14. PROJECT MEETINGS

14.1 Kickoff Meetings

At the start of construction, including prior to starting clearing, construction, or mobilization of a new area, a kickoff meeting will be held to review and discuss the scope and timing of activity. The meeting(s) will confirm working relationships and communication protocols, awareness of regulatory requirements, environmental sensitivities, mitigation measures, pre-clearing survey requirements, personnel and resource needs, agency notifications/permit conditions, schedule constraints and risks, hazard review, and safety performance. Key regulatory permits, approvals, CEMP requirements, and mitigation measures will be reviewed and documented. A key outcome of task meeting is confirmation of environmental monitoring resources needs and to confirm the work has been planned effectively to avoid foreseeable environmental impacts.

Contractors will be responsible for ensuring that their personnel and sub-contractors are appropriately trained and competent to implement the requirements of the CEMP and relevant management plans. Contractors shall ensure attendance of their personnel at kickoff meetings and tailgate meetings. The Environmental Monitor will provide additional and site-specific environmental information and background at Progress Meetings and crew Tailgate Meetings. The Environmental Monitor will also be on site in the field during construction activities to raise awareness and understanding of environmental matters.

14.2 Progress Meetings

Regular Progress Meetings will be held monthly during Major Works construction, chaired by the BW Gold Construction Manager, and will include representation from all relevant parties including the EM and, when their site visits coincide with the monthly meeting, the Independent Environmental Monitor. The environmental portion of these meetings will include, at a minimum, the following:

- A review of recent activities, and a discussion of any environmental concerns that should be communicated to the group;
- Identification of seasonal changes that will affect construction planning (e.g., activity restriction timing);
- Detailed review of any recent incidents, investigation findings and follow-up actions;
- An overview of upcoming work planned, and schedules;
- Review of contractors/personnel on-site or coming to site and associated training requirements; and
- Communication of any updates/revisions to the CEMP.

Minutes of these meetings will be maintained by the BW Gold Construction Manager.

14.3 Tailgate Meetings

Daily Tailgate Meetings at the crew level will be held to provide instruction in safety, environmental awareness, and task assignment. Tailgate Meetings will include a safety and environmental briefing, an overview or update regarding environmental sensitivities at a site that may be affected by construction activities, planned activities and map review, and awareness of mitigation measures/boundaries/working area and communication protocols from the Environmental Monitor and EPCM Contractor's Site Superintendent(s). Tailgate meetings, including content pertaining to environmental management and protection, will be documented by the Prime Contractor.

Should conditions change during the course of daily work at a construction site such that environmental risks increase (e.g., heavy rainfall and increased risk of sediment and erosion problems affecting adjacent watercourse), then crews are expected to respond, hold a Tailgate Meeting, and address environmental risks and mitigation due to changing conditions.

15. MONITORING PROGRAM

Successful implementation of the CEMP will require an ongoing process of monitoring, reassessment, and modification. At its most fundamental level, a successful monitoring program involves all site personnel. Keeping personnel trained and informed of the goals and purpose of the CEMP promotes a conscientious approach to environmental management. Site personnel will be properly equipped with the appropriate training and tools, and will fully understand their individual responsibility in implementing the CEMP. These “informal” inspections by all personnel are augmented by formal, regularly scheduled inspections performed by the Environmental Monitor or qualified professional. At a minimum, there will be one full-time Environmental Monitor on site during construction. The Environmental Monitor will focus on site-wide construction monitoring activities in accordance with the CEMP. The frequency of monitoring will be based on the level of risk. For example, the Environmental Monitor will monitor high-risk activities, such as watercourse crossings, at an hourly/daily frequency during the activity. Lower-risk activities, such as gravel placement for a roadway, will be subject to weekly monitoring. The EM will work with the Environmental Manager to determine daily and weekly monitoring priorities based on construction activities. The Environmental Monitor will be supported by subject matter experts as required.

Accurate, detailed, and standardized records will be kept throughout the monitoring program to support status reporting to Project management, regulatory agencies, and stakeholders.

15.1 Traffic and Access Monitoring

Ongoing informal monitoring on a continual basis by Site Security will be conducted to track traffic and access related mitigation measures on all Mine Site roads, including the MAR in accordance with the MSTCP. Traffic and Access monitoring during construction will include:

- Tracking of road safety incidents, including wildlife interactions/collisions, to determine trends and identify areas requiring further mitigation;
- Monitoring the effectiveness of animal escape way breaks in snow clearing banks;
- Monitoring unauthorized development of snowmobile trailer pullouts;
- Monitor and record unauthorized ATV access to mine site;
- Record incidental observations of wildlife locations;
- Record general observations of wildlife occurrence; and
- Record the amount and nature of traffic use by BW Gold and its Contractors.

Access to the Mine Site is controlled via the security checkpoint on the MAR, which is staffed by Site Security.

15.2 Metal Leaching/Acid Rock Drainage Monitoring

During the Construction phase ML/ARD monitoring will be undertaken in accordance with the ML/ARD Management Plan. Inorganic overburden will be monitored by collecting composite samples from test pits or active excavation areas as it is being excavated. One (1) composite overburden sample is to be collected for every 25,000 m^3 of material disturbed and analyzed at the onsite laboratory. A minimum of two well-spaced samples collected from each distinct Project component (e.g., plant site) where excavation of overburden amounts to < 50,000 m^3. An SOP for overburden sampling is provided as Appendix C.

15.3 Soils Monitoring

Soil monitoring will be conducted in accordance with the Soil Management Plan. At a minimum monitoring will include:

- **Salvage** – Daily visual inspections will be conducted during stripping to confirm that (1) weather and soil moisture conditions are appropriate for salvage, (2) all target reclamation material is being salvaged, as practical, (3) suitability criteria defined in are being applied, (4) target salvage depths are being achieved, and (5) reclamation materials are being appropriately segregated. If, during salvage operations, greater than 15% of surficial soils are inaccessible due to steep slopes[2], then the reclamation materials balance will be reviewed to confirm that adequate volumes of each surface soil type are still available to meet reclamation material needs. Salvage plans (e.g., areas, depths, and/or suitability criteria) may need to be adjusted accordingly.
- **Sampling** – Sampling of salvaged reclamation materials will be conducted during salvage and/or application as per SMP Section 9.1.5 (surface soils) and SMP Section 9.2.2 (overburden) to confirm material properties and suitability for reclamation.
- **Stockpiling** – Weekly stockpile development inspections (including consideration of foundation, layout, slope, and lift height) and completion inspections of the final structure, as well as supplemental inspections as required for erosion monitoring will be conducted. Stockpile volume and location tracking will be carried out during salvage and stockpile operations as described in SMP Section 10.3. Along with volume tracking, the reclamation materials balance will need to be reviewed to confirm the availability and suitability of reclamation materials aligns with mapped polygons and verify the accuracy of the projected reclamation materials balance.
- **Stockpile inspections** – Semi-annual inspections of stockpiles in spring and fall will be conducted to assess re-vegetation status, presence of invasive or non-desirable species and evidence of erosion. Presence of identification signage will also be confirmed. Stockpiles will also be inspected after significant rainfall events (as defined in the SMP).
- Confirmation identification signage is in place.
- Any additional monitoring requirements identified by the EPCM contractor.

Erosion and sediment control monitoring is presented in the SEPSCP including monitoring locations and frequencies.

15.3.1 Supervision by a Qualified Professional

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

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

15.3.2 Effectiveness Monitoring

The TARP associated with soils monitoring is provided in Table 9.1-3 of the Soil Management Plan.

15.4 Chemicals and Material Storage and Handling Monitoring

Weekly inspection of facilities for dangerous goods and hazardous materials will be implemented during construction in accordance with the CMSTHP (including the Cyanide Management Plan). Facilities will include relevant aboveground tanks, pipelines, connections, valves, gauges and meters, sumps and separators, secondary containment if relevant and inventory records. In general, inspections will include:

- Inspection of all permanent and temporary chemical (including fuel) storage facilities;
- Inspection for proper segregation, storage, and disposal practices; and
- Inspection of spill kits and available protective equipment for spill response.

15.5 Air Quality Monitoring

An EMA Air Discharge permit will be in effect for the mine site and will provide air quality monitoring conditions, including fugitive dust that is typical of a construction and operating mine site. An air quality monitoring program has been developed as part of the Air Quality and Dust Management Plan, which may require updating to satisfy permit conditions.

15.5.1 Meteorological Monitoring

Meteorological conditions are an important consideration when assessing air quality as they may contribute to windblown dust and will influence the behaviour of emissions following release.
This information is also important in ongoing updating of site climate baseline and understanding water balance. Site specific continuous meteorological monitoring is expected to be maintained throughout the Construction phase of the Project. Information from the on-site stations will be used in analysis and evaluation of fugitive dust monitoring described above.

There are two on-site meteorological stations. The details of each station, including the monitored parameters, are presented in Table 15.5-1.

Table 15.5-1: Meteorological Stations at Blackwater Mine

Station Name	Station Height	Latitude (º North)	Longitude (º West)	Elevation	Meteorological Parameters Monitored	Data Period Available
Low	10 m	53.29979	124.80025	1,050 masl	Air temperature, relative humidity, precipitation, wind speed and direction, barometric pressure, snow depth, net radiation, solar radiation	August 2011 to present
High	10 m	53.18113	124.84620	1,470 masl	Air temperature, relative humidity, precipitation, wind speed and direction, barometric pressure, snow depth, net radiation, solar radiation	July 2012 to present

Notes:
m = metres; masl = metres above sea level

15.5.1 Dustfall Monitoring

According to ENV 2020, dustfall monitoring and the dustfall Pollution Control Objectives have outdated methodology and criteria, and are no longer recommended by BC ENV. Therefore, visual monitoring of dust will be undertaken.

Mine personnel will be trained to be observant for dust related concerns which may arise as defined in the Fugitive Dust Management SOP. These observations, together with meteorological conditions and mitigation efforts taken to deal with a problem, will be recorded and included in monthly and annual reports. Visual monitoring will focus on areas where there are active surface earthworks, haul roads and overburden and soil stockpiles. Visual monitoring will occur on a daily basis at all locations where fugitive dust generation is occurring.

15.5.2 Particulate Matter Monitoring

A partisol sampler will be installed on the mine site at the exploration camp before the start of major works construction, and moved to the operations camp at the start of operations. The station will measure PM < 10 microns (PM_{10}) and PM < 2.5 microns ($PM_{2.5}$) mass concentrations on a 47 mm filter contained in a single-action filter change mechanism.

Samples will be collected over a 24-hour period at a target flow rate of 1 m^3/h. Sample volumes will be recorded and divided into the mass concentration to yield a 24-hour average concentration in units of $\mu g/m^3$. The partisol sampler is suitable for a wide variety of climate conditions and meets the United States Environmental Protection Agency guidelines for manual air samplers.

