilities and/or any construction disturbed areas, road runoff, borrow areas, or vegetation cleared areas. Conversely, “non-contact water” is used to describe water that has not come into contact with any project facilities or disturbed areas. Contact water during construction requires treatment for sedimentation only, which is done through BMPs.

1.3 EARLY WORKS ACTIVITIES

The Early Works activities are comprised of the following:

- Clearing, grubbing, grading, and construction of the mine access road and associated bridges
- Clearing, grubbing, grading, and construction of mine site roads
- Clearing, grubbing, ditching and sediment pond construction, site levelling, soil, and overburden removal at the Plant Site
- Tree clearing at the following locations:
  - Open Pit
  - Upper Overburden Dump Site
  - Mine Access Borrow Area
  - Southern Site-C Borrow Area
  - Tailings Storage Facility (TSF) Site C Starter Dam
  - Borrow and Preparation Area
  - Freshwater Reservoir Area
  - High Grade Ore Stockpile
  - Low Grade Ore Stockpile
  - Explosives Storage
  - Truck Shop and Mine Offices
  - Operations Camp

Early works activity areas are shown on Figure 1.1.



Note(s):

1. From ERM, 2021.

Figure 1.1 Mine Site Early Works

1.4 EARLY WORKS SCHEDULE

A high-level schedule for the Early Works activities is provided in Table 1.1.

Table 1.1 Early Works Activities Schedule

Project Activity / Milestone	Timing
Receipt of Early Works permits	Q2 2021
Construction start date	Q2 2022
Logging	Q2 2022
Construction of Mine Access Road and mine site haul roads	Q2-Q4 2022
Plant site erosion and sedimentation control works	Q2 2022
Plant Site earthworks	Commence Q2 2022

Note(s):

1. From ERM, 2021.
2. Q – quarter.

1.5 PERMIT CONDITIONS

1.5.1 *MINES ACT* PERMIT M-246

Section C of Permit M-246 outlines the requirements for implementation of an Environmental Management System comprised of Environmental Management Plans and Standard Operating Procedures. Section C.4 of the permit includes the following conditions related to this ESCP:

a) *The Permittee must implement the surface water monitoring program in the Early Works Erosion and Sediment Control Plan (Document 1.5 of Permit M-246). The Permittee must track changes to surface water, seepage, and groundwater quality and quantity on the mine site. The Permittee must ensure that the program is capable of providing early warning about the onset of ARD or an increase in contaminant loading*.

b) The Permittee must ensure that detection limits are sufficient to compare to water quality standards and permit requirements established by the British Columbia Ministry of Environment and Climate Change Strategy (ENV).

c) *The Permittee must ensure that an effective QA/QC program for the surface water, groundwater and seepage monitoring programs is included and implemented as part of the Early Works Erosion and Sediment Control Plan. The Permittee must ensure that this includes detection limits, performance criteria that define acceptable levels of precision and accuracy and reporting of any missed sampling events*.

d) *The Permittee must ensure that monitoring results of surface water, groundwater, and seepage quality and quantity are kept up to date in a dedicated database available for review by an Inspector of Mines upon request. The Permittee must ensure that water quality monitoring results, including interpretation of results, are reported and assessed in the Annual Reclamation Report. The Permittee must ensure that any significant changes or trends in water quality or quantity are discussed, and those that require additional evaluation and management are identified in the report*.

Section C.5 of the permit includes the following conditions related to this ESCP:

a) The Permittee must implement the Early Works Erosion and Sediment Control Plan (Document 1.5 of the permit).

b) The Permittee must ensure that the Early Works Erosion and Sediment Control Plan is reviewed annually with updates reported in the Annual Reclamation Report. The Permittee must provide all substantive changes to the Chief Permitting Officer prior to implementation.

c) The Permittee must ensure inspections are conducted at stream crossings, contact and non-contact water management structures and snow dumps daily during rain events and the snowmelt period on the mine site. Where excessive sediment laden runoff is observed, the Permittee must implement immediate remedial action.

d) The Permittee must appropriately characterize any significant releases of sediment laden water, defined as an unauthorized discharge to the receiving environment, with respect to extent and loading, and report it to the Chief Inspector.

e) The Permittee must ensure the characterization of unauthorized discharges of sediment-laden run-off must include, at a minimum, flow, total suspended solids, turbidity, pH, conductivity, temperature, dissolved oxygen, and total and dissolved metals, of both the effluent and the receiving water.

Early works activities are outlined in Section 1.3 of this report: the activities are not anticipated to result in changes to groundwater quality and quantity or cause metal leaching or acid rock drainage. Exposed or excavated overburden material to support early works is not expected to present a risk of metal leaching or acid rock drainage, as excavations will occur at shallow depths and not in bedrock (ERM, 2021). All overburden samples collected in the area of the Plant Site, TSF, and Mine Access Road were classified as non-potentially acid generating (ERM, 2021).

The environmental monitoring program for the early works activities is described in Section 6 of this ESCP: monitoring in contact water will be restricted to turbidity and total suspended solids during the early works activities.

1.5.2 ENVIRONMENTAL MANAGEMENT ACT PERMIT 110602

Permit 110602 authorizes BW Gold to discharge treated stormwater effluent to ground from early stage construction activities from a Sediment Control Pond (SCP) through an Infiltration Basin. The Authorized Works described in the Permit are the SCP, Rapid Infiltration Basins, discharge pipes and related appurtenances. Terms and conditions of the permit include:

- Regular inspection and maintenance of the Authorized Works.
- In the event of an emergency or other condition which prevents normal operation of the Authorized Works or leads to an unauthorized discharge, remedial action must be taken immediately to restore the normal operation and to prevent any unauthorized discharges.
- Emergencies or other conditions that prevent normal operation, and remedial actions taken, must be reported immediately to the EnvironmentalCompliance@gov.bc.ca email address.
- Effluent must not be discharged from the SCP emergency overflow spillway unless there is an event greater than the 1-in-10-year storm. The permittee must notify the director within 24 hours at EnvAuthorizationsReporting@gov.bc.ca in the event that effluent is discharged from the emergency overflow spillway.
- The hydrological site investigation that is outlined in the Rapid Infiltration Conceptual Design must be completed prior to the construction of the SCP, and the Information obtained during the site investigation must be used to inform the design and land area requirements for the Rapid Infiltration Basins. Any changes to the design of the Rapid Infiltration Basins after the site investigation is completed must be submitted to the director 60 days prior to the start of construction of the Rapid Infiltration Basins.
- All aspects of the ESCP during the Early Works must be implemented, maintained, and complied with, and any modifications made to the ESCP must be submitted to the director within 30 days of the modification.
- Visual monitoring of the SCP must be conducted daily while it is discharging to the Rapid Infiltration Basins, and visual monitoring of the Rapid Infiltration Basins must be conducted daily when there is effluent in the basins.
- A Decommissioning Plan for the SCP must be developed and submitted to the director 90 days prior to the decommissioning of the pond.

2.0 ENVIRONMENTAL SETTING AND SITE CONDITIONS

2.1 EXISTING SITE CONDITIONS

The information presented in this section is from the *2020 Hydrometeorology Report* (Knight Piésold Ltd., (KP) 2021a) and the 2020 Hydrology and Water Temperature Baseline Report (KP, 2020).

2.1.1 WATERSHEDS

The Blackwater deposit lies within the upper reaches of the Davidson Creek and Creek 661 catchment areas. The terrain within these catchments is predominantly gently inclined, except along the incised portions of Davidson Creek. Davidson Creek flows northeast from the Project site towards lower Chedakuz Creek, the confluence of the two creeks is approximately 800 m downstream of Tatelkuz Lake. Creek 661 flows northeast from the Project site into upper Chedakuz Creek upstream of Tatelkuz Lake.

Chedakuz Creek drains Tatelkuz Lake and flows north-west, passing under a bridge at the Kluskus FSR approximately 2 km downstream from the lake. An unnamed catchment drains Snake Lake, which is located between the Davidson Creek and Creek 661 catchments. The Snake Lake catchment area drains directly into Tatelkuz Lake, while Creek 661 flows northeast from the Project site into Chedakuz Creek upstream of Tatelkuz Lake.

Turtle Creek, located to the north of Davidson Creek, drains another catchment running parallel to Davidson Creek towards Chedakuz Creek. Turtle Creek flows close to Davidson Creek near the base, before flowing north under the Kluskus FSR to its confluence with Chedakuz Creek downstream of the Kluskus FSR. Chedakuz Creek flows north-west from this point for approximately 25 km to the Nechako Reservoir.

Along the south-west side of the Project site, Fawnie Creek, Matthews Creek and Creek 705 all flow south-west from the deposit area. Creek 705 is a tributary of Fawnie Creek, which flows towards Laidman Lake and joins with Matthews Creek. Fawnie Creek continues to Johnny Lake, into Entiako Provincial Park, and ultimately forming a portion of the flow of the Entiako River into the Nechako Reservoir.

2.1.2 TOPOGRAPHY AND TERRAIN AND NATURAL HAZARDS

The Project is situated on the Nechako Plateau of British Columbia, part of the Interior Plateau east of the Coast Mountain Range. The area is characterized by gently undulating, northwest-trending hills cut by small to medium-sized drainages. The elevation of the Blackwater property ranges from just over 1,000 metres above sea level (masl) in low-lying areas northeast of the proposed mine site to 1,800 masl on the southwest side of the property at the summit of Mount Davidson, which is the highest peak in the Fawnie Range. The Blackwater deposit is located on the northern flanks of the mountain.

2.1.3 CLIMATE AND HYDROLOGY

2.1.3.1 MEAN ANNUAL PRECIPITATION

Two climate stations are installed in the Blackwater Project study area: Blackwater Low and Blackwater High. Blackwater Low was installed in July 2011 at an elevation of 1,050 masl and Blackwater High was installed in July 2012 at an elevation of 1,470 masl. Precipitation data from Vanderhoof were used to

develop an estimate of long-term precipitation conditions for Blackwater Low and Blackwater High. The mean annual precipitation estimates are 564 mm for Blackwater High and 489 mm for Blackwater Low.

2.1.3.2 MONTHLY PRECIPITATION DISTRIBUTION

The monthly distribution of precipitation was estimated for the purpose of water management planning. Mean monthly precipitation values range from a low of 30 mm in March to 68 mm in June for Blackwater High, and 24 mm in March to 59 mm in June for Blackwater Low (KP, 2021a). Approximately 41% of the annual precipitation at the project site falls as snow (primarily between November and March). The remaining 59% of the annual precipitation falls as rain, which may occur in any month of the year, but largely falls in the period of April to October (KP, 2021a). The monthly precipitation statistics for Blackwater High are summarized in Table 2.1.

Table 2.1 Mean Monthly Precipitation Statistics

Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Precipitation (mm)	51	35	30	33	44	68	64	52	51	65	65	56
Rain (mm)	3	3	7	24	43	68	63	52	50	47	14	2
Ratio of Rainfall (%)	6	8	24	72	98	100	100	100	97	76	24	5
Snowfall (mm)	48	32	23	9	1	0	0	0	2	15	42	46
Ratio of Snowfall (%)	94	92	76	28	2	0	0	0	3	24	76	95

Note(s):
1. Blackwater high station.
2. From KP, 2021a.

2.1.3.3 INTENSITY-DURATION-FREQUENCY DATA

Estimates of extreme precipitation are required for a number of design aspects; the 24-hour extreme precipitation for different return period events and probable maximum precipitation (PMP) are summarized in Table 2.2.

Table 2.2 Estimated Annual Extreme Precipitation

Return Period (years)	24-Hour Extreme Rainfall (mm)	Scaling Vanderhoof (mm)
2	37	32
10	50	56
100	66	86
200	71	95
1,000	82	115
PMP	195	288

Note(s):
1. Blackwater high station. Table 2.15 from KP, 2021a.
2. Scaling Vanderhoof values recommended to be used as design values for the project.

2.1.3.4 MEAN ANNUAL RUNOFF

The annual stream hydrographs in the Blackwater Gold Project area are typically characterized by a very pronounced period of high flows during the spring freshet, followed by an extended period of steady low flows, with limited autumn storms. All creeks are affected by ice formation during the winter and the smaller systems typically freeze over for extended periods during cold snaps. Estimates of mean monthly and annual unit runoffs are summarized in Table 2.3.

Table 2.3 Mean Monthly and Annual Unit Runoff

Station	Area (km^2)	Mean Monthly Unit Discharge ($L/s/km^2$)												MAUD ($L/s/km^2$)	MAUR (mm)	MAD (L/s)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
H1	9	0.8	0.8	1.1	5.6	24.9	8.6	3.7	1.0	1.4	2.1	2.0	1.0	4.4	139	39
H2	44	2.1	2.0	2.3	7.7	30.1	16.7	8.9	3.6	3.4	4.1	3.0	2.3	7.2	227	316
H2B	46	2.2	2.1	2.6	8.6	32.4	18.7	10.3	4.2	3.9	4.9	3.4	2.5	8.0	252	368
H4B	61	2.7	2.6	3.1	6.7	24.1	14.9	8.6	3.3	3.9	4.8	3.7	3.1	6.8	215	418
H5	593	1.7	1.6	1.9	5.6	15.3	9.7	6.0	3.3	2.2	2.4	2.3	1.9	4.5	142	2663
H6	55	2.3	2.2	2.7	3.8	11.6	9.1	3.7	3.3	2.7	3.5	3.8	2.6	4.3	135	233
H7	42	0.8	0.7	0.9	6.5	27.3	13.4	6.4	1.1	2.2	3.1	1.2	1.0	5.4	170	227
H10	7	3.2	3.1	3.6	12.0	46.3	27.0	14.2	5.4	5.1	6.2	4.6	3.5	11.2	353	79
H11	15	0.7	0.6	0.8	4.6	15.8	11.9	4.2	2.7	2.5	2.9	1.5	0.9	4.1	129	60
L1-Outlet	392	1.5	1.4	1.7	5.4	15.3	9.6	5.6	3.1	2.0	2.1	2.1	1.7	4.3	136	1687

Note(s):

1. Table 3.4 from KP, 2021a.
2. MAUD - mean annual unit discharge.
3. MAUR - mean annual unit runoff.
4. MAD -mean annual discharge.

2.1.3.5 WET MONTH RUNOFF

Wet monthly flow values were estimated for the project area on the basis of the variability of the long-term flow series developed for the H5 hydrology monitoring station. The return period ratios are shown in Table 2.4. These values were estimated by fitting statistical distribution to the monthly flow values. Generally, the greatest variability of flows occurs during the freshet period, and the lowest variability occurs during the summer months.

Table 2.4 H5 Wet Monthly Return Period Streamflow Relationships

Month	Return Period Mean Monthly Discharge (L/s)				
	Mean	Wet Return Period			
		5 Yr	10 Yr	20 Yr	50 Yr
January	1,012	1,218	1,317	1,393	1,469
February	955	1,168	1,219	1,248	1,269
March	1,145	1,322	1,563	1,845	2,300
April	3,293	4,456	6,012	7,819	10,722
May	9,044	11,627	14,523	17,682	22,411
June	5,762	7,220	9,232	11,591	15,423
July	3,531	4,290	5,567	7,156	9,916
August	1,976	2,430	3,052	3,781	4,963
September	1,298	1,590	1,986	2,448	3,194
October	1,443	1,680	2,102	2,636	3,580
November	1,374	1,522	1,916	2,458	3,513
December	1,117	1,287	1,483	1,701	2,032
Mean Annual	2,663	3,318	4,164	5,147	6,733

Note(s):

1. Table 3.5 from KP, 2021a.

3.0 RISK DETERMINATION

3.1 SURFACE PREPARATION ACTIVITIES

Construction activities that have the potential to cause erosion and sedimentation are briefly described below:

- Clearing and Grubbing: Clearing operations include slashing, cutting, stockpiling, and removal (or burning) of trees and brush. Grubbing operations include the removal of the tree stumps and root masses left behind during clearing operations. Grubbing operations may cause localized soil exposure in areas where roots and stumps were removed.
- Stripping: Stripping is the removal of the organic mat from the construction site to expose the underlying mineral soil.
- Stockpiles: Stockpiles may include material removed from excavations, stripping, clearing, and borrow pits. The creation of stockpiles may disturb the vegetated soil surface, and create exposed slopes.
- Road Construction: access roads are constructed to accommodate construction equipment on the Project site. Construction of roads may involve cut slopes, fill slopes, ditches, or culvert installation.
- Culvert Installation: Culverts are installed to connect drainage courses and surface drainage flow. Installation of culverts may cause flow concentrations, create cut slopes, disturb the soil surface on slope faces, and create scour zones at the culvert inlet or outlet.
- Ditch Construction: Where channels or ditches are constructed to direct and transport water along or transverse to the road alignment, the original drainage pattern may be altered, concentrating flows and increasing flow velocity and erosion potential. Ditch construction creates exposed slopes that can be subject to erosion.
- Borrow Excavations: Borrow excavations can either be landscape borrows or dugout borrows.
- Snow clearing and storage: snow removal from roads and construction areas may contain suspended solids, which have the potential to enter watercourses during the snowmelt period.

There are numerous potential sources of erosion and sediment transport resulting from construction activities at the site. The key areas of concern at the site include:

- Heavy rainfall events and freshet runoff can create erosion and sedimentation in areas that did not have previously known erosion.
- Heavily trafficked areas and land disturbance caused by heavy mobile equipment can be a continuous source of soil displacement and compaction. With compaction, infiltration is reduced, and surface water has a greater potential for erosion. Proper planning prior to the commencement of heavy equipment and construction work can limit the disturbed footprint and mitigate erosion potential. During unusually heavy rain events oversaturated soils can exacerbate the problem.

3.2 SOIL LOSS ESTIMATION

The Universal Soil Loss Equation (USLE) is a mathematical model developed in the 1960s by the U.S. Department of Agriculture Soil Conservation Service to predict soil erodibility (Wall et al., 2002). The USLE and its derivatives (Revised or Modified Soil Loss Equation (RUSLE or MUSLE)), are based on erosion plot and rainfall simulator experiments, primarily for crops in the Eastern United States. The Revised Universal

Soil Loss Equation for Application in Canada (RUSLEFAC) was developed to specifically reflect Canadian conditions (Wall et al., 2002).

General conditions such as climate, soil, topography, vegetation, and land use practices affect erosion (Wall et al., 2002). The USLE or RUSLE equation to estimate the potential, long-term, average annual soil loss per hectare is (Wischmeier and Smith, 1978, presented in Wall et al. 2002):

$$A = R \, x \, K \, x \, L \, x \, S \, x \, C \, x \, P$$

Where:

A = potential, long-term, average annual soil loss per hectare [tonnes/ha/year]
R = rainfall factor [MJ•mm/ha/hr]
K = soil erodibility factor [tonnes•hr/MJ/mm]
L = slope length factor [dimensionless]
S = slope steepness factor [dimensionless]
C = cropping-management factor [dimensionless]
P = support practice factor [dimensionless]

The potential soil loss calculated for each worksite/area will be compared to guidelines for assessing potential soil erosion classes summarized in Table 3.1 (Wall at al., 2002). The suggested soil loss tolerance in Canada is 6 tonnes/ha/year.

Table 3.1 RUSLEFAC - Soil Loss Classes

Soil Erosion Class	Potential Soil Loss [tonnes/ha/year]
1 - Very Low	<6
2 - Low	6 – 11
3 - Moderate	11 – 22
4 - High	22 – 33
5 - Severe	>33

Note(s):

1. Table 1.1 from Wall et al. (2002).

The potential for surface erosion during the early works within the plant site was estimated using RUSLEFAC as 17 tonnes/ha/year, corresponding to a moderate soil erosion class.

4.0 EROSION AND SEDIMENT CONTROL MEASURES

4.1 EROSION MANAGEMENT AND SEDIMENT CONTROL STRATEGIES

The key strategy to control erosion and sedimentation is to protect the soil surface from rain and runoff (water management) and to capture eroded soil on site. These will be addressed through:

- Documentation of baseline conditions and erosion risk potential.
- Minimizing the extent and duration of exposure through planning and scheduling of erosion and sediment control (ESC) measure selection, installation, inspection, repair/modification, and decommissioning for every part of the construction schedule.
- Prioritizing drainage control, then erosion control, then sediment control - protecting areas to be disturbed from runoff by intercepting runoff and diverting it away from disturbed areas and keeping runoff velocities low.
- Retaining sediment on site by planning the location where sediment deposition will occur and constructing containment systems before other land-disturbance occurs.
- ESC performance monitoring and routine inspection of ESC measures, documentation of inspections, and prompt response to problems (maintenance and replacement of ESC measures as needed).
- Permanent site stabilization and decommissioning of ESC measures.

Erosion control should be viewed as the primary means in preventing the degradation of downstream aquatic resources, while sediment control should be viewed as a contingency plan. A greater emphasis will be placed on erosion control measures, especially in areas of elevated erosion potential; however, measures to address both erosion control and sediment control are required. Erosion control measures prevent exposed soils from being entrained by water or wind, while sediment controls address the removal of sediment suspended in water once erosion has occurred. Erosion and sediment control measures applied in series create a resilient system capable of protecting the natural environment from sediment impacts.

This ESCP describes design elements and provides guidance for control of all water originating from, or brought into, the mine site area during construction. Water will be controlled in a manner that minimizes erosion in areas disturbed by early works construction activities and prevents the release of untreated construction water, which could adversely affect the water quality of receiving waters.

Water management in the early stages of construction will focus on diverting non-contact water away from working areas, retention of the understory vegetation (brush and root networks) as much as possible during winter logging, and interception of contact water using BMPs. Disturbed areas will be seeded using quick establishing, weed-free seed mixes (native and approved non-native) for initial soil stabilization followed by planting of native vegetation in accordance with Reclamation and Closure practices to facilitate progressive closure and reclamation of the project where final slopes are created.

Erosion management and sediment control at the project will be a process of establishing diversion and collection ditches to manage surface water runoff, constructing the SCP, stabilizing disturbed land surfaces to minimize erosion, establishing temporary vegetation cover, and reclaiming the final slopes in accordance with the Reclamation and Closure Plan.

Potential effects from the construction activities in the absence of planned mitigation measures include:

- Increased surface erosion from disturbed and rehabilitated areas
- Increased sediment load entering the natural water system
- Siltation or erosion of watercourses and water bodies

The ESCP addresses these potential hazards for effective management of surface water and contact runoff during the early stages of construction. Sediment mobilization and erosion will be minimized by:

- Limiting the extent of land disturbance to the practical minimum.
- Scheduling activities to retain understory vegetation (brush and root networks) to the extent practicable during logging and removal of trees, until the transition to major works construction.
- Reducing water velocities across the ground using surface roughening and re-contouring, particularly on exposed surfaces and in areas where water concentrates.
- Progressively rehabilitating disturbed land and constructing drainage controls to improve stability of rehabilitated land.
- Protecting natural drainages and watercourses by working outside of riparian areas, or in conformance to management plans or BMPs within riparian management areas, if approved, and constructing appropriate sediment control devices.
- Installing rock riprap, rock channel lining, sediment filters, or other suitable measures on steep gradients.
- Restricting access to rehabilitated areas.
- Constructing appropriate temporary BMP measures (e.g., silt fences, hay bales) downslope of disturbed sites where more permanent sediment control measures are not appropriate, or in combination with more permanent measures.
- Implementing soil bioengineering techniques to contain sediment and enable disturbed surfaces to recover.
- Snow pile placement and management: proper siting of snow storage areas e.g., snow dumps will not be on disturbed, un-stabilized, or highly erodible sites, within waterbodies or riparian areas, or at a highpoint where runoff is likely to collect sediment and other pollutants as it melts.

The type of erosion or sediment control measure will be selected based on site-specific conditions such as:

- Site erosion potential classification
- Area of upstream soil exposure
- Terrain conditions and space constraints
- Construction method
- Anticipated concentrated rainfall amounts due to ditching or drainage pattern changes
- Level of risk to the receiving environment

4.2 PROCEDURAL CONTROLS

A work schedule that coordinates the timing of land-disturbing activities and the installation of ESC measures can be a cost-effective way to help reduce erosion risk. Runoff-control measures and diversions should be installed up-gradient of areas to be disturbed prior to grading. Principal sediment basins and traps, as needed, should be installed before any major site grading takes place, and additional sediment traps and sediment fences should be erected as grading takes place to keep sediment contained on-site at

appropriate locations. In steeper terrains, where construction of sediment basins may not be feasible, a combination of silt retention structures and filter bags may be employed, or diversion ditches may redirect flows to an area of flatter terrain where a sediment basin may be implemented.

4.3 PLANT SITE SEDIMENT CONTROL POND AND RAPID INFILTRATION BASINS

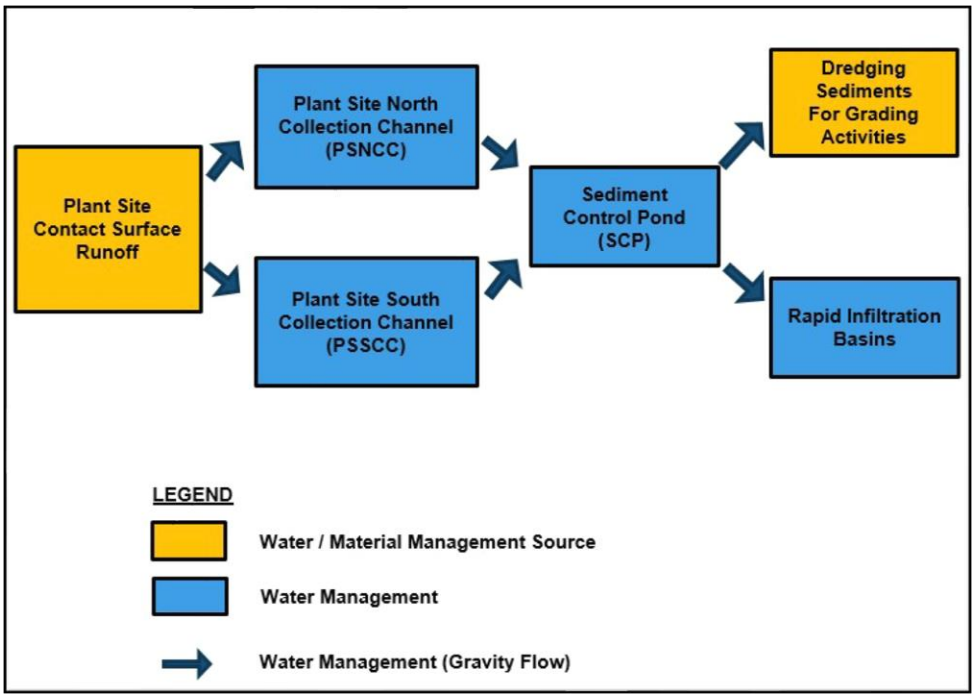
Currently the only SCP required for the Early Works Activities is for the Plant Site. Details on the SCP design and erosion control measures can be found in the *Surface Water Management and Sediment Control Design Report for the Plant Site Early Works* (KP, 2021b) and *Rapid Infiltration Concept for the Plant Site Sediment Collection Pond Discharge* (KP, 2021c). The Plant Site geotechnical site characterization report and the early works engineering work plan are included in Appendix A and Appendix B, respectively, of this report (KP, 2022a, 2022b).

The SCP is designed following the BC Ministry of Environment guidance document on size and operation of sediment ponds (ENV, 2015b). The pond will accommodate a live storage equal to the 1 in 10 year 24-hour storm event, with at least a half meter (0.5 m) of freeboard. The pond spillway has sufficient flow capacity to convey a flood event from a 1 in 200 year 24-hour storm event without overtopping.

The Plant Site North and South Collection Channels will collect surface contact runoff from the proposed Plant Site soil disturbance area. These channels will be located near the perimeter of the planned fill placement areas and will convey runoff into the SCP located at the northeast corner of the proposed disturbance area. Runoff occurring within the excavations will be conveyed to the perimeter collection channels. The SCP is designed to provide adequate residence time for sediment to settle out of suspension prior to water discharging into a Rapid Infiltration Basin (RIB) system downstream. From the RIBs, the surface contact runoff is expected to percolate and dissipate into the soil layer to avoid any overland flow into the forested area. A simplified water management plan schematic is presented on Figure 4.1.

A test pit site investigation program was completed by KP in November 2021 to characterize the subgrade material at the Plant Site Collection Channels, SCP, and RIBs (KP, 2022b). A total of 22 test pits were excavated at the Plant Site area, including four test pits at the SCP and Collection Channels and three test pits at the RIBs. The subgrade material was described according to soil type, size and shape of clasts, gradation, plasticity, colour, odour, compactness/consistency, soil structure, and moisture condition.

Infiltration testing was completed in the ablation till material in two test pits at the northern plant site RIB area: the test pit infiltration tests show an average infiltration rate of 0.004 m/hr for TP21-70 and 0.04 m/hr for TP21-71, which corresponds to an estimated annual hydraulic loading of 35 m/year and 336 m/year for TP21-70 and TP21-71, respectively (KP, 2022a). The materials encountered in the two test pits were similar, and the variability in results may be due to differences in material underlying the test pits (KP, 2022a).



Note(s):
1. From KP, 2021b

Figure 4.1 Water Management Schematic – Early Works

The RIB design incorporates an average annual hydraulic loading rate of approximately 88 m/year, which was based on the results of previous investigations at the site (KP, 2022b). The infiltration tests completed in 2021 indicate that local variability could be expected to influence operational performance of the RIBs. No changes to RIB land area requirements were recommended based on the results of the 2021 site investigation (KP, 2022b). The SCP outlet works will incorporate sufficient flow isolation and control components to manage hydraulic loading to the individual RIBs. Larger scale infiltration testing will be incorporated in the initial performance monitoring of the constructed RIBs, and the results will be considered in the operations, maintenance, and surveillance plans for the Plant Site SCP and RIBs.

The RIBs will be visually assessed during operation to determine if they are performing as designed. As infiltration performance may vary within each RIB, the amount of flow directed into each basin will be adjusted with the entry valves as required to maximize efficiency. If the infiltration rate is lower than expected during operations, additional contingency measures will be implemented, which may include:

- Pumping excess flow to an adjacent RIB if enough capacity exists.
- Construction of additional RIBs downgradient of the existing basins: connection valves will be placed to facilitate the implementation of additional RIBs if required.

The use of RIBs may require seasonal or annual removal of accumulated deposits or sediment on the basins to allow proper infiltration. The collected sediment will be deposited on the plant site pad within the secondary containment of perimeter collection channels where BMP will be applied. To avoid bonded ice surface forming at the bottom of the RIBs, and to facilitate infiltration during winter conditions, the construction of a ridge and furrow system may be implemented at the bottom of the RIBs.

A decommissioning plan for the Plant Site SCP will be developed and submitted to the director 90 days prior to the decommissioning of the pond. The plan will include:

- The pump out procedure for the effluent that cannot be discharged through the primary outlet.
- The sediment dewatering procedure.
- The decommissioning of the ponds, ditches, liners and outlets.

It is anticipated that the Plant Site SCP will be utilized during the construction and operations phases, with discharge pumped to the TSF during operations.

4.4 BEST MANAGEMENT PRACTICES

Installation of temporary erosion and sediment control features or BMPs will be the first step towards controlling erosion and sedimentation during construction. All temporary ESC features will require maintenance and inspection after each significant rainfall. These temporary features will be reclaimed after achieving soil and sediment stabilization.

BMPs reduce erosion potential by stabilizing exposed soil or reducing surface runoff flow velocity. Generally, two types of erosion control BMPs are used:

- Source control BMPs for protection of exposed surfaces
- Conveyance BMPs for control of runoff

Procedural BMPs are planning strategies that will be used and include:

- Scheduling of work
- Minimizing exposed soils wherever possible
- Maximizing work during favourable weather
- Preserving and using existing drainage systems wherever possible
- Installing BMPs early

Typical BMPs are described in this section.

4.4.1 CULVERTS

Culverts will be constructed along access and haul road alignments to allow for flow of water and drainage channels beneath the road. Culverts will be combined with Check Dams and Collection Ditches to pass surface runoff beneath the roads. Spacing of culverts along haul road alignments is dependent on both the grade and skew of the road, and the erosion hazard level.

4.4.2 DIVERSION DITCHES

Diversion ditches (DD) will be constructed upgradient of disturbed areas to intercept clean surface water runoff and convey it around areas to be disturbed to avoid excessive sheet flow. All diversion ditches will discharge through a stabilized outlet designed to handle the expected runoff velocities and volumes from the ditch without scouring. Each diversion ditch type will provide a minimum freeboard of 0.5 m between the top of flow and the ditch crest.

Two types of diversion ditches may be required: Type 1 (DD1) ditch in soil and Type 2 (DD2) ditch in rock. Whether ditch cross section type DD1 or DD2 is built will depend on site conditions during construction. Dimensions for the two types of diversion ditches are presented in Table 4.1.

Table 4.1 Diversion Ditch Dimensions

Dimension	DD1	DD2
Bottom width (mm)	500	500
Side slopes	2H:1V	0.5H:1V
Minimum Depth (mm)	500	500
Riprap thickness (mm)	300	-

Note(s):

1. V-shaped diversion ditches may also be constructed; design criteria will be provided in design reports and drawings.
2. If riprap is unavailable, a bituminous geomembrane or HDPE liner will be considered.

Type 1 Diversion Ditches (DD1) will require filter fabric to be placed along the base and sides of the ditch prior to placement of riprap. Fabric is placed continuously to maintain intimate contact with the base soil. Fabric is installed so that upstream strips overlap downstream strips by a minimum of 500 mm. Riprap (if available in sufficient quantity) will be placed so as to form a dense, uniform, well-graded mass with few voids, and some hand placement may be necessary to obtain good size distribution. As an alternative to riprap, the diversion ditches may be lined with a bituminous geomembrane or HDPE liner, or check dams will be used along with a monitoring, surveillance, and contingency program.

Diversion ditches will be inspected and maintained regularly and before and after major precipitation events to remove any blockages to flow (accumulated sediment, debris, etc.) that may reduce the design capacity. Typical diversion ditch designs are shown on Drawing C3803.

4.4.3 COLLECTION DITCHES

A runoff collection ditch (CD) intercepts contact water runoff from disturbed areas and diverts it to a stabilized area where it can be effectively managed. Collection ditches are used within construction areas to collect runoff and convey it to appropriate sediment control measures. Where fine grained soils are exposed, appropriate erosion protection materials will be installed based on the estimated magnitude of flow and the flow velocity. General locations and conditions may include:

- Below disturbed slopes to divert sediment-laden water to control facilities.
- At or near the perimeter of the construction area to prevent sediment-laden runoff from leaving the site.
- Below disturbed areas to prevent erosion if stabilization measures cannot be implemented immediately.

Collection ditches may be either temporary or permanent structures. Two types of collection ditches may be required: Type 1 (CD1) ditch in soil and Type 2 (CD2) ditch in rock. Whether ditch cross section type CD1 or CD2 is built will depend on site conditions. Dimension for the two types of collection ditches are presented in Table 4.2. Each collection ditch type will provide a minimum freeboard of 0.5 m between the top of flow and the ditch crest.

Table 4.2 Collection Ditch Dimensions

Dimensions	CD1	CD2
Bottom width (mm)	500	500
Side slopes	2H:1V	0.5H:1V
Minimum Depth (mm)	500	500
Riprap thickness (mm)	300	-

Note(s):

1. V-shaped collection ditches may also be constructed; design criteria will be provided in design reports and drawings.
2. If riprap is unavailable, a bituminous geomembrane or HDPE liner will be considered.

Type 1 Collection Ditches (CD1) will require filter fabric to be placed along the base and sides of the ditch prior to placement of riprap. Fabric is placed continuously to maintain intimate contact with the base soil. Fabric will be installed so that upstream strips overlap downstream strips by a minimum of 500 mm. Riprap (if available in sufficient quantity) will be placed so as to form a dense, uniform, well-graded mass with few voids, and some hand placement may be necessary to obtain good size distribution. As an alternative to riprap, the collection ditches may be lined with a bituminous geomembrane or HDPE liner, or check dams will be used along with a monitoring, surveillance, and contingency program.

Collection ditches will be inspected and maintained regularly and before and after major precipitation events to remove any blockages to flow (accumulated sediment, debris, etc.) that may reduce the design capacity. Typical collection ditch designs are shown on Drawing C3803.

4.4.4 ROCK CHECK DAMS

Rock check dams are small dams constructed across swales, drainage ditches, and waterways to avoid erosion by reducing flow velocity. Rock check dams accomplish this by interrupting the flow of water to form small ponds, thereby flattening the surface of the water, and reducing the velocity of flow (Government of Alberta, 2011). The obstructions induce infiltration and reduce erosion potential. Check dams are also used to distribute flows across a swale to avoid preferential paths and guide flows towards vegetation.

Rock check dams along the centreline of Collection or Diversion Ditches should form an asymmetrical triangle with the bottom of the ditch. Dam slopes of 3H:1V downstream and 2H:1V upstream will be used. The rock check dams will be spaced such that top of the middle of each downstream check dam is at the same elevation as the base of the previous dam - dam spacing and rock size will be determined by the supervising Engineer based on hydraulic conditions and gradient (Toronto and Region Conservation Authority, 2019). Rock check dams will be installed on all ditches exceeding 6.0% grade. Rock check dam construction will start from the downstream end of the ditch and be constructed upstream from that point. A minimum 100 mm deep trench must be excavated for the entire footprint of the Rock check dam, and spoiled material must be removed from the site.

Rock check dams require regular maintenance and should be inspected regularly, and before and after significant storm event (for the purpose of this plan, a significant storm event is equal to or greater than a 1 in 2 year return period precipitation event) It is important that rubble, litter, and leaves are removed from the upstream side of the dam. This is typically done when the sediment has reached a height of one-half of the original height of the dam.

4.4.5 STRAW BALE CHECK DAMS

Straw bale check dams are small, temporary dams constructed of straw bales as drop structures placed across channels to reduce a steep grade to intervals of flatter grades. Straw bale check dams are used for (Government of Alberta, 2011):

- Small open channels that drain ≤2 ha
- Channels with grade of <5%
- Flow velocities of <0.3 m/s

Straw bale check dams should only be a maximum of one straw bale in height, or 0.5 m maximum. Straw bales should be machine-made; weed free cereal crop straw such as wheat, oats, rye, or barley; tightly compacted and bound with two rows of wire or synthetic string; and show no signs of weathering and be no more than year old (Government of Alberta, 2011).

Structures will be inspected at weekly intervals and after each significant rainfall event. Damaged, decayed, or dislodged straw bales will be replaced immediately and erosion repairs will be made to prevent failure of the structure. Sediment build up will be removed before it reaches one-half the check structure height. Typical configurations for a straw bale check dam are shown on Drawings C3801.

4.4.6 ENERGY DISSIPATERS

Energy dissipaters are pools used to dissipate the energy of fast flowing water and control erosion at the outlet of a ditch or a conduit to minimize erosion of natural stream channels downstream. The energy dissipator will be set at zero grade and aligned straight with the direction of flow at the outlet, and constructed flush with the surrounding grade.

These structures are used in conjunction with diversion of non-contact water around construction areas and with diversion ditches and are typically located upstream of a receiving water body (e.g., stream, pond, lake, etc.). Drawings will be provided in the early works activities design reports.

4.4.7 SEDIMENT BASINS

A sediment basin is a temporary structure that is used to detain runoff from small drainage areas where so that sediment can settle out. The basin is typically maintained until the site is permanently protected against erosion by vegetation and/or structures. Sediment basins are generally located in areas where access can be maintained for sediment removal and proper disposal. Sediment basins are typically constructed at the end of collection ditches to detain sediment-laden runoff long enough to allow the majority of the sediment to settle out to comply with water quality objectives. A sediment basin can be created by excavating a basin, utilizing an existing depression, or constructing a dam on a slight slope downward from the work area. Sediment-laden runoff from the disturbed site is conveyed to the basin via ditches, slope drains, or diversion structures. The efficacy of sediment basins is largely dictated by the extent to which they are properly sized and constructed as designed; whether the banks are stabilized immediately following construction; and the extent to which they are regularly cleaned out / maintained.

The size of the temporary sediment basins is dependent on the size of the drainage areas. The exact locations and final geometry of each basin will be field-fit to minimize disturbance. The supervising Engineer will approve the sizing and location of these basins for the early works activities prior to construction. Three sizes of sediment basin (designated SB1, SB2, and SB3) are used for different size drainage areas, as

summarized in Table 4.3. The width and length dimensions correspond to the top of the wet storage area, at the base of the outlet structure.

Table 4.3 Recommended Configuration of Sediment Basins

Specification	SB1	SB2	SB3
Drainage Area (hectares)	<0.5	0.5 - 1	1 - 2
Length (m)	15	25	50
Width (m)	3	5	10
Depth of Wet Storage Excavation (m)	1	1	1
Embankment Height of Rock Outlet (m)	0.5	1	1
Minimum Spillway Weir Length (m)	1	2	3

Note(s):

1. From ENV, 2015b.

Sediment basins will be inspected regularly and cleaned out when the sediment has accumulated to one-half of the designed wet storage volume. Upland areas contributing to the trap/basin will be stabilized as quickly as possible to avoid frequent dredging and maintenance. The outlet will be checked regularly for sediment build-up that could prevent drainage and limit the overall carrying capacity of the basin. If the outlet is clogged by sediment, it will be cleaned or replaced. The dredged sediment will be disposed of in fill areas, soil stockpiles, designated waste areas, or other locations where it can be stabilized with vegetation or contained via sediment controls (e.g., silt fencing and hay bales).

Dredging will occur during low flow periods to minimize re-suspension of sediments. A typical configuration for a sediment basin is shown on Drawing C3803.

The requirement for sediment basins is not currently anticipated for the early works activities. BW Gold will apply to ENV for a discharge permit including the location of any proposed effluent discharge in the event that sediment basins will be utilized during the early works activities.

4.4.8 SLOPE DRAINS

Slope drains consist of flexible tubing or conduit and are required to convey concentrated runoff from the top to the bottom of a cut or fill slope into the appropriate BMP when ditches are deemed impractical (i.e., at steep ditch gradients, or unfavourable side slopes for ditch construction). Additionally, slope drains may be used in conjunction with rock check dams at the inlet to reduce velocities and to drain collection ditches into stabilized outlets. The entrance section to the drains will be well-entrenched and stable so that surface water can enter freely, and the drain will extend downslope beyond the toe of the slope to a stable area. The minimum slope drain diameter will be sized according to the contributing drainage area summarized in Table 4.4.

Slope drains will be inspected and maintained regularly, and any blocked or damaged parts will be cleaned, repaired, or removed and replaced. Sediment will be removed from the upslope inflow area, particularly before and after storm events, to prevent downslope sediment transport, which may cause plugging of the drainpipe and overtopping of the structure. The dredged sediment will be disposed of in fill areas, soil stockpiles, or other locations where it can be stabilized with vegetation or contained via sediment controls (e.g., silt fencing and hay bales). Dredging (if and when required) will occur during low flow periods to minimize re-suspension of sediments.

Table 4.4 Recommended Slope Drain Sizing

Drainage Area (Hectare)	Pipe Diameter (mm)
0.2	300
0.6	450
1.0	530
1.4	600
2.0	900

Note(s):

1. From government of Alberta, 2011.

4.4.9 SURFACE ROUGHENING

Cut and fill slopes will be roughened with tracked machinery where appropriate to reduce runoff velocity and erosion, increase infiltration, and aid in the establishment of vegetative cover with seeding. The roughening will be carried out by a tracked machine moving up and down the slope surfaces to create grooves perpendicular to the slope, creating undulations on the soil surface, as shown on Drawing C3801. This procedure is simple, inexpensive, and provides immediate short-term erosion control for bare soil where vegetative cover is not yet established, as a rough soil surface provides more favorable moisture conditions which will aid in seed germination compared to hard, compacted smooth surfaces.

4.4.10 FILTER BAGS

Filter bags are generally constructed from a sturdy non-woven geotextile capable of capturing particles larger than 150 microns. Filter bags will be installed at the discharge end of pumped diversion pipelines, via fabric flange fittings, to remove fine grained materials before discharging to the environment, as needed. Filter bags are generally temporary sediment control measures. Filter bags are installed on flat, stable, non-erodible foundations, or in well vegetated areas. The pumping rate is specified by the manufacturer. Discharge from filter bags is routed to avoid erosion.

A smaller variety of filter bags, referred to as filter socks, can be installed on the discharge ends of gravity flow pipes, such as slope drains, to filter silt particles before discharging to the environment. Filter bags will be inspected daily for defects, rips, tears, sediment accumulation, and erosion of the surrounding area. When sediment fills one-half of the volume of the filter bag, the filter bag will be removed from service and replaced. Spare bags will be kept nearby to minimize time required to recommence pumping activities. Once the used bag is fully drained, the bag and its contents will be disposed of in fill areas, soil stockpiles, or designated waste areas, as the material is inert and can be used for reclamation. A typical filter bag plan and cross section is provided on Drawing C3802.

4.4.11 WATERBARS

Waterbars, shown on Drawing C3802, are ridges or ridges and channels constructed diagonally across a sloping road or right-of-way at pre-designed intervals to limit the accumulation of erosive volumes of water. Waterbars reduce sheet flow and surface erosion of areas of exposed soil and/or roads by diverting runoff towards a stable vegetated area or diversion ditch. Spacing of waterbars will be field-fit based on slope grade, general erodibility of the surface, and anticipated flows. Waterbars will not direct runoff into a ditch

that channels water toward a watercourse unless the ditch is adequately designed with check dams and armouring where appropriate.

The height (measured from the channel bottom to the top of the ridge) will be a minimum of 0.45 m, the base width of the ridge will be 1.8 m minimum, and the side slopes will be 3:1 or flatter where vehicles cross. The crossing angle will be selected to provide a positive grade less than 2%.

The approximate spacing of waterbars is summarized in Table 4.5 and will be field-fit to locate the outlet in stable natural areas, where possible. Waterbars will be periodically inspected and sediment will be removed from the flow and outlet areas as needed.

Table 4.5 Recommended Waterbar Spacing

Grade (%)	Waterbar Interval (m)
< 5	35
5 – 10	30
10 – 20	20
20 – 35	15
>35	7.5

Notes:
1. From North Carolina Department of Environment and Natural Resources, 2013.

4.4.12 DIVERSION STRUCTURES

A temporary diversion structure consists of sandbags stacked in a pyramid formation with a polyethylene sheet placed diagonally in between as shown on Drawing C3802. Temporary diversion structures are useful for diverting streams and/or concentrated overland flows to an appropriate sediment basin or other BMP where it can be effectively managed. No temporary diversion structures are proposed during the early works stage that would require authorization under the *Water Sustainability Act*.

4.4.13 SILT RETENTION STRUCTURES

Silt fences are temporary sediment control devices used to protect water quality in nearby watercourses from sediment present in stormwater runoff, by forcing low volumes of overland flow to pool, allowing sediment to settle out of suspension. Silt fences are typically installed downslope of erosion-susceptible terrain to prevent sediment-laden sheet flow from entering receiving waters. Typical sites are catch points beyond the toe of fill, or on side slopes above waterways or drainage channels. Intercepted drainage pools along the uphill side of the fence to promote sediment settling. Silt fences will also be installed and maintained along down-gradient boundaries of all snow dumps. Drainage in contact with the fence is filtered through geotextile: the small pores of the silt fence filter coarse particles (fine sand to coarse silt) and restrict water exfiltration rates. Barrier locations are field-fit based on-site features and conditions (e.g., soil types, climate, terrain features, sensitive areas, etc.), design plans, existing and anticipated drainage courses, and other available ESC measures.

Silt fencing will be trenched according to Drawing C3801 for proper anchoring. The design criteria for silt fences includes:

- The size of the drainage area shall be no greater than 0.1 ha per 30 m length of fence
- Maximum flow path length above the silt fence should be no greater than 30 m

- Maximum slope gradient above the silt fence should be no greater than 2H:1V

Silt fences will be inspected for damages, tears, clogging, or erosion of the surrounding areas. Damaged sections will be repaired or replaced to maintain their functionality.

An alternative to a silt fence is a sediment retention berm, which is a small (approximately 600 mm high) berm that is constructed using random fill material (rock, wood chips, soil, topsoil). Sediment retention berms do not require removal of the underlying vegetation; however, voids along the base of the berm must be minimized.

4.4.14 TEMPORARY SEEDING

Exposed slopes and other disturbed areas will be seeded for initial soil stabilization using weed-free, quick establishing seed mixes (native and approved non-native). The purpose of temporary seeding is to stabilize the soil and reduce damage from wind and/or water until permanent stabilization is accomplished. Seeding is applicable to areas that are exposed and subject to erosion for more than 30 days, and is usually accompanied by surface preparation, fertilizer, and mulch; however, the timing of seeding is weather and season dependent and consequently this method is not applicable at all times. Temporary seeding may be accomplished by hand or mechanical methods, or by hydraulic application (hydroseeding), which incorporates seed, water, fertilizer, and mulch into a homogeneous mixture (slurry) that is sprayed onto the soil.

4.4.15 MULCHING

Mulching is the application of a uniform protective layer of straw, wood fibre, wood chips, or other acceptable material on or incorporated into the soil surface of a seeded area to allow for the immediate protection of the seed bed. The purpose of mulching is to protect the soil surface from the forces of raindrop impact and overland flow, foster the growth of vegetation, increase infiltration, reduce evaporation, insulate the soil, and suppress weed growth. Mulching also helps to hold fertilizer, seed, and topsoil in place in the presence of wind, rain, and runoff, and reduces the need for watering. Mulching may be utilized in areas that have been seeded either for temporary or permanent cover.

There are two basic types of mulches: organic mulches and chemical mulches. Organic mulches likely to be used include straw, hay, wood fibre, wood chips, and bark chips. This type of mulch is usually spread by hand or by machine (mulch blower) after seed, water, and fertilizer have been applied. Chemical mulches, also known as soil binders or tackifiers, are composed of a variety of synthetic materials. Chemical mulches are usually mixed with organic mulches as a tacking agent to aid in the stabilization process, and are not typically used as the sole control, except in cases where temporary dust and erosion control is required. The choice of materials for mulching will be based on soil conditions, season, type of vegetation, and the size of the area.

4.4.16 ROLLED EROSION CONTROL PRODUCT

Rolled erosion control products such as blankets, nets, and matting, are manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment, and protection of vegetation. Nets are made of high tensile material woven into an open net which overlays mulch materials. Blankets are made of interlocking fibres, typically held together by a biodegradable or photodegradable netting; blankets generally have lower tensile strength than nets but cover the ground more completely. Rolled

erosion control products will be used when mulch cannot be adequately tacked and where immediate ground cover is required to prevent erosion damage and will be used to aid permanent vegetated stabilization of slopes 2:1 or greater.

An alternative to the high tensile material woven blanket is a hemp fibre erosion control blanket comprised of fibres that are 100% biodegradable and created without the use of polypropylene netting. The hemp fibre blankets can be used for slope protection (for slopes up to 1H:1V) and on culvert inlets and outlets.

The rolled erosion control products will be monitored and repaired as necessary until ground cover is established. Products will be inspected weekly at a minimum and before and after each significant rainfall event.

4.4.17 POLYETHYLENE COVER

Polyethylene sheets can be used to temporarily cover newly exposed soil in situations when time does not permit other more permanent solutions to be applied. Soil that has high erosion potential will be covered immediately if a precipitation event is forecast. Strips of polyethylene should overlap each other in a configuration that prevents water from running underneath adjacent sheets. Runoff should be directed into an appropriate non-erodible or armoured drainage channel.

4.4.18 FLOCCULANTS

Flocculants are commercial products used to increase the rate of sedimentation in a SCP by increasing aggregation of fine sediments. Flocculants can be used to enhance removal of suspended sediment, particularly in situations where the sediment-laden water cannot be detained long enough to allow particles to settle (i.e., when water is being discharged from the emergency overflow spillway when there is an event greater than the 1-in-10 year storm, when turbidity levels are high and adequate detention times cannot be provided). Flocculants used will be:

- Harmless to fish, aquatic organisms, wildlife, and plants
- Biodegradable
- Legal for use in Canada and be accompanied with a Safety Data Sheet containing toxicity information confirming that the product is not toxic to aquatic life

Flocculants will only be used after all appropriate physical BMPs have been implemented. If flocculants will be used, the written manufacturer's instructions describing correct use of the product (e.g., dosage and settling time recommendations), site preparation, application, inspection, maintenance, and storage, will be followed.

The site Environmental Manager or Environmental Monitor will monitor water quality and flocculant dosage, and will notify the ENV within 24 hours at EnvAuthorizationsReporting@gov.bc.ca in the event that effluent is discharged from the emergency overflow spillway, in accordance with Section 3.1 of Permit 110602. ENV will also be notified within 24 hours if flocculant is used in the SCP.

5.0 PLAN IMPLEMENTATION

5.1 ROLES AND RESPONSIBILITIES

Roles and Responsibilities for the Construction activities are presented in the Project Construction Environmental Management Plan (CEMP) being prepared by ERM (2021). This information is summarized in Table 5.1.

Table 5.1 Early Works Activities Roles and Responsibilities

Role	Responsibilities
Project Sponsor	• Overall Early Works environmental management and performance.
Project Manager/ Field Manager	• Oversees CEMP updates, communications, and implementation. • Maintains compliance with permit and approvals. • Authorizes Stop Work authority to project personnel (e.g., environmental monitor(s) as per permits and approvals). • Notifies regulatory agencies or authorizes notification of environmental non-compliance or environmental incidences. • Provides onsite staff, including contractors, with the appropriate equipment and sufficient supplies, including spill kits and plans, emergency contact lists, Environmental Monitor(s), clean/appropriate machinery etc., that meet requirements specified in permits and the CEMP. • Reduces the potential for incidents on site by regularly monitoring the implementation of mitigation measures listed in permits and the CEMP. • Implements corrective actions, where non-compliances are identified, or incidents occur. • Confirms that onsite staff, including contractors, are trained for their job. • Reviews site environmental monitoring report(s), including incidents, daily/weekly, and final report. • Submits environmental monitoring reports to regulatory bodies.
Environmental Monitor (EM)	• Reports to the Project Manager on status of work and any environmental issues. • Communicates CEMP requirements to the Project Manager, and onsite workers, including contractors. • Completes or confirms completion of environmental orientation with onsite workers. • Provides corrective action advice to onsite staff and the Project Manager, where appropriate. • Has the authority to issue a Stop Work Order where activities are impacting, or may impact, water/sediment quality, fish/fish habitat, migratory birds, waterfowl, and other species. • Maintains records of site visits and non-compliances and environmental incidents. • Prepares weekly summary reports and the Completion Report. • Consults with other qualified professionals when implementing mitigation hierarchies (for example archaeology, raptors, adjusting timing windows).
Construction Personnel / Subcontractors	• Constructs works in accordance with approved engineering designs, permits and all relevant management plans. • Knows and supports BW Gold's environmental and health and safety requirements. • Notifies the Project Manager or Environmental Manager of any observed or potential non-compliances with permits and approvals. • Immediately reports incidents to the Project Manager or Environmental Manager and initiating an appropriate response. • Adheres to Stop Work Order. • Corrects deficiencies and any non-compliances upon direction from Project Manager or Environmental Manager.

The project owner/sponsor holds ultimate responsibility for ensuring that the ESCP is implemented. Water management will be planned and designed by the engineering design team, comprised of professional engineers registered in good standing with the Engineers and Geoscientists British Columbia. Roles and responsibilities with respect to ESC are described in Table 5.2.

Table 5.2 Erosion and Sediment Control Roles and Responsibilities

Role	Responsibilities
Project Sponsor	• Delegates responsibility to hired professionals (engineers, contractors, inspectors, etc.) who design, install, inspect, monitor, and decommission BMPs. • Obtain applicable permits and approvals. • Communicate with stakeholders and regulatory agencies, as required. • Liaise with Project Engineer, Project Manager, Contractors and EMs in relation to compliance with the ESCP to prepare reports in accordance with permitting requirements.
Project Engineer	• Develop a site wide water management plan showing the general arrangement of non-contact and contact water diversion ditches and sediment ponds. • Determine permits/approvals required and applies for them on behalf of the Project Sponsor. • Provide guidance on erosion and sediment control measures in accordance with established policies and best practices guidance. • Review the design and implementation of ESC measures (as specified by the EM) as it relates to on-going construction work. • Develop specifications and typical drawings for other water collection and conveyance structures (e.g., ditches, sumps) and stamps Issued for Construction drawings. • Review the effectiveness of implemented mitigation measures in consultation with the EM. • Review and approve on-site design modifications, communicates changes to appropriate approval agencies where required, and updates plans accordingly. • Develops contingency plans for certain stages or activities as needed.
Environmental Monitor (EM)	• Be a Certified Professional in Erosion and Sediment Control. • Specify erosion and sediment control measures, their sizing, and placement on site, and designs measures in accordance with established policies and best practices guidelines. • Prescribe field-fit erosion and sediment control measures. • Supervise the implementation of the ESC measures and document the completion of the ESCP and any field fit changes to the original work plan if they were required. • Conduct ongoing monitoring inspections to verify the effectiveness of the ESC measures and/or the need for additional works or contingency measures and monitor flow and water quality in the outlet of the Plant Site SCP, and infiltration in the discharge area. • Report to the Project Sponsor on the compliance of the construction activities with the environmental requirements during construction. • Temporarily halt work on identification of a non-compliant activity that has the potential to result in the release of a deleterious substance to a receiving waterbody. A formal Stop Work Order will be issued only if other forms of communication fail to resolve the problem, or if urgent attention needs to be focussed on resolving the problem. Recommend corrective measures to be taken to correct the non-compliant activity.
Construction Personnel / Subcontractors	• Install/construct measures based on approved plans and according to design specifications. • Ensure that their workers are appropriately trained, supervised, and have the necessary experience and competency to implement the requirements of the ESCP. • Provide input on construction-related aspects of ESCP implementation including labour, equipment and materials requirements, construction procedures and field constraints. • Inform the Project Sponsor and the Project Engineer if the conditions of the environment or construction practices change materially from that as anticipated under this ESCP and suggests ESC design modifications if needed. • Undertake corrective and preventative measures in response to non-conformances with the ESCP and ensure that such measures are implemented in a timely manner. • Corrects deficiencies and any non-compliances upon direction from Project Manager or Environmental Manager.

5.2 COMMUNICATION/TRAINING STRATEGY

All staff and subcontractors responsible for the management, implementation, monitoring, and reporting of erosion and sediment control measures will be experienced and will receive training specific to their roles in this plan prior to the commencement of their work.

5.3 ONSITE INSPECTION AND PLAN REVIEW

The success of the ESCP is dependent on monitoring of implemented BMPs. The Construction Personnel/Sub-Contractors and Environmental Monitor will inspect all erosion control measures periodically and after each significant runoff-producing rainfall event. For the purpose of this plan, a significant rainfall event will be considered as equal to or greater than the 1 in 2 year return period rainfall. Silt fences, sediment traps/basins, ditches, culverts, and SCP will be visually inspected for the following:

- Excess sediment build-up
- Structural/physical integrity
- Anticipated wear and tear

Sediment removal and proper disposal will be performed as required.

Once the ESC measures have been installed, their effectiveness will be monitored by the Environmental Monitor, and maintenance will be carried out, as necessary. All ESC measures and stream crossings, contact and non-contact water management structures, and snow dumps will be inspected by the Construction Personnel/Sub-Contractors and/or Environmental Monitor during and after significant rainstorms and during the snowmelt period during early works activities.

Immediate action will be taken by the Construction Personnel/Sub-Contractors when the need for maintenance or repair of ESC measures is identified for the ongoing performance of the measures. Monitoring will include but not be limited to the following:

- New erosion control prescriptions will be developed as needed based on encountered or anticipated erosion of disturbed soils, slopes, and ditches. Initial erosion will be inspected visually by searching for light surface material (litter or soil) movement, while sedimentation resulting from erosion will be determined by searching for deposition of soil particles at the bottom of slopes and depressions. Rilling, gullying, pedestalling, and unusual compaction are also indicators of erosion and will be recorded if and when observed.
- Sediment accumulation in ditches, check dams, and sumps will be identified, and maintenance actions will be recommended where needed.
- The physical integrity and stability of sediment pond components, including berms, outlet pipes, spillways, and downstream discharge channels.
- Sediment levels in the SCP will be measured monthly or prior to a predicted storm event to ensure that the minimum pond depth below the outlet pipe invert is present; sediment captured in traps will be removed in a timely manner.
- Revegetated areas will be monitored for evidence of wind and water erosion; remedial seeding and erosion-control measures will be applied when required.

The Environmental Monitor and Project Engineer will modify the ESCP when necessary, to reflect changing site conditions or new information which has been identified during construction. Any revisions to the ESCP will be communicated to ENV within 30 days. This plan, as a component of the Environmental Management System, will be reviewed annually, with any updates reported in the Annual Reclamation Report, in accordance with Condition C.1 (b) of Permit M-246. All substantive changes will be provided to the Chief Permitting Officer prior to implementation, in accordance with Condition C.5 (b) of Permit M-246.

BW Gold will conduct visual monitoring of the SCP daily while discharging to the RIBs and will conduct visual monitoring of the RIBs daily when there is effluent in the basins. Visual monitoring will include

monitoring for adequate infiltration, seepage, overland flow, and erosion in the area outside the SCP and RIBs. Daily inspections will be recorded and maintained on site for three years and will be made available to ENV staff upon request.

5.4 CONTINGENCY STRATEGIES AND RESPONSE

The design of erosion and sediment control measures should be viewed as a flexible process that responds to new information that is obtained throughout the construction phase. Contingency strategies for the Project will be active and adaptive, with ongoing inspection, maintenance, and re-evaluation for all BMP control measures and surrounding site conditions. If monitoring identifies that BMPs are not functioning adequately, the following steps will be taken:

- Confirm control measure/feature installed correctly
- Assess appropriate size or length/depth of control method with site circumstances
- Determine if alternate BMP/control method or contingency measures are required
- Assess if increased maintenance/inspections required

An inventory of ESC materials will be kept on site to address problems that may arise. The inventory list will be updated regularly to reflect a more accurate estimate of the quantities that should be stocked on site. The materials will provide a spectrum of measures to address a broad range of site conditions and severity.

5.5 CONSTRUCTION SEQUENCING

Construction activities will be performed in sequence to minimize the area of exposed soils. The Contractor will establish all ESC measures during the initial stages of construction to minimize sediment loading to natural watercourses. The planned order of early works construction activities is as follows:

1. Install ESC measures as shown on detail design drawings
2. Clear and strip work areas as required and link directly all ESC measures associated with each construction stage and area
3. Provide temporary erosion control measures for cut slopes
4. Construct Early Works components to design lines and grades shown on final Issued for Construction Drawings
5. Provide temporary erosion control measures for fill slopes
6. Complete final stabilization and seeding of disturbed surfaces and slopes
7. Reclaim temporary ESC measures

6.0 ENVIRONMENTAL MONITORING AND REPORTING

6.1 ON-GOING ENVIRONMENTAL MONITORING

BW Gold will continue to monitor surface water and groundwater quality as part of the baseline monitoring program that was implemented in 2011. The baseline monitoring program will transition into the surface water and groundwater program outlined in Appendix 9-E of the Joint Mines Act /Environmental Management Act Permits Application during construction and operation to meet the requirements of Section C.4 of permit M-246. The construction and operation water management and monitoring plan is designed to provide an early detection system and identify trends in surface water and groundwater quality so that potential impacts to the receiving environment can be investigated, mitigated, and avoided.

6.2 TRIGGER ACTION RESPONSE PLAN

6.2.1 SCHEDULED MONITORING

For this Early Works ESCP, a Trigger Action Response Plan (TARP) will be implemented for works in and around water, specifically clearing, grubbing, grading, and construction of the mine access road and associated bridges and mine site roads. Trigger-Response Plans are developed to plan appropriate actions used in response to observed changes in environmental conditions that are approaching or exceeding management objectives (ENV, 2019).

A performance-based approach will be used to assess the effectiveness of the ESCP. Effectiveness will be determined by the extent to which certain performance metrics – or targets – are being achieved. A receiving water target applies downstream of the construction site, in the water body to which the site drains. The key elements of a TARP (Ministry of Environment and Climate Change Strategy, 2019) are:

- Trigger: Identification of a clear threshold (location, water quality characteristic, level, frequency, duration)
- Action: Description of clear and time bound actions to be taken in response to a trigger being approached or exceeded
- Response: Clear process for determining and confirming if a trigger has been exceeded, a process for reporting the trigger exceedance; and a response that must be implemented

TSS is the parameter typically measured to assess effectiveness of ESC measures; determination of TSS requires collection of a water quality sample and analysis at an accredited laboratory. Water turbidity is often measured and used as a proxy for TSS, since *in situ* turbidity can be measured onsite with a handheld turbidity meter (in nephelometric turbidity units (NTUs)). The federal water quality guidelines for turbidity are extrapolated from the suspended sediment guidelines of a 25 mg/L and 5 mg/L change from background for short-term and long-term exposures, respectively, according to the suspended sediment and the general turbidity correlation of 3 to 1 (Canadian Council of Ministers of the Environment, 2002).

Because duration of exposure to elevated TSS and turbidity is a key factor in assessing aquatic impacts, as shown in Table 6.1, targets for construction runoff and downstream receivers will be an induced change in turbidity levels, in order to implement any needed corrective measures in a timely manner.

Table 6.1 Maximum Allowable Increase of TSS and Turbidity

Parameter	Background		
	Clear waters (TSS <25 mg/L Turbidity <8-NTU)	**Turbid waters (TSS 25-100 mg/L Turbidity 8-50 NTU)**	**Turbid waters (TSS >100 mg/L Turbidity >50 NTU)**
Total Suspended Solids (TSS)	• Change from background of 25 mg/L at any one time for a duration of 24 hours • Change from background of 5 mg/L at any one time for a duration of 30 days	• Change of background of 10 mg/L at any time	• Change from background of 10%
Turbidity	• Change from background of 8 NTU at any one time for a duration of 24 hours • Change from background of 2 NTU at any one time for a duration of 30 days	• Change of background of 5 NTU at any time	• Change from background of 10%

When turbidity levels exceed the induced change from 8 NTUs for a duration exceeding 24 hours, a water sample will be collected (an “action”) and submitted for laboratory analysis of TSS, turbidity, pH, conductivity, and total and dissolved metals, and temperature and dissolved oxygen will be measured in situ. Water quality will be sampled in the receiving watercourses upstream (to provide background levels where applicable) and downstream of the construction area runoff, within a maximum period of 30 minutes of each other, and the flow of the effluent and receiving water will be measured The water quality results for pH, total and dissolved metals, temperature, and dissolved oxygen will be evaluated for compliance with the provincial water quality guidelines for the protection of freshwater aquatic life.

In the event that a measurement is over the target listed in Table 6.1, a preliminary investigation (“response”) will take place to confirm whether the exceedance is valid (e.g., not simply a result of passing debris) and whether the construction site itself is the source of elevated turbidity measurements.

If the elevated turbidity level is valid and is a result of construction activities, the Environmental Monitor will inform the Project Manager or Field Manager, who shall cease all work that may have a direct or indirect impact on water quality, and immediately initiate additional mitigation actions. Upon confirmation of the exceedance, and no later than 10 hours after the exceedance began (or 10 hours after first light if the exceedance occurs at night), a preliminary notification will be sent out to other relevant parties (Project Sponsor). The notification will include:

- Date and time of inspection
- Site location information
- Timing, location, magnitude, and duration of turbidity exceedance
- Any information about suspected source of sediment
- Description of the repairs, maintenance and/or modifications of ESC measures planned in order to address the elevated sediment releases causing turbidity exceedances
- Estimated timing for the completion of repairs, maintenance and/or modifications

BW Gold will immediately notify the Chief Inspector of Mines if suspension of construction occurs due to environmental concerns in compliance with Condition C.2.(b) of Permit M-246. In addition, non-compliance reports will also be submitted to ENV at EnvironmentalCompliance@gov.bc.ca.

In the event that turbidity exceedances continue despite initial efforts to rectify ESC deficiencies, updated reports will be sent to the relevant parties daily until turbidity returns to the applicable target.

Depending on the site, the nature of the construction work, and the magnitude and duration of the exceedance, stop work orders may be issued if on-going exceedances are not rectified in a timely manner.

6.2.2 INCIDENT MONITORING

A TARP will also be implemented if signs of erosion are noted on site during the construction or operations phases outside of regular monitoring events. Three levels of qualitative triggers have been defined: examples of each trigger level and roles and responsibilities for the implementation of subsequent actions are summarized in Table 6.2.

Table 6.2 Incident Monitoring Triggers and Actions

Roles	• Trigger – Minor	• Trigger – Moderate	• Trigger – Major
First person On the Scene (First Responders) will assess conditions to determine the initial Trigger to be applied.	*Examples of Minor Triggers* *Freshet Preparation.* *Old and non-active erosion events.* *Small Rills, non-active.* *Equipment required is as per normal activities for maintenance and minor repairs.* *Small, easily manageable erosion events.* *Standing water in non-designated areas.*	*Examples of Moderate Triggers:* *Active ditch erosion.* *Existing Freshet Conditions.* *24-hr storm events >32 mm rain precipitation (2-Year return period).* *Conditions that are active and have the potential to cause operational changes due to access restrictions or have potential for threats to infrastructure.* *Standing water in non-designated areas that have potential for mobility or interfere with operations.*	*Examples of Major Triggers:* *Slopes with active gullies and erosion channels where large volumes of sediment including rock is entrained.* *Immediate threats to infrastructure.* *Major sedimentation threats to water bodies.* *24-hr storm events >50 mm rain precipitation (10-Year return period).* *Prolonged heavy rainfall events > 3 days.* *Standing water in non-designated areas that have potential for mobility or interfere with operations in high risk/critical areas.*
First Responder - First person on the scene who discovered the event. **Project Engineer** - Personnel designated to perform inspections.	1. Note areas where erosion event has occurred, notify Supervisor. 2. If possible redirect flows or correct event immediately. 3. Inspectors to note culverts that may be plugged and that may need attention to be ready for spring freshet flows. 4. Investigate source of erosion event as necessary to prevent repeats or to reduce/remove potential for larger event.	1. All Minor Response duties. 2. Provide immediate actions/assistance as necessary to minimize negative effects of erosion event if safe to do so. 3. Notify EPCM contractor of event including location, potential for damage, proximity to water body, and safety aspects.	1. All Moderate Response duties. 2. Prevent entry by non-essential personnel and maintain a safe distance. 3. If safe to do so, minimize negative effects. 4. Release the scene to Mine Rescue upon their arrival as necessary.
Contractor	1. Provide assistance to First Responder/Inspector as necessary.	1. All Minor Response duties. 2. Determine level of effort required to mitigate the hazard and repair the damage. 3. Organize mitigations/repairs. 4. Notify Environmental Manager, if associated with water bodies or in receiving environment. 5. Notify Mine Manager if event associated inside the pit or with catch benches or with tailings storage facility. 7. Notify department superintendent/superintendent as necessary.	1. All Moderate Response duties. 2. Depending on gravity of situation, initiate Mine Emergency Response Procedures. 3. Ensure safety of the First Responder and safety of the crew by preventing non-essential personnel from entering area. 4. Notify Engineering and Environmental Departments. 5. Notify Project Engineer.
Environmental Monitor	1. Schedule inspections and designate inspectors in fall periods for freshet readiness in spring. 2. Share notes of inspections with EPC Contractor and Construction Manager as necessary. 3. Review SEPSCP and revise as necessary. 4. Ensure revisions are communicated to all affected departments.	1. Respond to notifications for further inspection. 2. If sedimentation into waterbody, perform up and downstream samples for water quality to determine compliance. Note: Full suite samples may be necessary. 3. Direct environmental/erosion controls that may have to take place to mitigate impacts, reduce environmental hazard. 4. Record event and mitigations for reporting purposes.	1. All Moderate Response duties. 2. Notify Environmental Manager. 3. Prepare for and assist in receiving environment investigations and impact assessments.
Construction Manager	1. Schedule inspections and designate inspectors in fall periods for freshet readiness in spring. 2. Share notes of inspections with Environment Monitor as necessary.	1. Provide resources/guidance to event responders as necessary. 2. Determine if outside agencies are required to provide assistance. 3. Determine courses of action to prevent/mitigate damage to resources.	1. All Moderate Response duties. 2. Notify Environmental Manager. 3. Notify Safety Lead. 4. Notify Mine Manager.
Environmental Manager	1. Duties as normal.	1. Report event to external agencies, Indigenous groups as necessary.	1. All Moderate Response duties. 2. Provide recommendations to senior management on risks, mitigations and impacts.
Mine Manager	1. Duties as normal.	1. Duties as normal.	1. Notify Corporate Executive as necessary. 2. Ensure all necessary funding and resources are provided in an efficient manner.

6.3 SEDIMENT CONTROL POND DISCHARGE MONITORING

Given that the discharge from the Plant Site SCP is not to a water-course but rather to the RIBs, a specific trigger is not being considered to cease discharge from the SCP. Instead, turbidity will be used as an indicator to consider the implementation of potential contingency measures, such as the addition of flocculant. Some instances when the addition of flocculants can be added are during high flow events.

In the event that there is discharge from the SCP emergency spillway to the RIBs, BW Gold will notify the Director of Environmental Management Act Authorization – North Region within 24 hours at EnvAuthorizationsReporting@gov.bc.ca, in accordance with Section 3.1 of Permit 110602.

6.4 REPORTING

6.4.1 EARLY WORKS ACTIVITIES REPORTING

Reporting will be done in accordance with the CEMP – Early Works Phase (ERM, 2021). The Environmental Monitor will prepare weekly monitoring reports that will include a summary of environmental monitoring (e.g., date and time of each sample, weather conditions) and related results (e.g., receiving water results compared to Maximum Allowable Increase levels for any works in and around water, instrument calibration records, etc.), and documentation of all non-compliance instances, including the level of exceedance, the duration of exceedance, the mitigation measures taken, verification of the reporting of the exceedance and any related communications with regulators regarding the exceedance event, and future measures to be taken to avoid or control further exceedances.

Following completion of the early works construction activities, the Environmental Monitor will prepare a completion report that includes the following information specific to this ESCP:

- Maintenance activities
- Inspection results
- Assessment of the effectiveness of the BMPs based on the sampling results
- A brief description of ongoing activities at the site related to maintenance and monitoring of site areas

6.4.2 PERMIT 110602 ANNUAL REPORT

An Annual Report from the previous year will be submitted to the director within 60 days of the end of the calendar year. The Annual Report will include a summary outlining all the non-compliance report(s) required by Section 4.3 of Permit 110602, including any use of the emergency spillway. If no non-compliances have occurred this will be indicated in the report. The Annual Report will be submitted by email to the Ministry's Routine Environmental Reporting Submission Mailbox at EnvAuthorizationsReporting@gov.bc.ca or as otherwise instructed by the director.

6.4.3 PERMIT 110602 NON-COMPLIANCE NOTIFICATION AND REPORTING

BW Gold will immediately notify the director or designate by email at EnvironmentalCompliance@gov.bc.ca or as otherwise instructed by the director, of any non-compliance with the requirements of Permit 110602. BW Gold will immediately take remedial action to remedy any effects of such non-compliance. Written confirmation of all non-compliance events, including available test results, will be provided to the Director

within 24 hours of the original notification by email at EnvironmentalCompliance@gov.bc.ca, or as otherwise instructed.

A Non-Compliance Report will be submitted to the Director within 30 days of any non-compliance.

The non-compliance report will include:

a) An explanation of the most probable cause(s) of the noncompliance.
b) A description of remedial action planned and/or taken by the permittee to prevent similar noncompliance(s) in the future.

6.4.4 PERMIT M-246 COMPLIANCE STATUS REPORT

If suspension of construction occurs due to environmental concerns, BW Gold will immediately notify the Chief Inspector, as stipulated in Section C.2 (b) of Permit M-246.

BW Gold will track the compliance status of all permit conditions and inspection orders in a form acceptable to the Chief Inspector and maintain an up-to-date tracking table on site. The tracking table will be available at the mine site at all times and to a Mines Inspector upon request.

An annual Compliance Status report will be submitted to the Chief Inspector by March 31st of each year. The Annual report will include a summary of outstanding non-compliance issues and an action plan, for achieving compliance.

7.0 REFERENCES

B.C. Ministry of Energy, Mines and Petroleum Resources. 2020. Developing Management Plans for Mines in British Columbia - Erosion and Sediment Control Plan.

B.C. Ministry of Energy, Mines and Low Carbon Innovation. 2021. Health, Safety and Reclamation Code for Mines in British Columbia.

B.C. Ministry of Environment. 2015a. Technical Guidance 3 – Environmental Management Act – Developing a Mining Erosion and Sediment Control Plan. Version 1. Environmental Protection Division.