Fine particulate sampling will occur every third day, alternating between $PM_{2.5}$ and PM_{10}, between May and October. During winter conditions, sampling frequency will be weekly.

15.5.3 Nitrogen Dioxide and Sulfur Dioxide Monitoring

Nitrogen dioxide and sulphur dioxide will be sampled using a passive air sampling system (PASS) whereby gas pollutants are monitored by passive diffusion through a diffusive surface onto an adsorbent membrane or filter. PASS monitors will be installed at the exploration camp prior to the start of major works construction and at the operations camp at the start of operations.

Monitors will be under a protective rain shelter, attached to a supporting pole. Site personnel will collect and replace the PASS units approximately every 30 days, and submit the units to an accredited laboratory for analysis.

PASS laboratory results will be reviewed for sample integrity issues and erroneous data. Field notes, chains of custody, comments from the laboratory, and professional judgement will also be considered during the review process. Invalid data will be omitted from final analyzed datasets. Because PASS sampling is passive, hourly nitrogen dioxide and sulphur dioxide concentrations cannot be sampled using this method and therefore will not be compared against the hourly Canadian Ambient Air Quality Standards.

15.6 Water Quality Monitoring

15.6.1 Erosion and Sediment Control Monitoring

A performance-based approach will be used to assess the effectiveness of erosion and sediment controls and drainage control. Monitoring will occur at minimum weekly during spring freshet and monthly outside of freshet and in open water periods, as well as after each significant melt event or runoff-producing rainfall event. During in stream works, the Environmental Monitor will be at the site full time and sample a minimum of three times daily.

Effectiveness will be determined by the extent to which certain performance metrics are being achieved. The TARP provided in Table 9-2 of the SEPSCP will be implemented for managing significant rainfall events and for works in and around water to plan appropriate actions used in response to observed changes in environmental conditions that are approaching or exceeding management objectives.

A receiving water target applies downstream of a construction site, in the water body to which the site drains.

Total suspended solids (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 (CCME 2002).

Because duration of exposure to elevated TSS and turbidity is a key factor in assessing aquatic impacts, as shown in Table 15.6-1, 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.

During all required inspections detailed above, if turbidity levels are observed to appear to be exceeding the induced change from 8 NTUs for a duration exceeding 24 hours, a water sample will be collected and submitted for laboratory analysis of TSS. A background water sample will be collected in the receiving watercourse upstream of construction runoff and downstream of the construction area during the same sampling event, in order to determine the change from background. During construction activities near water, “background” for the purpose of TSS and turbidity monitoring, will be based on water samples collected in a receiving stream upstream of the construction area.

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.

Table 15.6-1: Monitoring Triggers – Maximum Allowable Increase of TSS and Turbidity

Parameter	Background		
	Clear Waters	Turbid Waters	
	(TSS <25 mg/L Turbidity <8-NTU)	(TSS 25-100 mg/L Turbidity 8-50 NTU)	(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%

In the event that a measurement is over the target listed in Table 15.6-1, a preliminary investigation will take place to confirm whether the exceedance is valid (e.g., not simply a result of passing debris or beaver damming activity) and whether the construction site itself is the source of elevated turbidity measurements. BW Gold will engage suitably qualified individuals to supervise the construction activities, where

necessary, who will determine the validity of a result deemed and whether it results from construction or other external factors. BW Gold anticipates that this will be a requirement of the ENV discharge permit. Should a measurement exceed a trigger, the Environmental Monitor will visually inspect the construction area to evaluate if the result is reasonably being caused by construction activities. If it is, then the actions in the TARP will be triggered without delay. If, however, the Environmental Monitor visually determines that the construction activities are not reasonably the cause of an exceedance, then the Environmental Monitor will implement other validation techniques to ascertain the source of the exceedance. This would include further field-truthing upstream of the construction area to understand if a natural slide event, for instance, has caused the exceedance. Also, calibration of the *in situ* monitoring instrument(s) would be undertaken. The clarification above outlines how the Environmental Monitor 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.

If the elevated turbidity level is valid and is a result of construction activities, the Environmental Monitor will inform the Project Engineer or EM, 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, a preliminary notification will be sent out to relevant parties (e.g., Construction Manager) at the earliest safe opportunity to do so. 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; and
- Estimated timing for the completion of repairs, maintenance and/or modifications.

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 target.

Depending on the site of the exceedance, 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.

15.6.2 Mine Site Water Quality Monitoring

The mine site water quality monitoring program includes the evaluation of the quality of contact water and non-contact water that has been diverted around the mine site or captured for use in the mill process (MSDP, Table 7.3-1). Monitoring will be completed during construction and operations on a monthly basis for parameters and sites indicated in Table 7.3-2 of the MSDP. Parameters to be monitored include constituents recommended by the BC MOE (2016) as well as parameters identified as Parameters of Concern and Parameters of Potential Concern.

Mine site water quality monitoring also includes groundwater with the establishment of groundwater wells at 29 locations to monitor groundwater quality and at 40 locations to monitor groundwater flow (see MSDP, Table 7.3.5 and Table 7.3-6). Monitoring of water levels and water quality at groundwater discharge points will assist in characterizing potential for impacts to surface water from groundwater. Seep surveys will also be completed to understand groundwater flow in the Project area and specifically down-gradient of the TSF, and stockpiles, to identify potential pathways for seepage from these facilities.

Seep monitoring will include descriptions of seeps and waterbodies encountered during mapping, their frequency and location, elevation, and water quality.

Data analysis will include an evaluation of concentration trends and comparison to trigger levels identified in Section 9.3.2 (MSDP, Table 10-1) and events triggering adaptive management actions (MSDP, Table 11-1).

15.6.3 Receiving Environment Water Quality Monitoring

The AEMP has been developed for aquatic receiving environment monitoring. Surface water quality monitoring at receiving water quality monitoring stations identified in the AEMP, Table 4.2-1) will be conducted during the Construction phase to assess Project-related effects on surface water quality. The AEMP will be conducted on an annual basis beginning the first year of Construction, with monitoring frequency (monthly, weekly, or quarterly) at each of the sampling locations identified in Table 4.2-2 of the AEMP.

Data analysis and reporting will focus on the Parameters of Concern and Parameters of Potential Concern for the Project, in addition to the constituents with available BC and federal water quality guidelines for the protection of aquatic life, approved science based environmental benchmarks or water quality standards. The AEMP adaptive management framework identifies the triggers to determine effectiveness of mitigation and whether additional mitigation is required to address effects of the Project on water quality (Table 6.2-2, AEMP).

15.7 Vegetation Monitoring

Vegetation monitoring during Construction will be in accordance with the VMP and summarized in Table 15.7-1.

Table 15.7-1: Vegetation Monitoring Plan

Monitoring Activity	Measurable Parameter (s)	Frequency	Timing
Office and field review of pre-clearing surveys and boundaries	■ Pre-clearing survey is completed and sensitive features and mitigation specified ■ Boundaries and works zones flagged (RMAs) ■ Clearing is within *Mines Act* permit boundary ■ Clearing work windows are identified and work is during the correct window	Variable	Prior to clearing occurring
Vegetation clearing	■ Clearing dimension size in relation to planned activity ■ Avoidance of rare plants, ecosystems at risk, riparian areas through implementation of pre-clearing survey, flagging, and mitigation measures	Variable	When clearing is occurring
	Clearing work windows: ■ for instream works refer to the *Fisheries Act* authorization (to be issued) ■ breeding bird season refer to the WMMP (Table 3.3-1)	Variable	When clearing is occurring
Post-clearing revegetation	■ Total area disturbed (m^2) ■ Total area (m^2) revegetated and the specific prescriptions ■ Revegetation plots including vegetation species cover, composition, diversity and, invasive plant species ■ Documentation of evidence of erosion including sheet erosion, rills, gullies	Annual	May to October

Monitoring Activity	Measurable Parameter (s)	Frequency	Timing
	■ Periodic inspections of the re-vegetated areas to assess performance objectives (including photos) compared to prescription targets ■ Evaluation of the success of the revegetation prescriptions in meeting site objectives and, if required, identification of additional mitigation activities		
Post-clearing windthrow monitoring	■ The effectiveness of windthrow reduction measures used; ■ The number and species of wind-thrown trees; ■ The approximate area affected; and ■ Bark beetle presence (e.g., Douglas-fir or spruce bark beetle)	Variable	March to September
Vegetation maintenance	■ Vegetation maintenance within road and transmission line RoWs	Variable	March to September
	■ Document management actions in RMAs to confirm consistent with RMA mitigation measures	Variable	When activity in RMA occurs
Woody debris management	■ Volume of wood cut (identified in License to Cut) ■ Volume of wood stockpiled or used for progressive reclamation ■ Volume of wood disposed of or sold ■ Assess fire hazard of stored woody debris ■ Bark beetles present that may cause forest health issues (e.g., Douglas-fir or spruce bark beetle)	Annual	April to October (fire hazard assessments) ; May to August (beetle assessments)

15.7.1 Invasive Plants

The invasive plant monitoring plan including monitoring frequency is provided in the in the IPMP, Section 9.

15.7.2 Effectiveness Monitoring

A TARP associated with vegetation monitoring is provided in Table 11-1 of the VMP.

15.8 Wetland Monitoring

A summary of the wetland monitoring program plan is provided below. A comprehensive monitoring plan, including endpoints and data analysis, is provided in the WMOP.

15.8.1 Pre-construction

There is a fair amount of uncertainty on the amount of wetland loss and offsetting as described in the WMOP. As such, and pursuant to DS Condition 5.5.1, BW Gold is conducting pre-construction surveys within the CPD boundary (except the TL alignment and three re-routes) to supplement baseline data from the Environmental Assessment, confirm absence of red- or blue-listed wetlands, map wetland extent, and classify wetlands. Planning for these surveys have been initiated and will be completed in 2022. The survey results will be provided to the IAAC, EAO, ECCC, FLNRORD and Indigenous groups. The survey results will be used to refine the current wetland balance amount of wetland loss requiring compensation, provide a baseline for offsetting monitoring and assist in planning additional offsetting.

The scope of pre-construction surveys in 2022 is anticipated to include:

1. The potential wetland near the plant site will be delineated with flagging and GPS coordinates by a QP from ERM and Indigenous Monitors from LDN and UFN will be invited to participate. The plant site tree clearing activity has also been flagged for the project IEM who will be invited to observe tree clearing near the delineated potential wetland polygon (Appendix G from WMOP). Sediment and Erosion Control measures such as silt fencing and haybales will be installed after the tree clearing to ensure any potential impacts to the delineated wetland from spring freshet are mitigated. This area will be monitored closely during the spring melt period. A post-trip report will be prepared and provided to Aboriginal Groups and the EAO.
2. Detailed mapping of wetlands from aerial photographs on the mine site at a scale of 1:5,000.
3. Field surveys of the mine site to classify mapped wetlands into wetland associations based on the vegetation communities at each site and identify any red or blue-listed wetlands on the mine site.
4. Field surveys of the mine site to assess wetland function and provide baseline conditions for future monitoring program (discussed below).
5. Detailed mapping and field surveys of the Matthews Creek offsetting site to identify the current conditions on site and provide baseline data for a future monitoring program.
6. Detailed mapping and field surveys of the reference sites to provide a baseline to measure natural change in the future.
7. Reconnaissance field surveys of other wetlands in the regional area to assess them as potential additional offsetting areas.

15.8.2 Monitoring Loss of Wetlands in the Project Boundary during All Phases

The extent, location, and type (class and association) of wetlands impacted by the development of the Project will be recorded in a GIS database using pre-construction polygons a base layer overlain by as-built survey results and reviewed by a QP. This database will be updated annually to record all actual wetland losses. The baseline surveys and assessment conclusions were conservative and overestimate the area of impacted wetlands so an accurate accounting of each affected wetland will help confirm EA predictions and determine the overall requirements for offsetting.

15.8.3 Timing and Frequency

Monitoring activities will be completed annually during the Construction phase during July/August commencing and continuing at discrete construction sites through the life of mine.

15.9 Wildlife Monitoring

A summary of the wildlife monitoring program plan to be implemented prior to construction and during construction activities is provided below. The comprehensive monitoring plan, including endpoints and data analysis specific to each species, is provided in the WMMP.

15.9.1 Pre-construction

15.9.1.1 Amphibians

The DS Condition 8.10 requires that if construction cannot be planned to avoid the sensitive periods identified in Condition 8.9, then pre-construction surveys will be conducted to identify western toad breeding habitat.

Field surveys during the baseline program (2011 to 2013) identified breeding ponds for western toad inside the planned Project footprint. Sources of current breeding ponds will be identified using these baseline data and pre-construction surveys in the mine site and transmission line right-of-way. Surveys will follow standard methods for pond breeding amphibians described in *Inventory Methods for Pond-Breeding Amphibians and Painted Turtle (*RIC 1998).

Pre-construction surveys were conducted during the summer of 2021 following standard time-limited visual encounter survey protocols, searching ponds for adults, tadpoles, and metamorphs. These data are being presented in a 2021 baseline report which have been incorporated into the WMMP. Maps and breeding locations reported during baseline studies in 2013 will also be included in this report. Data will be used to inform plans for clearing during operations, taking into account sensitive periods.

15.9.1.2 Bats

Both DS and EAC Conditions require pre-construction surveys to be conducted to determine whether hibernacula and roosts occur and their distribution (P 23c, DS 8.14, 8.15).

Hibernacula surveys include:

- The mine site and transmission line right-of-way will be searched for rock outcrops and these areas searched for cave entrances. If cave entrances are found, then Autonomous Recording Units (ARUs) will be used to record whether bats are using these caves as hibernacula.
- During the fall, concurrent with other surveys, the buildings of the existing camp will be searched for signs of bats using buildings as hibernacula.

Roost surveys include:

- The mine site (and a buffer surrounding the mine site) and transmission line right-of-way will be searched for wildlife trees and snags (dead, standing mature trees) in suitable roosting habitat – near foraging habitat such as wetlands where insects are abundant. Wildlife trees will be marked and their position recorded.
- Wildlife trees will be searched for signs of bat roosts – lifted bark, droppings, and sounds.
- Methods for roost surveys will take into account FLNRO (2014) Section 2.4.1.
- Autonomous Recording Units will be placed in wetlands to determine if bats are present in these areas.

In accordance with EAC Condition 23.C Table 1, an inventory will be kept of features that may function as hibernacula and roosts. If it is not possible to conduct clearing outside of the sensitive season for bats, then pre-clearing surveys would be conducted at these features and mitigation applied including setback buffers.

Pre-construction surveys were conducted during the summer of 2021 for the hibernacula and roost surveys described above. These data are being presented in a 2021 baseline report which has incorporated into the WMMP. Maps and breeding locations reported during baseline studies in 2013 will be included in the WMMP.

15.9.1.3 Caribou

Please refer to the Caribou Mitigation and Monitoring Plan.

15.9.1.4 Moose

Condition 23d of the EAC directs BW Gold to conduct pre-construction surveys to confirm or update the habitat suitability mapping for moose:

> *"the means by which information from the habitat suitability mapping for the Project Site will be confirmed or updated for the use of the Project Site by grizzly bears and moose prior to Construction at the Project Site, and in consultation with Aboriginal Groups."*

Pre-construction field surveys were undertaken in summer 2021 to conduct habitat suitability field validation for several key species, including moose, in the mine site and transmission line right-of-way.

Pre-construction surveys:

- Followed British Columbia Wildlife Habitat Ratings Standards;
- Were conducted by wildlife biologists with members of Aboriginal Groups;
- Considered existing terrestrial ecosystem mapping of the project site to identify habitat types for further assessment;
- Will be used to evaluate the existing habitat suitability mapping, with data and results reported in a 2021 baseline wildlife report; and
- A technical report and report for lay audiences will be delivered to Aboriginal Groups at least 60 days prior to the start of construction at the Project site.

Condition 23c of the EAC and federal condition 8.6 require BW Gold to conduct pre-construction surveys for habitat features for moose, including mineral licks. Federal condition 8.2 also requires that the locations where wildlife corridors cross Project roads be identified and wildlife crossing signs be installed prior to construction.

Provincial standards or guidelines do not exist for identifying mineral licks and trails. Field surveys for licks were conducted during summer of 2021 and included walking surveys in the mine site and transmission line right-of-way during other surveys (habitat suitability mapping, birds, and amphibians) with incidental reporting of salt licks whenever they were observed. Surveys for wildlife corridors included driving and walking surveys along project roads to identify trails and wildlife sign. These data will be reported in a 2021 baseline wildlife report and have been incorporated into the WMMP, along with any comparable data collected as part of baseline studies 2011-2013 and 2016-2017.

15.9.1.5 Furbearers

Pre-construction baseline surveys were undertaken in 2021 to conduct field verification of habitat suitability mapping and identify suitable habitat for key species, including denning habitat for furbearers (American marten, fisher, wolverine) in compliance with DS Condition 8.10.

Field surveys for furbearer denning habitat suitability (American marten, fisher, and wolverine) were conducted from June 8 – June 19, 2021 in the mine site and transmission line local study areas. Field survey protocols followed the *Wildlife Habitat Rating Standards* (RIC 1999a).

Survey locations were assessed for abiotic and biotic ecosystem variables, and rated for each species denning habitat suitability using a six-class system from nil to very high. Habitat ratings were further refined in the field based on the plot-in-context, distance to species specific habitat features, and distance to disturbance. Wildlife sign was also recorded at each site to document relative level of use of the site. These data will be reported in a 2021 baseline wildlife report and have been incorporated into the WMMP, along with any comparable data collected as part of baseline studies

15.9.1.6 Grizzly Bear

Condition 23d of the EAC requires pre-construction surveys for grizzly bear so that:

> *"…information from the habitat suitability mapping for the Project Site will be confirmed or updated for the use of the Project Site by grizzly bears and moose prior to Construction at the Project Site, and in consultation with Aboriginal Groups."*

Pre-construction field surveys were conducted in the mine site and transmission line right-of-way during the summer of 2021. Surveys and follow up were designed to meet EAC Condition 23d. These surveys:

- Considered existing terrestrial ecosystem mapping of the Project site to identify habitat types for further assessment;
- Followed standard habitat suitability mapping standards in British Columbia Wildlife Habitat Ratings Standards;
- Included Aboriginal Groups working with wildlife biologists to conduct the surveys in the field;
- Will be followed by a 2021 baseline report which evaluates the accuracy of the habitat suitability mapping for the Project;
- Will be followed by an assessment of mitigation measures for grizzly bear, and new mitigations consistent with the BC Environmental Mitigation Policy will be added if required; and
- Will be followed by a technical report and report for lay audiences delivered to Aboriginal Groups at least 60 days prior to the start of Construction at the Project site.

15.9.1.7 Birds

DS Condition 4.3 requires pre-construction surveys in the mine site and transmission line right-of-way to validate the results of habitat suitability modelling for migratory birds, including migratory birds that are listed species at risk. Survey results will be used to inform mitigation measures for migratory bird habitat and will be incorporated into the WMMP in consultation with Aboriginal and Indigenous groups and relevant provincial and federal authorities.

DS Condition 8.16 requires pre-construction surveys for short-eared owl in high-value nesting and foraging habitat.

Pre-construction surveys will include:

- Habitat suitability model validation for migratory birds, including migratory birds that are listed species at risk, conducted by the Proponent and presented in the Application/EIS and Blackwater Gold Project – Waterbird Memo;
- Validation of the applicability of fisher habitat suitability model for interior forest habitats to migratory birds, as identified by in Blackwater Gold Project – Forest Birds;
- Surveys for migratory bird species at risk and their habitat within the LSA to identify any additional mitigation measures required during construction; and
- Identifying areas of the transmission line route which pose a higher mortality risk to birds, for implementation of mitigation measures and follow-up monitoring.

Pre-construction field surveys will be undertaken within the mine site and transmission line right-of-way following provincial protocols for habitat suitability mapping.

- Field surveys for birds are required to ground-truth habitat suitability mapping models. Surveys follow RISC standards and during the breeding bird season one year prior to construction:
  - RIC 1998. Inventory Methods for Forest and Grassland Songbirds, Version 2.0;
  - RIC 1999. Inventory Methods for Waterfowl and Allied Species, Version 2.0;
  - RIC 1998. Inventory Methods for Swallows and Swifts, Version 2.0;
  - Knight et al. (2019) Canadian Nightjar Survey Protocol, 2019, which replaces RIC (1998) Inventory Methods for Nighthawks and Poorwills, Version 2.0; and
  - RISC 2006. Inventory Methods for Owl Surveys, Version 1.0.

Pre-construction surveys were conducted during the summer of 2021 to accomplish these goals. Species-specific surveys were conducted for several species at risk that require specialized surveys due to their unique natural history. The data from these surveys will be reported in a 2021 baseline wildlife report. Based on the results of pre-construction surveys conducted in 2021, mitigation measures will be updated, as necessary, in consultation with Aboriginal and Indigenous groups and relevant authorities.