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8.0 CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared:

Stephanie Eagen, R.P. Bio.
Senior Environmental Scientist

Reviewed:

Jim Fogarty, P.Eng.
Senior Engineer

KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
1001011
EGBC PERMIT TO PRACTICE

Approval that this document adheres to the Knight Piésold Quality System:

APPENDIX A

Blackwater Gold Project – Plant Site Area and Sediment Control Pond – Site Characterization Summary

(Pages A-1 to A-26)

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

February 14, 2022

Mr. Alastair Tiver
Vice President Projects
BW Gold Ltd.
3085 - 595 Burrard Street
Vancouver, British Columbia
Canada, V7X 1L3

Knight Piésold Ltd.
Suite 1400 - 750 West Pender Street
Vancouver, British Columbia
Canada, V6C 2T8
T +1 604 685 0543
E vancouver@knightpiesold.com
www.knightpiesold.com

Dear Alastair,

RE: Blackwater Gold Project – Plant Site Area and Sediment Control Pond – Site Characterization Summary

1.0 INTRODUCTION

BW Gold Ltd. (BW Gold), a wholly owned subsidiary of Artemis Gold Inc. (Artemis), is developing the Blackwater Gold Project (the Project), which is located approximately 112 km southwest of Vanderhoof in central British Columbia (BC), as shown on Figure 1. The Project is a large gold-silver deposit, which is proposed to be developed as a conventional truck-shovel open pit mine with a gold processing plant. The ore will be processed in a plant by a combined gravity circuit and whole ore leaching to recover gold and silver into a gold-silver doré product.

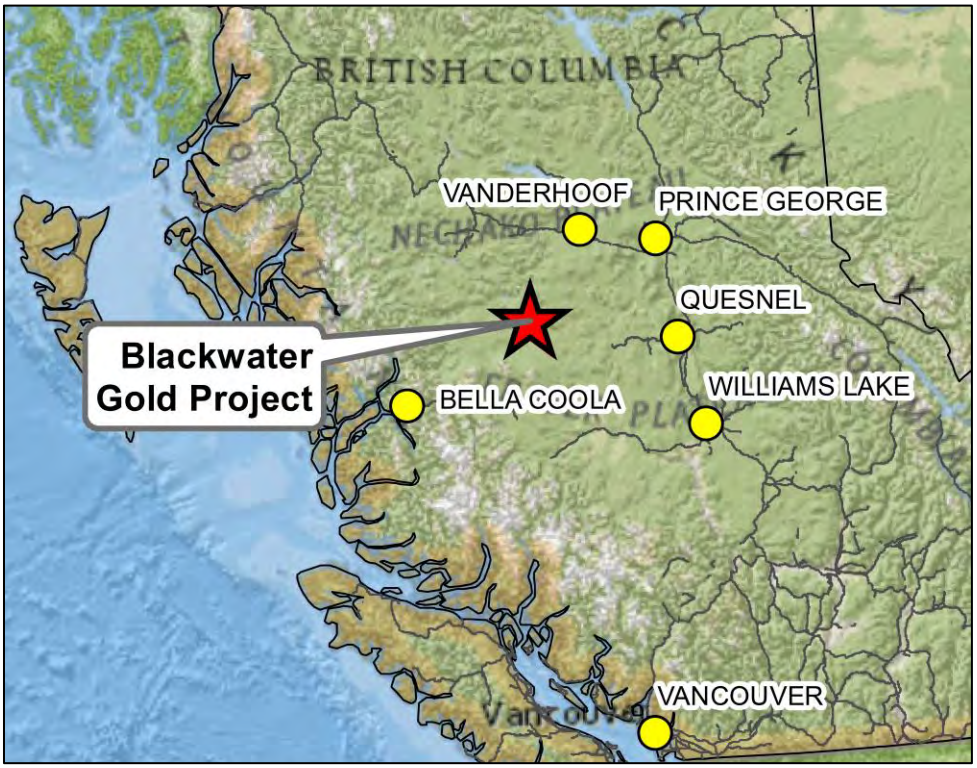


Figure 1 Project Location Map

The Blackwater area was actively explored by Richfield Ventures Corp. (Richfield) beginning in 2009. The Blackwater property was obtained by New Gold Inc. (New Gold) through the acquisition of Richfield in June 2011. Knight Piésold Ltd. (KP) was retained by New Gold beginning in early 2011 to provide technical support for the Project and has been involved continuously since early 2011 in various engineering and environmental aspects. Artemis entered into an asset purchase agreement in June 2020 to acquire Blackwater from New Gold. BW Gold is the holding entity for the mineral claims and was the party to the purchase agreement with New Gold. Artemis prepared a feasibility study in 2021 based on a revised approach to developing the Project. KP contributed to the design of the TSF and associated water management facilities for the 2021 Feasibility Study (the 2021 FS).

KP prepared the design of the plant site sediment control pond (SCP) and associated collection channels in the vicinity of the plant site area (KP, 2021a) and outlined additional concepts for several rapid infiltration basins (RIBs) (KP, 2021b) supporting an Early Works (EW) permit application. The *Mines Act* (MA) and *Environmental Management Act* (EMA) Permits were issued on June 22 and 24, 2021, respectively, authorizing the EW construction activities, including earthworks at the process plant location and the associated erosion and sediment control works designed by KP.

BW Gold submitted a joint *Mines Act* and *Environmental Management Act* Permits Application (the Joint Application) on November 26, 2021, seeking authorization for construction of the Project. KP prepared a report on the Plant Site Foundation Assessment (KP, 2021c), which was submitted with the Joint Application providing the characterization of the foundation conditions in the area and foundation design recommendations for the proposed process plant and associated infrastructure. The plant site area foundation characterization was informed by a geotechnical investigation conducted in the plant site area in February 2021. The factual data from this geotechnical investigation program was included in the 2020-2021 Geotechnical Site Investigation Data Report (KP, 2021d) and incorporated in the Dam Site Characterization Report (KP, 2021e), both of which were included in the Joint Application. The Dam Site Characterization Report compiles available geotechnical, geological, hydrogeological information for the mine site and provides a comprehensive assessment of the site conditions.

A supplemental test pitting program was completed in November 2021, including excavation of additional test pits in the plant site area and infiltration testing in two test pits to assess infiltration characteristics in the vicinity of the plant site SCP and RIBs. The factual data from the test pitting program is summarized in the Q4 2021 Test Pit Summary Letter (KP, 2022a). The location of the drillholes and test pits conducted in the plant site area are shown on Figure A.1 in Appendix A.

This letter report compiles all geological, geotechnical, and hydrogeological information collected from the site investigation programs and provides an updated characterization of the subsurface conditions at the plant site area, SCP, and RIBs.

2.0 SITE CONDITIONS

2.1 PHYSIOGRAPHIC SETTING

The Project site is situated on the Nechako Plateau, which is characterised by gently undulating northwest trending highlands dissected by small to medium sized valleys, drainages, and other low-lying areas. It features broad valleys with gentle slopes that have been shaped during glaciation. The elevation of the Blackwater property ranges from just over 1,000 m in low-lying areas northeast of the proposed mine site to 1,800 m at the summit of Mt. Davidson on the southwest side of the property. The Blackwater deposit is located on the northern flanks of Mt. Davidson.

The surficial deposits at the Project site are from the Fraser Glaciation, the last period of ice sheet glaciation in BC. The Cordilleran ice sheet covered the Blackwater mine area at the peak of the last (Fraser) glaciation approximately 19,000 years ago. At the peak of glaciation, the localized ice flow direction in the Project area was toward the northeast, as evidenced by drumlins, eskers, and other streamlined glacial landforms. Geomorphological evidence of glaciation suggests that at the height of the Fraser Glaciation, the ice elevation exceeded 1,750 masl, higher than most of the tallest peaks in the region.

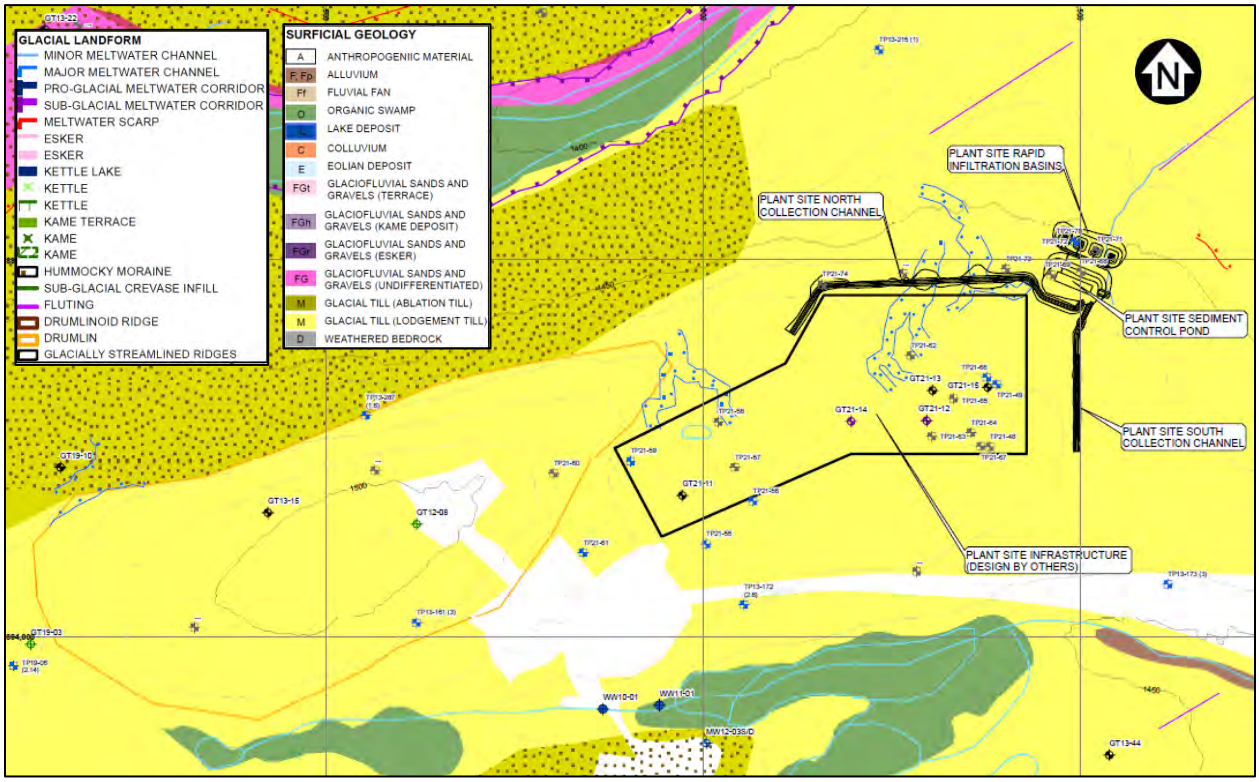
2.2 REGIONAL GEOMORPHOLOGY

Deglaciation commenced approximately 16,000 years ago and progressed by frontal retreat to the west or southwest towards the Coast Mountains and progressively lowering of the ice sheet surface by downwasting. The pattern of ice-marginal and subglacial meltwater channels indicates that areas of higher elevation in the vicinity of the mine site became ice-free before valley floors and other low-lying areas. Glacial ice appears to have stagnated in the Davidson Creek valley during late deglaciation producing ice stagnation landforms such as kettles and kames. The presence of eskers, kettles, and kames along this and other corridors shows that meltwater was largely confined in subglacial tunnels, rather than being proglacial. A large amount of glacial meltwater was channeled along Davidson Creek and other valleys in the area, producing eskers and meltwater channels.

Geomorphic evidence indicates that the meltwater corridors at the base of the stagnant ice mass evolved over the short period during which they were active. Downward-stepping terraces within some meltwater corridors show that active channel floors were progressively lowered by fluvial erosion as the ice melted. The lowest and youngest terraces may have formed in proglacial settings after the meltwater ceased to be confined by ice. Evidence also exists for shifts in meltwater discharge among the major meltwater corridors over this period. The oldest corridors lie somewhat higher than the Davidson Creek corridor and are truncated by it. The modern drainage system became established as soon as the area was fully deglaciated, probably around 13,000 years ago. Since then, there has been little geomorphic change in the study area (Clague, 2018).

2.3 LOCAL SURFICIAL GEOLOGY

The glacial landform mapping completed for the Project area indicates that the proposed plant site area is situated to the northeast of a drumlin landform. The primary surficial materials anticipated in the proposed plant site area comprise lodgement glacial till as evidenced by glacial fluting observed in the landform mapping. Minor meltwater channels, flowing towards the north, are present locally and differences in the surficial geology may be present in the vicinity of these channels. The surficial geology and landform map is shown on Figure A.2 in Appendix A.



Note(s):

1. Information shown on Figure 2 is available from the attached source Figure A.2 included in Appendix A.

Figure 2 Plant Site Area – Surficial Geology and Landform Map

2.4 REGIONAL SEISMICITY

The Project site is situated within a region of BC where the level of recorded historical seismic activity has been low. However, higher seismicity is associated with the Queen Charlotte - Fairweather fault system located offshore of the west coast of BC and the Alaskan panhandle. The level of seismicity in the interior of BC and the Rocky Mountains region drops off rapidly with distance from the west coast and to the north. The seismicity of southwestern BC associated with the Cascadia and Explorer subduction zones has the potential for large magnitude 8 to 9+ earthquakes, but too distant to make a significant contribution to the seismic hazard at the Project site. A detailed seismic hazard assessment for the Project site is presented in a separate KP report (KP, 2021f).

2.5 LOCAL BEDROCK GEOLOGY

Bedrock exposure is rare at the Project site and is typically restricted to higher elevation areas. Andesites of the Eocene Ootsa Lake Group are found at the eastern half of the proposed waste and management facilities including the proposed plant site area. Mudstones, sandstones, and conglomerates of the Jurassic Bowser Lake Group; and fragmentals and felsic tuff of the Late Cretaceous Kasalka Group are found at central and western parts of the Project site.

The structural geology of the Project area was interpreted by SRK Consulting (Canada) Inc. (SRK) in 2013 (SRK, 2013) based on a series of airborne magnetic, electromagnetic, and radiometric data sets. A

northeast striking fault is inferred to be present at the southern part of the plant site area based on the regional structural geology maps which incorporated SRK's interpretation (New Gold, 2014).

3.0 SUBSURFACE CONDITIONS

3.1 STRATIGRAPHY

The stratigraphy of the surficial materials and bedrock at the Project from surface downward is as follows:

- Holocene Deposits (Topsoil)
- Fraser Glaciation Deposits including
  - Glacial Till (includes Ablation Till, Lodgement Till, Undifferentiated Till)
  - Glaciofluvial
  - Glaciolacustrine
- Reworked Regolith
- Bedrock
  - Completely Weathered Bedrock
  - Highly Weathered Bedrock
  - Intact Bedrock

The surficial materials and bedrock at the proposed plant site area is described in Section 3.2 below. Cumulative detailed description of these materials found from the entire Project area can be found in the Dam Site Characterization Report (KP, 2021e).

3.2 MATERIAL AND FOUNDATION CONDITIONS

3.2.1 GENERAL

The geotechnical properties of the surficial material and bedrock at the plant site area were assessed using the information collected from the drillhole, test pits, and laboratory testing completed in 2021. Information from 23 test pits, 5 geotechnical drillholes, and 2 condemnation drillholes, completed at the vicinity of the plant site area, have been used characterize the material and foundation conditions at the plant site area. The associated drillhole and test pits divided into the infrastructure and the erosion and sediment control areas are summarized in Table 1 and shown on Figure A.1.

Table 1 Plant Site Drillhole and Test Pit Summary

Plant Site Areas	Drillhole Sites	Test Pit Sites
Main Infrastructure - Crusher, Ore Stockpile, Tanks, and Buildings	GT21-11 to GT21-15, CDH127	TP21-48, TP21-49, TP21-55 to TP21-61
Surface Water Management Structures - Collection Channels, Sediment Control Pond (SCP), and Rapid Infiltration Basins (RIBs)	CDH124	TP12-129, TP21-68 to TP21-74

The unit interval thicknesses are summarized in Table 2. The available laboratory index testing results and compaction results are summarized in Tables 3 and 4 and presented in Figures 2 to 4. In-situ downhole seismic testing results are summarized in Table 5. Descriptions of the surficial materials and bedrock units are provided in the sections 3.2.2 to 3.2.7.

Table 2 Plant Site – Unit Interval Thickness and Elevation Summary

Unit	Interval Thickness (mbgs)	Top Elevation (masl)
Topsoil	0.2 - 0.5	1,487.0 – 1,450.0
Glacial Deposits	0.5 – 46.1	1,486.7 – 1,449.7
Reworked Regolith	2.4 – >4.6	1,455.3 – <1,424.0
Bedrock (Highly and Intact)	-	1,452.4 – 1,425.6

Table 3 Plant Site – Laboratory Index Testing Summary

Unit	Particle Size Distribution (% Retained)				Moisture Content (%)	Atterberg Limits	Specific Gravity
	Total Test Count	Gravel	Sand	Fines		Plasticity Index, PI (%)	
Ablation Till	4	32	44	21	8	NP	2.6
Lodgement and Undifferentiated Till	20	29	36	35	9	7	
Glaciofluvial	1	23	66	11	9	-	-
Glaciolacustrine	1	0	69	31	21	NP	2.6
Reworked Regolith	4	24	37	39	10	-	-

Note(s):

1. Average values shown.

Table 4 Plant Site – Laboratory Compaction Testing Summary

Unit	Standard Proctor		
	Total Test Count	Corrected Maximum Dry Density (kg/m^3)	Corrected Optimum Moisture Content (%)
Ablation Till	7	2110-2270 (2180)	6-10 (7)
Lodgement and Undifferentiated Till			
Glaciofluvial	-	-	-
Glaciolacustrine	-	-	-
Reworked Regolith	-	-	-

Note(s):

1. Minimum and maximum values shown. Average value shown in brackets.

Table 5 Plant Site - Downhole Seismic Testing Summary

Unit	Downhole Seismic Testing	
	Data Points Count	Shear Wave Velocity, Vs (m/s)
Ablation Till	2	463-531 (500)
Lodgement and Undifferentiated Till	59	406-1044 (800)
Glaciofluvial	-	-
Glaciolacustrine	-	-
Reworked Regolith	1	1038

Note(s):

1. Minimum and maximum values shown. Average value shown in brackets.

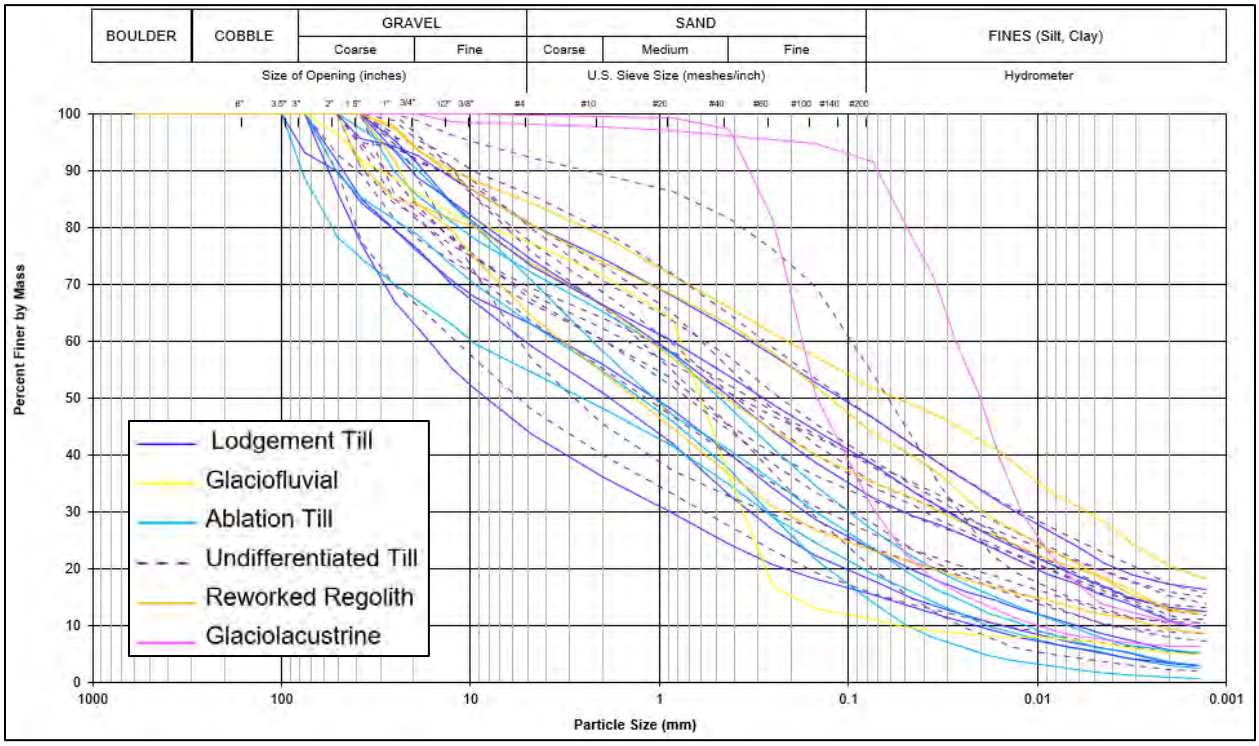


Figure 3 Plant Site Samples – Particle Size Distribution

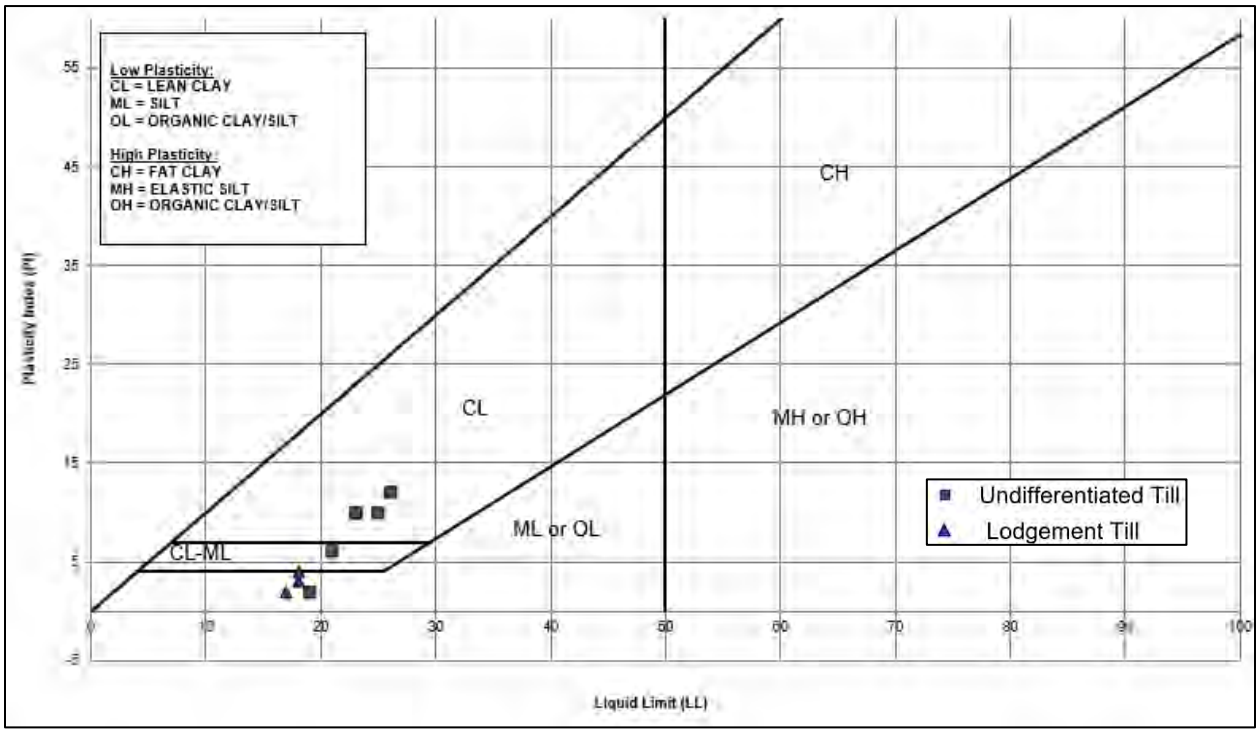


Figure 4 Plant Site Samples – Plasticity Chart

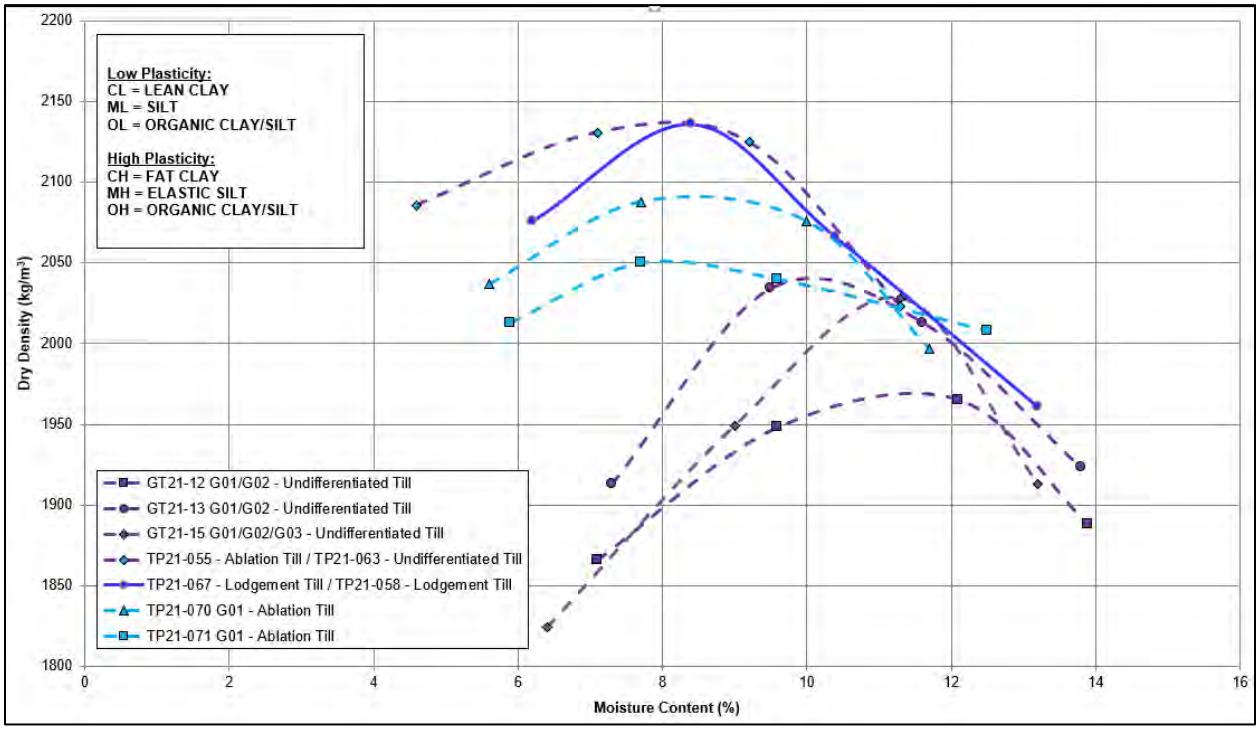


Figure 5 Plant Site Samples – Compaction Data

3.2.2 TOPSOIL

A topsoil layer varying in thickness from 0.2 to 0.5 m is present over the entire proposed plant site area, and generally observed to be orangey brown to light grey organic layer with fine to medium sand and trace silt and gravel with root inclusion. Wetland organic material was observed at test pit TP21-59 consisting of black, spongy, moist to saturated, silty peat material.

3.2.3 GLACIAL DEPOSITS

Glacial sequences were identified with thicknesses ranging from 0.5 m to the west and increasing in depth to up to 46 m to the east of the proposed plant site area. The glacial sequences are predominantly composed of glacial till with minor interlayers of glaciolacustrine units and shallow glaciofluvial deposits.

- **Glacial Till** – Glacial till is the dominant overburden material encountered across the site, immediately below the topsoil layer, and includes ablation till, lodgement till, and undifferentiated till. The glacial till materials.
  - Ablation till is present at surface with thickness ranging from 0.5 to 5.5 m. Ablation till is present at the northern and western part of the plant site area. These deposits were observed to be well graded, non-plastic, greyish brown to orangey brown, massive, moist, compact, gravelly sand to sandy gravel material with trace silt and cobbles. Particle size distribution data shows grain size composition averages of 32% gravel, 44% sand, and 21% fines. The ablation till was tested with an average moisture content of 8% and is non-plastic.

- Lodgement and undifferentiated till occur below at depth throughout the site with interval thickness ranging from 18.1 to 45.8 m and increasing depth towards the eastern part of the plant site area with a maximum depth of 46.1 mbgs. These deposits were observed to be gap graded to well graded, non-plastic to medium plasticity, dark brown to greyish brown, massive, moist, stiff to very still gravelly sandy silt material to compact to dense gravelly silty sand material. Particle size distribution data shows grain size composition averages of 29% gravel, 36% sand, and 35% fines. An average moisture content of 9% and plasticity index of 7% was determined for the tested samples of lodgement and undifferentiated till materials.
- Standard proctor testing of the glacial till materials resulted in an average corrected maximum dry density of 2,180 kg/m^3 and an average optimum moisture content of 7%. Specific gravity testing resulted in an average of 2.6.
- Downhole seismic testing completed in the glacial till materials yielded a range in shear wave velocity from 406 to 1044 m/s. The shear wave velocity in the ablation till material has an average of approximately 500 m/s while the lodgement and undifferentiated tills have an average of approximately 800 m/s.

- **Glaciofluvial Deposits -** Glaciofluvial (undifferentiated) deposits were encountered close to surface at two test pits (TP21-49 and TP21-72) located at the northeastern part of the plant site area. These deposits correspond to the minor meltwater channels with flow direction towards the north. These glaciofluvial deposits were observed to be well graded, non-plastic, massive, light to greyish brown, compact, moist to wet, sand and gravel to gravelly sand material. Particle size distribution data shows grain size composition averages of 23% gravel, 66% sand, and 11% fines. Laboratory testing of the glaciofluvial deposit samples indicate an average moisture content of 9%.
- **Glaciolacustrine Units -** A localized 1-m thick layer in between glacial till layers was encountered in drillhole GT21-15 only located at the eastern part of the plant site area, at a depth of approximately 16 mbgs and at a top elevation of 1,454 masl. This glaciolacustrine unit was observed to be uniformly graded, non-plastic, indistinctly laminated, brown, moist, sand with some silt material. A surficial 0.5-m thick possible glaciolacustrine layer overlying ablation till was encountered in test pit TP21-59 at the western part of the plant site area at a top elevation of 1,478 masl. This unit was observed to be uniformly graded, indistinctly stratified, low to medium plasticity, greyish brown, soft to firm, moist to wet, sandy silt material. Particle size distribution data shows grain size composition averages of 0% gravel, 69% sand, and 31% fines. The glaciolacustrine unit was tested with an average moisture content of 21% and is non-plastic. One specific gravity test in the glaciolacustrine unit resulted in a value of 2.6.

3.2.4 REWORKED REGOLITH

The Fraser glacial sequence rests on a reworked weathered bedrock horizon termed as “reworked regolith”. The reworking is due to gravitational and perhaps glacial overriding on top of the weathered bedrock. This unit was encountered in four of the five drillholes within the plant site area with thickness ranging from 2.4 to greater than 4.6 m. The reworked regolith was observed to be gap graded, low to medium plasticity, massive, moist, mottled dark brown to reddish grey with iron oxide staining. Particle size distribution data shows grain size composition averages of 24% gravel, 37% sand, and 39% fines. Laboratory testing indicates an average moisture content of 10% for the reworked regolith material. One downhole seismic data point was collected in the reworked regolith resulting in a shear wave velocity of 1,038 m/s.

3.2.5 BEDROCK

The bedrock at the site is categorized into completely weathered, highly weathered, and intact bedrock depending on weathering and strength characteristics. Completely weathered bedrock is absent in topographically high areas such as the plant site area where it was not encountered. Highly weathered bedrock was intercepted in drillhole GT21-12 at a depth of 46.9 mbgs and an elevation of 1,426 masl located at the southeastern part of the plant site area. The bedrock surface deepens to the east where condemnation drillhole CDH127 intercepted bedrock at a depth of 65.5 mbgs and an elevation of 1,406 masl. A condemnation drillhole CDH124 located at the plant site SCP intercepted bedrock at a depth of 81.1 mbgs and an elevation of 1,371 masl.

Bedrock is higher to the west of the plant site area as intercepted in drillholes GT12-11 and GT12-14 at 26 mbgs (1,450 masl) and 22.6 mbgs (1,452 masl), respectively. Bedrock was encountered close to surface in two test pits further west with a depth of 1 mbgs (1,486 masl) in TP21-60 and a depth of 1 mbgs (1,483 masl) in TP21-61. The bedrock lithology is predominantly andesite which can generally be described as a strong rock with 'FAIR' RMR_{89} Rating (KP, 2021e).

3.3 GROUNDWATER CONDITIONS

Groundwater elevations were measured in open holes during and immediately after the February 2021 drilling program. The open hole groundwater levels varied from 6 m to 38 mbgs. Artesian conditions were not observed. VWPs were installed after the completion of drillholes GT21-12 and GT21-14 and the measured static groundwater levels in October 2021 were 30 mbgs (1,443 masl) and 25 mbgs (1,450 masl), respectively.

Groundwater seepage was observed at depths from 0.5 to 3 mbgs in test pit TP21-59 located at the western part of the plant site area where it is near a wetland. Groundwater seepage was also observed at depths from 1 to 2 mbgs in the highly weathered bedrock in test pit TP21-61. Minor groundwater seepage was observed at depths ranging from 1.25 to 2.5 mbgs in five other test pits (TP21-49, TP21-55, TP21-56, TP21-66, and TP21-72) throughout the plant site area. The seepage was generally observed in ablation till and undifferentiated till overlying a lodgement/undifferentiated till unit.

Infiltration testing was completed in the ablation till material in test pits TP21-70 and TP21-71 at the northern plant site RIB area. The results of the test pit infiltration tests show an average infiltration rate of 0.004 m/hr for TP21-70 and 0.04 m/hr for TP21-71, which corresponds to an estimated annual hydraulic loading of 35 m/year for TP21-70 and 336 m/year for TP21-71. The materials encountered in the two test pits were similar, and the variability in results may be due to differences in material underlying the test pits. A meltwater channel is located in close proximity to TP21-71 and may influence the infiltration capacity on the eastern side of the proposed plant site SCP and RIBs.

The RIB design contemplates an average annual hydraulic loading rate of approximately 88 m/year (KP, 2021b), which was based on the results of previous investigations at the site. The infiltration tests completed in 2021 indicate that the average hydraulic loading rate is reasonably consistent with local site conditions, but that local variability could be expected to influence operational performance of the RIBs. No changes to RIB land area requirements are recommended based on the results of the investigations; however, it is recommended that the SCP outlet works incorporate sufficient flow isolation and control components to manage hydraulic loading to the individual RIBs consistent with their observed performance. Larger scale infiltration testing should be incorporated in the initial performance monitoring of the

constructed RIBs, and the results should be considered in the operations, maintenance, and surveillance plans for the Plant Site SCP and RIBs.

4.0 SUMMARY AND CONCLUSIONS

This updated site characterization for the proposed plant site area and associated erosion and sediment control works at Blackwater was prepared based on the results of the 2020-2021 geotechnical investigation program and the more recent Q4 2021 test pitting program. The characterization of the plant site area remains consistent with the previous assessment (KP, 2021c) and confirms the previously inferred characteristics of the foundation materials present at the proposed Plant Site SCP and RIBs.

The proposed facilities will be founded on glacial deposits comprising mainly till, localized surficial glaciofluvial deposits at the northeastern part, and localized minor discontinuous glaciolacustrine sediments. The bedrock at the proposed plant site area is characterized as a strong, slightly to highly weathered andesite where it is closer to surface to the west and as deep as 66 mbgs to the southeast and 81 mbgs to the northeast at the plant site SCP area. Groundwater levels are expected to be deep in the area with measured depths ranging from 25 to 30 mbgs at two sites; however, there the potential for shallower layers with perched water above this depth as indicated by the minor groundwater seepage observations in several of the test pits.

Please do not hesitate to contact the undersigned with any questions regarding this letter report.

Yours truly,
Knight Piésold Ltd.

Prepared: _____
Joseph Cristobal, P.Eng.
Senior Engineer

Reviewed: _____
Daniel Fontaine, P.Eng.
Specialist Engineer | Associate

Approval that this document adheres to the Knight Piésold Quality System: DDF

Attachments:

Appendix A	Reference Plan Maps
Appendix B	Site Characterization Assurance Statements

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SRK Consulting (Canada) Inc. . (2013). Structural Geology Interpretation of the Blackwater and Capoose Areas, British Columbia dated September 20, 2013. Proj. No. 3CN021.001. Toronto.

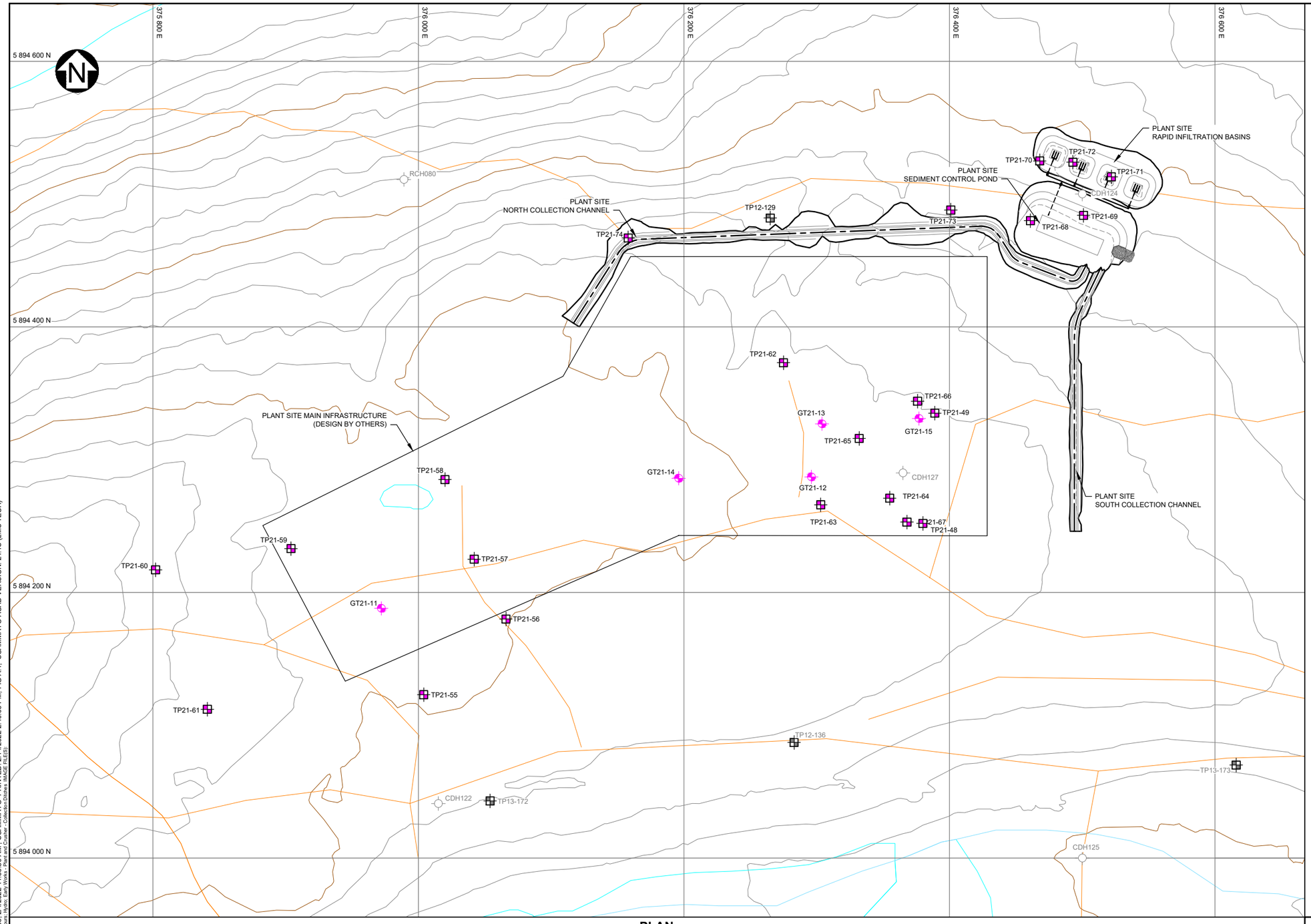
Copy To: Ryan Todd, Travis Desormeaux, Alex Kourline

/jbc

APPENDIX A

Reference Plan Maps

(Figures A.1 to A.2)



PLAN
SCALE A

LEGEND:

- 2021 GEOTECHNICAL SONIC DRILLHOLE
- HISTORICAL CONDEMNATION DRILLHOLE
- 2021 TEST PIT
- 2020 TEST PIT
- 2019 TEST PIT
- 2013 TEST PIT
- 2012 TEST PIT
- EXISTING ACCESS TRAILS

NOTES:

1. COORDINATE GRID IS UTM NAD83, ZONE 10U.
2. CONTOUR INTERVAL IS 5 METRES.
3. EXISTING GROUND BASE ON LIDAR TOPOGRAPHY PROVIDED BY EAGLE MAPPING LTD. (AUGUST 2011).
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE MAIN INFRASTRUCTURE FOOTPRINT PROVIDED BY AUSENCO (MAY 2021).
6. PLANT SITE EROSION AND SEDIMENT CONTROL STRUCTURES BASED ON IFC DRAWINGS INCLUDED IN KP MEMORANDUM VA22-00058 (JANUARY 2022).

FOR INFORMATION ONLY

SCALE A: 200 100 0 200 400 600 800 1000 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	14FEB'22	ISSUED WITH LETTER	JBC	SKC	DDF

BW GOLD LTD.

BLACKWATER GOLD PROJECT

PLANT SITE GENERAL ARRANGEMENT DRILLHOLE AND TEST PIT PLAN

Knight Piésold CONSULTING

P/A NO. VA101-457/36 | REF NO. VA22-00111

FIGURE A.1 | REV 0

SAVED: M:\101\00457\36\A\Acad\FIGS\B06 2/4/2022 11:56:50 AM SCAMMAYO PRINTED: 2/14/2022 2:40:06 PM, FIG A.1 SCAMMAYO ACAD VERSION: 24.1S (LMS TECH)
XREF FILE(S): Existing Roads & Trails, 2020 Topo Grid Contours, Hydro, Early Works - Plant and Crusher - Collection Ditches (IMAGE FILE(S))

PLANT SITE RAPID INFILTRATION BASINS

PLANT SITE NORTH COLLECTION CHANNEL

PLANT SITE SEDIMENT CONTROL POND

PLANT SITE SOUTH COLLECTION CHANNEL

PLANT SITE INFRASTRUCTURE (DESIGN BY OTHERS)

GT13-22
TP13-272 (3)
TP13-285 (0)
TP13-284 (1.4)
GT13-46
TP13-287 (1.6)
GT19-10
GT13-15
GT12-08
TP21-60
TP21-59
TP21-58
TP21-57
GT21-11
TP21-56
TP21-55
TP21-61
TP13-161 (3)
GT19-03
TP19-06 (2.14)
TP13-172 (2.6)
WW10-01
WW11-01
MW12-03S/D
TP13-215 (1)
TP21-74
TP21-73
TP21-62
TP21-66
GT21-13
GT21-15
TP21-65
TP21-49
GT21-14
GT21-12
TP21-64
TP21-63
TP21-48
TP21-67
TP21-70
TP21-72
TP21-71
TP21-69
TP21-68
TP12-118 (1.5)
TP13-173 (3)
DK/MW-05
GT13-44

1400
1450
1500

375,500
376,000
376,500
377,000
5,894,500
5,894,000

N

GLACIAL LANDFORM
- MINOR MELTWATER CHANNEL
- MAJOR MELTWATER CHANNEL
- PRO-GLACIAL MELTWATER CORRIDOR
- SUB-GLACIAL MELTWATER CORRIDOR
- MELTWATER SCARP
- ESKER
- ESKER
- KETTLE LAKE
- KETTLE
- KETTLE
- KAME TERRACE
- KAME
- KAME
- HUMMOCKY MORAINE
- SUB-GLACIAL CREVASE INFILL
- FLUTING
- DRUMLINOID RIDGE
- DRUMLIN
- GLACIALLY STREAMLINED RIDGES

SURFICIAL GEOLOGY
- A — ANTHROPOGENIIC MATERIAL
- F, Fp — ALLUVIUM
- Ff — FLUVIAL FAN
- O — ORGANIC SWAMP
- L — LAKE DEPOSIT
- C — COLLUVIUM
- E — EOLIAN DEPOSIT
- FGt — GLACIOFLUVIAL SANDS AND GRAVELS (TERRACE)
- FGh — GLACIOFLUVIAL SANDS AND GRAVELS (KAME DEPOSIT)
- FGr — GLACIOFLUVIAL SANDS AND GRAVELS (ESKER)
- FG — GLACIOFLUVIAL SANDS AND GRAVELS (UNDIFFERENTIATED)
- M — GLACIAL TILL (ABLATION TILL)
- M — GLACIAL TILL (LODGEMENT TILL)
- D — WEATHERED BEDROCK

Legend

GENERAL
- CONTOUR 50 m
- CONTOUR 10 m
- RIVER/STREAM
- TEST PIT (NO SEEPAGE OBSERVED)
- TEST PIT (SEEPAGE OBSERVED)
- STOCKPILE
- OPEN PIT
- SURFICIAL GEOLOGY STUDY AREA

GROUNDWATER MONITORING SITES
- DRILLHOLE WITH VIBRATING WIRE PIEZOMETER
- DRILLHOLE WITH NO INSTALLATION
- DRILLHOLE WITH STANDPIPE PIEZOMETER
- DRILLHOLE WITH WIRE PEIZOMETER NESTED STANDPIPE PIEZOMETER
- MONITORING WELL
- WELL

50 25 0 50 100 150 200 Meters

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	14FEB'22	ISSUED WITH LETTER	JBC	KK	JEH

NOTES:
1. BASE MAP: SURFICIAL GEOLOGY TAKEN FROM DRAWING 0002 (VA19-01017).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:5,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. INFORMATION SHOWN IS BASED ON TERRAIN MAPPING AS SUMMARIZED IN KP REFERENCE NO. VA19-01017.
5. PROPOSED MINE SITE GENERAL ARRANGEMENT FROM TSF LIFE OF MINE DESIGN REPORT DATED AUGUST 2021. TS = TOPSOIL STOCKPILE.
6. PLANT SITE MAIN INFRASTRUCTURE FOOTPRINT PROVIDED BY AUSENCO (MAY 2021).
7. PLANT SITE EROSION AND SEDIMENT CONTROL STRUCTURES BASED ON IFC DRAWINGS INCLUDE IN KP MEMORANDUM VA22-00058 (JANUARY 2022).

BW GOLD LTD.

BLACKWATER GOLD PROJECT

SURFICIAL GEOLOGY AND LANDFORM MAP PLANT SITE

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-457/36	VA22-00111

FIGURE A.2 REV 0

SAVED: \\knightpiesold.local\VA-Prj$\101\00457\36A\GIS\Figs\VA22-00111\Fig A2_PlantSiteSurficialGeologyAndLandformMap_R0.mxd: Feb 14, 2022 2:18 PM: kkrauszova

APPENDIX B

Site Characterization Assurance Statements

Appendix B1	Design Engineer Assurance Statement (CP)
Appendix B2	Supporting Registered Professional's Assurance Statement (DDF)
Appendix B3	Supporting Registered Professional's Assurance Statement (JBC)

APPENDIX B1

Design Engineer Assurance Statement (CP)

(Pages B1-1 to B1-3)

APPENDIX B1 – DESIGN ENGINEER'S SITE CHARACTERIZATION ASSURANCE STATEMENT FOR PLANT SITE AREA AND SCP

Note: This statement is based on the template provided in the *Site Characterization for Dam Foundations in BC* guideline (APEGBC, 2016).

To: The Owner(s) Date: February 14, 2022

Name: BW Gold Ltd.

Address: 595 Burrard St #3083

Vancouver, British Columbia, Canada, V7X 1L3

For the dam:

UTM (Location):	Approximately 376 500 E, 5 894 485 N (Coordinate grid is UTM (NAD83) Zone 10)
Located at (Description):	Blackwater Gold Project
Name of dam or description:	Plant Site Area – Sediment Control Pond and Infiltration Basins
Provincial dam number:	Not applicable (not yet constructed)
Dam function:	Surface Water Management

(Herein referred to as "the Dam")

Current project stage is:

(Check one)

☐ Feasibility design

✓ Detailed design

☐ Construction/operations

The undersigned hereby gives assurance that he is a qualified EGBC-registered professional and is a professional engineer and is the **Design Engineer** for the dam project identified above. The following reports must be read in conjunction with this Assurance Statement:

- I have reviewed and accepted the characterization letter report [Blackwater Gold Project – Plant Site Area and Sediment Control Pond – Site Characterization Summary, Ref. No. VA101-457/36, Cont. No.: VA22-00111, February 14, 2022] in accordance with the *EGBC Professional Practice Guidelines – Site Characterization for Dam Foundations in BC*.
- I have prepared, reviewed, signed, sealed, and dated the detailed design letter [Surface Water Management and Sediment Control Design Report for the Plant Site Early Works, Ref. No. VA101-457/33, Cont. No.: VA21-00232, February 5, 2021], the conceptual design letter [Rapid Infiltration

Concept for the Plant Site Sediment Collection Pond Discharge, Ref. No. VA101-457/33, Cont.: VA21-00711, April 20, 2021] and the [Plant Site Early Works Erosion and Sediment Control Engineering Work Plan, Ref. No. VA101-00457/36, Cont. No.: VA22-00058] to assist with an application for *Mines Act* and *Environmental Management Act* permits associated with the Early Works construction activities at the project site.

In preparing the site characterization letter report, I have completed the following activities:

(Check the applicable items)

Completed by the Design Engineer	Activity
✓	Collected and reviewed available and relevant background information, documentation, and data
☐	Visited the site and reviewed the conditions in the field that may be relevant for site characterization
☐	Developed and executed a site characterization program that provides information to support the design of the dam, subject to the qualifications noted
✓	Reviewed previous site characterization studies and data and updated the dam site characterization assessment report to include all data and, where appropriate, revised interpretations of data
✓	Assessed potential areas of risk identified during site characterization programs to date and, as far as is practical, addressed the risks
✓	Evaluated the level of complexity of the site and documented how it was assessed and supported by the site characterization program(s)
✓	Reviewed and accepted all assurance statements submitted by the supporting registered professionals (SRPs)
☐	Prepared a data record report
☐	Prepared the dam site characterization report, which interprets the site conditions

In preparing the site characterization letter report, I have completed the following activities or reviewed and accepted such activities completed by a supporting registered professional (SRP):

(Check the applicable items)

Completed by the Design Engineer	Completed by the SRP, and reviewed and accepted by the Design Engineer	Activity
☐	✓	1. Assessed the surficial and bedrock geological models to confirm that they adequately support the understanding of the spatial variability of the geotechnical properties of the foundation materials
☐	✓	2. Carried out sufficient in situ and laboratory testing to quantify the geotechnical properties of the foundation materials
☐	✓	3. Assessed the strength properties of the foundation materials with consideration of stress state and response to loadings
☐	✓	4. Assessed the hydrogeological properties of the foundation materials with consideration of potential hydraulic gradients, artesian pressures, and seepage flow paths
☐	✓	5. Assessed the seismotectonic conditions to provide a basis for the seismic hazard analysis of the dam
✓	✓	6. Evaluated the level of complexity of the site and documented how it was assessed and supported by the site characterization program(s)

✓	☐	7. Reviewed and accepted all assurance statements submitted by the supporting registered professionals (SRPs)
☐	✓	8. Prepared a data record report
☐	✓	9. Prepared the dam site characterization report, which interprets the site conditions

I hereby give my assurance that based on the site characterization letter, at this point in time:

(Check one)

✓ The site characterization letter report is reasonably comprehensive and supports the design of the facility.

Comments:

- This is the first site characterization assurance statement prepared for this facility.
- It is recommended that larger scale infiltration testing should be incorporated in the initial performance monitoring of the constructed infiltration basins, and the results should be considered in the operations, maintenance, and surveillance plans for the Plant Site Sediment Control Pond and Rapid Infiltration Basins.

☐ The dam site characterization report is not sufficiently comprehensive to support the design of the Dam, in that the dam site characterization report identifies areas of potential concern that require additional investigation as set out in section(s) _____ of the attached dam site characterization report

Name: Carlos Penate, M.Eng., P.Eng.

Signature: Date: February 14, 2022

Address: 1400-750 West Pender Street

Vancouver, British Columbia, Canada, V6C 2T8

Telephone: +1 (604) 685-0543

Email: cpenate@knightpiesold.com

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
45299

2022-02-14

(If the EGBC professional is a member of a firm, complete the following:)

I am a member of the firm Knight Piésold Ltd. and I sign this letter on behalf of the firm.

APPENDIX B2

Supporting Registered Professional's Assurance Statement (DDF)

(Pages B2-1 to B2-2)

APPENDIX B2 - SUPPORTING REGISTERED PROFESSIONAL'S ASSURANCE STATEMENT OF PROFESSIONAL SERVICES

To: The Design Engineer Date: February 14, 2022

Name: Carlos Penate, P.Eng.

Address: 1400-750 West Pender Street
Vancouver, British Columbia, Canada, V6C 2T8

For the dams:

UTM (Location):	Approx. 376 500 E, 5 894 485 N (Coordinate grid is UTM (NAD83) Zone 10)
Located at (Description):	Blackwater Gold Project
Name of dam or description:	Plant Site Area – Sediment Control Pond and Infiltration Basins
Dam function:	Surface Water Management
Owned by:	BW Gold Ltd.

Current project stage is:

(Check one)

- ☐ Feasibility design
- ✓ Detailed design
- ☐ Construction/operations

This is to advise that the undersigned is a supporting registered professional (SRP) retained by Knight Piésold Ltd. to carry out supporting professional services for the dam.

I undertook supporting professional services in the following:

(Check applicable sections)

- ☒ Bedrock/structural geology
- ☒ Surficial geology
- ☒ Geotechnical investigations
- ☐ Hydrogeology
- ☐ Seismotectonic investigations
- ☒ Other [preparation of site characterization letter report]

The undersigned herby gives assurance that the supporting professional services indicated above and the documents prepared by this supporting registered professional for the project, including preparing the characterization letter report [Blackwater Gold Project – Plant Site Area and Sediment Control Pond – Site Characterization Summary, Ref. No. VA101-457/36, Cont. No.: VA22-00111, February 14, 2022], have been carried out in a manner that meets the intent of the applicable EGBC guidelines and good professional practice.

These professional services are described, and the results of them reported on in the documents prepared by me, or under my direct supervision, which bear my professional seal.

(With respect to field reviews, initial the following statements, as applicable. Leave blank those that are not applicable.)

☐ Field review(s) are not applicable

✓ Field review(s) are applicable:

- ✓ I have performed field review(s) for the services identified above.
- ☐ Field review(s) have been performed by _____.

I confirm that I have communicated and liaised as required with the appropriate EGBC professionals for the purposes of my services.

I hereby give my assurance that I am an EGBC-registered professional.

Name: Daniel Fontaine, P.Eng.

Signature: DF Date: February 14, 2022

Address: 1400-750 West Pender Street
Vancouver, British Columbia, Canada, V6C 2T8

Telephone: +1 (604) 685-0543

Email: dfontaine@knightpiesold.com

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
2022-02-14
D. D. FONTAINE
36208

(If the EGBC professional is a member of a firm, complete the following:)

I am a member of the firm Knight Piésold Ltd. and I sign this letter on behalf of the firm.

APPENDIX B3

Supporting Registered Professional's Assurance Statement (JBC)

(Pages B3-1 to B3-2)

APPENDIX B3 - SUPPORTING REGISTERED PROFESSIONAL'S ASSURANCE STATEMENT OF PROFESSIONAL SERVICES

To: The Design Engineer Date: February 14, 2022

Name: Carlos Penate, P.Eng.

Address: 1400-750 West Pender Street

Vancouver, British Columbia, Canada, V6C 2T8

For the dams:

UTM (Location):	Approx. 376 500 E, 5 894 485 N (Coordinate grid is UTM (NAD83) Zone 10)
Located at (Description):	Blackwater Gold Project
Name of dam or description:	Plant Site Area – Sediment Control Pond and Infiltration Basins
Dam function:	Surface Water Management
Owned by:	BW Gold Ltd.

Current project stage is:

(Check one)

- ☐ Feasibility design
- ✓ Detailed design
- ☐ Construction/operations

This is to advise that the undersigned is a supporting registered professional (SRP) retained by Knight Piésold Ltd. to carry out supporting professional services for the dam.

I undertook supporting professional services in the following:

(Check applicable sections)

- ☒ Bedrock/structural geology
- ☒ Surficial geology
- ☒ Geotechnical investigations
- ☒ Hydrogeology
- ☒ Seismotectonic investigations
- ☒ Other [preparation of site characterization letter report]

The undersigned herby gives assurance that the supporting professional services indicated above and the documents prepared by this supporting registered professional for the project, including preparing the characterization letter report [Blackwater Gold Project – Plant Site Area and Sediment Control Pond – Site Characterization Summary, Ref. No. VA101-457/36, Cont. No.: VA22-00111, February 14, 2022], have been carried out in a manner that meets the intent of the applicable EGBC guidelines and good professional practice.

These professional services are described, and the results of them reported on in the documents prepared by me, or under my direct supervision, which bear my professional seal.

(With respect to field reviews, initial the following statements, as applicable. Leave blank those that are not applicable.)

☐ Field review(s) are not applicable

✓ Field review(s) are applicable:

- ✓ I have performed field review(s) for the services identified above.
- ☐ Field review(s) have been performed by _____.

I confirm that I have communicated and liaised as required with the appropriate EGBC professionals for the purposes of my services.

I hereby give my assurance that I am an EGBC-registered professional.

Name: Joseph Cristobal, P.Eng.

Signature: _____ Date: February 14, 2022

Address: 1400-750 West Pender Street
Vancouver, British Columbia, Canada, V6C 2T8

Telephone: +1 (604) 685-0543

Email: jcristobal@knightpiesold.com

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
2022-02-14
J. B. CRISTOBAL
41641

(If the EGBC professional is a member of a firm, complete the following:)

I am a member of the firm Knight Piésold Ltd. and I sign this letter on behalf of the firm.

APPENDIX B

Plant Site Early Works Erosion and Sediment Control Engineering Work lan

(Pages B-1 to B-32)

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

MEMORANDUM

Date:	January 26, 2022	**File No.:**	VA101-00457/36-A.01
		Cont. No.:	VA22-00058
To:	Alex Kourline		
Copy To:	Alastair Tiver, Alex Shepard, Shane Budd		
From:	Cyrus Niamir		
Re:	**Plant Site Early Works Erosion and Sediment Control Engineering Work Plan**		

1.0 GENERAL

This Engineering Work Plan (EWP) and the Issued for Construction (IFC) Drawings have been prepared to support tendering and construction activities for the Plant Site Early Works Erosion and Sediment Control.

The surface contact runoff from the Plant Site disturbance area will be collected by the Plant Site North and South Collection Channels. These channels will be located near the perimeter of the Plant Site and will convey surface contact runoff into the Plant Site Sediment Control Pond (SCP) located at the northeast corner of the Plant Site. The SCP is designed to provide temporary storage of surface contact runoff prior to discharge to the Rapid Infiltration Basins (RIBs). The RIBs are located downstream of the SCP and allow the outflow from the SCP to infiltrate into the surficial overburden layer.

2.0 IFC DRAWINGS

This EWP should be reviewed with reference to the IFC Drawings (the Drawings) listed in Table 2.1, which are included in Appendix A. An extension to the permit boundary has been applied for by BW Gold Ltd. (BW Gold). The previous boundary has been removed from the IFC drawings for clarity.

Table 2.1 IFC Drawings

Drawing Number	Drawing Revision	Drawing Title
G0006	Rev 1	Technical Notes
G0040	Rev 1	Construction Material Gradations
C3810	Rev 2	Erosion and Sediment Control Plan - Plant Site - General Arrangement - Phase 1 (Early Works)
C3811	Rev 2	Erosion and Sediment Control Plan - Plant Site - North Collection Channel - Plan and Profile
C3812	Rev 2	Erosion and Sediment Control Plan - Plant Site - North Collection Channel - Cross Sections
C3813	Rev 2	Erosion and Sediment Control Plan - Plant Site - South Collection Channel - Plan and Profile
C3814	Rev 2	Erosion and Sediment Control Plan - Plant Site – South Collection Channel - Cross Sections
C3815	Rev 2	Erosion and Sediment Control Plan - Plant Site - Sediment Control Pond - Plan and Sections
C3816	Rev 2	Erosion and Sediment Control Plan - Plant Site - Additional Sections and Details
C3820	Rev 0	Erosion and Sediment Control Plan - Plant Site – Sediment Control Pond Piping – Plan and Section
C3821	Rev 0	Erosion and Sediment Control Plan - Plant Site – Sediment Control Pond Piping Detail – Plan

3.0 BILL OF QUANTITIES

A bill of quantities for the Plant Site SCP, collection channels, and RIBs are attached in Table 1.

4.0 OPERATION AND MAINTENANCE

It is expected that after each storm event, some collected sediment will remain in the SCP and RIBs. This sediment shall be excavated or dredged to maintain functionality consistent with the design intent of the systems. The sediment removed from the SCP and RIBs will be used as fill material for the grading of the plant site, if appropriate or otherwise disposed within designated waste areas identified by BW Gold. Visual inspections of the sediment levels in the pond and the integrity of the collection channels, berms, discharge pipes and RIBs will be required after each significant rainfall event to identify if maintenance is required.

5.0 TECHNICAL SPECIFICATIONS

5.1 GENERAL

The Drawings are to be read in conjunction with the information provided in this EWP. The Drawings will take precedence in the case of a discrepancy. The Owner or its Constructor shall notify the Engineer upon any discovery of discrepancies between the Drawings, Technical Specifications, and the constructed work.

5.2 COMMUNICATION AND RESPONSIBILITIES

The parties with responsibilities for the construction of the work are as follows:

- Owner – refers to the BW Gold senior management group and technical services department.
- Constructor – refers to the entity responsible for constructing the work, including performance of Quality Control (QC) testing to confirm the work is in compliance with the Drawings and Technical Specifications. This could include the mine operations team of BW Gold and all contractors of BW Gold.
- Engineer – refers to the Design Engineer employed by Knight Piésold Ltd. (KP) or an employee or subconsultant nominated by KP working under the responsible charge of the Design Engineer. KP is responsible for preparation of the designs described herein and Quality Assurance (QA) of the work.

Typical project communications and quality documentation will include the following:

- Request for Information (RFI) – RFIs shall be used to request design clarification, substitution, or changes. RFIs are written by the Owner or Constructor and submitted to the Engineer. The Engineer will prepare a response to the RFI.
- Submittals - Submissions of relevant design information shall be prepared by the Owner and Constructor to verify that procured materials and equipment, QC plans and test results, and construction methods meet the design intent. These submittals may also include work plans (i.e. procedures and methods), as-built survey information, supplied material specifications (catalogues or QC test results), etc. Where appropriate, the Engineer will prepare a response to the submittal that will include either approval or required amendments.
- Non-Conformance Report (NCR) – The Engineer or Constructor can submit an NCR if a final product, material or construction method deviates from the IFC Drawings, Technical Specifications, or other approval. The NCR shall identify the non-conformance, provide an explanation and if possible, suggest remedial actions. No work is to continue until the non-conformance has been resolved.

- Subgrade Inspection Record (SIR) – An SIR will be prepared following inspection of the subgrade of any work where subgrade approval is required. The SIR will document the conditions of the subgrade and will provide approval for the commencement of fill placement or required remedial actions.

5.3 CONSTRUCTION DEWATERING

The Constructor shall build, maintain, and operate all ditches, sumps, and other temporary diversion and protection works needed to divert surface water through or around the construction site and away from the construction work while construction is in progress. Storm runoff from disturbed areas shall discharge to the appropriate collection control facilities for retention of surface water runoff as described in Section 7.0. Construction dewatering activities shall be performed as follows:

- Provide and maintain, at all times during construction, proper equipment and facilities to promptly and adequately remove and dispose of all water entering excavations. Maintain foundation conditions until backfilling operations have been completed to such an extent that the placed material will not be damaged by allowing water levels to return to natural elevations.
- Conduct dewatering, at all times, in such a manner to preserve the natural undisturbed capacity of the subgrade soils at the bottom of excavations. Evaluate the impact of the anticipated subsurface soil/water conditions on the proposed method of excavation and removal of water.
- Operate the dewatering system until the excavation is adequately backfilled. Provide for continuous system operation when necessary. Arrange for standby pumps and appropriate backup power if electrical power is the primary energy source for a dewatering system.
- Monitor operations to verify that the system(s) lower the groundwater levels at a rate required to maintain a dry excavation resulting in a stable subgrade for inspection and backfill.
- Collect water entering the excavation from precipitation or surface runoff in shallow ditches around the perimeter of the excavation. Collect and pump from the excavation to maintain a dry bottom with no standing water.
- Dispose of water in an approved area so that backflow or site discharge does not occur.

5.4 CLEARING, GRUBBING, REMOVAL OF TOPSOIL AND UNSUITABLE MATERIALS

The Constructor shall clear and grub all ground surfaces to the limits shown on the IFC Drawings. In order to minimize erosion and contamination of the surface runoff, clearing and grubbing shall be performed only as and when required to enable each portion of the work to be carried out.

The work area will shall be logged and cleared of timber prior to commencing construction. Clearing in the work area shall not be commenced until the project boundaries are surveyed in the field and confirmed. Grubbing of the work area shall consist of the complete removal of all vegetation and organic matter and grubbing to remove all roots and stumps. All roots over 50 mm in diameter, protruding from the ground surface, shall be grubbed to a depth of 300 mm below the ground surface. Pieces of wood less than 75 mm in diameter and 1,000 mm in length may be scattered within the clearing limits and will be incorporated with the topsoil during topsoil stripping operations.

After an area has been cleared and grubbed and the debris removed, the Constructor shall remove the topsoil and/or unsuitable materials and either windrow or stockpile this material in designated areas identified by the Owner. The Constructor will be required to remove and stockpile all the available topsoil from disturbed areas shown on the Drawings for later use in reclaiming the site. Topsoil is described as a dark brown organic layer that ranges in thickness from approximately 150 mm to over 2,000 mm in some parts of the project area. Unsuitable material will generally be comprised of saturated soils or fill materials

which when compacted, do not achieve the required density. The material is to be stockpiled in a neat workmanlike manner in the designated areas such that it will be stable and protected from erosion.

After removal of topsoil and/or unsuitable material in a work area and before any additional work is undertaken:

- The Engineer shall inspect the area to determine whether removal of topsoil material has been completed satisfactorily.
- An as-built survey will be performed by the Constructor in order to verify topsoil quantities removed and stockpiled.

5.5 EXCAVATION AND FOUNDATION PREPARATION

Excavation

The Constructor shall develop excavation methods, techniques and procedures with due consideration regarding the nature of the materials to be excavated and shall take such precautions as are necessary to preserve, in an undisturbed condition, all materials outside the lines and grades shown on the Drawings. The Constructor shall be permitted to carry out excavation and shaping of the foundations by whatever method it considers most suitable, providing it is consistent with producing an acceptable result consistent with the design intent as determined by the Engineer. The Owner and Constructor shall be solely and completely responsible for the safety, stability, maintenance, support and protection of all excavations. The Constructor shall supply, install and provide all temporary supports, bulkheads, canopies, sheeting and bracing, divert surface water, remove water from the excavations, and shall provide and maintain such drainage and pumping facilities as are necessary to stabilize and protect the excavations. Except as otherwise instructed by the Engineer, such temporary support and facilities shall be removed by the Owner or Constructor on completion of the work.

The Constructor shall not excavate beyond the lines and grades shown on the Drawings without the prior approval of the Engineer. Material from the excavations, which meets, or can be processed to meet, the specifications of the construction materials, shall be either stockpiled for later use, or used directly for construction of the work. Excavated materials not suitable for use in construction shall be disposed of in designated disposal areas identified by the Owner.

Subgrade Preparation for Fill Placement

Foundation preparation of any surface that is to receive fill and from which topsoil, unsuitable material or temporary cover has already been removed shall consist of trimming and levelling to a consistent surface suitable for fill material. Proof rolling, with a minimum of 4 passes of a smooth drum or sheepsfoot drum vibratory roller, may be required by the Engineer to produce a well compacted, smooth or roughened surface depending on the design intent of the structure and conditions observed during the subgrade inspection. Roller specifications are further discussed in Section 5.8. Placing of fill materials on excavated surfaces shall not commence until the preparation of the surfaces has been approved in writing by the Engineer.

Subgrade Preparation for Geosynthetics and Pipework

Subgrade surfaces prepared for placement of overlying geosynthetics or pipework shall be trimmed and dressed to form a surface that is firm, dry, smooth and free of projections of sharp rock fragments that could puncture or damage the overlying materials. The surfaces shall be rolled with a smooth drum vibratory roller to bed gravel particles into the soil matrix.

Particles not bedded during the rolling process shall be removed by raking, brooming, and/or hand-picking rocks from the surface. Any holes, depressions or rough areas created during this process shall be filled with suitable fill material free of sharp rock fragments meeting the design specifications. The surface must then be rolled again.

Placing of geosynthetics or pipeworks on excavated surfaces shall not commence until the preparation of the surfaces has been approved in writing by the Engineer.

Subgrade Inspection

The Constructor shall notify the Engineer when the excavation and subgrade preparation is complete to the design lines and grades and ready for inspection. The Engineer will inspect the area and provide approval for continued construction or specify the required remedial actions to complete prior to placement of fill, geosynthetics, and/or pipeworks.

Inspection requirements for subgrade surface preparation include:

- An as-built survey will be collected by the Constructor and submitted to the Engineer to verify that the design lines and grades were achieved.
- The Engineer shall inspect the area to determine whether subgrade preparation was completed satisfactorily.
- The Engineer will prepare a SIR documenting the subgrade conditions observed during the inspection.

5.6 EARTHWORKS AND EARTHFILL PROPERTIES

Earthfill material gradations, placement and compaction specifications are shown on Drawing G0040. QC testing requirements are included in Section 5.11. General requirements for earthworks construction are as follows:

- Correct and complete clearing and grubbing
- Correct and complete removal and stockpiling of topsoil
- Achievement of design lines and grades
- Drainage and diversion of surface runoff and groundwater
- Stability of excavations and stockpiles
- Foundation approvals before covering with fill materials
- Identification of suitable materials in local excavations, borrow areas and stockpiles
- Procurement of suitable materials from outside sources
- Planning and haul patterns for transportation of materials
- Placement of the specified fill materials
- Compaction of specified fill materials
- Testing of specified fill materials

Fill materials shall be durable and shall not, except as otherwise specified, contain more than a small proportion of thin, flat, or elongated particles. They shall also be free of topsoil, organics, and other deleterious material. Except as otherwise specified, the particles shall be hard and resistant to breakdown during handling. Fill materials that will be required for construction of the work are as follows:

- Zone S - Constructed from low permeability glacial till. The material will consist of well graded silty sand with some gravel and will generally require no processing except for the removal of oversized particles.

- Zone F - Constructed with clean, fine to coarse sand. This material will be processed non-reactive fluvial materials from approved sources.
- Zone C - Constructed with random fill comprising non-reactive waste rock and overburden.
- Riprap Bedding - Processed quarry rock supplied by rock excavation or from approved outside sources. Riprap bedding will be placed under riprap in select locations.
- Riprap - Processed quarry rock supplied by the rock excavation or from approved outside sources. Riprap will be placed in ditches and ponds where erosion protection is required, and rock foundations are not encountered during excavation. Riprap shall be placed and not dropped to avoid damaging geotextile.

5.7 FILL PLACEMENT

The Constructor shall develop procedures for placing fill as shown on the Drawings and provided in these Technical Specifications. No fill materials shall be placed in embankments, berms or trenches until foundation preparation in the fill area has been completed and approved in writing by the Engineer. The Constructor shall construct the work only with materials meeting the specified requirements or approved equivalents. The fill material shall be free from lenses, pockets and layers of materials that are substantially different in gradation from the surrounding material in the same zone.

Fill material shall be excavated, transported, placed, and spread in such a manner that segregation is avoided. The equipment used for placing fill shall be such that it does not cause segregation of the material. Fill shall be placed and spread in such a manner that no gaps are left between adjacent placed loads of materials. The work shall be constructed by placing, spreading, and, where required, compacting the specified fill material in continuous lifts of the specified thickness. The fill shall be levelled prior to compaction using a dozer or grader to obtain a smooth surface free from depressions. The surface of each lift shall be sloped only at such grades as are necessary to maintain adequate surface drainage at all times.

Any material placed which does not meet the specified requirements shall be removed or remixed, blended, disked, or otherwise reworked by the Constructor to produce a material that meets the specified material requirements. If a non-conforming material has been placed upon by additional fill materials, it is the responsibility of the Constructor to excavate and replace the non-conforming and affected conforming materials, unless otherwise approved by the Engineer.

The Owner or its Contractor shall exercise particular care in fill placement for trench backfill or working near pipes, valves, instrumentation, or structures to avoid damage to the work. Fill shall not be placed against concrete until a minimum of 7 days have elapsed after concrete placement.

In fills that require moisture conditioning, the Constructor shall condition the material to the moisture content designated by the Engineer. The Constructor shall adopt all measures necessary to achieve moisture content within one percent of the specified moisture content, distributed uniformly throughout the layer of material being placed, prior to compaction. Wherever necessary, after a layer of fill has been placed, the moisture content of the fill material shall be modified to maintain the fill material within the range specified. If after placing, spreading and levelling any fill material becomes too wet for proper compaction as determined by the Engineer, it shall be either removed or the moisture content reduced to a value acceptable to the Engineer by scarification or other approved methods. Suitable disc harrows or other approved equipment shall be available for use if required. Equipment used by the Constructor to apply water to fill material shall be designed to apply water uniformly and at sufficient rates to achieve the designated moisture content. Water tank trucks shall be equipped with positive shut-off valves so that there

is no leakage from the nozzles when the equipment is not operating. In the event that leaks do occur, they shall be repaired immediately. Moisture conditioning shall be carried out in a manner that will avoid flow of water between different material types.

Fill Placement During Freezing Conditions

The Constructor will be permitted to place fill materials in freezing conditions only if the materials can be placed and compacted to the specified densities that would normally be achieved if freezing conditions did not prevail. Criteria for placing fill materials during freezing conditions are summarized below.

(i) All ice and snow and loose frozen fill materials shall be removed from compacted fill surfaces or prepared foundations prior to placing any new fill materials.
(ii) Fill materials can be placed on previously placed and compacted frozen fill or approved frozen foundations provided that the surfaces are cleaned as per (i) above.
(iii) Where the previous compacted surface of any layer is too smooth to bond properly with the succeeding layer it shall be scarified or otherwise roughened to provide a bonding surface before the next layer is placed.
(iv) Only non-frozen fill can be used as fill. Frozen soils shall be removed from the borrow areas prior to excavation of non-frozen fill materials. Fill materials must meet the specified moisture content criteria before excavation in the borrow areas and before placement in the work area.
(v) The fill materials shall be immediately spread, compacted, and tested after placement to achieve the specified density before the material freezes.
(vi) Fill placement and compaction should occur rapidly and in relatively small areas. The exposed surfaces shall be kept to a minimum so as to minimize the potential for fill materials to become frozen before they are compacted to the specified densities.
(vii) Any fill materials that become frozen prior to adequate compaction shall be removed to spoil.
(viii) Fill materials shall not be placed when there is any accumulation of snow or ice on surfaces to be covered by the succeeding layers of fill.

5.8 COMPACTION

All fill material, after placing, spreading, and levelling to the appropriate lift thickness, shall be compacted in accordance with the requirements presented herein, and to the requirements specified on the Drawings. Compaction of each lift of fill shall proceed in a systematic, orderly, and continuous manner such as to ensure that no part of the lift is left uncompacted. The compaction shall be carried out by routing the compaction equipment parallel to the axis of the embankment or berm. When such routing is impractical, the compaction equipment may be routed in any direction provided that all of each lift receives the compaction specified. These measures may be taken at the lower elevations of the fill, in areas adjacent to concrete, and in trenches. The rolling pattern at all zone boundaries or construction joints shall be such that the full number of roller passes required in one of the adjacent zones or on one side of the construction joint extends completely across the boundary or joint. Should the surface of the fill become rutted or uneven subsequent to compaction it shall be re-graded and re-compacted by the Constructor, before the next layer of fill is placed. All large particles that interfere with compaction shall be removed from the zone in which they were placed, either prior to or during compaction.

If the Constructor wishes to use alternative equipment, it shall submit to the Engineer for approval complete details of such equipment and the methods proposed for its use. Unless otherwise approved by the Engineer, all fill material shall be compacted using the following specified equipment:

(i) Smooth Drum and Sheepsfoot Drum Vibratory Rollers:
- Smooth drum and sheepsfoot drum vibratory rollers shall be equipped with a suitable cleaning device to prevent the accumulation of material on the drum during rolling. Each roller shall have a total static weight of not less than 10 tonnes at the drum when the roller is standing on level ground. The drum shall be not less than 1.5 metres in diameter and not more than 2.2 metres in width. The vibration frequency of the roller drum during operations shall be between 1,100 and 1,500 vibrations per minute and the centrifugal force developed by the roller at 1,250 vibrations per minute shall not be less than 18 tonnes.
- The power of the motor driving the vibrator shall be sufficient to maintain the specified frequency and centrifugal force under the most adverse conditions that may be encountered during compaction of the fill. Propulsion equipment for the roller shall be adequate to propel the roller at speeds up to 6 km/hr.
- A minimum overlap of 300 mm shall be maintained between the surfaces traversed by adjacent passes of the roller drum. The roller shall be propelled at 3 km/hr during compaction.