15.9.2 Pre-clearing

15.9.2.1 Furbearers

If construction is scheduled during sensitive time periods, pre-construction surveys will be conducted to identify American marten, fisher, and wolverine denning habitat (WMMP Table 4.5-1; DS 8.9, 8.10). Planning for surveys and adaptive management for probable active dens will be in consultation with FLNRORD and Aboriginal and Indigenous groups. Surveys will generally follow *Inventory Methods for Medium-Sized Territorial Carnivores – Coyote, Red Fox, Lynx, Bobcat, Fisher, and Badger, Version 2.0* (RIC 1999b). Ground-based surveys, stratified by habitat suitability, will be conducted in winter prior to any clearing or construction in the sensitive period. Detailed surveys methods are provided in Section 4.5.2.1 of the WMMP.

15.9.2.2 Grizzly Bear

DS Condition 8.10 and EAC Condition 23c indicate that if construction cannot be avoided during the sensitive periods for bears, that pre-construction surveys will be conducted for grizzly bear denning habitat. Detailed surveys methods are provided in Section 4.6.2.1 of the WMMP.

15.9.2.3 Birds

EAC Condition 23c, Table 1, indicates that if vegetation clearing must occur during the sensitive period, then pre-clearing surveys will be conducted to identify active nests and establish appropriate setback buffers. Detailed survey methods are provided in Section 4.7.2.1 of the WMMP.

Note that “pre-construction surveys” are conducted to gather information for planning purposes ahead of the construction period. In contrast, “pre-clearing surveys” are conducted in the closest window possible prior to vegetation clearing during sensitive periods (typically within one week), if clearing cannot be feasibly conducted at another time.

15.9.3 Mitigation Measure Effectiveness Monitoring

Wildlife monitoring will be conducted during construction to evaluate the effectiveness of mitigation measures and inform adaptive management. Not all mitigation measures can be directly monitored, but

mitigation measures that can be monitored are provided in Table 15.9-1, and further detailed in the WMMP (Section 4).

Additional wildlife monitoring will be initiated during the construction period in support of federal follow-up programs in accordance with the WMMP. However, this work has long-term objectives (e.g., population-level monitoring) and the results will likely not provide meaningful opportunity for adaptive management at the time-scale of construction (i.e., 2 years).

Table 15.9-1: Mitigation Measure Effectiveness Monitoring for Wildlife

Potential Effect	Wildlife Valued Components	Mitigation	Monitoring Method	Frequency
Clearing and Construction				
Habitat Loss	Plant Species and Ecosystems at Risk	Clearing and construction mitigations to minimize disturbance (establish targeted no work zones and demarcated buffers)	Report on construction mitigations implemented during clearing	Annual during Construction
Habitat Alteration – Sediment Control	Amphibians, Birds, Plant Species and Ecosystems at Risk	Manage sediment and erosion risks during clearing and construction	Report on sediment control measures implemented	Annual during Construction
Habitat Alteration – Timing Windows	Amphibians, Bats, Birds, Caribou, Furbearers, Grizzly Bear	Conduct clearing and construction during least-harm timing windows wherever practicable, or conduct pre-clearing/pre-construction surveys and implement mitigations	Pre-construction surveys, Report on Project clearing and construction activities	Annual
Habitat Alteration – Vegetation Management	Birds, Plant Species and Ecosystems at Risk	Minimize forest edge area, maintain edge habitat, and reduce windthrow risk	Report on forest edge management and windthrow risk assessment	Annual
Habitat Alteration – Vegetation Management	Plant Species and Ecosystems at Risk	Manage equipment and clearing to avoid introduction of invasive plant species	Invasive species monitoring program	Annual
Habitat Alteration – Wetlands and Riparian Habitat	Amphibians, Insects, Waterbirds	Construction mitigations: no work zones, vegetated buffers, sediment/erosion control, waste management	Wetlands monitoring program	Annual
Habitat Alteration - Wetlands and Riparian Habitat	Amphibians, Birds, Plant Species and Ecosystems at Risk	Manage drainages to minimize loss or diversion of drainage systems	Report on drainage management measures	Annual during Construction
Disturbance	All	Incidental reporting of wildlife	Incidental reporting of wildlife, wildlife cameras	Annual
Disturbance	All	Training personnel on wildlife policies and mitigation measures - conduct onboarding and refreshers	Report on number of personnel who have undergone onboarding and refresher trainings	Annual
Disturbance	Caribou	Stop nearby work if caribou are observed on the Project site during construction	Incidental reporting of wildlife	Annual

Potential Effect	Wildlife Valued Components	Mitigation	Monitoring Method	Frequency
Disturbance	Caribou, Moose	Identify mineral licks outside of the Project footprint, buffer these areas if the are retained and apply mitigation	Pre-construction surveys, Report on mitigation actions	One-time
Roads				
Habitat Alteration	All	Use existing roads and reclaim roads wherever practicable	Length of new roads constructed and length of roads reclaimed following construction, compared to high quality habitat for each VC	One-time
Habitat Alteration	Caribou, Furbearers, Grizzly Bear, Moose	Manage vegetation to reduce attractiveness of roadsides	Report on vegetation management activities	Annual
Disturbance	All	Use of buses to reduce traffic	Monitor traffic on access roads	Annual
Disturbance	All	Establish and enforce set speed limits	Monitor speed limits	Annual
Disturbance	All	Avoid using salt on roads wherever possible	Report on use of anti-icing agents	Annual
Disturbance	Caribou, Moose, Furbearers, Grizzly Bear	Manage snow banks to allow animals to cross	Audit of snow banks	Annual
Disturbance	All	Restrict access to mine site by visitors	Report on records from security personnel	Annual
Disturbance	Amphibians, Caribou, Moose, Furbearers, Grizzly Bear	Identify wildlife trails and potential road crossings, provide signage where trails meet roads	Pre-construction surveys, reporting of road incidents, report on signage	Annual

15.10 Archaeological and Cultural Heritage Monitoring

Archaeological sites and cultural heritage resources will be monitored to address adverse effects on known and as-yet unknown heritage resources or values described in the:

- Cultural and Spiritual Resources Management Plan.

Known and as-yet unknown sites (as identified by the chance find procedure) potentially affected by Project activities will be monitored as summarized below:

- Sites within 50 m of Project activities will be flagged as "No Work Zones" on the ground and monitored by the EM and Aboriginal Monitors during construction in the vicinity of the site.
- Sites that are identified by Indigenous groups as confidential will be monitored by the Aboriginal Monitors during construction in the vicinity of the site.
- Sites located 50 to 150 m of Project activities will be monitored on an annual basis by the EM and Aboriginal Monitors to verify that known heritage sites remain intact and are not impacted by the Project and check the condition of site protection (i.e., flagging or fencing).
- Monitoring records will be maintained and reporting will be conducted as described in Section 16. Indigenous group representatives and/or Indigenous Knowledge Holders will be invited to be involved, and/or, identify representatives who will be involved, in the implementation of the Cultural and Spiritual Resources Management Plan.

15.11 Noise and Vibration

Noise compliance monitoring will occur once (1) during the Major Works Construction phase comprising a total of two (2) seasonal measurements; the first being during the early spring/summer (March through June), and the second being during the late fall (September through November) in accordance with Section 10.2.2 of the NVEMP.

Monitoring will be conducted at two (2) locations, summarized as follows:

- M1 – Construction Camp area; and
- M2 – Doug short ranch.

The locations are shown in Figure 10-1 of the NVEMP.

Compliance monitoring will require a minimum of 48 hours of continuous monitoring at each location, which may be extended depending on local influences (wind, rain, abnormal noise events etc.), as directed by the QP for environmental noise. Monitoring shall be conducted with a sound level meter that meets the minimum technical specifications in the IEC or EN 61672-2 (2013) + AMD1:2017 CSV Class 1 or newer, for Class 1 sound level meters.

16. REPORTING AND RECORD KEEPING

Internal reporting is the responsibility of the Environmental Monitor. External reporting is the responsibility of BW Gold's EM, with delegation as necessary to appropriate personnel. Consultants and contractors hired to implement reporting aspects of the monitoring programs will be suitably qualified professionals or qualified persons.

16.1 Internal Reporting

16.1.1 Weekly Report

Environmental Monitors will document field observations and photos in a weekly Environmental Monitoring form.

16.1.2 Monthly Report

The Environmental Monitors will summarize key findings, outcomes, challenges, successes, work areas, incidents, and non-compliance issues in a monthly Environmental Monitoring Report. This report will track issues, provide overview of progress, and support communications related to the Project's progress.

Distribution of the report outside of the Project Team (i.e., BW Gold, contractor's Management Team, and Environmental Monitors) is the responsibility of BW Gold's EM.

16.1.3 Completion Reporting

A Project Completion Report (PCR) will be prepared by the Environmental Monitor for distribution to the contractors and BW Gold at the completion of the initial Construction phase, and after defined construction projects during Operation. The PCR will contain the following information and provide a high level overview of the extent of the Project construction and environmental successes and challenges:

- Project organization and parties;
- Description of the extent and type of construction across the Project and challenges;
- Communication approach and success;
- Overview of the environmental requirements for the Project;
- Examples of environmental mitigation measures (both successful and inadequate);
- Compliance summary for the nature and type of incidents and environmental impacts;
- Recommendations for improvements for environmental performance; and
- The Environmental Monitor's professional designation and qualifications.

16.1.4 Incident Reporting

Environmental incidents will be communicated by the individual who detects an incident to their superintendent and to the Environmental Manager.

Incident and non-compliance reports will be prepared by the Environmental Monitor for distribution to the Project Team and any applicable regulatory agencies. Key information to include in the incident report includes:

- The location, cause and nature of the incident;
- Environmental or Project features affected (e.g., road, watercourse, forest land, infrastructure);

- Time, extent, and magnitude/quantity of material or area affected;
- Response and actions to control the incident;
- Any follow-up tasks required, mitigation/remediation/corrective actions, or additional sampling needs;
- Notifications of the incident and communication within and outside the Project Team; and
- Typically photographs, GPS location, and a map are included for clarification and understanding of proximity risks.

Environmental incidents during Construction can be grouped into two general categories based upon impact magnitude and complexity.

Minor incidents have no permanent or long-term impact on the environment and are generally small scale in nature with simple remedies and may occur frequently on a construction project.

Major environmental incidents are infrequent, can have widespread, permanent or lethal/toxic impacts, are complex to resolve, and may require extensive remediation or cleanup resources.

Minor incidents with little consequence to the environment will be reported within 24 hours to the Environmental Monitor. Examples of minor incidents include non-compliance with mitigation measures, lack of spill cleanup equipment, and non-compliance with flagging of sensitive areas. Cleanup and remediation of the incident will be the responsibility of the Contractor, in consultation with the Environmental Monitor, to address the causes, potential impacts, and long-term risks. The Contractor's Environmental Representative, with the support of the Environmental Monitor, will complete an Environmental Incident Report Form within 48 hours detailing the root causes, consequence, impacts, remediation approach, recommendations and any photos or maps. The Contractor's Environmental Representative/Manager, Environmental Monitor, and Site Superintendent will review and sign-off on the incident report and provide copies to the Contractor and BW Gold's Environmental Manager within 48 hours. Minor issues are generally resolved immediately and no follow-up is required once addressed. Minor issues of similar nature that begin to occur frequently will trigger further investigation.