(ii) Hand Guided Vibratory Compactors:
- The Constructor shall use hand guided vibratory compactors to compact fill in trenches, around structures and in other confined areas which are not accessible to larger equipment. Such compaction shall be capable of compacting the material to an equivalent density as that achieved by the larger vibratory roller.

The Constructor shall take every precaution when operating compaction equipment to avoid damage to adjacent structures, and to avoid disturbing the foundation. Any such damage or disturbance shall be repaired or remedied by the Constructor at their own expense.

5.9 GEOTEXTILE PROPERTIES

Geotextile shall be packaged and shipped in standard roll lengths and widths. It shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. Geotextile will comprise non-woven needle punched synthetic fibre fabric supplied in rolls and composed of polypropylene with inhibitors added to base plastic to resist deterioration by ultraviolet light and heat. The minimum required geotextile properties are presented in Table 5.1 below:

Table 5.1 Geotextile Properties

Property	Minimum Value Required	Standard
Grab Strength	1,400 N	ASTM D4632
Puncture Strength	3,510 N	ASTM D6241
Elongation at Break	50 %	ASTM D4632
Tear Strength	500 N	ASTM D4533
Permeability	0.8 s^{-1}	ASTM D4491
Apparent Opening Size	150 microns	ASTM D4751

The surfaces underlying the geotextile shall be approved by the Engineer and shall be smooth and free of ruts or protrusions which could damage the geotextile. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall be free of tensile stresses, folds and wrinkles so that the overlying materials will not excessively stretch or tear the fabric. On slopes steeper than 10H:1V, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction. Anchoring

of the terminal ends of the geotextile shall be accomplished using key-in trenches or aprons at the crest and toe of slope.

Successive sheets shall be overlapped in such a manner that the upstream sheet is placed over the downstream sheet and/or the upslope over the downslope. The overlying material placement shall begin at the toe and proceed up the slope. Riprap shall be placed carefully and not be dropped from a height exceeding one meter.

5.10 PIPEWORK AND APPURTENANCES

All materials furnished by the Constructor shall be new, suitable and the best of their respective kind and shall be subject to approval by the Engineer. They shall comply with the latest applicable standards for:

- American Society for Testing and Materials (ASTM)
- American Water Works Association (AWWA)
- American Society of Mechanical Engineers (ASME)

Any contradictions between standards shall be submitted to the Engineer for review.

Pipe, fittings, valves, and other appurtenances shall be loaded and unloaded by lifting with hoists in such a manner as to avoid damage or hazard. Under no circumstances shall the pipe or pipe fittings be dropped to the ground or into trenches. Pipe shall not be skidded or rolled against pipe already on the ground. The interior of all pipes, fittings and valves shall be kept free from dirt and foreign material at all times.

Pipe shall be made of High-Density Polyethylene (HDPE), which shall be in accordance with ASTM D3350, ASTM F714, ASTM F2206 and ASTM F2619. All piping is to be installed to the minimum pipeline pressure rating. Installation of HDPE pipework shall be in accordance with AWWA M55 requirements and the manufacturer's specifications.

Joining of HDPE pipe shall be butt fusion as per ASTM F2620. Butt fusion joined pipes shall not be misaligned by more than ±3 mm. Gaskets are to be used for all flanged joints and the gaskets shall be centered accurately in the joint. Bolts, studs, and nuts to be installed and tightened as per manufacturer's instructions for any flanged joints.

Where perforations are specified, they shall be circular and arranged in symmetrical rows parallel to the axis of the pipe. Perforation hole diameters to be at minimum 10 mm and at maximum 15 mm.

Pipework shall be laid to the maximum extent, in long lengths as to minimize the number of joints required. The Constructor shall develop methods to avoid damage to piping during installation or backfilling. The pipe foundation shall be inspected prior to laying of the pipe and the pipe will not be placed on timber or rock outcrops that can cause stress concentrations. Placement of the HDPE pipe shall be sequenced to protect all pipework from damage due to vehicle and equipment traffic. Barricades and flagging shall be installed so that towers are visible to vehicle and equipment traffic.

The Constructor shall construct the pipework to the lines and grades as shown on the Drawings, maintaining a negative grade on the pipeline to prevent pooling and/or air pockets. Survey control shall be maintained on all aspects of the work and all locations shall be verified prior to commencement of construction.

5.11 QUALITY CONTROL

The Constructor shall be responsible for QC of the work and perform the following tasks:

- Samples of fill materials are to be collected and tested to confirm the earthfill properties of the fill materials as described in Section 5.6.
- Visual inspection and verification of lift thicknesses as described in Section 5.7.
- Field density tests on the compacted fill and any other tests considered necessary to ascertain that the fill being placed or already placed meets the specified requirements.

The results of the tests carried out by QC personnel will be final and conclusive in determining compliance with the Technical Specifications and the Drawings. Notwithstanding any QC testing, the Constructor shall be responsible for performing such tests as are necessary to control the quality of the materials prior to delivery to, and after incorporation in the fill.

The Constructor shall render such assistance as is necessary to enable such sampling and testing to be carried out expeditiously. Samples for QC testing will be excavated and collected by the Constructor. Sample pits excavated for quality purposes shall be backfilled and compacted by the Contractor using fill material similar to that excavated and compacted, at no extra charge. The Constructor shall allow sufficient time for QC and QA personnel (described in Section 6.3) to conduct the required test work in order to determine the acceptability of each lift. Performing the tests or the time taken to interpret their results shall not constitute grounds for a claim by the Constructor for additional compensation or an extension of time.

Tests carried out by QC and QA personnel will be performed in accordance with the principles and methods prescribed by the American Society for Testing and Materials (ASTM) and other such recognized authorities with such methods being modified, if necessary, to take into account local conditions and materials containing large particle sizes.

QC testing for the purposes defined above will be as follows:

(i) Control tests on samples of fill materials taken from the borrow areas and stockpiles prior to placement and compaction.
(ii) Record tests on fill materials after placement and compaction.

All fill materials as well as fill beneath and around structures or pipework, must meet the specified gradations and placing requirements. The minimum control testing frequencies for earthworks materials are provided in Table 5.2. The minimum record testing frequencies for earthworks materials are provided in Table 5.3.

Table 5.2 Minimum Control Testing Frequency

Material	Control Tests (1 per / X m^3)		
	C1	C2	C3
Zone C	500	500	-
Zone F	25	25	-
Zone S	250	250	250
Riprap Bedding	50	50	-
Riprap	Visual Inspection		

Note(s):
1. C1 – Particle Size Distribution (ASTM D422).
2. C2 – Optimum Moisture Content (ASTM D2216).
3. C3 – Standard Proctor (ASTM D698).

Table 5.3 Minimum Record Testing Frequency

Material	Record Tests (1 per / X m^3)				
	R1	R2	R3	R4	R5
Zone C	500	500	-	-	-
Zone F	25	25	-	-	-
Zone S	250	250	250	250	250
Riprap Bedding	50	-	-	-	-
Riprap	Visual Inspection				

Note(s):
1. R1 – Particle Size Distribution (ASTM D422).
2. R2 – Optimum Moisture Content (ASTM D2216).
3. R3 – Standard Proctor (ASTM D698).
4. R4 – Field Density by Nuclear Methods (ASTM D2922).
5. R5 – Field Moisture Content (ASTM D2216).

As part of the inspection requirements, the Engineer shall be responsible for performing QA and properly documenting any issues or concerns noted during inspections. The role of QA is detailed in Section 6.

5.12 SUBMITTALS

Submittals to the Engineer include but are not limited to the following:

- RFIs
- Work Plans (Procedures and Methods)
- Supplier Material Specifications (Catalogues or QC tests)
- QC Test Results and Reports
- As-Built Surveys

6.0 QUALITY ASSURANCE

6.1 REVIEW OF QC TESTING

All of the test results derived from QC testing are to be reviewed by QA personnel as they become available. QA personnel will carry out spot checks to verify the accuracy of the data and will carry out an independent analysis of test results as necessary for QA purposes. This review will be used to summarize the following:

- Conformance of the materials and workmanship with the Technical Specifications and the Drawings.
- Identification of any non-compliant test results and trends with respect to compliance over time.
- At the completion of work, the Contactor will provide a QC summary of all results as part of any approval request.

During QA inspections, any quality issues detected shall be communicated to QC personnel on site so that appropriate corrective actions can immediately be taken before the work results in a non-conformance. If the QC testing identifies samples that do not comply with the requirements of the Technical Specifications and the Drawings and if subsequent re-testing confirms this, then appropriate corrective measures shall be taken. This may include removal of the non-compliant materials, developing modifications to the construction procedures and/or reviewing the design objectives for the particular material. Any requested

modifications to the Technical Specifications and/or the Drawings shall be submitted as a RFI to the Engineer for review and approval.

6.2 MATERIAL SUBSTITUTIONS

All "equal/equivalent" materials shall be approved by the Engineer in advance of their use. QA personnel will review each request with regards to the requirements of the Technical Specifications, the Drawings and the design objectives for the material, and the request will be forwarded to the Engineer for approval.

As soon as reasonably possible, the Engineer will inform the Owner or Constructor in writing of the acceptance or rejection of the proposed “equal/equivalent” material. In the case of rejection, the reasons will be clearly stated.

6.3 INDEPENDENT TESTING

From time to time, the Engineer may request that additional independent testing be carried out on selected items of the work to verify that the intent of the designs is being met. QA personnel will arrange for such testing to be carried out and coordinate with the Owner and Constructor for access to appropriate aspects of the work.

7.0 SEDIMENT AND EROSION CONTROL STRATEGIES

7.1 GENERAL

Construction of the work is expected to adhere to the Surface Erosion Prevention and Sediment Control Plan (KP, 2021) which was developed based on the recommendations by the Ministry of Energy, Mines and Low Carbon Innovation (EMLI formally EMPR, 2020). The relevant best management practices (BMPs) associated with the plant site early work activities have been extracted from this plan and are presented below as reference.

Erosion control BMPs reduce erosion by stabilizing exposed soil or by reducing surface runoff flow velocities. There are generally two types of erosion control BMPs:

- Source control BMPs for protection of exposed surfaces
- Conveyance BMPs for control of runoff

Descriptions of BMPs to be used at the site are provided below. Typical BMP figures are attached in Appendix B.

7.2 BEST MANAGEMENT PRACTICES

Construction Water Management

Diversion ditches are constructed upgradient of disturbed areas to intercept clean surface water runoff and convey it around areas to be disturbed to avoid excessive sheet flow. All diversion ditches should discharge through a stabilized outlet designed to handle the expected runoff velocities and volumes from the ditch without scouring. Each diversion ditch type should provide a minimum freeboard of 0.5 m between the top of flow and the ditch crest.

Collection ditches intercept contact water runoff from disturbed areas and divert it to stabilized areas where it can be effectively managed. Collection ditches are used within construction areas to collect runoff and convey it to appropriate sediment control measures. Where fine grained soils are exposed, appropriate

erosion protection materials shall be installed based on the estimated magnitude of flow and the flow velocity. General locations and conditions may include:

- Below disturbed slopes to divert sediment-laden water to control facilities.
- At or near the perimeter of the construction area to prevent sediment-laden runoff from leaving the site.
- Below disturbed areas before stabilization to prevent erosion if stabilization measures cannot be implemented immediately.

Rock Check Dams

Rock check dams are small dams constructed across ditches, and waterways to avoid erosion by reducing flow velocity. Rock check dams accomplish this by interrupting the flow of water to form small ponds, thereby flattening the surface of the water, and reducing the velocity of flow. The obstructions induce infiltration and reduce erosion potential. Check dams are also used to distribute flows across a swale to avoid preferential paths and guide flows towards vegetation.

Rock check dams require regular maintenance and shall be inspected regularly, and before and after every large storm event. It is important that rubble, litter, and leaves are removed from the upstream side of the dam. This is typically done when the sediment has reached a height of one-half of the original height of the dam.

Sediment Basins

A sediment basin is a temporary structure that is used to detain runoff from small drainage areas so that sediment can settle out. The basin is typically maintained until the site is permanently protected against erosion by vegetation and/or structures. Sediment basins are generally located in areas where access can be maintained for sediment removal and proper disposal. Sediment basins are typically constructed at the end of collection ditches to detain sediment-laden runoff long enough to allow the majority of the sediment to settle out to comply with water quality objectives. A sediment basin can be created by excavating a basin, utilizing an existing depression, or constructing a dam on a slight slope downward from the work area. Sediment-laden runoff from the disturbed site is conveyed to the basin via ditches or diversion structures. The efficacy of sediment basins is largely dictated by the extent to which they are properly sized and constructed as designed; whether the banks are stabilized immediately following construction; and the extent to which they are regularly cleaned out / maintained.

Stream Diversion Structures

A temporary diversion structure consists of sandbags stacked in a pyramid formation with a polyethylene sheet placed diagonally in between. Temporary diversion structures are useful for diverting streams and/or concentrated overland flows to an appropriate sediment basin or other BMP where it can be effectively managed.

Vegetation Management and Re-vegetation

Natural vegetation is one of the best and most cost-effective methods of reducing the potential for erosion and sedimentation. Vegetation keeps soil secure and ground cover reduces raindrop velocities. In order to preserve vegetation, a “no-entry” vegetation buffer shall be maintained to prevent excess clearing, particularly around water bodies, prior to clearing vegetation from surrounding areas. If preserving natural vegetation is not a viable option, cleared areas that will not include infrastructure shall be re-vegetated as soon as practical after construction activities have ended.

Mulching

Mulching is the application of a uniform protective layer of straw, wood fiber, wood chips, or other acceptable material on or incorporated into the soil surface of a seeded area to allow for the immediate protection of the seed bed. The purpose of mulching is to protect the soil surface from the forces of raindrop impact and overland flow, foster the growth of vegetation, increase infiltration, reduce evaporation, insulate the soil, and suppress weed growth. Mulching also helps to hold fertilizer, seed, and topsoil in place in the presence of wind, rain, and runoff, and reduces the need for watering. Mulching may be utilized in areas that have been seeded either for temporary or permanent cover.

There are two basic types of mulches: organic mulches and chemical mulches. Organic mulches likely to be used include straw, hay, wood fiber, wood chips, and bark chips. This type of mulch is usually spread by hand or by machine (mulch blower) after seed, water, and fertilizer have been applied. Chemical mulches, also known as soil binders or tackifiers, are composed of a variety of synthetic materials. Chemical mulches are usually mixed with organic mulches as a tacking agent to aid in the stabilization process, and are not used as mulch alone, except in cases where temporary dust and erosion control is required. The choice of materials for mulching shall be based on soil conditions, season, type of vegetation, and the size of the area.

Rolled Erosion Control Products

Rolled Erosion Control Products (RECPs) are geosynthetic or organic materials composed of two layers of coarse mesh that contain a central layer of permeable fibres in between. These products take the form of flexible sheet materials that are often composed of organic materials that decompose over time. When intended for long-term use, RECPs are made from UV-stable synthetics such as polypropylene.

RECPs are used to cover un-vegetated cut or fill slopes in order to provide erosion control when seeding or mulching alone is unsuccessful. RECP sheets shall be anchored with special stakes or rocks and shall be in direct, tight contact with the soil surface in order to perform effectively.

Slope Roughening

Cut and fill slopes are roughened with tracked machinery or by other means, to reduce runoff velocity, increase infiltration, reduce erosion, and to aid in the establishment of vegetative cover with seed. Roughening is typically be carried out by a tracked machine moving up and down the slope, creating undulations on the soil surface. This procedure is simple, inexpensive, and provides immediate short-term erosion control for bare soil, where vegetative cover is not yet established. Compared to hard, compacted smooth surfaces a rough soil surface provides more favorable moisture conditions, which will aid in seed germination. Slope roughening works best on flat to moderately sloped areas.

Filter Bags

Filter bags are generally constructed from a sturdy non-woven geotextile capable of capturing particles larger than 150 microns. Filter bags are installed at the discharge end of pumped diversion pipelines, via fabric flange fittings, to remove fine grained materials before discharging to the environment, as needed. Filter bags are generally temporary sediment control measures. Filter bags are installed on flat, stable, non-erodible foundations, or in well vegetated areas. The pumping rate is specified by the manufacturer. Discharge from filter bags is routed to avoid erosion.

A smaller variety of filter bags, referred to as filter socks, can be installed on the discharge ends of gravity flow pipes, such as slope drains, to filter silt particles before discharging to the environment. Filter bags

shall be inspected daily for defects, rips, tears, sediment accumulation, and erosion of the surrounding area. When sediment fills one-half of the volume of the filter bag, the filter bag shall be removed from service and replaced. Spare bags shall be kept nearby to minimize time required to recommence pumping activities. Once the used bag is fully drained, the bag and its contents can be disposed of as solid waste.

Waterbars

Waterbars are ridges or ridges and channels constructed diagonally across a sloping road or right-of-way to limit the accumulation of erosive volumes of water at pre-designed intervals. Waterbars reduce sheet flow and surface erosion of areas of exposed soil and/or roads by diverting runoff towards a stable vegetated area or diversion ditch. Spacing of waterbars shall be field-fit based on slope grade, general erodibility of the surface, and anticipated flows. Waterbars should not direct runoff into a ditch that channels water toward a watercourse unless the ditch is adequately designed with check dams and armouring where appropriate.

Silt Fencing

Silt fencing is a perimeter control type BMP used to intercept sheet flow runoff and used in conjunction with other BMPs. Typical silt fencing comprises a geotextile fabric anchored to posts driven into the ground. Silt fencing promotes sediment control by filtering water that passes through the fabric and increases short term retention time, allowing suspended sediments to settle.

Silt fences shall be placed parallel to slope contours to maximize ponding efficiency when required. Barrier locations are informally chosen based on site features and conditions (e.g., soil types, terrain features, sensitive areas, etc.), design plans, existing and anticipated drainage courses, and other available erosion and sediment controls. Typical barrier sites are catch points beyond the toe of fill or on side slopes above waterways or drainage channels. Silt fences shall not be used for wide low-flow, low-velocity drainage ways, for concentrated flows, in continuous flow streams, for flow diversion, or as check dams. Silt fencing shall be installed in backfilled trenches for proper anchoring.

All silt fences shall be inspected and maintained, as required, following major rainfall events. Proper installation and frequent maintenance are required for effective sediment control.

Straw Bales

A straw bale barrier consists of straw bales placed end to end along a level contour in a channel and then staked to hold them in place. The straw bale barrier detains and filters stormwater runoff, creating a small pond behind the barrier where sedimentation occurs. Straw bales, along with silt fences, significantly reduce sediment accumulation in sediment control ponds and basins.

7.3 MONITORING

The success of the erosion and sediment control mitigation is dependent on monitoring of implemented BMPs. The contractor and environmental monitoring technicians should inspect all erosion control measures periodically and after each significant runoff-producing rainfall event. BMPs shall be visually inspected for the following:

- Excess sediment build-up
- Structural/physical integrity
- Visible wear and tear

Sediment removal and proper disposal shall be performed as required.

Yours truly,
Knight Piésold Ltd.

Prepared: 2022-01-26
Cyrus Niamir, P.Eng.
Senior Engineer

Reviewed:
Carlos Penate, M.Eng., P.Eng.
Senior Engineer

Approval that this document adheres to the Knight Piésold Quality System: DDF

Attachments:

Table 1 Rev 0	Updated Material Take-offs
Appendix A	Plant Site Early Works Sediment Pond IFC Drawings
Appendix B	Sediment and Erosion Control BMP Figures

References:

Knight Piésold Ltd. (KP, 2021). Early Works Erosion and Sediment Control Plan. February 4, 2021. Vancouver, British Columbia. Ref No: VA101-457/33-11 Rev 1.

/cbn

Knight Piésold CONSULTING

TABLE 1

BW GOLD LTD.
BLACKWATER GOLD PROJECT

PLANT SITE EARLY WORKS EROSION AND SEDIMENT CONTROL
UPDATED MATERIAL TAKE-OFFS

Print Jan/26/22 9:57:40

Item			No.	Length (m)	Diameter (mm)	Area (m²)	Volume (m³)	Notes
Plant Site North Collection Channel (PSNCC) and Plant Side South Collection Channel (PSSCC)	Fill (Zone C)		-	-	-	-	4,410	
	Cut		-	-	-	-	2,460	
	Riprap		-	-	-	-	1,410	D_{50} = 200mm
	Geotextile		-	-	-	5,080	-	
Sediment Control Pond (SCP)	Fill (Zone C)		-	-	-	-	3,730	
	Cut		-	-	-	-	5,230	
	Liner	0.6 m Thick Fill (Zone S)	-	-	-	-	1,870	
		0.5 m Thick Fill (Zone C)	-	-	-	-	1,560	
		Geotextile	-	-	-	3,110	-	
	Inlet	Riprap	-	-	-	-	210	D_{50} = 565mm
			-	-	-	-	50	D_{50} = 150mm
		Geotextile	-		-	170	-	
	Outlet	Riprap	-	-	-	-	140	D_{50} = 565mm
		Geotextile	-	-	-	290	-	
Rapid Infiltration Basins (RIBs)	Pipe, DR17 HDPE, Plain End Connected [1,2]		1	140	200	-	-	
	Pipe, DR17 HDPE, Perforated, Plain End Connected [1,2]		1	60	200	-	-	
	Tee, DR17 HDPE, Fabricated, Plain End Connected [1,2]		5	-	200	-	-	
	90° Elbow, DR17 HDPE, Fabricated 3-Segment, Plain End Connected		8	-	200	-	-	
	22.5° Elbow, DR17 HDPE, Fabricated 2-Segment, Plain End Connected		8	-	200	-	-	
	Cross, DR17 HDPE, Fabricated, Plain End Connected		4	-	200	-	-	
	Gate Valve, Class 150, Raised Face, Flange Connected, Handwheel Operated		1	-	200	-	-	
	Flange Adapter, DR 17 HDPE, c/w Ductile Iron Back-up Ring and Gasket		12	-	200	-	-	
	Blind Flange, HDPE		2	-	200	-	-	
	Fill (Zone C)		-	-	-	-	4,490	
	Cut		-	-	-	-	360	
	Sand (Zone F)		-	-	-	-	45	

\\KPL\VA-Prj$\1\01\00457\36\A\Correspondence\VA22-00058 - Plant Site Early Works Erosion and Sediment Control EWP\[Table 1 - Plant Site Early Works Erosion and Sediment Control - Updated Material Take-offs.xlsm]Civil

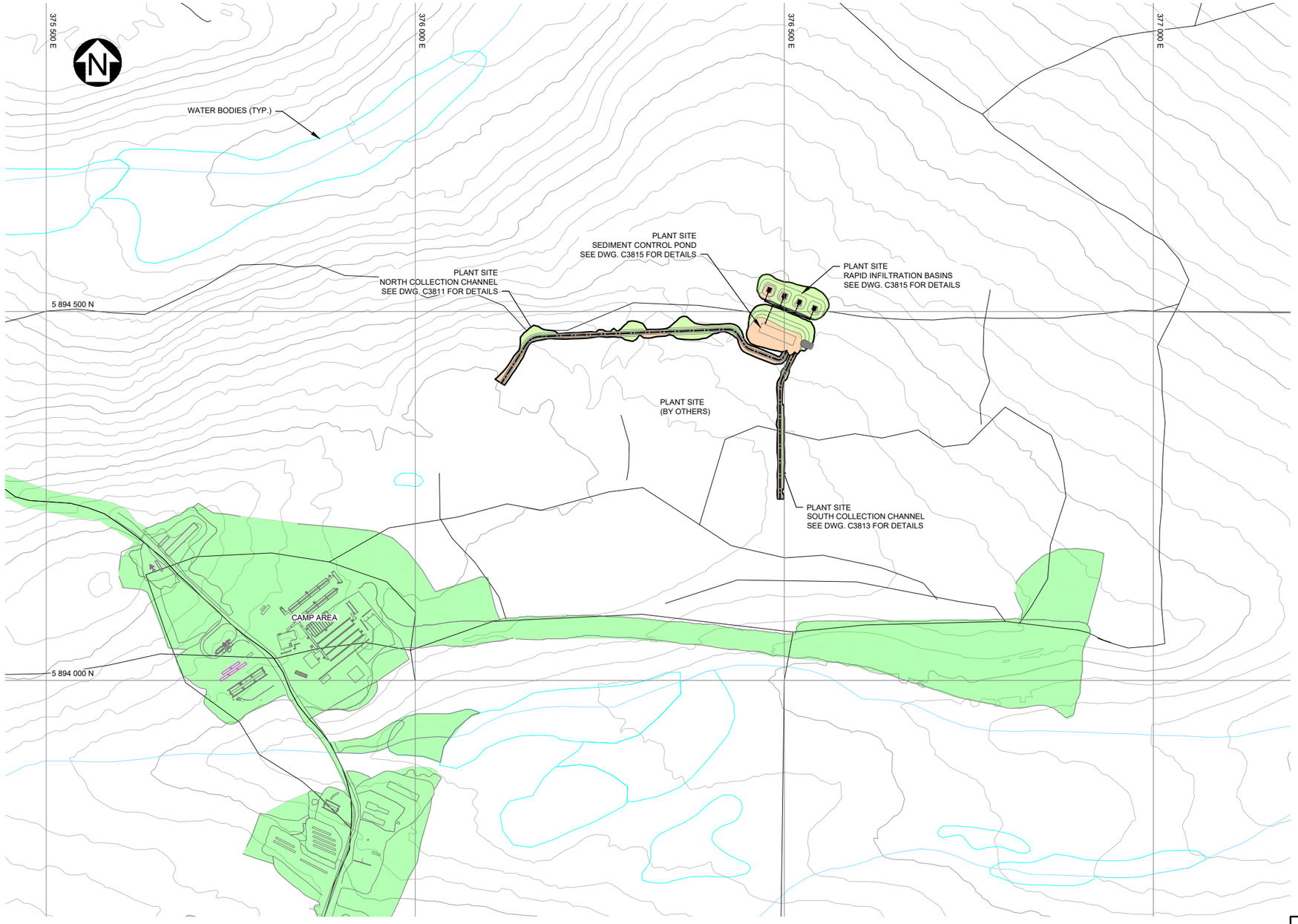
NOTES:
1. NOMINAL DIAMETER 200 mm HDPE DR17, UNLESS NOTED OTHERWISE.
2. QUANTITIES SHALL BE VERIFIED IN THE FIELD.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JAN'22	ISSUED WITH MEMO VA22-00058	CAP	CBN

APPENDIX A

Plant Site Early Works Sediment Pond IFC Drawings

C3810 R2
C3811 R2
C3812 R2
C3813 R2
C3814 R2
C3815 R2
C3816 R2
C3820 R0
C3821 R0
G0006 R1
G0040 R1



PLAN
SCALE A

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED IN AUGUST 2011 BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. IT IS EXPECTED THAT DRAINAGE WILL EVOLVE AS CONSTRUCTION PROGRESSES. THE CATCHMENTS AREAS AND COLLECTION CHANNEL SIZES ARE TO BE EVALUATED BY A QUALIFIED PROFESSIONAL TO VERIFY THAT THE DESIGNS ARE REFLECTIVE OF CURRENT SITE CONDITIONS.
5. BEST MANAGEMENT PRACTICES (BMP) FOR SEDIMENT AND EROSION CONTROL WILL BE APPLIED DURING CONSTRUCTION AND OPERATION OF COLLECTION CHANNELS AND SEDIMENT CONTROL POND.
6. SUITABLE FOUNDATION MATERIAL TO BE APPROVED BY THE ENGINEER IN THE FIELD.
7. FOUNDATION PREPARATION SHALL CONSIST OF REMOVAL OF VEGETATION, MUD, DEBRIS, AND SOFT AND DELETERIOUS MATERIAL.
8. CUT AND FILL SLOPES SHALL BE CONFIRMED IN THE FIELD. SLOPES SHALL BE NO STEEPER THAN 3H:1V FOR THE POND AND 2.5H:1V FOR THE COLLECTION CHANNELS.
9. SEE DWG. G0006 FOR NOTES AND SPECIFICATIONS.

LEGEND:

- FILL AREAS
- CUT AREAS
- PREVIOUSLY CLEARED AREA
- EXISTING EXPLORATION ACESS ROAD

ISSUED FOR CONSTRUCTION

60 30 0 100 200 300 m
SCALE A

DRG. NO.	DESCRIPTION
C3816	ESCP - PLANT SITE - ADDITIONAL SECTIONS AND DETAILS
C3815	ESCP - PLANT SITE - SEDIMENT CONTROL POND - PLAN AND SECTIONS
C3813	ESCP - PLANT SITE - SOUTH COLLECTION CHANNEL - PLAN AND PROFILE
C3811	ESCP - PLANT SITE - NORTH COLLECTION CHANNEL - PLAN AND PROFILE
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	26JAN'22	ISSUED FOR CONSTRUCTION	CAP	ELG	CR	DDF
1	16DEC'21	REVISED ARRANGEMENT ISSUED FOR CLIENT REVIEW	CAP	ELG	DDF	DDF
0	04FEB'21	ISSUED FOR PERMITTING	CAP	ELG	KLA	DDF

REVISIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PEÑATE ROJAS
45299
2022-01-26

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL PLAN PLANT SITE GENERAL ARRANGEMENT PHASE 1 (EARLY WORKS)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3810	2

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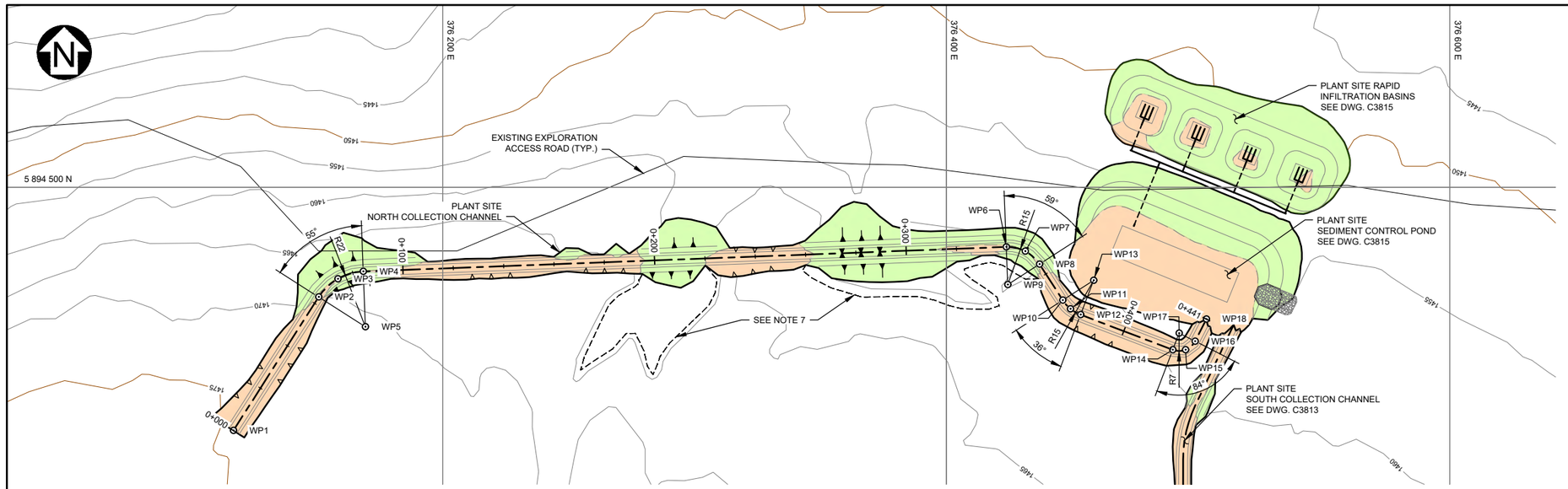
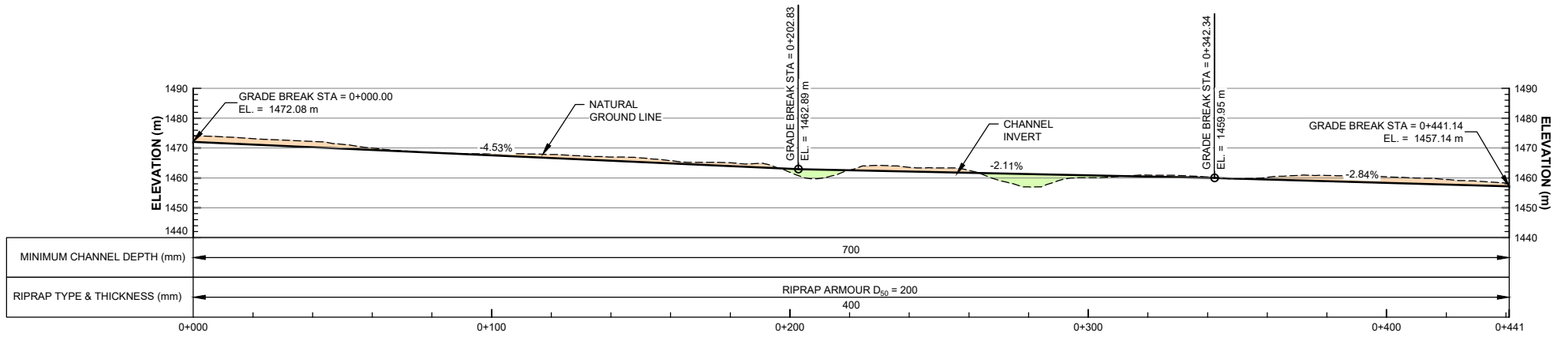


PLAN
SCALE A



NORTH COLLECTION CHANNEL - PROFILE
SCALE A

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED IN AUGUST 2011 BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. FOR CROSS SECTIONS SEE DWG. C3812.
5. TYPICAL SECTIONS SHOWN ON DWG. C3816.
6. SEE DWG. G0006 FOR NOTES AND SPECIFICATIONS.
7. PLACE FILL TO PROMOTE POSITIVE DRAINAGE PRIOR TO PLANT SITE BULK EARTHWORKS FILL PLACEMENT.

NORTH COLLECTION CHANNEL WORK POINTS

POINT NO.	NORTHING	EASTING	INVERT ELEVATION (m)
WP1	5,894,402.79	376,116.85	1,472.08
WP2	5,894,455.86	376,150.72	1,469.23
WP3	5,894,463.12	376,158.34	1,468.75
WP4	5,894,466.02	376,168.45	1,468.27
WP5	5,894,444.00	376,169.30	N/A
WP6	5,894,475.78	376,423.84	1,460.00
WP7	5,894,474.09	376,431.34	1,459.80
WP8	5,894,468.92	376,437.02	1,459.58
WP9	5,894,460.79	376,424.41	N/A
WP10	5,894,454.58	376,446.26	1,459.10
WP11	5,894,451.15	376,449.34	1,458.96
WP12	5,894,448.85	376,453.33	1,458.83
WP13	5,894,462.48	376,458.53	N/A
WP14	5,894,434.89	376,489.96	1,457.72
WP15	5,894,434.89	376,495.05	1,457.57
WP16	5,894,438.30	376,498.83	1,457.42
WP17	5,894,441.53	376,492.50	N/A
WP18	5,894,447.11	376,503.33	1,457.14

LEGEND:

FILL AREAS
CUT AREAS

ISSUED FOR CONSTRUCTION

SCALE A 20 10 0 20 40 60 80 100 m

DRG. NO.	DESCRIPTION
C3816	ESCP - PLANT SITE - ADDITIONAL SECTIONS AND DETAILS
C3815	ESCP - PLANT SITE - SEDIMENT CONTROL POND - PLAN AND SECTIONS
C3813	ESCP - PLANT SITE - SOUTH COLLECTION CHANNEL - PLAN AND PROFILE
C3812	ESCP - PLANT SITE - NORTH COLLECTION CHANNEL - CROSS SECTIONS
C3810	ESCP - PLANT SITE - GENERAL ARRANGEMENT - PHASE 1 (EARLY WORKS)
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	26JAN'22	ISSUED FOR CONSTRUCTION	CAP	ELG	CR	DDF
1	16DEC'21	REVISED ARRANGEMENT ISSUED FOR CLIENT REVIEW	CAP	ELG	DDF	DDF
0	04FEB'21	ISSUED FOR PERMITTING	CAP	ELG	KLA	DDF

REVISIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
45299
2022-01-26

Knight Piésold CONSULTING

BW GOLD LTD.

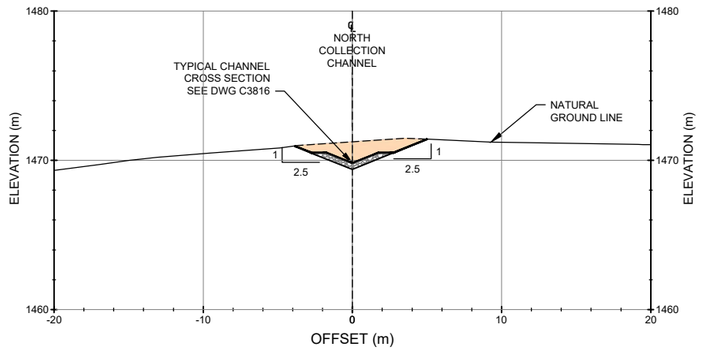
BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL PLAN PLANT SITE NORTH COLLECTION CHANNEL PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3811	2

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED IN AUGUST 2011 BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. SEE DWG. G0006 FOR NOTES AND SPECIFICATIONS.
5. PLACE FILL TO PROMOTE POSITIVE DRAINAGE PRIOR TO PLANT SITE BULK EARTHWORKS FILL PLACEMENT.



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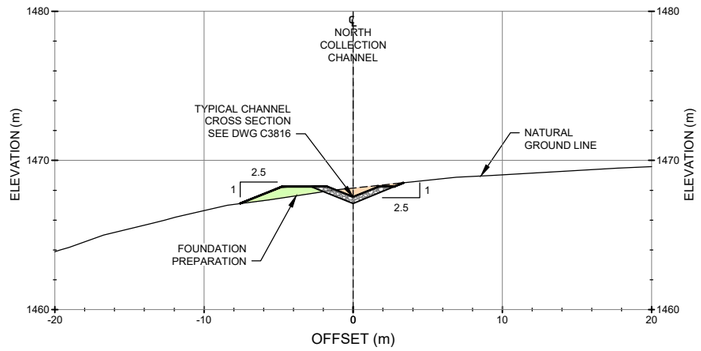

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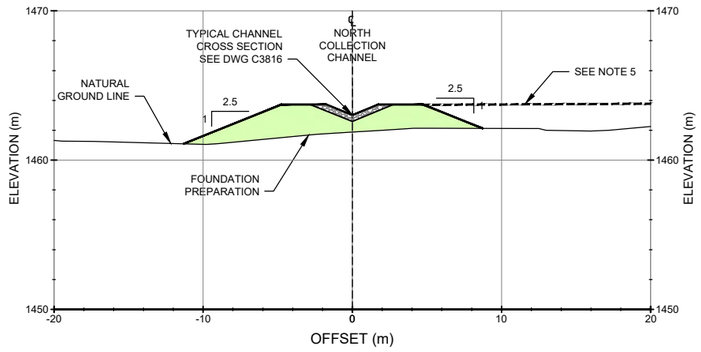

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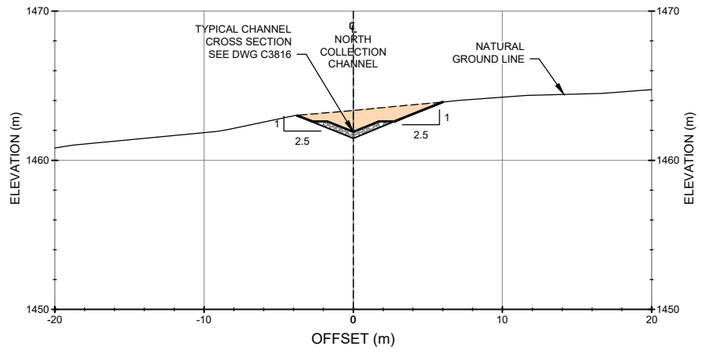

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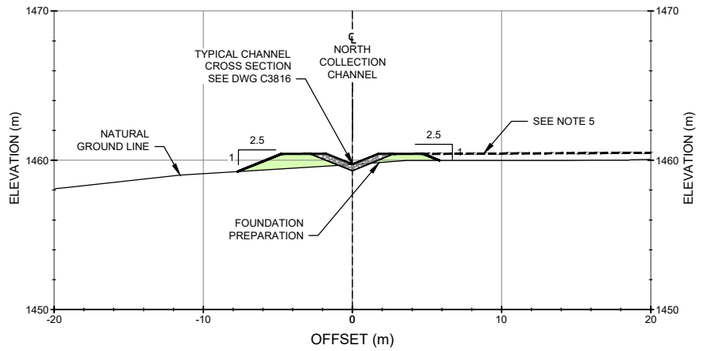

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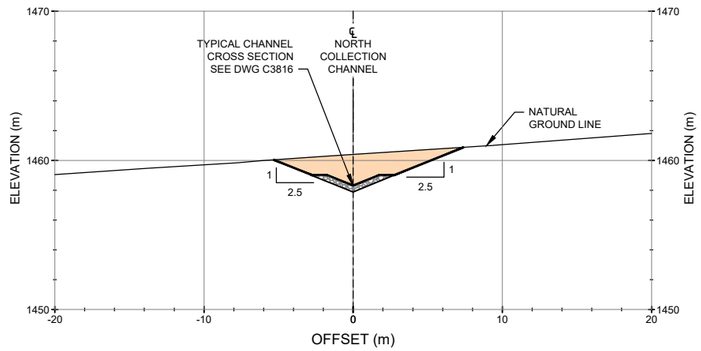


CROSS SECTION - STA. 0+400
SCALE A

LEGEND:

FILL AREAS

CUT AREAS

ISSUED FOR CONSTRUCTION

SCALE A 4 2 0 4 8 12 16 20 m

DRG. NO.	DESCRIPTION
C3816	ESCP - PLANT SITE - ADDITIONAL SECTIONS AND DETAILS
C3811	ESCP - PLANT SITE - NORTH COLLECTION CHANNEL - PLAN AND PROFILE
C3810	ESCP - PLANT SITE - GENERAL ARRANGEMENT - PHASE 1 (EARLY WORKS)
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	26JAN'22	ISSUED FOR CONSTRUCTION	CAP	ELG	CrVDDF	
1	16DEC'21	REVISED ARRANGEMENT ISSUED FOR CLIENT REVIEW	CAP	ELG	DDF	DDF
0	04FEB'21	ISSUED FOR PERMITTING	CAP	ELG	KLA	DDF

REVISIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
45299
2022-01-26

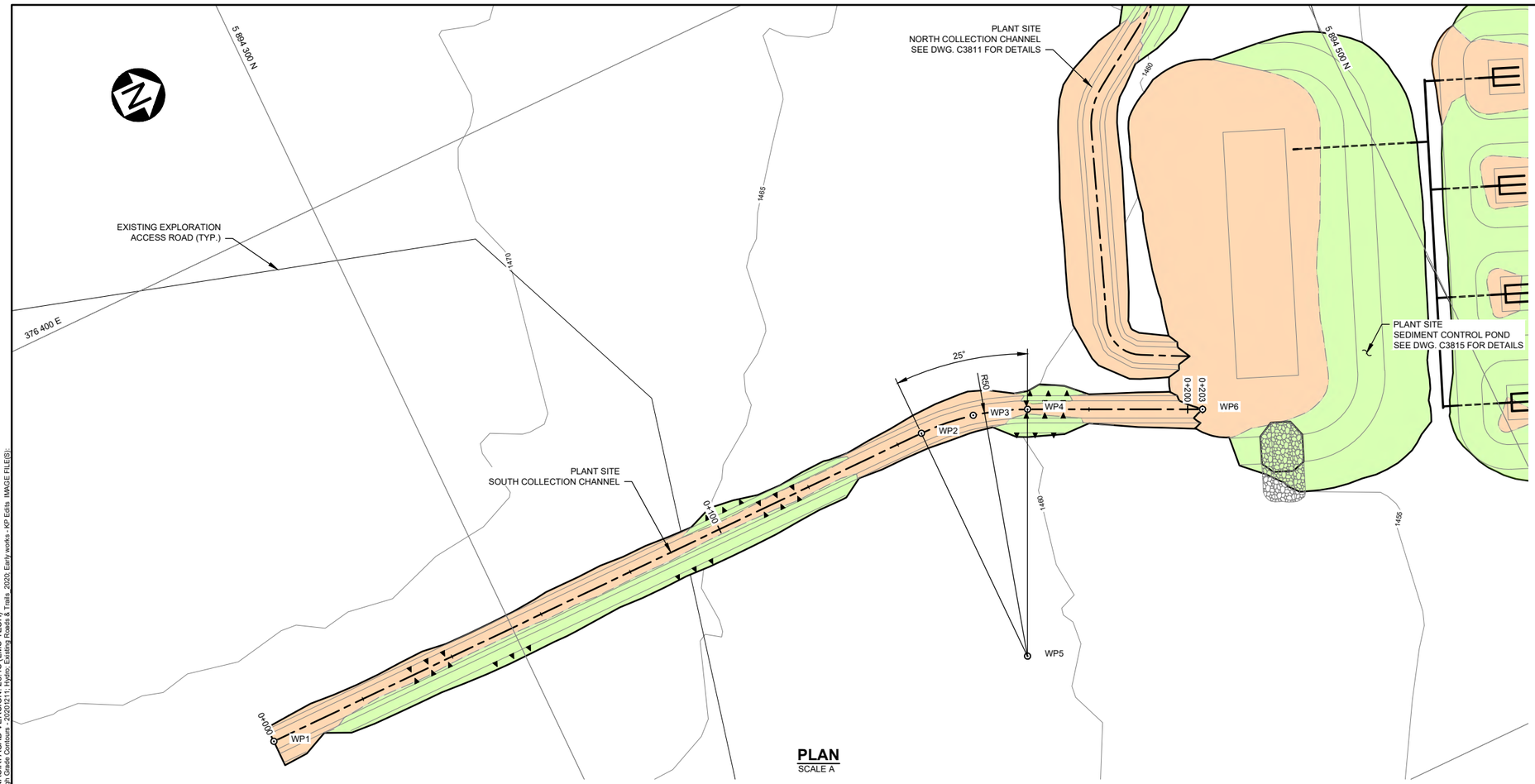
Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL PLAN
PLANT SITE
NORTH COLLECTION CHANNEL
CROSS SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3812	2



PLAN
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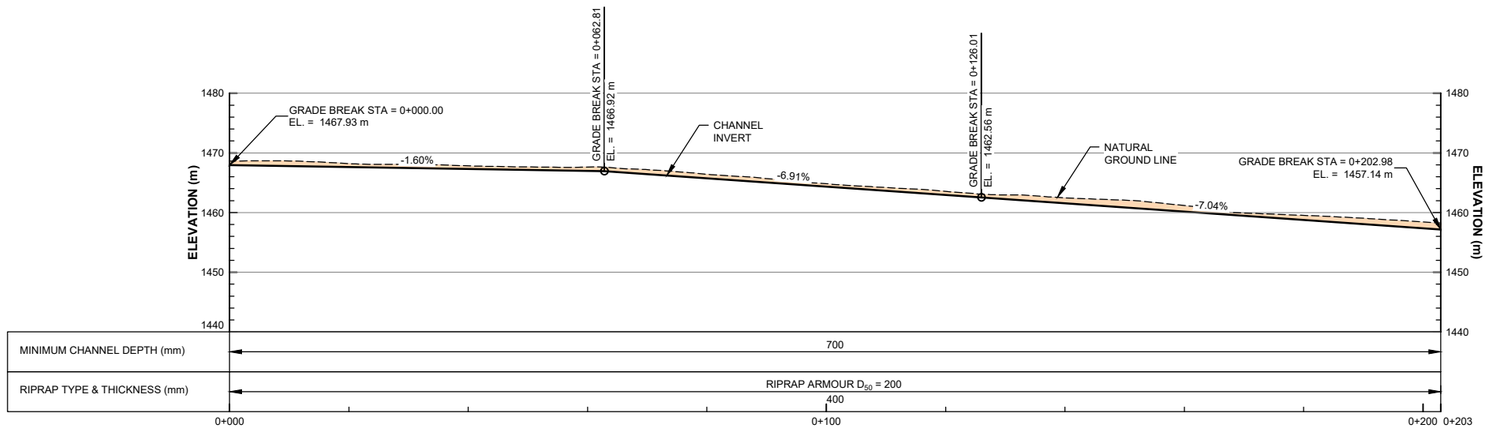


SOUTH COLLECTION CHANNEL - PROFILE
SCALE A

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED IN AUGUST 2011 BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. FOR CROSS SECTIONS SEE DWG. C3814.
5. TYPICAL SECTIONS SHOWN ON DWG. C3816.
6. SEE DWG. G0006 FOR NOTES AND SPECIFICATIONS.

SOUTH COLLECTION CHANNEL WORK POINTS

POINT NO.	NORTHING	EASTING	INVERT ELEVATION (m)
WP1	5,894,246.00	376,494.08	1,468.63
WP2	5,894,391.32	376,494.08	1,462.26
WP3	5,894,402.33	376,495.31	1,461.56
WP4	5,894,412.79	376,498.93	1,460.10
WP5	5,894,391.32	376,544.08	N/A
WP6	5,894,444.82	376,514.16	1,458.26

LEGEND:

- FILL AREAS
- CUT AREAS

ISSUED FOR CONSTRUCTION

SCALE A 20 10 0 20 40 60 80 100 m

DRG. NO.	DESCRIPTION
C3816	ESCP - PLANT SITE - ADDITIONAL SECTIONS AND DETAILS
C3815	ESCP - PLANT SITE - SEDIMENT CONTROL POND - PLAN AND SECTIONS
C3814	ESCP - PLANT SITE - SOUTH COLLECTION CHANNEL - CROSS SECTIONS
C3811	ESCP - PLANT SITE - NORTH COLLECTION CHANNEL - PLAN AND PROFILE
C3810	ESCP - PLANT SITE - GENERAL ARRANGEMENT - PHASE 1 (EARLY WORKS)
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

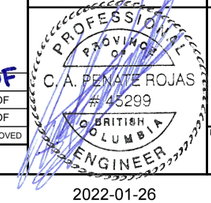
REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	26JAN'22	ISSUED FOR CONSTRUCTION	CAP	ELG	CrvDDF	
1	16DEC'21	REVISED ARRANGEMENT ISSUED FOR CLIENT REVIEW	CAP	ELG	DDF	DDF
0	04FEB'21	ISSUED FOR PERMITTING	CAP	ELG	KLA	DDF

REVISIONS



2022-01-26

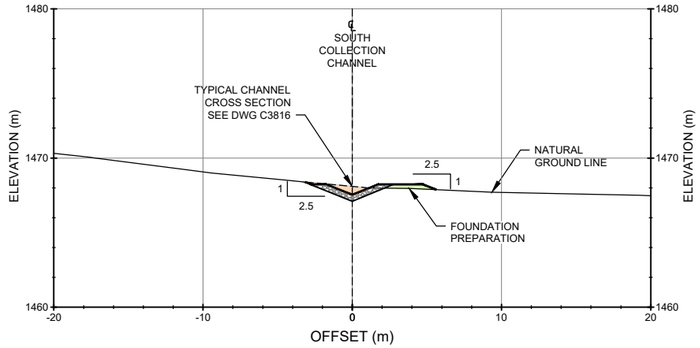
Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL PLAN PLANT SITE SOUTH COLLECTION CHANNEL PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3813	2



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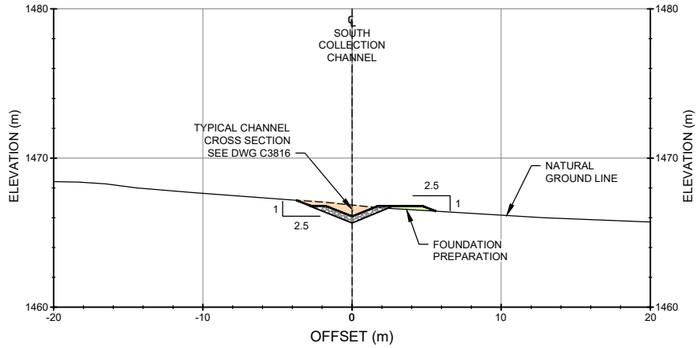

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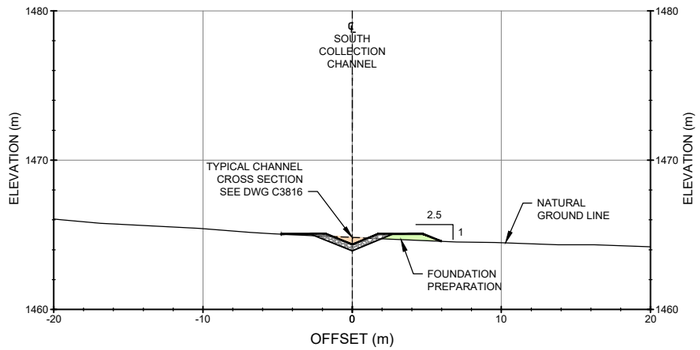

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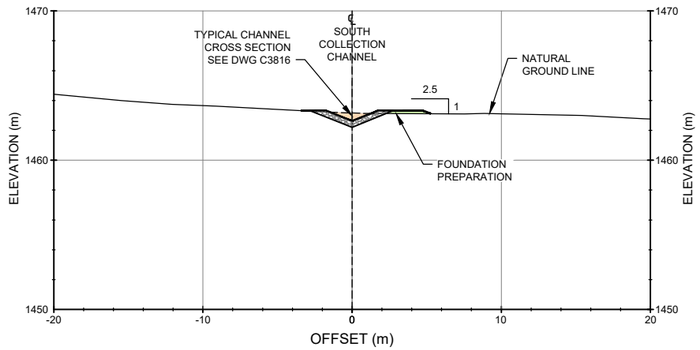

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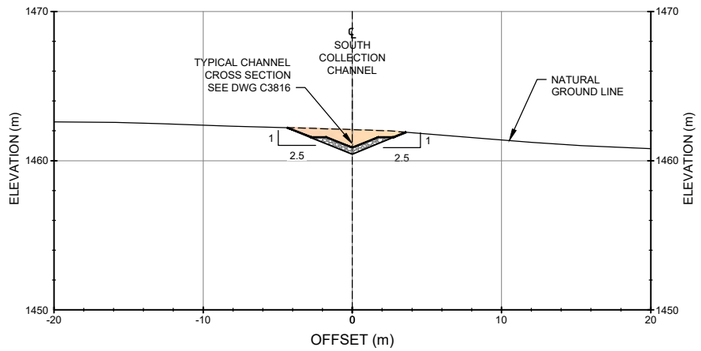

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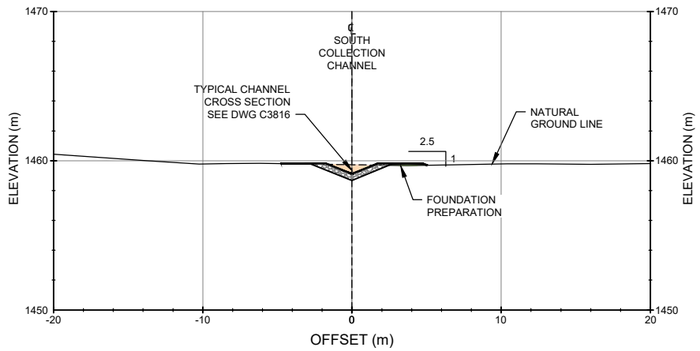

CROSS SECTION - STA. 0+175
SCALE A

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED IN AUGUST 2011 BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. SEE DWG. G0006 FOR NOTES AND SPECIFICATIONS.

LEGEND:

FILL AREAS

CUT AREAS

ISSUED FOR CONSTRUCTION

SCALE A 4 2 0 4 8 12 16 20 m

DRG. NO.	DESCRIPTION
C3816	ESCP - PLANT SITE - ADDITIONAL SECTIONS AND DETAILS
C3813	ESCP - PLANT SITE - SOUTH COLLECTION CHANNEL - PLAN AND PROFILE
C3810	ESCP - PLANT SITE - GENERAL ARRANGEMENT - PHASE 1 (EARLY WORKS)
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
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1	16DEC'21	REVISED ARRANGEMENT ISSUED FOR CLIENT REVIEW	CAP	ELG	DDF	DDF
0	04FEB'21	ISSUED FOR PERMITTING	CAP	ELG	KLA	DDF

REVISIONS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C.A. PENATE ROJAS # 45299

2022-01-26

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL PLAN PLANT SITE SOUTH COLLECTION CHANNEL CROSS SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3814	2

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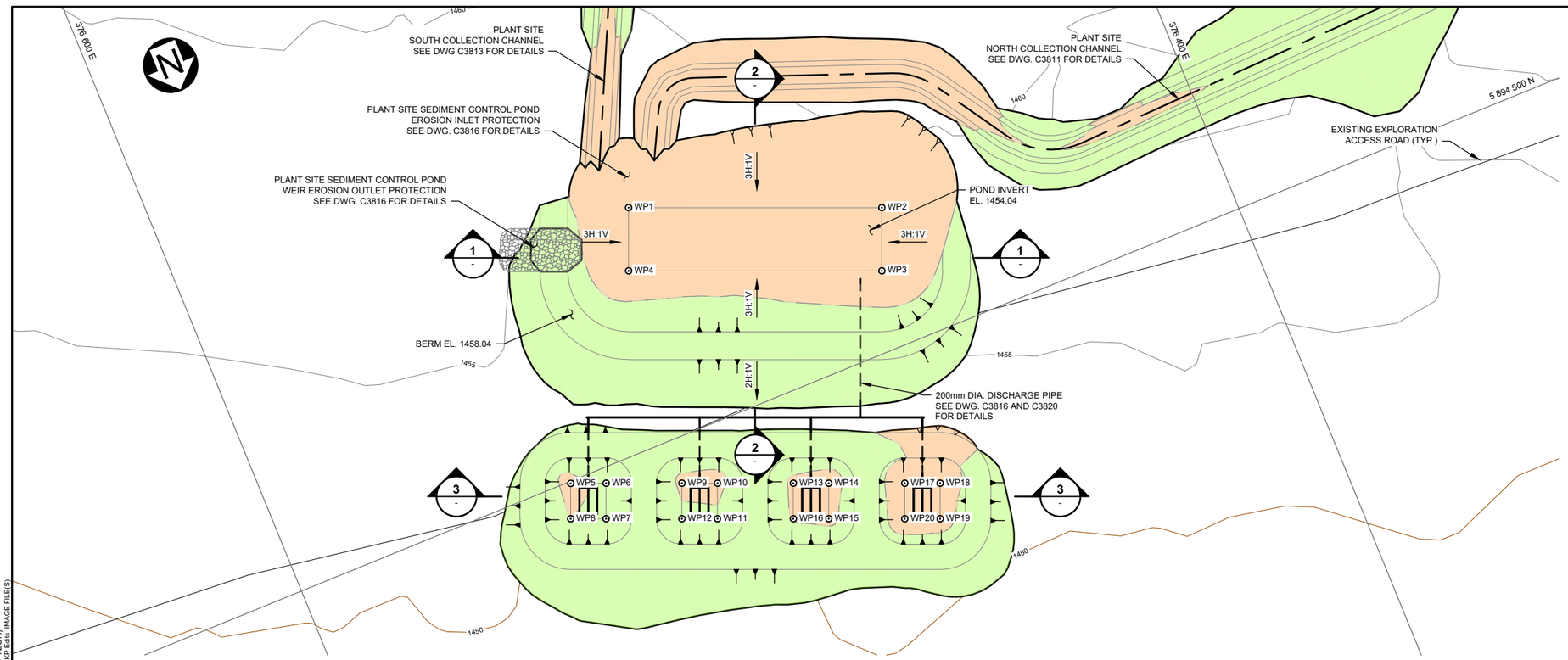
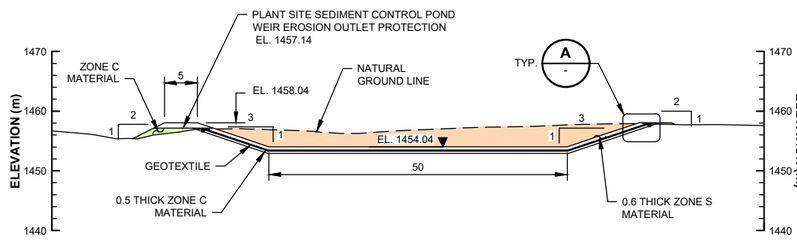


PLAN
SCALE A



1 SECTION
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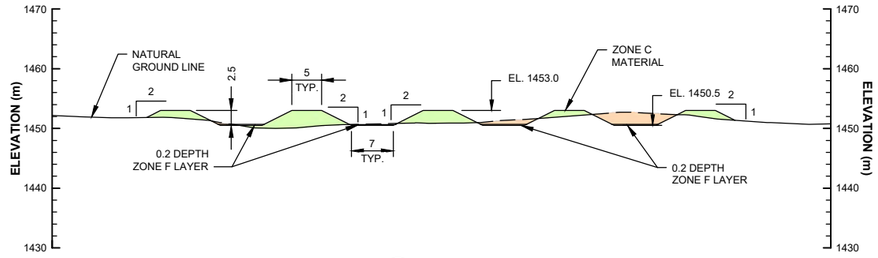

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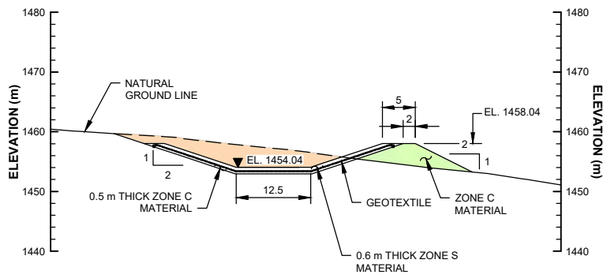
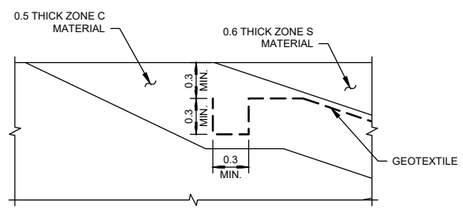
SCALE A



2 SECTION
SCALE A



A DETAIL
SCALE B

NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. GROUND TOPOGRAPHY DERIVED FROM LIDAR SURVEY COMPLETED IN AUGUST 2011 BY EAGLE MAPPING LTD. CONTOUR INTERVAL IS 5 m.
3. ALL COORDINATES ARE IN UTM NAD83 ZONE 10U.
4. SEE DWG. G0006 FOR NOTES AND SPECIFICATIONS.

SCP WORK POINTS TABLE

POINT NO.	NORTHING	EASTING	INVERT ELEVATION (m)
WP1	5,894,453.80	376,511.54	1,454.04
WP2	5,894,472.70	376,465.25	1,454.04
WP3	5,894,484.27	376,469.98	1,454.04
WP4	5,894,465.37	376,516.27	1,454.04

INFILTRATION BASIN WORK POINTS TABLE

POINT NO.	NORTHING	EASTING	INVERT ELEVATION (m)
WP5	5,894,499.88	376,542.75	1,450.50
WP6	5,894,502.52	376,536.26	1,450.50
WP7	5,894,509.00	376,538.91	1,450.50
WP8	5,894,506.35	376,545.39	1,450.50
WP9	5,894,508.19	376,522.37	1,450.50
WP10	5,894,510.83	376,515.89	1,450.50
WP11	5,894,517.31	376,518.54	1,450.50
WP12	5,894,514.67	376,525.02	1,450.50
WP13	5,894,516.50	376,502.01	1,450.50
WP14	5,894,519.15	376,495.52	1,450.50
WP15	5,894,525.63	376,498.17	1,450.50
WP16	5,894,522.98	376,504.65	1,450.50
WP17	5,894,524.82	376,481.64	1,450.50
WP18	5,894,527.46	376,475.16	1,450.50
WP19	5,894,533.94	376,477.80	1,450.50
WP20	5,894,531.30	376,484.28	1,450.50

LEGEND:

FILL AREAS

CUT AREAS

ISSUED FOR CONSTRUCTION

SCALE B: 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m

SCALE A: 10 5 0 10 20 30 40 50 m

DRG. NO.	DESCRIPTION
C3816	ESCP - PLANT SITE - ADDITIONAL SECTIONS AND DETAILS
C3813	ESCP - PLANT SITE - SOUTH COLLECTION CHANNEL - PLAN AND PROFILE
C3811	ESCP - PLANT SITE - NORTH COLLECTION CHANNEL - PLAN AND PROFILE
C3810	ESCP - PLANT SITE - GENERAL ARRANGEMENT - PHASE 1 (EARLY WORKS)
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	26JAN'22	ISSUED FOR CONSTRUCTION	CAP	ELG	CN	DDF
1	16DEC'21	REVISED ARRANGEMENT ISSUED FOR CLIENT REVIEW	CAP	ELG	DDF	DDF
0	04FEB'21	ISSUED FOR PERMITTING	CAP	ELG	KLA	DDF

REVISIONS

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. A. PENATE ROJAS
45299
2022-01-26

Knight Piésold CONSULTING

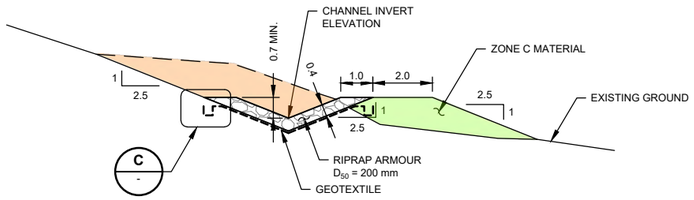
BW GOLD LTD.

BLACKWATER GOLD PROJECT

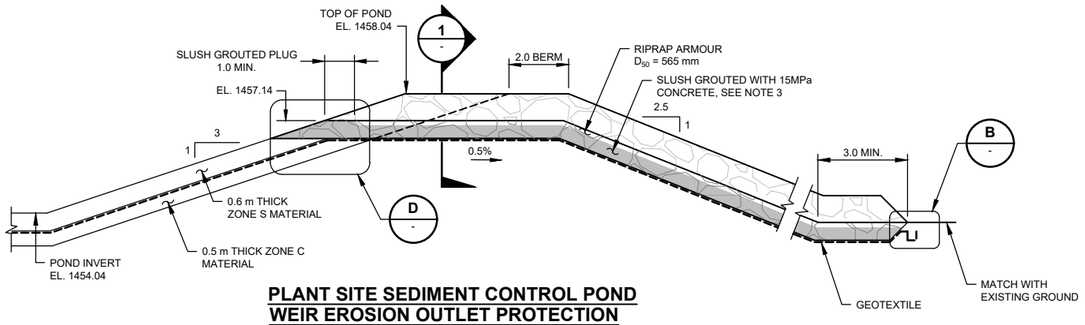
EROSION AND SEDIMENT CONTROL PLAN PLANT SITE SEDIMENT CONTROL POND PLAN AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3815	2

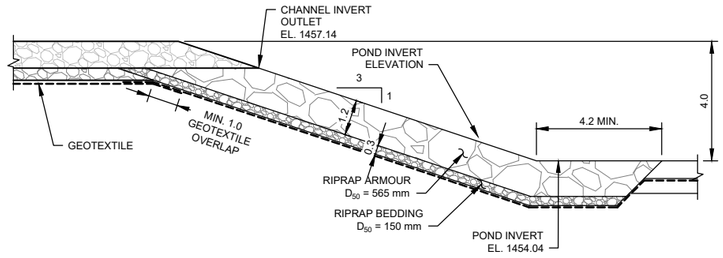
SAVED: M:\1\101\00457\33\A\acad\DWGS\C3815C3815_1/26/2022 8:16:28 AM, ANASIRI PRINTED: 1/26/2022 8:41:03 AM, C3815, ANASIRI ACAD VERSION: 23.1S (LMS TECH)
XREF FILE(S): Topo 5m Contours; Early Works - Plant and Crusher - Collection Ditches; Hydro Plant Site Rough Grade Contours - 20201211; Plant Site Facility - 20201204; Existing Roads & Trails - 20200; Early works - KP Edits IMAGE FILE(S):

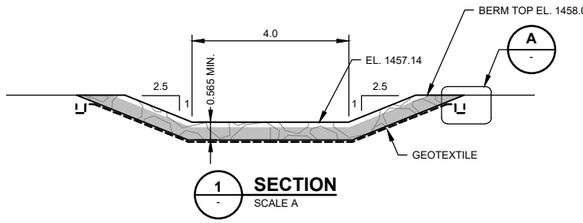


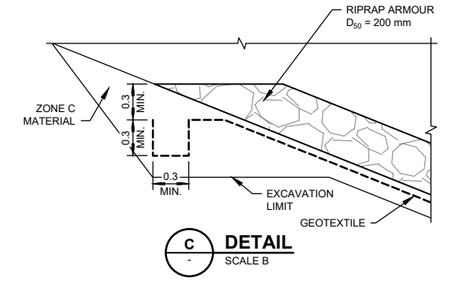
TYPICAL COLLECTION CHANNELS
SCALE A

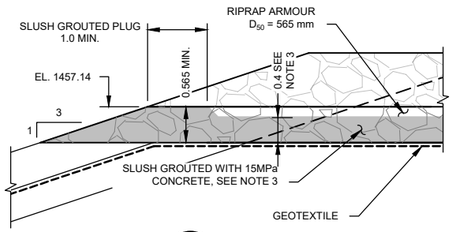


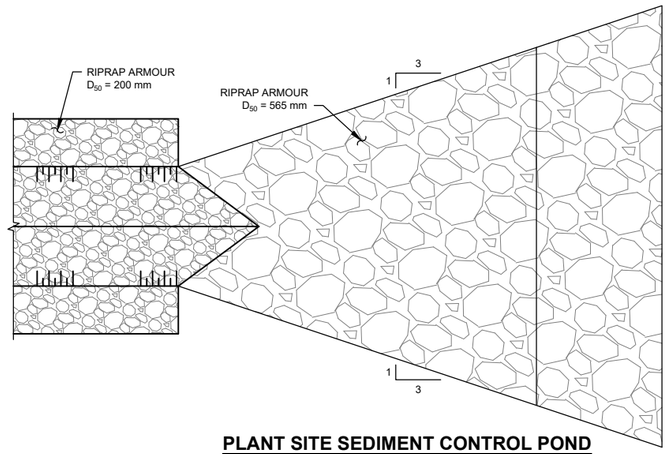
PLANT SITE SEDIMENT CONTROL POND WEIR EROSION OUTLET PROTECTION
SCALE A



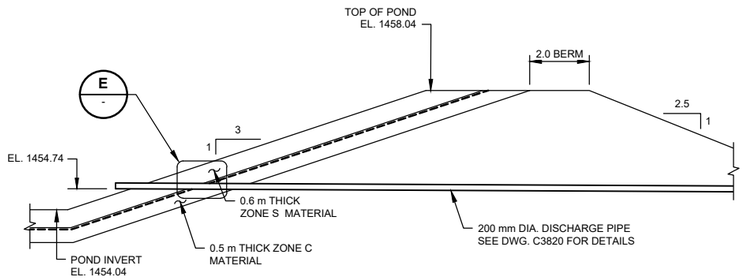




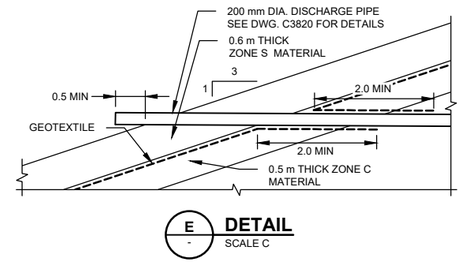


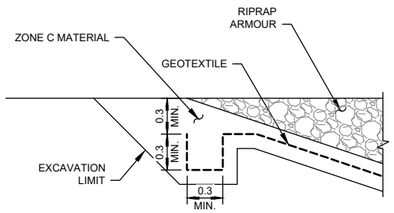


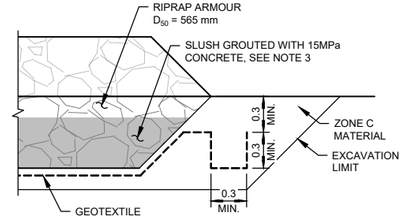
PLANT SITE SEDIMENT CONTROL POND EROSION INLET PROTECTION
SCALE A



PLANT SITE SEDIMENT CONTROL POND DISCHARGE PIPE
SCALE A







NOTES :

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. RIPRAP IN THIS AREA SHALL BE GROUTED TO 70% (TOP 30% NOT GROUTED) OF RIPRAP THICKNESS USING 15MPa CONCRETE. A FINAL ROUGH SURFACE SHALL REMAIN TO AID ENERGY DISSIPATION.
3. SEE DWG. G0006 FOR NOTES AND SPECIFICATIONS.

LEGEND:

FILL AREAS

CUT AREAS

SCALE C 1 0.5 0 1 2 3 4 5 m

SCALE B 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m

SCALE A 2 1 0 2 4 6 8 10 m

ISSUED FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
C3815	ESCP - PLANT SITE - SEDIMENT CONTROL POND - PLAN AND SECTIONS
C3814	ESCP - PLANT SITE - SOUTH COLLECTION CHANNEL - CROSS SECTIONS
C3813	ESCP - PLANT SITE - SOUTH COLLECTION CHANNEL - PLAN AND PROFILE
C3812	ESCP - PLANT SITE - NORTH COLLECTION CHANNEL - CROSS SECTIONS
C3811	ESCP - PLANT SITE - NORTH COLLECTION CHANNEL - PLAN AND PROFILE
C3810	ESCP - PLANT SITE - GENERAL ARRANGEMENT - PHASE 1 (EARLY WORKS)
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	26JAN'22	ISSUED FOR CONSTRUCTION	CAP	ELG	CV	DDF
1	16DEC'21	REVISED ARRANGEMENT ISSUED FOR CLIENT REVIEW	CAP	ELG	DDF	DDF
0	04FEB'21	ISSUED FOR PERMITTING	CAP	ELG	KLA	DDF

REVISIONS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. A. PEÑATE ROJAS # 45299

2022-01-26

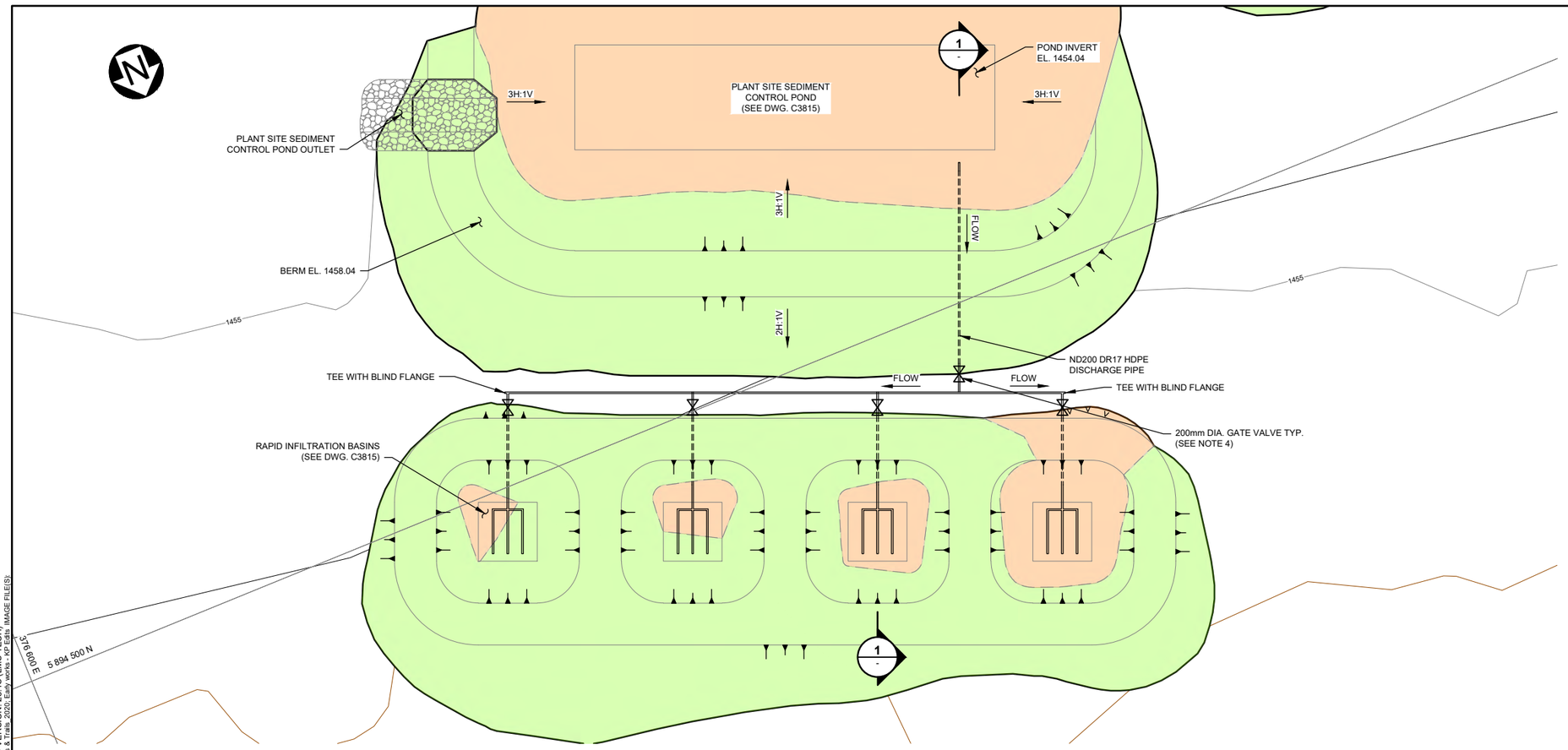
Knight Piésold CONSULTING

BW GOLD LTD.