Major incidents are those with the potential to cause permanent, widespread, lethal, or cumulative impacts: a pollution release to the environment, a contravention of legislation and/or permit conditions, or risk to human health and safety. These incidents are rare, but are more complex and resource intensive to remediate than minor incidents. Examples of major incidents include a major sediment release into a stream and damage to fish habitat or critical wildlife habitat (e.g., bear den).

Major incidents must be reported immediately to the Environmental Monitor, EPCM Contractor, EM, and applicable regulatory agencies. The Contractor must immediately respond to control, contain, and minimize any impact on the environment or risk to people. An Initial Incident/Spill Report Form will be completed within the same day as the occurrence by the Contractor's Environmental Representative. The Initial Incident/Spill Report will detail the root causes, consequences, impacts, and remediation approach for the incident as well as any recommendations, photos, or maps.

The Contractor's Environmental Representative, the Environmental Monitor and the EPCM Contractor, and the EM will conduct an immediate investigation and site visit to prepare a Major Incident Report and provide copies to the Contractor and BW Gold within 24 hours. External agency and Indigenous group/ stakeholder notification may be required and will be conducted by BW Gold in accordance with the Accident and Malfunction Administration and Communication Plan. Control of a major incident may require assistance from external agencies (e.g., sediment discharge into a sensitive area, etc.) in which case BW Gold will coordinate the response. Extensive follow-up, sampling of the environment, and remediation may be required during or after a major incident.

A draft Environment Incident Report form is provided in Appendix H.

Additionally, any incidents (human-wildlife interactions where there is active deterrence and direct harm, injury, damage, or wildlife mortality occurs) will have formal incident reporting completed in accordance with Section 5.1.1 of the WMMP. A draft Wildlife Incident Report form for use during the Construction phase is provided in Appendix I.

16.2 External Reporting

16.2.1 Compliance Reporting

Compliance reporting will be subject to *Mines Act* and *Environmental Management Act* permit conditions and Conditions 5, 12(l), and 36 of the EAC.

16.2.2 Environmental Monitoring Committee

BW Gold has established the EMC and its terms of reference pursuant to EAC Condition #19 Committee meetings will be the primary venue to provide regular construction updates and report monitoring results. Monthly reports will be distributed to EMC members a minimum of 5 business days prior to the next scheduled meeting and will be a standing agenda item for discussion. BW Gold will maintain and distribute meeting minutes for each committee meeting.

16.2.3 Environmental Assessment Certificate Reporting

16.2.3.1 Annual Reporting

Condition 5 of the EAC sets out reporting requirements. BW Gold must submit a report to the attention of the EAO and Aboriginal Groups on the status of compliance with EAC #M19-01 at the following times:

a. At least 30 days prior to the start of Construction;
b. On or before March 31 in each year after the start of Construction;
c. At least 30 days prior to the start of Operations;
d. On or before March 31 in each year after the start of Operations;
e. At least 30 days prior to the start of Closure;
f. On or before March 31 in each year after the start of Closure until the end of Closure;
g. At least 30 days prior to the start of Post-closure; and
h. On or before March 31 in each year after the start of Post-closure until the end of Post-closure.

BW Gold will submit reports to the EAO and Aboriginal Groups within the timelines specified in Condition 5.

16.2.3.2 Independent Environmental Monitor Reporting

Condition 12(l) sets out phase completion reporting requirements to be prepared and submitted by the Independent Environmental Monitor. BW Gold will include provisions for a Construction phase completion report in the Independent Environmental Monitor's terms of engagement. Information sharing and reporting by the Independent Environmental Monitor will not be provided to BW Gold in advance of providing such information or reports to the Environmental Assessment Office and Aboriginal Groups.

16.2.3.3 Accidents and Malfunctions Reporting

Condition 36 sets out requirements to develop an Accidents and Malfunction Administration and Communication Plan. Accidents and malfunctions that occur during the Construction phase will be reported to Aboriginal Groups, Tatelkus Indian Reserve 28, other nearby residents, local communities or other users of the area in accordance with the Accidents and Malfunction Administration and Communication Plan.

16.2.4 Federal Decision Statement Annual Reporting

DS Conditions 2.11, 2.12 and 2.13 set out annual reporting requirements related to the implementation of conditions in the DS. Condition 2.14 sets out information sharing requirements related to the annual reports. Reporting will commence when BW Gold begins to implement the conditions set out in the DS. Requirements in DS Conditions 2.11 – 2.14 are presented below.

DS Condition 2.11 requires:

> *"The Proponent [BW Gold] shall, commencing in the reporting year during which the Proponent begins the implementation of the conditions set out in this Decision Statement, prepare an annual report that sets out:*
>
> *2.11.1 the activities undertaken by the Proponent in the reporting year to comply with each of the conditions set out in this Decision Statement;*
>
> *2.11.2 how the Proponent complied with condition 2.1;*
>
> *2.11.3 for conditions set out in this Decision Statement for which consultation is a requirement, how the Proponent considered any views and information that the Proponent received during or as a result of the consultation, including a rationale for how the views have, or have not, been integrated;*
>
> *2.11.4 the information referred to in conditions 2.5 and 2.6 for each follow-up program;*
>
> *2.11.5 the results of the follow-up program requirements identified in conditions 3.14, 3.15, 3.16, 4.5, 5.5, 6.11, 6.12, 6.13, 6.14, 8.18.6, 8.20.5, 8.21, and 8.22 if required;*
>
> *2.11.6 any update made to any follow-up program in the reporting year;*
>
> *2.11.7 any modified or additional mitigation measures implemented or proposed to be implemented by the Proponent, as determined under condition 2.9 and rationale for why mitigation measures were selected pursuant to condition 2.5.4; and*
>
> *2.11.8 any change(s) to the Designated Project in the reporting year."*

DS Condition 2.12 requires:

> *"The Proponent [BW Gold} will provide the draft annual report to Indigenous groups, no later than June 30 following the reporting year to which the annual report applies. BW Gold will consult Indigenous groups on the content and findings in the draft annual report."*

DS Condition 2.13 requires:

> *"The Proponent [BW Gold], in consideration of any comments received from Indigenous groups pursuant to condition 2.12 shall revise and submit to the Agency [Impact Assessment Agency of Canada] and Indigenous groups a final annual report, including an executive summary in both official languages, no later than September 30 following the reporting year to which the annual report applies."*

DS Condition 2.14 requires:

> *"The Proponent [BW Gold] shall publish on the Internet, or any medium which is publicly available, the annual reports and the executive summaries referred to in conditions 2.11 and 2.13, the offsetting plan(s) referred to in condition 3.11, the compensation plan referred to in condition 8.18 and, if required, condition 5.3, the whitebark pine management plan referred to in condition 8.20, the communication plans referred to in conditions 6.15 and 10.5, the reports related to accidents and malfunctions referred to in conditions 10.4.2 and 10.4.3, the schedules referred to in conditions 11.1 and 11.2, and any update(s) or revision(s) to the above documents, upon submission of these documents to the parties referenced in the respective conditions. The Proponent shall keep these documents publicly available for 25 years following the end of decommissioning of the Designated Project. The Proponent shall notify the Agency and Indigenous groups of the availability of these documents within 48 hours of their publication."*

DS Condition 2.15 requires:

> *"When the development of any plan is a requirement of a condition set out in this Decision Statement, the Proponent [BW Gold] shall submit the plan to the Agency and to Indigenous groups prior to construction, unless otherwise required through the condition."*

16.3 Record Keeping

BW Gold will assume the responsibility of record keeping associated with the CEMP. Data will be entered into suitable electronic databases (consideration will be given to programs such as Microsoft Access or SAP). Quality control checks will be preformed by a senior member of the environment team upon receipt of results. Data will be entered in a format and program(s) (such as Microsoft Excel or R Project) that allows for comparison between years, and be stored in a single file format for each type of survey or monitoring activity. Monitoring data will be stored for 25 years beyond decommissioning, and be made available for review upon request for regulatory inspections and for Indigenous auditing purposes.

17. EVALUATION AND ADAPTIVE MANAGEMENT

BW Gold will conduct and document quarterly review of the CEMP to assess the effectiveness of mitigation measures.

The CEMP is a living document that will evolve over time in response to the results of the construction environmental monitoring program, changing conditions or development at the site, updates to scientific methods, and through consultation and discussions with relevant stakeholders, including Aboriginal and Indigenous groups. This process of improvement with changing conditions is referred to as Adaptive Management.

The CEMP adaptive management framework as outlined in Section 5 contains the following elements:

- Plan
  - The CEMP includes planned mitigation measures and monitoring programs to meet *Mines Act* and *Environmental Management Act* permits conditions, and DS and EAC Conditions and is engaging with Aboriginal and Indigenous groups and relevant federal and provincial authorities on these measures and programs.
- Do
  - Implementing the mitigation measures as described in the CEMP.
- Monitor
  - The CEMP includes monitoring programs to detect potential effects and test Application/ EIS predictions.
- Adjust
  - The CEMP defines qualitative and quantitative triggers to measure the level of change relative to baseline conditions in order to determine whether construction mitigation measures need to be altered or additional mitigation measures implemented.

18. PLAN REVISION

The CEMP is a “living” document and it will be reviewed annually at a minimum. Changes to the CEMP, including additions or updates to site specific ESC prescriptions, SOPs, mitigation measures or monitoring programs, will be driven largely by revisions to discipline-specific management plans. Proposed changes will be reviewed and discussed with the Blackwater Environmental Monitoring Committee and Aboriginal Groups prior to implementation. Revised versions of the CEMP will be dated, version controlled, signed and filed with the Chief Inspector of Mines, Environmental Assessment Office and Aboriginal Groups and posted to BW Gold’s Project website in accordance with EAC Condition 42(c).