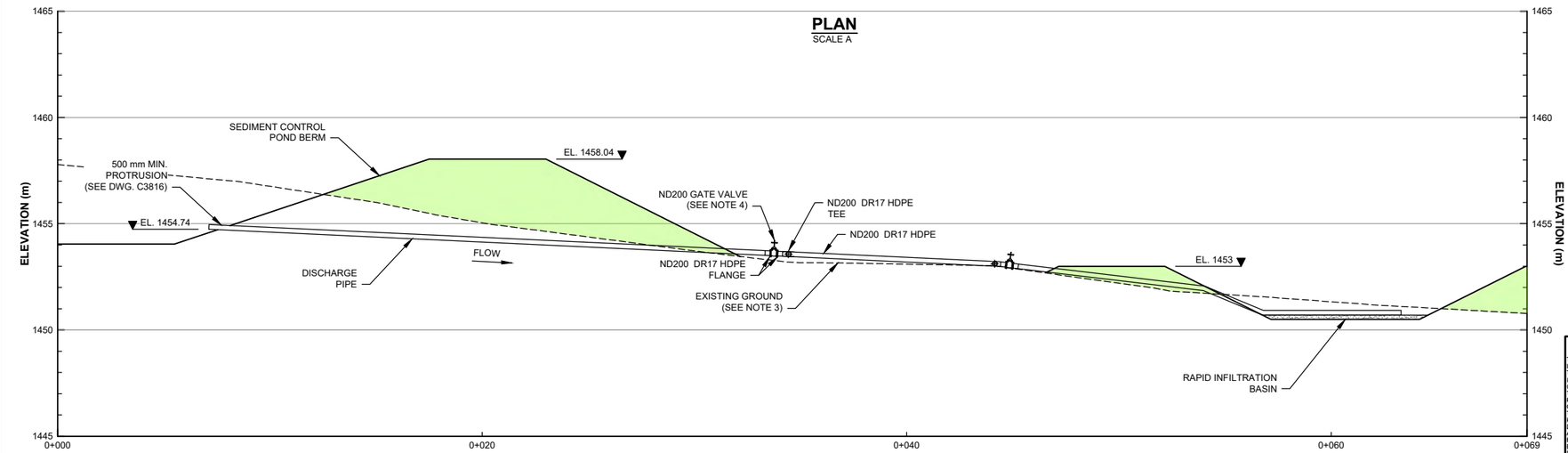
BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL PLAN PLANT SITE ADDITIONAL SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3816	2



PLAN
SCALE A



1 - SECTION
SCALE B

LEGEND:

- FILL
- CUT
- SAND / ZONE F (FILTER ZONE)
- DISCHARGE PIPE
- DISCHARGE PIPE (BELOW GROUND)

NOTES :

1. SEE DRAWINGS G0006 FOR NOTES AND SPECIFICATIONS.
2. CONTRACTOR TO SUBMIT HDPE BONDING PROCEDURE FOR REVIEW AND APPROVAL.
3. REGRADING AS NECESSARY TO ALLOW FOR COMPLETE GRAVITY DRAINAGE TOWARDS RAPID INFILTRATION BASINS AND PREVENT POOLING IN PIPE.
4. ALL FLANGES AND VALVES TO BE SUPPORTED IN A MANNER AS TO PROVIDE ADEQUATE CLEARANCE FOR INSTALLATION AND MAINTENANCE.

ISSUED FOR CONSTRUCTION

SCALE B: 2.5 1.25 0 2.5 5 7.5 10 12.5 m

SCALE A: 6 3 0 10 20 30 m

DRG. NO.	DESCRIPTION
C3821	ESCP - PLANT SITE - SEDIMENT CONTROL POND PIPING DETAIL - PLAN
C3816	ESCP - PLANT SITE - ADDITIONAL SECTIONS AND DETAILS
C3815	ESCP - PLANT SITE - SEDIMENT CONTROL POND - PLAN AND SECTIONS
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	26JAN'22	ISSUED FOR CONSTRUCTION	MJB1	RMM	CN	DDF

REVISIONS

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — M. J. BARRETT # 50410

2022-01-26

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL PLAN PLANT SITE SEDIMENT CONTROL POND PIPING PLAN AND SECTION

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3820	0

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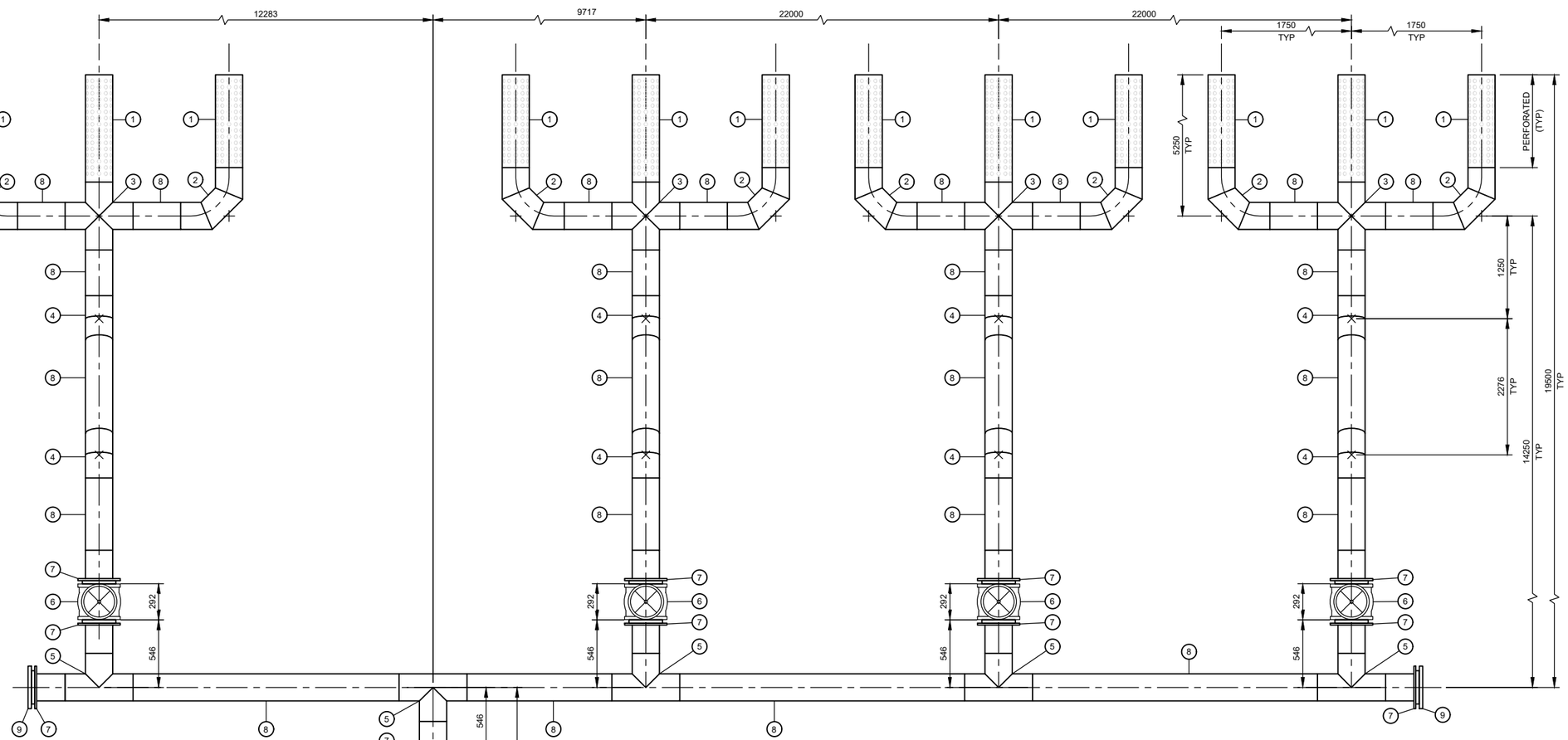
XREF FILE(S): Topo_5m Contours, Early Works + Plant and Crusher - Collection Ditches Hydro P Plant Site Rough Grade Contours - 20201121, Plant Site Facility - 20201204, Existing Roads & Trails_2020, Early works - KP Edits IMAGE FILE(S):



PLAN
SEDIMENT POND DISCHARGE PIPING
NTS

MATERIAL LIST			
ITEM NO.	DIAMETER (mm)	QTY.	DESCRIPTION
1	200	59 m	PIPE, DR17 HDPE, PERFORATED, PLAIN END CONNECTED
2	200	8	90 DEGREE ELBOW, DR17 HDPE, FABRICATED 3-SEGMENT, PLAIN END CONNECTED
3	200	4	CROSS, DR17 HDPE, FABRICATED, PLAIN END CONNECTED
4	200	8	22.5 DEGREE ELBOW, DR17 HDPE, FABRICATED 2-SEGMENT, PLAIN END CONNECTED
5	200	5	TEE, DR17 HDPE, FABRICATED, PLAIN END CONNECTED
6	200	5	GATE VALVE, CLASS 150, RAISED FACE, FLANGE CONNECTED, HANDWHEEL OPERATED
7	200	12	FLANGE ADAPTER, DR17 HDPE, C/W DUCTILE IRON BACK-UP RING AND GASKET
8	200	138 m	PIPE, DR17 HDPE, PLAIN END CONNECTED
9	200	2	FLANGE, BLIND, HDPE

NOTES:

1. SEE DRAWINGS G0006 FOR NOTES AND SPECIFICATIONS.
2. ALL VALVES AND FLANGES ARE CLASS 150 UNLESS SPECIFIED OTHERWISE.
3. MATERIAL PRESSURE RATING IS THE MINIMUM REQUIRED.
4. ALL HDPE MATERIALS ARE TO BE PE4710 AS PER ASTM D3350-06 UNLESS NOTED OTHERWISE.
5. HDPE FLANGE ASSMEBLY INCLUDES: FLANGE ADAPTER & BACK-UP RING.

ISSUED FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
C3820	ESCP - PLANT SITE - SEDIMENT CONTROL POND PIPING - PLAN AND SECTION
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	26JAN'22	ISSUED FOR CONSTRUCTION	MJB1	RMM	DDF	DDF

REVISIONS

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — M. J. BARRETT # 50410

2022-01-26

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

EROSION AND SEDIMENT CONTROL PLAN PLANT SITE SEDIMENT CONTROL POND PIPING DETAIL PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3821	0

GENERAL:

1. COORDINATE GRID IS UTM NAD 83 ZONE 10U.
2. GROUND TOPOGRAPHY BASED ON INFORMATION PROVIDED BY EAGLE MAPPING ON AUGUST 8 AND 9, 2011.
3. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
4. DRAWINGS WILL BE READ IN CONJUNCTION WITH THE PROJECT TECHNICAL SPECIFICATIONS. THE DRAWINGS WILL TAKE PRECEDENCE IN THE CASE OF A DISCREPANCY.
5. THE ENGINEER SHALL BE NOTIFIED UPON ANY DISCOVERY OF DISCREPANCIES BETWEEN THE ISSUED DRAWING SET AND/OR CONSTRUCTED WORKS.
6. MAINTAIN SURVEY CONTROL ON ALL ASPECTS OF THE WORKS. VERIFY ALL LINES, GRADES, LOCATIONS AND TIE-IN POINTS PRIOR TO COMMENCEMENT OF THE WORKS. NOTIFY THE ENGINEER IMMEDIATELY OF ANY DISCREPANCY.
7. CONFIRM THE LOCATION OF ALL ROAD AND PIPE CROSSINGS.
8. ALL MATERIALS USED WILL BE THE BEST SUITED FOR THE APPLICATION BASED ON SUPPLIER SPECIFICATIONS.

DESIGN CHANGE MANAGEMENT:

1. MATERIALS OR PRODUCTS USED WILL BE AS SPECIFIED ON THE DESIGN DRAWINGS OR EQUIVALENT AS APPROVED BY THE ENGINEER.

INSTRUMENTATION:

1. ALL WATER LEVEL, PORE PRESSURE, SURFACE AND SUBSURFACE DEFORMATION INSTRUMENTATION ARE TO BE INSTALLED WITH WIRELESS CAPABILITIES TO AUTOMATICALLY COLLECT AND TRANSMIT DATA.
2. FLOW MONITORING INSTRUMENTATION SHALL BE SURVEILLED AUTOMATICALLY OR MANUALLY DEPENDING ON THE LOCATION AND MONITORING SETUP, AS DETERMINED BY THE ENGINEER. FLOW MONITORING INSTRUMENTATION SHALL BE COMPRISED OF THE FOLLOWING:
   - V-NOTCH WEIRS AT THE END OF PERMANENT INLET AND OUTLET PIPES OR
   - FLOW METERS ON PERMANENT PUMPS.
3. DATA LOGGERS WITH CELLULAR TRANSMITTING CAPABILITIES ARE TO BE INSTALLED AT THE TOE OF MAIN DAM C AT EACH INSTRUMENTATION SECTION.
4. DAM CREST SURFACE DISPLACEMENT TO BE AUTOMATICALLY MONITORED BY TOTAL STATION AND SURVEY PRISMS.
5. SURVEY PRISMS INSTALLED AT 100 METER INTERVALS ON MAIN DAM C CREST.
6. AUTOMATIC TOTAL STATIONS TO SCAN SURVEY PRISMS AT A MINIMUM ONCE DAILY. AUTOMATIC MONITORING TO COMMENCE AT SUBSTANTIAL COMPLETION.

FOUNDATIONS:

1. THE FOUNDATION LEVELS GIVEN ON THE DRAWINGS ARE ANTICIPATED LEVELS. THE FINAL FOUNDATION LEVELS WILL BE DETERMINED BY THE ENGINEER BASED ON ACTUAL SITE CONDITIONS.
2. EXCAVATIONS WITH SIGNIFICANT WATER SEEPAGE MAY REQUIRE REDUCED EXCAVATION SLOPES THAN WHAT IS SHOWN ON THE EXCAVATION DRAWINGS AND WILL REQUIRE DEWATERING. CONTRACTOR TO ALLOW FOR SUCH DEWATERING SYSTEM.
3. BLINDING CONCRETE / LEAN MIX CONCRETE MUDSLAB MAY BE REQUIRED IN THE BOTTOM OF SOME FOUNDATION EXCAVATIONS. MINIMUM THICKNESS OF BLINDING CONCRETE SHALL BE 50 mm WITH A MAXIMUM NOMINAL THICKNESS OF 200 mm. THE BLINDING CONCRETE SHALL NOT BE THICKER THAN 400 mm AT DEEP INFILL AREAS SUCH AS ROCK EXCAVATION OVER-BREAK.
4. BLINDING CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF AT LEAST 15 MPa AT 28 DAYS.
5. FOR BLINDING LAYER CONCRETE THICKER THAN NOMINAL 200 mm USE CONVENTIONAL TYPE C25 CONCRETE UP TO DESIGN GRADE AND ELEVATION, FROM WHERE THE SPECIFIED CONCRETE STRENGTH FOR THE STRUCTURAL MEMBER SHOULD BE USED.
6. PRIOR TO PLACING BLINDING CONCRETE, REMOVE AND REPLACE ALL AREAS OF LOOSE OR SOFT MATERIAL OR COMPACT SUB GRADE SOILS AS SPECIFIED.
7. FREEZING OF BLINDING LAYER CONCRETE AND/OR EXPOSED FOUNDATION MATERIAL SHALL NOT BE ALLOWED AND WILL BE REJECTED BY THE ENGINEER.
8. ALL EXCAVATIONS AND FOUNDATION MATERIAL ARE TO BE INSPECTED AND ACCEPTED BY THE ENGINEER PRIOR TO PLACING BLINDING CONCRETE, FORMWORK OR ANY REINFORCEMENT. HOLD EXCAVATION FOR INSPECTION AND APPROVAL BY ENGINEER.
9. ALL EXCAVATIONS SHALL BE KEPT FREE OF STANDING WATER AT ALL TIMES.

TEMPORARY STRUCTURES:

1. THE CONSTRUCTOR SHALL DESIGN AND DETAIL ALL TEMPORARY STRUCTURES USED FOR THE CONSTRUCTION OF THE PERMANENT WORKS.
2. MAINTAIN ALL STRUCTURES IN A STABLE CONDITION DURING CONSTRUCTION AND ENSURE AT ALL TIMES THAT NO PART OF THE STRUCTURE IS OVER STRESSED DUE TO THE CONSTRUCTION ACTIVITIES.
3. PERMANENT WORKS SHALL NOT BE ALLOWED TO BE UNDERCUT OR UNDERMINED BY ANY CONSTRUCTION ACTIVITIES.

PIPEWORKS AND APPURTENANCES:

1. GENERAL
   - 1.1. PIPELINE ALIGNMENTS TO BE CONFIRMED IN THE FIELD TO ENSURE PIPELINE INSTALLATION AND OPERATION DO NOT INTERFERE WITH OTHER INFRASTRUCTURE/OPERATING ACTIVITIES.
   - 1.2. CONFIRM THE LOCATION OF ALL HIGH AND LOW POINTS ALONG THE PIPELINE ALIGNMENT, FOR THE INSTALLATION OF COMBINATION AIR/VACUUM RELEASE VALVES AND DRAIN POINTS, RESPECTIVELY.
   - 1.3. GEOTECHNICAL REQUIREMENTS
     - 1.3.1. PIPE FOUNDATION SHALL BE INSPECTED BY THE ENGINEER PRIOR TO LAYING OF THE PIPE. ANY SOFT SPOTS OR HARD SPOTS, SUCH AS ROCK OUTCROP, NOT EXPECTED SHALL BE SURVEYED AND REPORTED TO ENGINEER FOR CHECKING AND INSTRUCTIONS. PIPE SHALL NOT BE INSTALLED ON TIMBER (PIPE SUPPORTS) OR ROCK OUTCROPS THAT CAN CAUSE STRESS CONCENTRATIONS UNLESS NOTED OTHERWISE.
   - 1.4. PIPELINE THICKNESS SHOWN IS THE MINIMUM THICKNESS REQUIRED.
   - 1.5. MINIMUM HDPE BEND RADIUS IS TO BE CONFIRMED BASED ON MANUFACTURERS SPECIFICATION.
   - 1.6. AS PART OF THESE SPECIFICATIONS THE MANUFACTURER SHALL HAVE INSPECTED THE END PREPARATION, THICKNESS AND DIAMETERS AS PER SPECIFICATIONS. THIRD PARTY QUALITY ASSURANCE SHALL VERIFY THAT THE PIPE MEETS THE REQUIRED SPECIFICATIONS PRIOR TO BEING SHIPPED TO SITE.
   - 1.7. PRESSURE RATING - ALL EQUIPMENT IS TO BE RATED TO THE INSTALLED MINIMUM PIPELINE PRESSURE RATING UNLESS OTHERWISE NOTED.
   - 1.8. QUALITY ASSURANCE (QA) - THE MANUFACTURER SHALL ALWAYS HAVE IN EFFECT, A QA PROGRAM, WHICH CLEARLY ESTABLISHES THE AUTHORITY AND RESPONSIBILITY OF THOSE RESPONSIBLE FOR THE QA PROGRAM. PERSONS PERFORMING QUALITY FUNCTIONS SHALL HAVE SUFFICIENT AND WELL-DEFINED RESPONSIBILITY, AND AUTHORITY TO ENFORCE QUALITY REQUIREMENTS, TO IDENTIFY, INITIATE, RECOMMEND AND PROVIDE SOLUTIONS TO QUALITY PROBLEMS AND TO VERIFY THE EFFECTIVENESS OF THE SOLUTION.
   - 1.9. MANUFACTURING AND INSTALLATION
     - 1.9.1. EQUIPMENT SUPPLIERS SHALL PROVIDE MATERIAL OF HIGH AND CONSISTENT QUALITY.
     - 1.9.2. MATERIAL TESTING - WHERE APPLICABLE, MATERIALS TESTING SHALL BE RECORDED, AND TEST CERTIFICATES SUBMITTED TO THE OWNER OR ENGINEER IF REQUESTED.
     - 1.9.3. SHIPPING - THE SUPPLIER SHALL ARRANGE FOR THE DELIVERY OF EQUIPMENT AND MATERIALS TO THE CONSTRUCTION SITE. THE CONSTRUCTOR SHALL HAVE RESPONSIBILITY FOR UNLOADING AND STORING THE SUPPLIED EQUIPMENT.
     - 1.9.4. FINAL TESTING - THE INSTALLED EQUIPMENT SHALL BE TESTED AS REQUIRED BY THE OWNER BEFORE FINAL ACCEPTANCE. TESTING SHALL BE PERFORMED IN ACCORDANCE WITH THE SUPPLIER'S INSTALLATION PROCEDURES. TESTS SHALL BE DONE IN DRY AND WET CONDITIONS AS SPECIFIED BY THE MANUFACTURER'S RECOMMENDATIONS AND SHALL INCLUDE ALL RELEVANT COMPONENTS OF EQUIPMENT.
     - 1.9.5. TESTS - UPON COMPLETION OF THE WORK, THE SYSTEMS SHALL BE TESTED BY THE SUPPLIER'S REPRESENTATIVE TO DEMONSTRATE THAT ALL EQUIPMENT IS FUNCTIONING SATISFACTORILY IN THE MANNER REQUIRED.
     - 1.9.6. INSTALLATION AS PER SUPPLIER SPECIFICATION. INSTALLATION BY BOLTING TO FLANGE MATCHING ASME/ANSI B16.5 CLASS 150 OR THREAD CONNECTED TO PIPELINE OR VALVE AS OTHERWISE SPECIFIED ON DESIGN DRAWINGS.
     - 1.9.7. WATER MAY INCLUDE MINOR QUANTITIES OF SUSPENDED SILTS OR SANDS AND FLOATING OR NEUTRAL BUOYANCY DEBRIS. SLURRIES MAY INCLUDE LARGE QUANTITIES OF SUSPENDED SILTS OR SANDS, BED LOADS IN PIPE INVERT, AND FLOATING OR NEUTRAL BUOYANCY DEBRIS.
2. PIPE MATERIAL
   - 2.1. HDPE PIPE MATERIALS SHALL BE IN ACCORDANCE WITH ASTM D3350, ASTM F714, ASTM F2206 AND ASTM F2619.
   - 2.2. STEEL PIPE MATERIALS SHALL BE IN ACCORDANCE WITH ASTM A53 OR EQUIVALENT.
3. LENGTH
   - 3.1. PIPELINE LENGTHS ARE ENGINEER'S ESTIMATES ONLY. ACTUAL LENGTH SHALL BE MEASURED ON SITE
4. HDPE - PIPE AND FITTINGS
   - 4.1. INSTALLATION OF HDPE PIPE SHALL MEET AWWA M55 REQUIREMENTS.
   - 4.2. THE OUT OF ROUNDNESS OF PIPE ENDS SHALL BE CONSISTENT WITH THE DIAMETER AND WALL THICKNESS OF THE PIPE SUPPLIED AND THE TYPE OF JOINT. ANY OUT OF ROUNDNESS SHALL BE LIMITED TO A SMOOTH OVAL THAT MAY BE JACKED BACK IN A CIRCULAR SHAPE.
   - 4.3. HDPE PIPE DIMENSION AND WORKMANSHIP FOR PIPE AND FITTINGS SHALL BE IN ACCORDANCE WITH ASTM F714.
   - 4.4. JOINED HDPE PIPE FOR BUTT JOINT FUSION SHALL BE ACCURATELY ALIGNED AND RETAINED IN POSITION DURING THE WELDING OPERATION. THE JOINED PIPES SHALL NOT BE MISALIGNED BY MORE THAN +/- 3 mm.
   - 4.5. THE ERECTION AND SITE JOINING OF THE PIPE SHALL PROCEED IN A MANNER AIMED TO CONTROL THE TEMPERATURE OF THE PIPE.
   - 4.6. ALL HDPE JOINING SHALL BE BUTT FUSION AS PER ASTM F2620 UNLESS NOTED OTHERWISE.
   - 4.7. ALL HDPE FITTINGS TO BE OF THE SAME POLYETHYLENE RESIN AS THE JOINED PIPE.
   - 4.8. THE DIMENSION RATIO (DR) OF THE FITTING SHOWN IS THE MINIMUM REQUIRED.
   - 4.9. PERFORATIONS TO BE CIRCULAR AND ARRANGED IN ROWS PARALLEL TO THE AXIS OF THE PIPE.
   - 4.10. PERFORATION ROWS TO BE ARRANGED IN TWO EQUAL GROUPS PLACED SYMMETRICALLY ON EITHER SIDE OF THE LOWER HALF OF THE PIPE.
   - 4.11. MINIMUM NUMBER OF ROWS OF PERFORATIONS TO BE 4 ROWS.
   - 4.12. PERFORATION HOLE DIAMETER TO BE AT MINIMUM 10 mm AND AT MAXIMUM 15 mm.
   - 4.13. PERFORATION ROWS TO BE ARRANGED IN EITHER STAGGERED OR STRAIGHT ROWS WITH A LONGITUDINAL HOLE SPACING OF 150 mm.
5. FLANGED JOINTS
   - 5.1. USE GASKETS FOR ALL FLANGED JOINTS UNLESS OTHERWISE SHOWN ON THE DRAWINGS OR REQUIRED BY THE ENGINEER. CENTRE GASKETS ACCURATELY IN THE JOINT.
   - 5.2. LUBRICATE BOLTS, STUDS AND NUTS WITH FLANGE BOLT LUBRICANT SO THAT THE NUTS CAN BE RUN UP BY HAND.
   - 5.3. TAKE CARE TO PREVENT EXCESSIVE INITIAL TENSIONING OF BOLTS AND STUDS, AND TO ENSURE THAT TENSION IS APPLIED UNIFORMLY.
   - 5.4. REMOVE RUST PREVENTIVE COMPOUND APPLIED TO THE FACES OF FLANGES BEFORE SHIPMENT PRIOR TO INSTALLATION. DO NOT USE ACID OR TOOLS THAT MAY DAMAGE FINISHED SURFACES FOR CLEANING FLANGES.
6. COATING AND LINING OF CARBON STEEL APPURTENANCES
   - 6.1. ALL STEEL PIPE, FLANGES, ETC. TO BE FURNISHED WITH POLYURETHANE LININGS AND COATINGS, 625 um (25 MILS) DRY FILM THICKNESS (DFT), IN ACCORDANCE WITH AWWA C222, WITH SSPC SP10 SURFACE PREPARATION FOR 75 um PROFILE
7. VALVES
   - 7.1. THE PRESSURE CLASS RATING OF ALL VALVES IS THE MINIMUM REQUIRED.
   - 7.2. GATE VALVE
     - 7.2.1. GATE VALVES ARE TO BE PERMANENTLY INSTALLED AT PIPE JUNCTIONS TO ALL RAPID INFILTRATION BASINS (RIBS). THE VALVES ARE TO BE FLANGE CONNECTED. THE VALVES ARE TO REMAIN OPEN DURING NORMAL OPERATING CONDITIONS. THE VALVES MAY BE CLOSED TO ISOLATE INDIVIDUAL RIBS.
     - 7.2.2. SERVICE: CLEAR WATER
     - 7.2.3. MAXIMUM OPERATING PRESSURE: 125 psi
     - 7.2.4. VALVE TYPE: GATE
     - 7.2.5. ACTUATION: HANDWHEEL-OPERATED VISUAL POSITION INDICATOR
     - 7.2.6. MATERIALS OF CONSTRUCTION
       - 7.2.6.1. BODY: A 216-WCB
       - 7.2.6.2. GATE: A 216-WCB
       - 7.2.6.3. SEAT: A 105
       - 7.2.6.4. STEM: 13CR
       - 7.2.6.5. MAKE/MODEL (OR SIMILAR): BERIC DAVIS CAST CARBON STEEL GATE VALVE CLASS 150

ISSUED FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	26JAN'22	ISSUED FOR CONSTRUCTION	CBN	SKC	DDF	DDF
0	29OCT'21	ISSUED FOR PERMITTING	CBN	SKC	DDF	DDF

REVISIONS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. B. NIAMIR # 41576

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BLACKWATER GOLD PROJECT

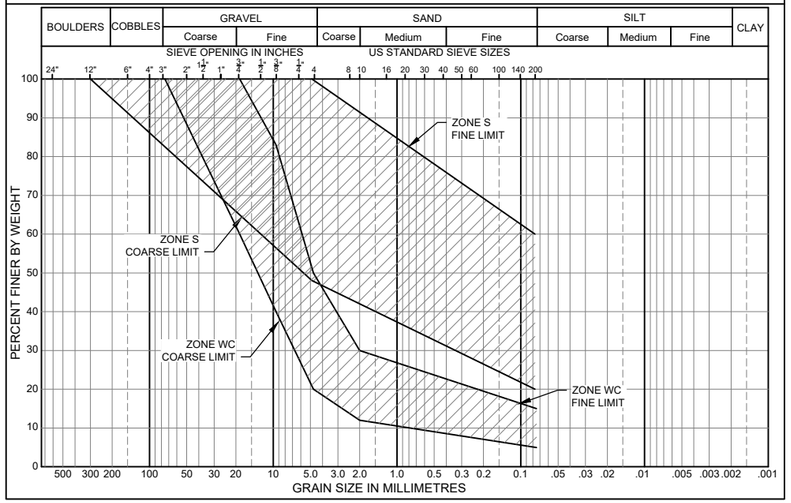
TECHNICAL NOTES

PA NO.	DRAWING NO.	REVISION
VA101-457/33	G0006	1

2022-01-26

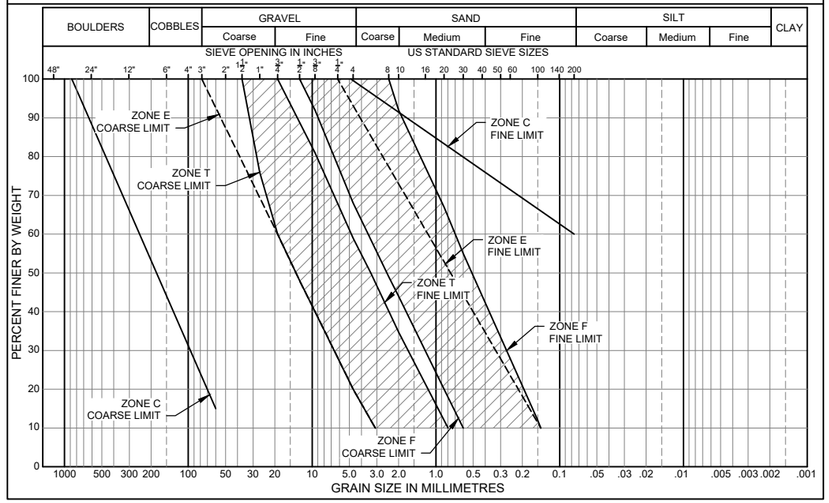
UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE - S, WC



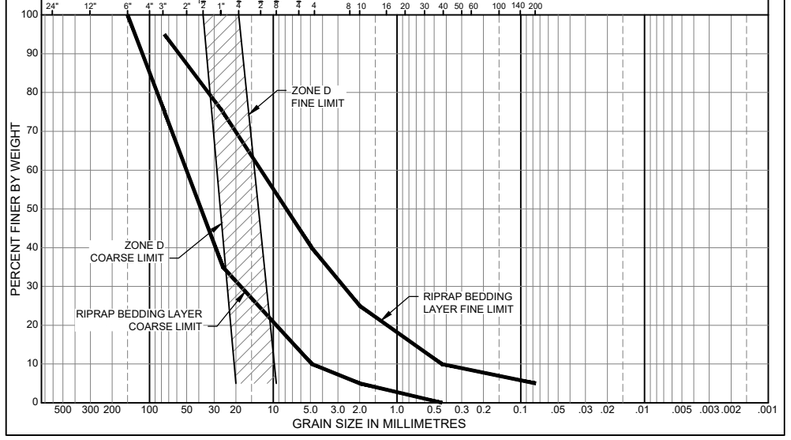
UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE - F, T, E, C



UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE - D, RB



MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS

ZONE	MATERIAL TYPE	LOCATIONS	PLACING AND COMPACTION REQUIREMENTS
S	GLACIAL TILL	SEAL ZONE	PLACED, MOISTURE CONDITIONED AND SPREAD IN MAXIMUM 300 mm THICK LAYERS (AFTER COMPACTION). VIBRATORY COMPACTION TO 95% OF STANDARD PROCTOR MAXIMUM DRY DENSITY OR AS APPROVED BY THE ENGINEER
F	SAND	FILTER ZONE	PLACED AND SPREAD IN MAXIMUM 600 mm THICK LAYERS AND COMPACTED WITH MINIMUM 4 TO 6 PASSES OF 10 TON SMOOTH DRUM VIBRATORY ROLLER, OR AS APPROVED BY THE ENGINEER
T	GRAVEL	TRANSITION ZONE	PLACED AND SPREAD IN MAXIMUM 600 mm THICK LAYERS AND COMPACTED WITH MINIMUM 4 TO 6 PASSES OF 10 TON SMOOTH DRUM VIBRATORY ROLLER, OR AS APPROVED BY THE ENGINEER.
E	ENGINEERED FILL	FOUNDATIONS	PLACED AND SPREAD IN MAXIMUM 150 mm THICK LAYERS. VIBRATORY COMPACTED TO 100% OF STANDARD PROCTOR MAXIMUM DRY DENSITY OR AS APPROVED BY THE ENGINEER.
C	WASTE ROCK OVER BURDEN	SHELL ZONE	PLACE AND SPREAD IN MAXIMUM 1000 mm THICK LAYERS. UNIFORMLY COMPACTED BY SELECTIVE ROUTING OF HAUL TRUCK TRAFFIC ON MAIN FILL AND BY 10 TON SMOOTH DRUM VIBRATORY ROLLER ON THE FILL EDGES.
D	DRAIN ROCK	DRAINS	PLACED AROUND DRAINAGE PIPES AND WRAPPED WITH GEOTEXTILE.
R	RIPRAP	RIPRAP	PLACED WITH EXCAVATOR BUCKET IN INTERLOCKING FASHION WITH MINIMAL COMPACTIVE EFFORT.
RB	RIPRAP BEDDING	RIPRAP	PLACE AND SPREAD IN MAXIMUM 150 mm THICK LAYERS. UNIFORMLY COMPACTED BY BUCKET TAMPING.
WC	WEARING COURSE	ROADS	PLACE AND SPREAD IN MAXIMUM 150 mm THICK LAYERS. EACH LAYER SHALL BE COMPACTED BY A MINIMUM OF 4 PASSES OVER THE ENTIRE SURFACE WITH 10 TON SMOOTH DRUM VIBRATORY ROLLER.

NOTES:

1. FOR GENERAL NOTES SEE DRAWING G0006.
2. RIPRAP TO BE HARD, DENSE AND DURABLE TO WITHSTAND LONG EXPOSURE TO WEATHERING.
3. RIPRAP STONES SHALL BE ANGULAR IN SHAPE. NO STONE SHALL EXCEED A LENGTH TO BREADTH OR THICKNESS OF 3.
4. SELECTED BC MINISTRY OF TRANSPORTATION RIPRAP CLASSES AND DIMENSIONS SHOWN IN TABLE 1 AND TABLE 2.
5. SEE PROJECT TECHNICAL SPECIFICATIONS FOR ADDITIONAL MATERIAL REQUIREMENTS.