19. QUALIFIED PROFESSIONALS

The contents of this CEMP have been derived from a number of standalone management plans (see Section 2) prepared by respective qualified professionals, where required. This CEMP has been developed under the direct supervisions of, or reviewed by, the following qualified professional:

<original signed by>

Rolf Schmitt, M.Sc., P.Geo.
Technical Director

20. 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 CONCORDANCE TABLE WITH ENVIRONMENTAL ASSESSMENT CERTIFICATE #M19-01 (JUNE 21, 2019)

Table A-1: Concordance Table with Environmental Assessment Certificate #M19-01 (June 21, 2019)

Condition	Condition	Location in Plan
Condition 2 (Plan Development)	Where a condition of this Certificate requires the Holder to develop a plan, program or other document, any such plan, program or other document must, at a minimum, include the following information: a. purpose and objectives of the plan, program or other document;	Section 2
	b. roles and responsibilities of the Holder and Employees;	Section 3,Table 3-1
	c. names and, if applicable, professional certifications and professional stamps/seals, of those responsible for the preparation of the plan, program, or other document;	Section 19
	d. schedule for implementing the plan, program or other document throughout the relevant Project phases;	Section 6
	e. means by which the effectiveness of the mitigation measures will be evaluated including the schedule for evaluating effectiveness;	Section 17
	f. schedules and methods for the submission of reporting to specific agencies, Aboriginal Groups and the public and the required form and content of those reports; and	Section 16.1 (Internal Reporting); Section 16.2 (External Reporting).
	g. process and timing for updating and revising the plan, program or other document, including any consultation with agencies and Aboriginal Groups that would occur in connection with such updates and revisions.	Section 18
Condition 3 (Adaptive Management)	Where a condition of this Certificate requires the Holder to develop a plan, program or other document that includes monitoring, including monitoring of mitigation measures or monitoring to determine the effectiveness of the mitigation measures, the Holder must include adaptive management in that plan. The objective of the adaptive management is to address the circumstances that will require the Holder to implement alternate or additional mitigation measures to address effects of the Project if the monitoring shows that those effects: a. are not mitigated to the extent contemplated in the Application; b. are not predicted in the Application; or c. have exceeded the triggers identified in paragraph g) of this condition. The adaptive management in the plan must include at least the following: a. the monitoring program that will be used including methods, location, frequency, timing and duration of the monitoring;	Section 17 (Evaluation and Adaptive Management)

Condition	Condition	Location in Plan
Condition 3 (Adaptive Management; *cont'd*)	b. the baseline information that will be used, or collected where existing baseline information is insufficient, to support the monitoring program;	No baseline information is required to be collected to support monitoring.
	c. the scope, content and frequency of reporting of the monitoring results;	
	d. the identification of qualitative and quantitative triggers, which, when observed through monitoring required under paragraph d), will require the Holder to alter existing, or develop new, mitigation measures to avoid, reduce, and/or remediate effects;	The CEMP does not include any triggers and will defer to triggers identified in management plans that apply during the Construction phase.
	e. the methods that will be applied to detect when a numeric trigger, or type or level of change referred to in paragraph g), has occurred;	The CEMP does not include any triggers. The CEMP will defer to triggers identified in management plans that apply during the Construction phase.
	f. a description of the process for and timing to alter existing mitigation measures or develop new mitigation measures to reduce or avoid effects;	
	g. identification of the new and/or altered mitigation measures that will be applied when any of the changes identified in paragraphs a) to c) occur, or the process by which those will be established and updated over the relevant timeframe for the specific condition;	
	h. the monitoring program that will be used to determine if the altered or new mitigation measures and/or remediation activities are effectively mitigating or remediating the effects and or avoiding potential effects; and	
	i. the scope, content and frequency of reporting on the implementation of altered or new mitigation measures. If there are any requirements or mitigation measures required in the plan, program or other document for which adaptive management, or elements of adaptive management listed in paragraphs d) to l) are assessed to be not appropriate or applicable, the plan must include identification of those requirements and measures, and the rationale for that assessment.	

Condition	Condition	Location in Plan
Condition 4 (Consultation)	Where a condition of this Certificate requires the Holder consult a particular party or parties regarding the content of a plan, program or other document, the Holder must, to the satisfaction of the EAO: a. provide written notice to each such party that: i. includes a copy of the plan, program or other document; ii. invites the party to provide its views on the content of such plan, program or other document; and iii. indicates: 1. if a timeframe for providing such views to the Holder is specified in the relevant condition of this Certificate, that the party may provide such views to the Holder within such time frame; or 2. ii. if a timeframe for providing such views to the Holder is not specified in the relevant condition of this Certificate, specifies a reasonable period during which the party may submit such views to the Holder; b. undertake a full and impartial consideration of any views and other information provided by a party in accordance with the timelines specified in a notice given pursuant to paragraph (a); c. provide a written explanation to each such party that provided comments in accordance with a notice given pursuant to paragraph (a) as to: i. how the views and information provided by such party to the Holder have been considered and addressed in a revised version of the plan, program or other document; or ii. why such views and information have not been addressed in a revised version of the plan, program or other document; d. maintain a record of consultation with each such party regarding the plan, program or other document; and e. provide a copy of such consultation record to the EAO, the relevant party, or both, promptly upon the written request of the EAO or such party. The copy of such consultation record must be provided to the EAO, relevant party, or both, no later than 15 days after the Holder receives the request for a copy of the consultation record, unless otherwise authorized by the EAO.	This draft of the CEMP was provided to Aboriginal Groups for review and comment. BW Gold revised the plan in response to comments.

Condition	Condition	Location in Plan
Condition 13 (Construction Environmental Management Plan)	The Holder must retain one or more Qualified Professionals to develop a Construction Environmental Management Plan. The plan must be developed in consultation with EMPR, ENV, FLNRORD, and Aboriginal Groups. The plan must include, at a minimum, the means by which the following will be addressed:	
	a. access management;	Section 9.1
	b. invasive plants management;	Section 9.9
	c. waste management;	Section 9.1; Section 12
	d. emergency response	Section 11
	e. human-wildlife conflict;	Section 9.11
	f. visual resource management;	Section 9.1
	g. erosion and sediment control;	Section 9.2
	h. spill prevention and response for hydrocarbon storage and leaks or other accidental emissions from machinery or equipment;	Section 10
	i. metal leaching (ML) and acid rock drainage (ARD) management;	Section 9.6
	j. geological and terrain hazards; and	Section 9.1
	k. vegetation management.	Section 9.9
	The Holder must provide the draft plan that was developed in consultation with EMPR, ENV, FLNRORD and Aboriginal Groups to the EAO, EMPR, ENV, FLNRORD, and Aboriginal Groups for review a minimum of 90 days prior to the planned commencement of Construction or as listed in the Document Submission Plan required by Condition 10 of this Certificate.	BW Gold to provide the draft plan to EAO, EMLI, ENV, FLNRORD and Aboriginal Groups for review a minimum of 90 days prior to planned commencement of construction.
	The plan and any amendments thereto, must be implemented to the satisfaction of a Qualified Professional throughout Construction and to the satisfaction of the EAO.	Future requirement

APPENDIX B CONCORDANCE TABLE WITH FEDERAL DECISION STATEMENT CONDITIONS (APRIL 15, 2019)

Table B-1: Concordance with Federal Environmental Assessment Decision Statement Conditions

Condition	Requirement	Location in Plan
Condition 2.1 (General Conditions)	The Proponent shall ensure that its actions in meeting the conditions set out in this Decision Statement during all phases of the Designated Project are considered in a careful and precautionary manner, promote sustainable development, are informed by the best information and knowledge available at the time the Proponent takes action (including community and Indigenous traditional knowledge), are based on methods and models that are recognized by standard-setting bodies, are undertaken by qualified individuals, and have applied the best available economically and technically feasible technologies.	Section 4
Condition 2.2 (General Conditions)	The Proponent shall, when mitigation is a requirement of a condition set out in this Decision Statement, give preference to avoiding the adverse environmental effect of the Designated Project over minimizing the adverse environmental effect of the Designated Project. If unable to avoid the adverse environmental effect, the Proponent shall give preference to minimizing the adverse environmental effect of the Designated Project over compensating for the adverse environmental effect of the Designated Project. If unable to minimize the adverse environmental effect, the Proponent shall compensate for the adverse environmental effect of the Designated Project.	Section 9
Condition 2.3 (General Conditions)	The Proponent shall, where consultation is a requirement of a condition set out in this Decision Statement: ■ 2.3.1 provide a written notice of the opportunity for the party or parties being consulted to present their views and information on the subject of the consultation; ■ 2.3.2 provide all information available and relevant on the scope and the subject matter of the consultation and a period of time agreed upon with the party or parties being consulted, not less than 15 days, to prepare their views and information; ■ 2.3.3 undertake a full and impartial consideration of all views and information presented by the party or parties being consulted on the subject matter of the consultation; ■ 2.3.4 strive to reach consensus with Indigenous groups; and ■ 2.3.5 advise the party or parties being consulted on how the views and information received have been considered by the Proponent including a rationale for why the views have, or have not, been integrated. The Proponent shall advise the party or parties in a time period that does not exceed the period of time taken in 2.3.2.	Section 16.2.4
Condition 2.4 (Consultation)	The Proponent shall, where consultation with Indigenous groups is a requirement of a condition set out in this Decision Statement, determine and strive to reach consensus with each Indigenous group regarding the manner by which to satisfy the consultation requirements referred to in condition 2.3, including: ■ 2.4.1 the methods of notification; ■ 2.4.2 the type of information and the period of time to be provided when seeking input; ■ 2.4.3 the process to be used by the Proponent to undertake impartial consideration of all views and information presented on the subject of the consultation; and ■ 2.4.4. the period of time and the means by which to advise Indigenous groups of how their views and information were considered by the Proponent.	Section 16.2.4

APPENDIX C STANDARD OPERATING PROCEDURE – OVERBURDEN MONITORING

Appendix C: Standard Operating Procedure – Overburden Monitoring

OBJECTIVE

Overburden materials monitoring is conducted to validate pre-mine ML/ARD characterization data and associated geochemical source term model assumptions. In addition, the understanding of overburden geochemistry is crucial for reclamation planning. The objective of this Standard Operating Procedure (SOP) is to provide guidance for BW Gold Ltd. personnel for the collection and preparation of overburden samples for the Blackwater Gold Project (the Project). The sampling protocols described in this SOP are intended to ensure that overburden sample collection and preparation methodology support accurate and representative geochemical characterization of overburden material encountered during site excavation activities. This SOP follows general requirements outlined in the Metal Leaching and Acid Rock Drainage (ML/ARD) Management Plan.

SCOPE

This SOP describes activities related to the operational ML/ARD monitoring of mine rock through the mine life of the Project and covers the following tasks:

- Sampling selection and collection protocols.
- Sample shipping and handling details.
- Select laboratory analyses and procedures.
- Quality assurance and quality control (QA/QC) requirements.
- Communications with the analytical laboratories.
- Documentation of results.