GRADATION OF ROCK SIZES IN EACH CLASS OF RIPRAP

CLASS OF RIPRAP (kg)	D50 (mm)	ROCK GRADATION PERCENTAGE SMALLER THAN GIVEN ROCK MASS (kg)		
		15%	50%	85%
5	150	0.5	5	15
10	200	1	10	30
50	330	5	50	150
250	565	25	250	750
1000	900	100	1000	3000
2000	1130	200	2000	6000

APPROXIMATE AVERAGE DIMENSION OF EACH SPECIFIED ROCK CLASS MASS (mm) (SG = 2.64)

CLASS OF RIPRAP (kg)	D50 (mm)	APPROXIMATE AVERAGE DIMENSION (mm)		
		15%	50%	85%
5	150	70	150	215
10	200	90	200	285
50	330	155	330	475
250	565	260	565	815
1000	900	415	900	1295
2000	1130	525	1130	1630

ISSUED FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
G0006	TECHNICAL NOTES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	26JAN'22	ISSUED FOR CONSTRUCTION	CBN	SKC	DDF	DDF
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REVISIONS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. B. NIAMIR # 41576 ENGINEER

2022-01-26

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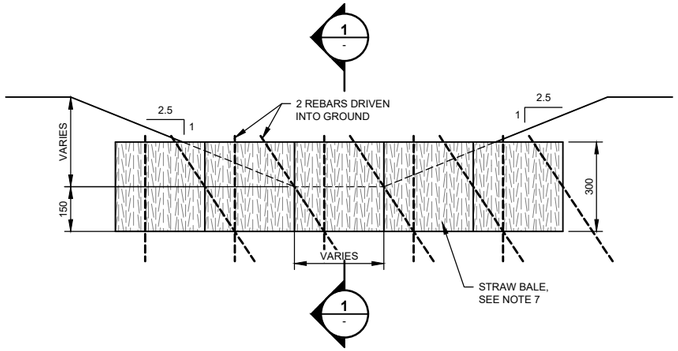
CONSTRUCTION MATERIAL GRADATIONS

PA NO.	DRAWING NO.	REVISION
VA101-457/33	G0040	1

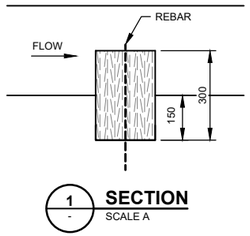
APPENDIX B

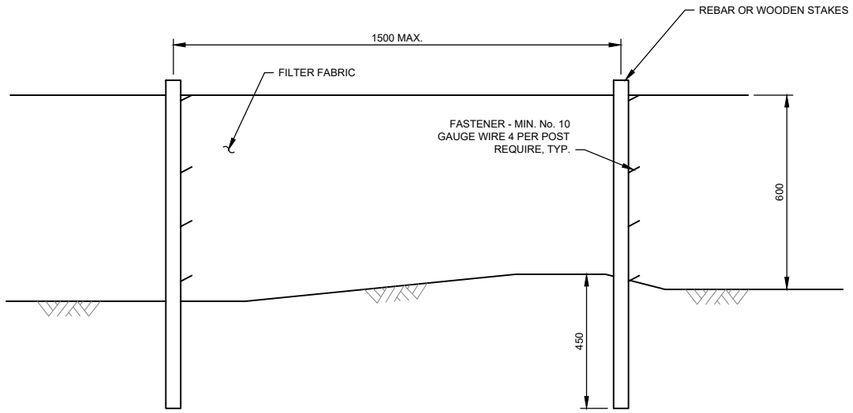
Sediment and Erosion Control BMP Figures

(Figures 1B to 2B)

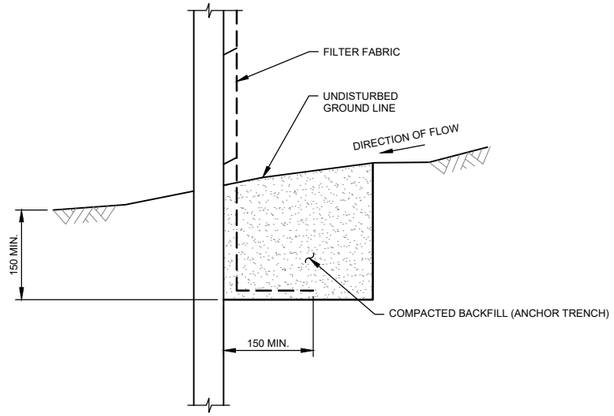


STRAW BALE ON CHANNEL
SCALE A

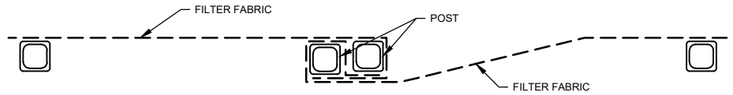




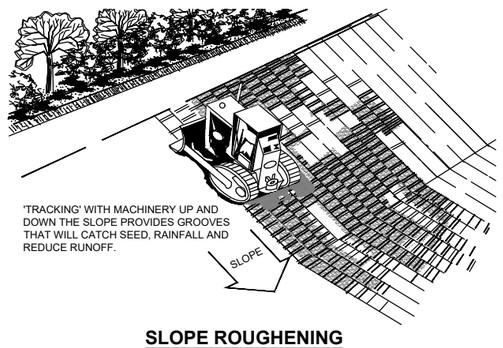
SILT FENCING PROFILE
SCALE A



SILT FENCING - CROSS SECTION
SCALE B



SILT FENCES ATTACHMENT
SCALE B



SLOPE ROUGHENING
NTS

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. BEST MANAGEMENT PRACTICES (BMP) FOR SEDIMENT AND EROSION CONTROL WILL BE APPLIED DURING CONSTRUCTION AND OPERATION OF COLLECTION CHANNELS AND SEDIMENT CONTROL POND.
3. FOUNDATION PREPARATION SHALL CONSIST OF REMOVAL OF VEGETATION, MUD, DEBRIS, AND SOFT AND DELETERIOUS MATERIAL.
4. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
5. SITE GRADING SURFACE WATER RUNOFF TO BE DIRECTED TO THE COLLECTION CHANNELS AT ALL TIMES DURING SITE DISTURBANCE ACTIVITIES UNTIL FINAL STABILIZATION IS ACHIEVED.
6. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL MEASURES PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
7. STRAW BALE SHALL BE IMPLEMENTED ON COLLECTION CHANNELS WHEN REQUIRED BY THE CONTRACTOR. TYPE OF CHANNELS MAY INCLUDE NON-CONTACT RUNOFF, CONTACT RUNOFF, ACCESS ROAD, PERMANENT AND TEMPORARY CHANNELS.

FOR INFORMATION ONLY

SCALE B: 100 50 0 100 200 300 400 500 mm
SCALE A: 200 100 0 200 400 600 800 1000 mm

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	25JAN'22	ISSUED WITH MEMO	CAP	SKC/ABN	CBN

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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 1 OF 2

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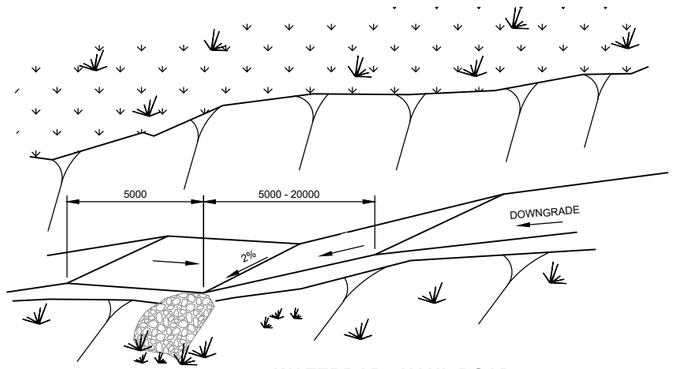
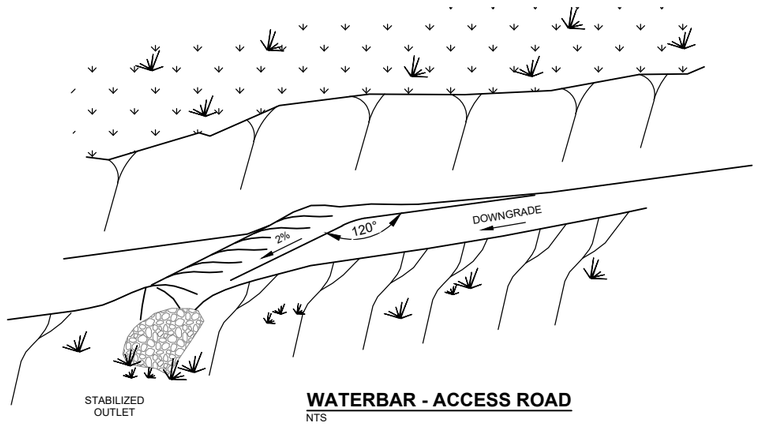
P/A NO. VA101-457/36 | REF NO. VA22-00058

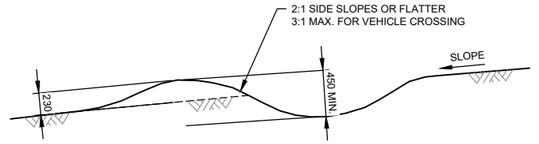
FIGURE 1B | REV 0



WATERBAR - HAUL ROAD
NTS



WATERBAR - ACCESS ROAD
NTS



WATERBAR - TYPICAL SECTION
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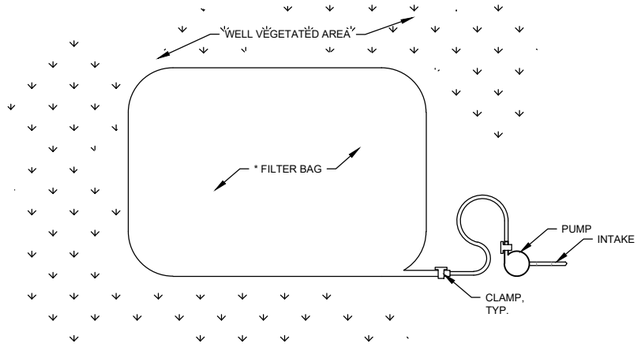
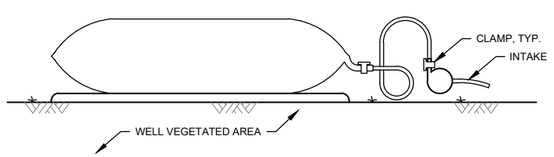
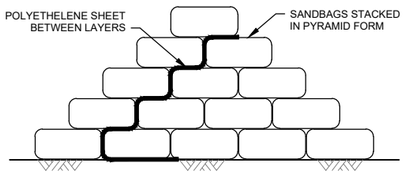


FILTER BAG PLAN
NTS



FILTER BAG CROSS SECTION
NTS



TEMPORARY STREAM DIVERSION STRUCTURE
NTS

NOTES:

1. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
2. SURFACE WATER RUNOFF TO BE DIRECTED TO THE EROSION CONTROL BMPS AT ALL TIMES DURING SITE DISTURBANCE ACTIVITIES UNTIL FINAL STABILIZATION IS ACHIEVED.
3. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL BMPS PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
4. AN AREA IS CONSIDERED TO HAVE ACHIEVED FINAL STABILIZATION WHEN IT HAS A MINIMUM UNIFORM 70% VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER TO RESIST ACCELERATED SURFACE EROSION.
5. DIVERSION STRUCTURE TO CONSIST OF SANDBAGS OR U-SHAPED METAL PLATE.

FOR INFORMATION ONLY

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	25JAN'22	ISSUED WITH MEMO	CAP	SKC/ABN	CBN

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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 2 OF 2

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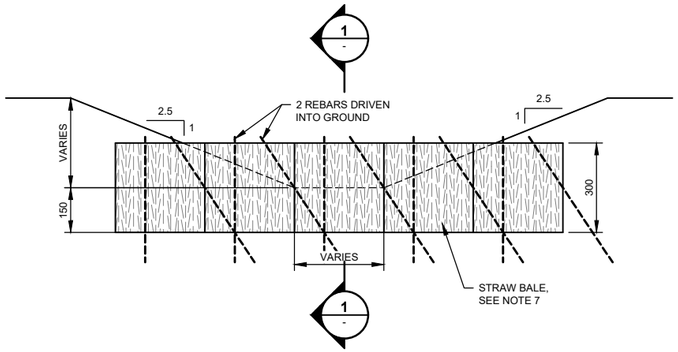
P/A NO. VA101-457/36 | REF NO. VA22-00058

FIGURE 2B | REV 0

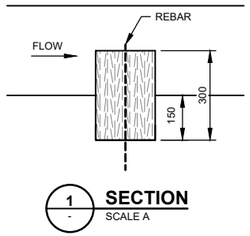
APPENDIX C

Drawings

C3801 Detailed Design – Not for Construction
C3802 Detailed Design – Not for Construction
C3803 Detailed Design – Not for Construction



STRAW BALE ON CHANNEL
SCALE A



SECTION
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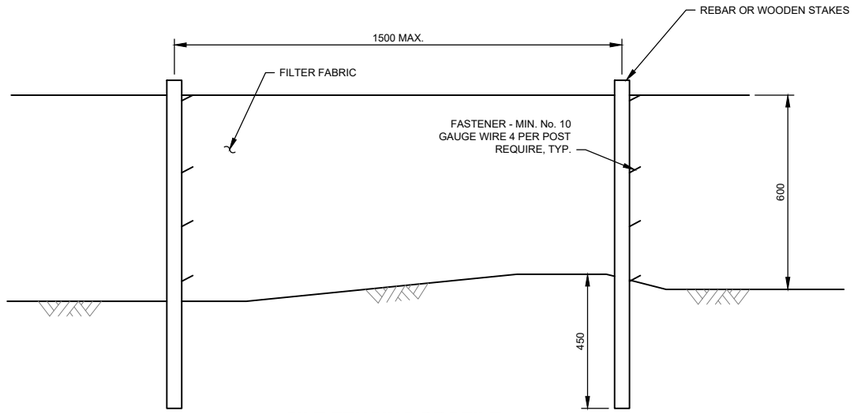
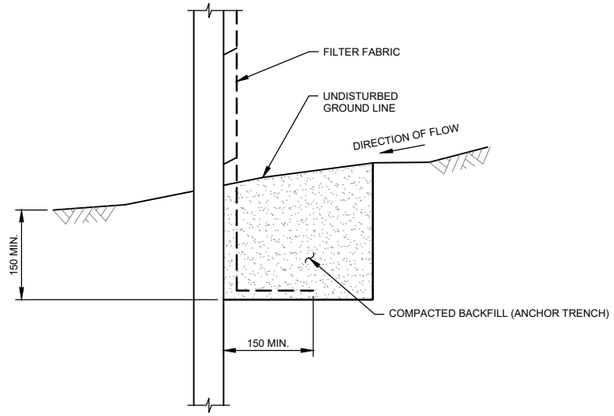


SILT FENCING PROFILE
SCALE A



SILT FENCING - CROSS SECTION
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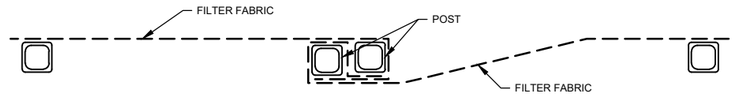

SILT FENCES ATTACHMENT
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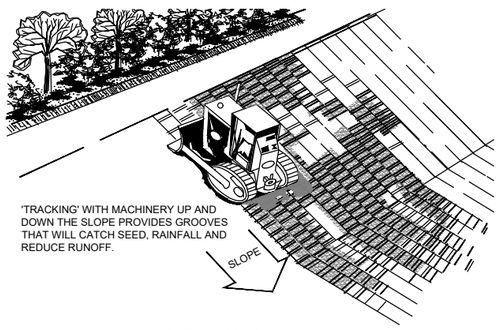

SLOPE ROUGHENING
NTS

NOTES :

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2. BEST MANAGEMENT PRACTICES (BMP) FOR SEDIMENT AND EROSION CONTROL WILL BE APPLIED DURING CONSTRUCTION AND OPERATION OF COLLECTION CHANNELS AND SEDIMENT CONTROL POND.
3. FOUNDATION PREPARATION SHALL CONSIST OF REMOVAL OF VEGETATION, MUD, DEBRIS, AND SOFT AND DELETERIOUS MATERIAL.
4. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
5. SITE GRADING SURFACE WATER RUNOFF TO BE DIRECTED TO THE COLLECTION CHANNELS AT ALL TIMES DURING SITE DISTURBANCE ACTIVITIES UNTIL FINAL STABILIZATION IS ACHIEVED.
6. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL MEASURES PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
7. STRAW BALE SHALL BE IMPLEMENTED ON COLLECTION CHANNELS WHEN REQUIRED BY THE CONTRACTOR. TYPE OF CHANNELS MAY INCLUDE NON-CONTACT RUNOFF, CONTACT RUNOFF, ACCESS ROAD, PERMANENT AND TEMPORARY CHANNELS.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE B 100 50 0 100 200 300 400 500 mm

SCALE A 200 100 0 200 400 600 800 1000 mm

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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 1

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3801	0

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04FEB'21	ISSUED FOR PERMITTING	CAP	SKC		

REVISIONS

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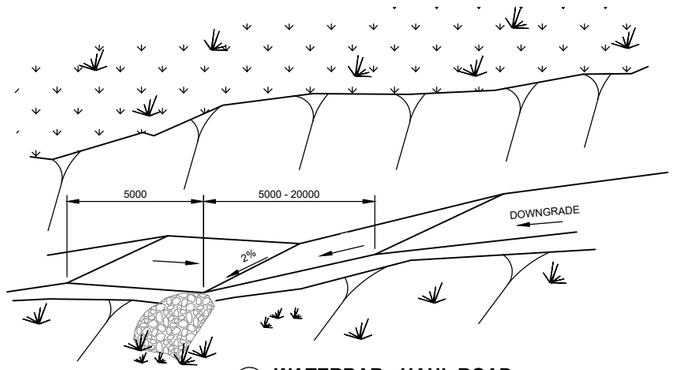
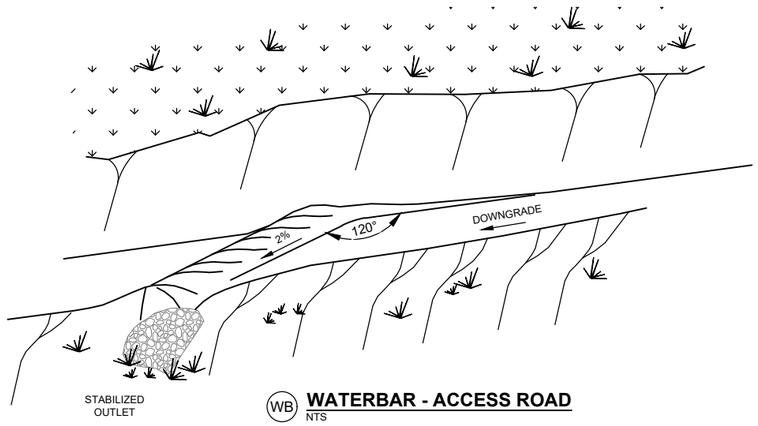


WB **WATERBAR - HAUL ROAD**
NTS



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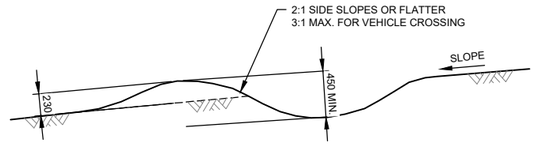
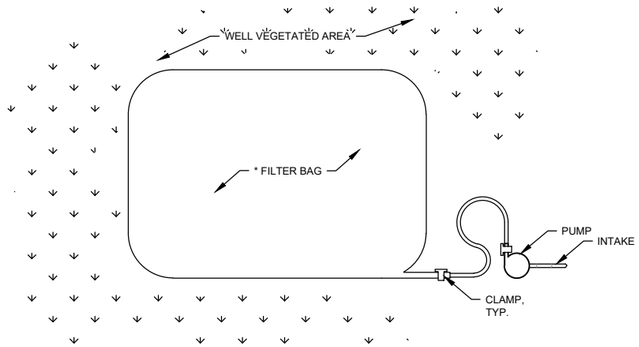
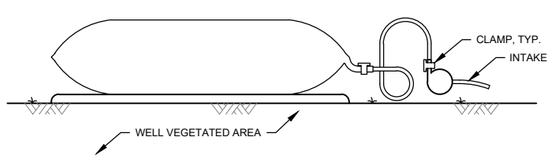


WB **WATERBAR - TYPICAL SECTION**
NTS

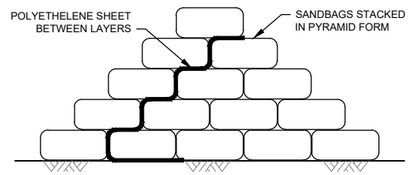


FB **FILTER BAG PLAN**
NTS



FB **FILTER BAG CROSS SECTION**
NTS

AS **ARMOURED SLOPE - TYPICAL**
NTS



DS **TEMPORARY STREAM DIVERSION STRUCTURE**
NTS

NOTES:

1. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
2. SURFACE WATER RUNOFF TO BE DIRECTED TO THE EROSION CONTROL BMPS AT ALL TIMES DURING SITE DISTURBANCE ACTIVITIES UNTIL FINAL STABILIZATION IS ACHIEVED.
3. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL BMPS PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
4. AN AREA IS CONSIDERED TO HAVE ACHIEVED FINAL STABILIZATION WHEN IT HAS A MINIMUM UNIFORM 70% VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER TO RESIST ACCELERATED SURFACE EROSION.
5. DIVERSION STRUCTURE TO CONSIST OF SANDBAGS OR U-SHAPED METAL PLATE.

DETAILED DESIGN
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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 2

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3802	0

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04FEB'21	ISSUED FOR PERMITTING	CAP	SKC		

REVISIONS

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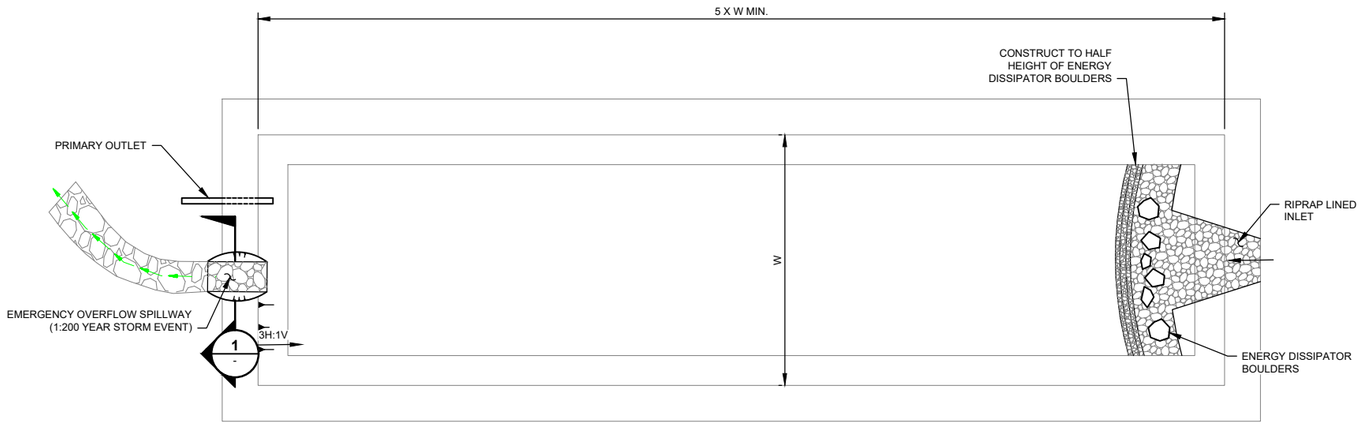
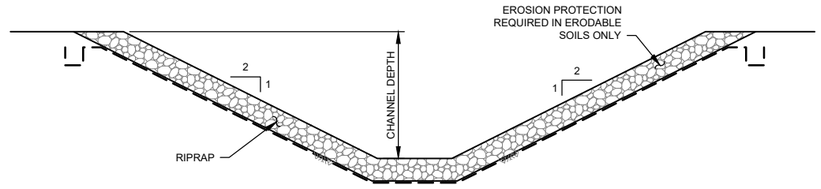
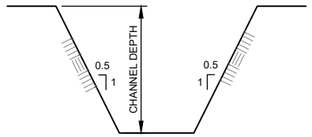
XREF FILE(S): IMAGE FILE(S): Kensington BMP schematics1, Page_4 riprap armour for slope



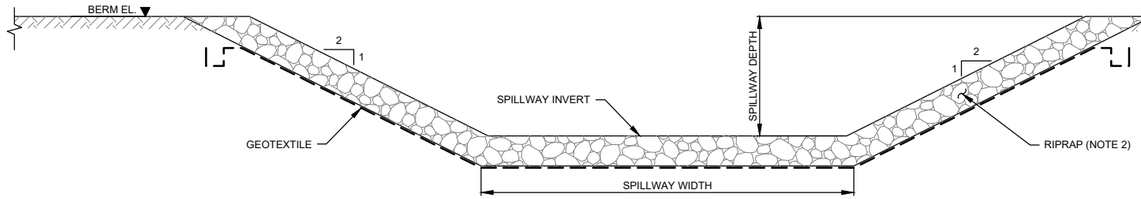
SP **SEDIMENT POND PLAN VIEW**
SCALE A



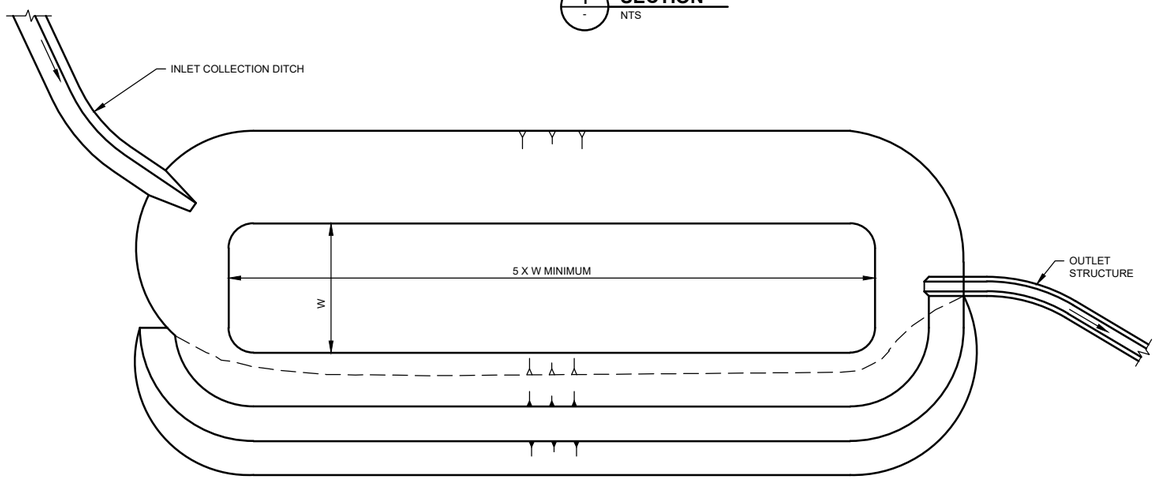
DD1 CD1 **DIVERSION / COLLECTION DITCH IN SOIL**
NTS



DD2 CD2 **DIVERSION / COLLECTION DITCH IN ROCK**
NTS



1 - **SECTION**
NTS



SB **SEDIMENT BASIN PLAN**
NTS

NOTES:

1. SEDIMENT POND LINING REQUIREMENTS SUBJECT TO ENGINEERS REVIEW OF FOUNDATION MATERIAL.
2. RIPRAP TO BE SPECIFIED FOR EACH INDIVIDUAL SEDIMENT POND DURING DETAILED DESIGN PHASE.
3. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS OTHERWISE NOTED.

DETAILED DESIGN
NOT FOR CONSTRUCTION

10000 5000 0 10000 20000 30000 40000 50000 mm
SCALE A

DRG. NO.	DESCRIPTION
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REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04FEB'21	ISSUED FOR PERMITTING	CAP	SKC		

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EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 3

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3803	0

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Appendix F ESC Trigger-Response Plan

Appendix F Erosion And Sediment Control Trigger Response Plan

Erosion And Sediment Control Trigger Response Plan		
Version:	E.1	
Replaces:	0.1	
Creation Date:	06/01/2023	
Scope	To define a performance-based approach for receiving environment monitoring to assess the effectiveness of the Surface Erosion Protection and Sediment Control Plan	
Review Date:		
Document Team Members:		
Document Owner:	Mine Manager	
Document Approver:		
Related Documents:		
Key Contacts:	Jack Love/Sarah Harrison Environmental Manager	jlove@artemisgoldinc.com/ sharrison@artemisgoldinc.com
Change Requests:		

Scope

This trigger response plan (TRP) outlines specific actions to follow for works in and around water in response to measured changes in water quality parameters in the receiving environment that are approaching management objectives.

Responsibilities

Individuals with key roles and responsibilities with respect to the Surface Erosion Protection and Sediment Control Plan (SEPSCP) are listed in Table 2-1.

Table 2-1: Blackwater Roles and Responsibilities

Role	Responsibility
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, Environmental Management System (EMS) implementation, overall environmental performance and protection, and permit compliance. The Mine Manager may delegate their responsibilities to qualified personnel. Reports to the General Manager.
Construction Manager (CM)	The CM is accountable for ensuring environmental and regulatory commitments/ and obligations are being met during the construction phase. Reports to the Mine Manager.
Environmental Manager (EM)	The EM is responsible for the day-to-day management of the Project's environmental programs and compliance with environmental permits, updating EMS and management plans. The EM or designate will be responsible for reporting non-compliance to the CM, and Engineering, Procurement and Construction Management contractor, other contractors, the Company and regulatory agencies, where required. The Environmental Manager informs the Environmental Monitors of current site conditions that may influence monitoring programs. Supports the CM and reports to the Mine Manager.
Environmental Monitors	Environmental Monitors (Environmental Specialists and Technicians, including Certified Professionals in Erosion and Sediment Control) are responsible for tracking and reporting on environmental permit obligations through field-based monitoring programs. Report to the EM.
EPCM contractor and other contractors	The EPCM contractor and other contractors report to the CM and provide day to day project management and assurance in their areas of responsibility that the SEPSCP is being effectively implemented in accordance with applicable contractual terms and conditions. The Contractors liaise closely with the Construction and Environmental Managers and Environmental Monitors on a day-to-day basis regarding the implementation and maintenance of the measures outlined in the SEPSCP. The EPCM contractor and other contractors will correct deficiencies and address any non-compliances upon direction from CM or EM/

SEPSCP Trigger Response Plan

Purpose

A performance-based approach will be used to assess the effectiveness of the SEPSCP during regularly scheduled monitoring. TRPs identify specific actions to be used in response to observed or measured changes in conditions that are approaching management objectives (British Columbia Ministry of Environment and Climate Change Strategy. 2022). The management objectives for the purpose of this SEPSCP TRP are the British Columbia water quality guidelines for turbidity and total suspended solids (TSS) for the protection of aquatic life listed in Table 3-1. Since determination of TSS requires collection of a water quality sample and analysis at an accredited laboratory, turbidity is often used as a proxy, since in situ turbidity (measured in nephelometric turbidity units (NTUs)) can be measured onsite with a handheld turbidity meter, allowing any needed responses to be made in a timely manner.

Table 3-1: Maximum Allowable Increase of TSS and Turbidity

Parameter	Background		
	Clear Waters (Turbidity <8-NTU)	Turbid Waters	
		(Turbidity 8-50 NTU)	(Turbidity >50 NTU)
Turbidity	Change from background of 8 NTU for a duration of 24 hours Change from background of 2 NTU for a duration of 30 days	Change from background of 5 NTU at any time	Change from background of 10%
TSS	Change from background of 25 mg/L for a duration of 24 hours Change from background of 5 mg/L for a duration of 30 days	Change from background of 10 mg/L at any time	Change from background of 10%

Source: British Columbia Ministry of Environment and Climate Change Strategy. 2021.

Monitoring Locations

SEPSCP TRP impact monitoring locations will be established downstream/downgradient of a construction area in a receiving environment water body to which site runoff drains. As the water quality guidelines for turbidity and TSS are induced changes from “background”, turbidity and TSS will also be monitored upstream of construction areas during each sampling event. Background and impact monitoring locations will vary by work area and will be set by the EM or Environmental Monitors prior to area disturbance. An example of the location of monitoring sites is shown on Figure 1.

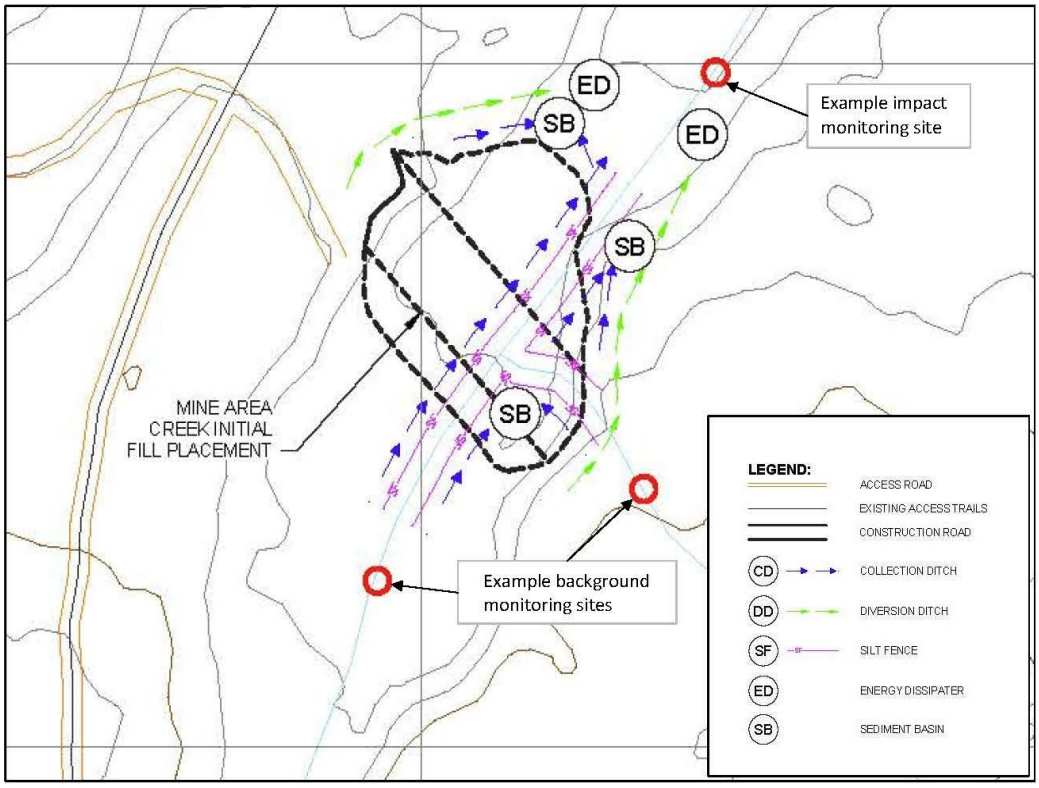

Figure 1 Background and Impact Monitoring Location Example

Source: Figure 8-2 from SEPSCP - Main Dam C Site Establishment – Erosion and Sediment Control Plan

Trigger Levels

Trigger levels are set at pre-determined turbidity and TSS levels: if turbidity levels at impact monitoring sites are approaching the trigger levels during regularly scheduled monitoring, a series of responses are implemented, depending on the potential risk to the receiving environment, as illustrated on Figure 2.

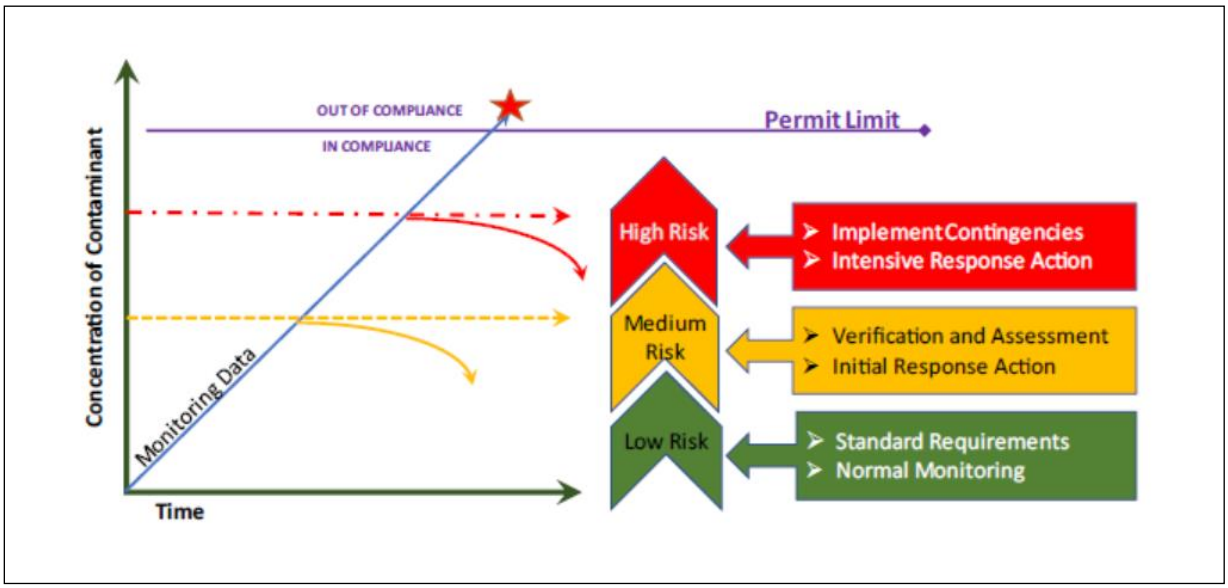

Figure 2 SEPSCP TRP Schematic

Source: British Columbia Ministry of Environment and Climate Change Strategy. 2022.

Triggers are required to be set below critical thresholds that must be obtained (British Columbia Ministry of Environment and Climate Change Strategy. 2022). The critical threshold is defined for this SEPSCP TRP as the BC water quality guidelines listed in Table 3-1, and the triggers are set at 75% (Medium Risk) and 90% (High Risk) of the guidelines:

- Medium Risk Turbidity triggers:
  - Clear waters: Change from background of 6 NTU at any one time for a duration of 24 hours;
  - Turbid waters (Turbidity 8-50 NTU) : Change from background of 3.75 NTU at any time;
  - Turbid waters (Turbidity >50 NTU) : Change from background of 7.5% at any time.
- High Risk Turbidity triggers:
  - Clear waters: Change from background of 7.2 NTU at any one time for a duration of 24 hours;
  - Turbid waters (Turbidity 8-50 NTU) : Change from background of 4.5 NTU at any time;
  - Turbid waters (Turbidity >50 NTU) : Change from background of 9% at any time.

Responses

Medium Risk Trigger Exceedance Responses

During all scheduled monitoring, the following responses will be implemented by the Environmental Monitor:

- Immediately report to EM.
- Calibrate the in situ monitoring instrument(s) and measure turbidity upstream and downstream of the construction area again.
- Visually inspect the construction area to evaluate if the elevated turbidity downstream is reasonably being caused by construction activities (i.e., inspect installed erosion and sediment control (ESC) measures to determine if functioning as designed).
  - If elevated turbidity is determined to be caused by construction activities, report results to EM and work with site personnel to repair existing ESC measures or install additional measures as needed.
  - If the construction activities are not reasonably the cause of the elevated turbidity, then the Environmental Monitor will implement other validation techniques to ascertain the source of the exceedance (e.g., passing debris or beaver damming activity).
- Measure turbidity upstream and downstream of the construction area following repair/installation of ESC measures until turbidity values at downstream areas return to background levels.

High Risk Trigger Exceedance Responses

During all scheduled monitoring, the following responses will be implemented by the Environmental Monitor:

- All responses outlined for Medium Risk Trigger Exceedance.
- Collection of a water sample upstream and downstream of the construction area for laboratory analysis of TSS.

- Continue in situ turbidity monitoring on a regular basis until analytical results are received.
- If the elevated turbidity and TSS level are valid and documented to be the result of construction activities, the Environmental Monitor will inform the EM or EPCM contractor and other contractors (as appropriate), who shall cause all work that may have a direct or indirect impact on water quality to cease, and immediately initiate additional mitigation actions.
- Measure turbidity upstream and downstream of the construction area following additional mitigation actions until turbidity values at downstream areas return to background levels.
- Upon confirmation of the exceedance, a preliminary notification will be sent out to relevant parties (e.g., CM) at the earliest safe opportunity to do so.
- In the event that turbidity exceedances continue despite initial efforts to rectify ESC deficiencies, update reports will be sent to the relevant parties at an agreed upon frequency until turbidity falls back below the applicable trigger.
- Depending on the site of the exceedance, the nature of the construction work, and the magnitude and duration of the exceedance, further stop work orders may be issued if on-going exceedances are not rectified in a timely manner.

Notifications

- Notifications required in the event of High Risk Trigger Exceedances will include:
- Date and time of inspection;
- Site location information;
- Timing, location, magnitude, and duration of turbidity exceedance;
- Any information about suspected source of sediment;
- Description of the repairs, maintenance and/or modifications of ESC measures planned in order to address the elevated sediment releases causing turbidity exceedances; and
- Estimated timing for the completion of repairs, maintenance and/or modifications.

Revision, Review, and Approval

Version	Date	Nature of Change	Page Inserted, Replaced, Revised, or Cancelled	Prepared By (Qualified Registered Professional)
1.0	TBD			

References:

British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.

British Columbia Ministry of Environment and Climate Change Strategy. 2022. Development and Use of Trigger Response Plans. Version 1. Technical Guidance MIN-12. *Environmental Management Act*.