DEFINITIONS

ABA	Acid-Base Accounting
ML/ARD	Metal Leaching and Acid Rock Drainage
NAG	Non-Acid Generating
PAG	Potentially Acid Generating
PPE	Personal Protective Equipment, including hardhat, steel toed boots and safety glasses
QA/QC	Quality Assurance and Quality Control

PREPARATION*

The work covered by the SOP will be performed by responsible mine personnel following BW Gold's Health and Safety policies and procedures including the use of personal protective equipment (PPE), following safe work practices/procedures, and completing assessment of hazards and controls. Mine personnel implementing this SOP must be aware of potential hazards that include but are not limited to the following:

- **Hazards**:
  - Slips, trips and falls.
  - Working near heavy mobile and stationary equipment.

The following training is required for personnel implementing the activities outlined in this SOP.

- **Training**:
  - Knowledge of overburden sampling protocols.
  - Trained and qualified to conduct overburden sampling including SOP review and sign off.
  - Trained and qualified to work around heavy mobile and stationary equipment and in areas where explosives are used.
  - Knowledge of overburden geology.

This SOP requires the following equipment and supplies:

- **Equipment**:
  - Standard PPE.
  - Hand auger or trowel/shovel.
  - Flagging tape and/or marking paint.
  - Notebook.
  - Sample bag(s).
  - Zip ties.
  - Camera.
  - GPS.

** Note that the components listed do not reflect the laboratory equipment and training requirements for the execution of the on-site geochemical analyses.*

IMPLEMENTATION

The ML/ARD Management Plan requires overburden sampling to be conducted prior to and during excavation at a minimum sample frequency of one (1) sample per 25,000 m^3 of material disturbed. Where excavation of overburden amounts to less than 50,000 m^3 within a distinct Project area to be disturbed, a minimum of two well-spaced samples are to be collected. All samples should be mapped and recorded within a database such that the samples the spatial distribution of low- and high-risk overburden materials can be tracked. Overburden monitoring will ensure that appropriate material is being stockpiled in designated laydown areas and can be used for reclamation activities.

TASKS

	Person Responsible
Preparation	
■ Sample tags are generated before sampling for every sample to be collected in the field. The tag identifies each sample with a unique identifier. Sample identifiers will be generated using the prefix "OB-", a two-digit identifier for the calendar year, and a four-digit numerical value starting with 0001 for the overburden sample.	Mine Geologist/ Environmental Technician
Sample Collection	
■ Each overburden sample needs to be collected by a qualified technician and/or geologist. The sample taken should represent material that will be disturbed during construction and mining activities.	
■ Overburden samples will be collected prior to and during excavation of material as follows:	
- Prior: Test pits or transect samples from overburden area surface, after removal of surficial organic soil.	
- During: Composite samples from the deeper portions of the overburden cut that that are not reachable prior to excavation (e.g., near overburden bedrock interface).	
■ Pre-excavation: Collect monitoring samples from test pits or hand auger holes that are at least 0.5 m in depth unless bedrock is encountered at a shallower depth. Collect a minimum of four (4) sub-samples from an equivalent number of auger holes along a transect or along a test pit. The transect or test pit should have a minimum length of 10 m. Each sub-sample should comprise at least 1 kg of material.	
■ Excavation: Collect monitoring samples from active construction areas where overburden is being disturbed and exposed. Samples from this portion of the monitoring program will target deeper horizons (i.e., > 0.5 m depth) including material directly overlying the bedrock-overburden interface.	
- Where safe access allows, collect a minimum of four (4) samples from an equivalent number of auger holes along a transect (minimum length of 10 m). Sample collection should focus on the deeper zones of the overburden cut. If the bedrock-overburden contact is <0.5 m below the cut surface, recover samples from the excavation surface using a hand trowel or similar device.	
- Where access into the overburden cut is unsafe, collect the sub-samples from overburden stockpiles next to the excavation site. In this case, instruct the excavator operator to carefully place overburden material from the targeted area (≥ 10 m radius) into small stockpiles near the edge of the cut while roughly maintaining the spatial integrity. Then, conduct the sampling from these stockpiles in the same manner as described above.	
■ Composite all sub-samples at equal proportion to create a sample representative of the transect or test pit. Each composite sample should comprise a minimum of 3 kg of overburden material.	

- Place a sample tag into the composite sample bag. Record the sample tag number along with sample characteristics any observations associated with the sample taken. At a minimum, include the following information recorded with each sample:
  - General soil characteristics.
  - Observations regarding grain size (e.g., presence and abundance of pebbles).
  - Location within pit on map or as coordinates.
  - Any observations (e.g., Fe-staining, geological features, etc.).
- Seal the sample bag with a zip tie and prepare for delivery to the on-site laboratory for the analysis of aqua regia digestible metals. It is the technician's responsibility to give clear delivery instructions if the sample is not delivered personally.

  Note: All overburden geochemical analyses are to be conducted on the <2 mm fraction and therefore, the on-site lab will be required to screen the submitted sample before analysis the remove larger particle sizes.

QA/QC Sample Collection

- Collect a minimum of one (1) field duplicate sample for every 10 regular samples and send to an accredited external laboratory.
- Collect the field duplicate sample in the same manner as the primary sample. Ideally, the duplicate is a split of the test sample; whereby a larger composite sample amounting to at least 6 kg is collected from which the duplicate overburden material is sub-sampled.
- Place the duplicate in a separate sample bag with a unique sample ID tag. The duplicate sample ID tag and location must be recorded in the notes.

Analytical Parameters

- Send regular monitoring samples to the on-site laboratory for the analysis of aqua regia digestible metals and total sulphur by LECO furnace.
- Submit QA/QC (duplicate) samples to an accredited laboratory for the full suite of ABA analyses and solid phase element determination by aqua regia digestion. The full list of parameters to be measured shall be included on the COC and includes the following parameters:
  - Total S (LECO) and sulphate S (by HCl digestion).
  - Total inorganic carbon.
  - Modified neutralization potential (NP).
  - Aqua regia digestible metals.
- Ship the completed COC form with the QA/QC samples to the external laboratory and an electronic version sent via e-mail to a Qualified Person (QP) for geochemistry and the accredited laboratory.

DATA ANALYSIS AND RECORD KEEPING

All background information collected during sample collection as outlined above shall be digitized in an appropriate database. Overburden monitoring data will be compiled, linked with the background information, and evaluated by the Chief Geologist and reviewed by the Environmental Manager or designate with the help of a QP for geochemistry as needed. The definition of the environmental class (e.g., PAG1, NAG4, etc.) to inform ML/ARD management strategies will be based on analytical surrogates derived for aqua regia digestible metals results as described in the ML/ARD Management Plan. External analytical results of the QA/QC (duplicate) samples will serve the confirmation of the on-site laboratory performance as well as the ongoing validation of the surrogate accuracy. These data are to be merged with the master ML/ARD monitoring database as they become available.

REVISION CONTROL SHEET

Date	Nature of Change	Page Inserted, Replaced, Revised, or Cancelled	Prepared By
July 30, 2021	Initial Version		Lorax Environmental Services Ltd.
September 3, 2021	Revised based on review by Artemis		Lorax Environmental Services Ltd.
September 10, 2021	Revised based on additional review by Artemis		Lorax Environmental Services Ltd.

APPENDIX D CHYTRIDIOMYCOSIS PREVENTION PROTOCOL

Appendix D: Chytridiomycosis Prevention Protocol

Clean equipment by removing foreign material (e.g., mud, vegetation) and sediment. This is best done at the work site or at pre-identified wash areas nearby.

1. Detach parts and accessories to access all surface areas, remove interior seats and mats. Work top to bottom and clean interior last.
2. Physically remove foreign material and sediment, e.g., using shovels and brooms.
3. If needed, power-wash exterior with water pressure ≥ 620 kPa.

Disinfect equipment between work sites using chemicals such as Bleach (6% NaClO) or Vircon (1% KPMS).

1. Check ecological information and ecotoxicity hazards on the Manufacturer's Safety Data Sheet.
2. Apply disinfectant > 50 m away from aquatic habitats.
3. Follow safety guidelines for PPE, concentrations, application method, and contact time.
4. Rinse with water.

Dry equipment for 24 hours if disinfected, or for five days if not disinfected.

APPENDIX E WHITE NOSE SYNDROME PREVENTION PROTOCOL

November 6, 2014

Western Canada White Nose Syndrome Transmission Prevention

Contents:

Background	1
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Report It	4
Clean It	4
Decontaminate It	4
Swap It	6
Stay Informed	6

Preventing a giant leap of the P.d. fungus is the most important thing humans can do for western bats.

Background

White Nose Syndrome (WNS) is a devastating disease that is destroying bat populations in North America. The cause of this disease is a cold-loving fungus *called Pseudogymnoascus (formerly Geomyces) destructans (P.d.),* which is expanding its range across North America at an alarming rate. WNS is expected to spread to western North America in the coming years.

Bats are an integral component of the ecosystem; as the primary consumer of night-time insects, bats play an important role in pest control for crops and forests. Bats are long-lived mammals; some species live over 40 years. Bats also have slow reproductive rates; most species have one young per year. Bat populations are vulnerable to WNS because they are unable to quickly bounce back from mass mortality, as has been evidenced in eastern North America.

WNS infected bat in Eastern USA

This document outlines how you can prevent a giant leap of the P.d. fungus to western North America, and minimize the possibility of spreading the fungus within the west if it is already here, or if it arrives in the near future.

Hibernating bats are most at risk to WNS disease. Bats that migrate (e.g. hoary bat) can travel hundreds and even thousands of kilometers, while *hibernating* bats do not tend to travel long distances between summer and winter roosts. There is a significant difference in bat diversity on the east and west side of the Rocky Mountains, suggesting this may be a partial barrier to bat movement. If bat-to-bat transfer remains the mode of spread for this fungus, and humans take precautions to not spread the fungus, the west could remain WNS free for many years. ***Preventing a giant leap of the P.d. fungus is the most important thing humans can do for western bats.***

Bat ecologist counts bats

Delaying the arrival of WNS to western North America also allows researchers more time to study western bats. Very little is known about the winter ecology of many bat species. The west has a richer species diversity of bats than in the east, and it is not known how WNS will impact western specific species. Biologists require time to learn about where western bat species overwinter, what constitutes critical winter habitat, and what is normal winter ecology and behaviour. By determining these details, western bats will benefit; and mitigation techniques can be developed to help reduce the impact of WNS in the west. At a minimum, enough will be learned about winter ecology to facilitate population recovery post-WNS.

WNS Risk Assessment Tool

Use this tool to determine if you are at risk to transmit WNS, and the actions you should take.

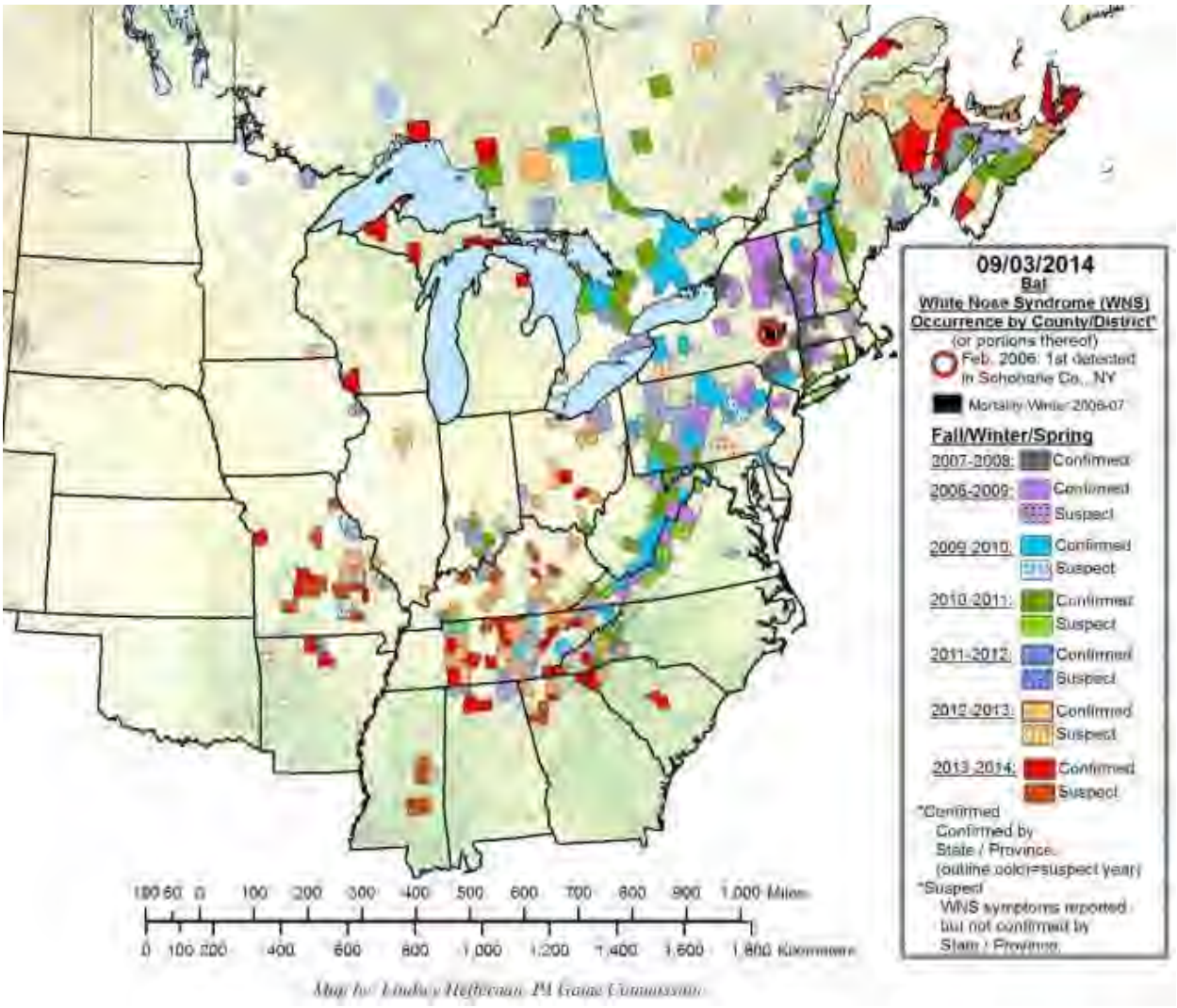
Scenario	Risk Level	Action	Description
You have been underground in western North America where *P.d. is not known to occur; bats or bat signs (e.g. guano, skeletons) were observed in the site.*	**Low**	**Report It** **Clean It**	Report your sightings, your information is critical to research. Thoroughly wash equipment, clothing & body. Ensure you are not bringing soil/ debris to another cave.
You have been underground in western North America where *P.d. is not known to occur; no bats and no bat signs were observed at the site.*	**Low**	**Clean It**	Thoroughly wash equipment, clothing & body. Ensure you are not bringing soil/ debris to another cave.
You have been underground outside of western North America. The area you visited is not known to have P.d. *This includes, but is not limited to: Manitoba, American mid-West, and Mexico*	**Moderate**	**Decontaminate It**	Thoroughly wash equipment, clothing, and body; dispose of materials where possible instead of re-using (eg. soiled gloves), and decontaminate everything that is to be reused underground.
You have been in a cave/mine that has more than 10 recently dead bats evident	**High**	**Report It** **Swap It**	Do not re-use your equipment/ clothing in an underground location in an area that is not known to have *Pd.* **Equipment used in High Risk areas should not go underground in western North America**
You have been in a cave/mine that has bats that show signs of WNS	**High**	**Report It** **Swap It**	
You have been underground in an area known to have Pd. *This includes, but is not limited to: eastern North America, Europe, and Asia*	**High**	**Swap It**	

Purpose

In caves housing WNS-infected bats, spore levels are high and thus the chance of having spores on equipment and clothing is high. The greatest density of spore contamination is likely to occur on anything that enters into a WNS positive cave. Fungal spores are very resistant and are easily spread; risk of infection is extremely high if decontamination is not adequate. **Cavers should not go underground in the West with equipment or clothing that has been used underground in the East because of the high likelihood that this equipment has P.d. spores.**

Cavers want to ensure they are not the vector that spreads this disease. While decontamination techniques have been developed, their effectiveness in all situations on all substrates, is not proven. Decontamination techniques *reduce* the risk of spread of spores, but cannot guarantee it. Cavers must evaluate the level of risk they could transport of spores; the WNS Risk Assessment Tool (page 2) is intended to assist in cavers' choice of equipment and actions.

Because cavers respect their environment and value conservation, compliance with these protocols is expected.



Report It

If you see or hear evidence of bats please report your findings. Winter sightings are particularly important to understanding the over-wintering behaviours of western bat species.

Report your bat sightings to:
Wildlife Conservation Society Canada: clausen@wcs.org
BC Bat Action Team: bcbats@gmail.com
Alberta Speleological Society: info@caving.ab.ca

Report any significant number of dead bats and/or signs of WNS (e.g., white muzzle) in western Canada to:
In Alberta: Margo Pybus, Provincial Wildlife Disease Specialist
Email: margo.pybus@gov.ab.ca Phone: 1-877-944-0313 or 780-427-3462
In British Columbia:
Dr. Helen Schwantje, Ministry of Forest, Lands and Natural Resources
Email: Helen.schwantje@gov.bc.ca Phone: 250-953-4285
Dr Purnima Govindarajulu, Ministry of Environment:
Email: Purnima.Govindarajulu@gov.bc.ca Phone: 250 387 9755

Healthy little brown bats

Clean It

Equipment used in caves with a **low risk** of having WNS should be cleaned to reduce the introduction of foreign matter to other caves. Dirt and debris should be cleaned with water. The use of scrubbing tools and pressurized water aid in a more thorough cleaning. Rope should be cleaned with a rope brush to better clean off grit. Pressure washers at car washes are not recommended because of the potential contact of petrochemical products with nylon caving equipment.

Decontaminate It

Equipment used in caves with a **moderate risk** of containing WNS should be decontaminated to eliminate spores that could be on caving equipment.

Reducing spore load can be done in two ways: 1. Removing spores, 2. Inactivating spores (can no longer cause infection). Spores can be removed from surfaces by thorough washing, however, because not all spores can be removed this way, especially from porous substrates such as rope, webbing, and clothing. Potential spores need to be killed/ inactivated. There are two options of decontamination to inactivates spores: A) Submersion in hot water and B) Chemical disinfectant

A) Submersion in Hot Water

The most universally available and preferred option for decontamination of gear is:
Step 1) Clean It following the instructions above. A gentle dish detergent such as Dawn or Camp Soap is encouraged and proven to be more effective in decontamination, but is not required.
Step 2) Submerse gear in water ≥50ºC (122ºF) for 20 minutes. Because fungal spores are resistant, it is crucial the ***50 for 20*** guideline be met. Cooler water or shorter time will compromise the effectiveness of this method. Soaking can be done in a standard washing machine, but may require adjustments to the hot water heater or additional hot water. Testing the effective temperature is required to determine viability.

B) Chemical Disinfectant

Alcohol based disinfectants, such as wipes and hand wash, are not effective for destroying P.d. spores

This option is intended for equipment that cannot be submersed in hot water.
Step 1) Clean dirt and debris off gear using water. The use of scrubbing tools, pressurized water and dish detergent such as Dawn or Camp Soap is encouraged and proven to be more effective in decontamination, but is not required.
Step 2) Disinfect in accordance with label of the chosen product
Disinfectant products must be used in accordance with the label and material safety data sheets (MSDS). Disinfectant products and the contaminated rinse water must be managed and disposed of as per product directions to avoid contamination of groundwater, drinking water, surface water, or any other form of water.
Two chemical treatments are available options include:
1. Household chlorine bleach solution (e.g. Javex) diluted to 10% by volume (1 part bottled bleach solution, 9 parts water).
2. Quaternary ammonium products containing 0.3% ammonium quaternary compounds (quatts). These quaternary ammonium products must be used at the label dilution for best fungicidal activity.
Products currently available in Canada:

Clorox Disinfecting Wipes (.29 quatts*)
Lysol Disinfecting wipes (.26 quatts*)
ASEPTOL 2000 S.E.C. Repro Inc. http://www.secrepro.com/en/sanitary/aseptol_2000.php

Alcohol based disinfectants, such as wipes and hand wash, ***are not*** effective for destroying *P.d.* spores as determined by US FWS.
Note: Some products listed by the U.S. Fish and Wildlife Service (US FWS) decontamination protocol are not available in Canada.
* 0.26 quatt wipes were proven effective in testing by US FWS

Planning for Decontamination:

If you are going to a **moderate risk** cave you will have to decontaminate your gear before and after the trip:

- Choose gear that can be most effectively decontaminated. Rubber boots will be less affected by multiple hot water submersions or chemical treatments than leather boots; and because rubber is not porous, spores will wash away more easily.
- Prepare a strategy for cleaning and treatment of equipment. How and where will all equipment and waste materials be contained, stored, treated or discarded after your trip?
  - Bring bags - Gear should be isolated (quarantined) at the cave/mine entrance, in sealed plastic bags or containers. Be mindful of cross-contamination during quarantine, put your cave suit, boots and equipment into a garbage bag as soon as possible once you exit the cave or return to your vehicle.
  - Be aware of cross contamination. If equipment is not quarantined it can pass spores to camp gear, backpacks, and vehicles. Be prepared to clean and disinfect the outside surfaces of containers and bags prior to putting them in vehicles or storage areas. Do not wear your caving boots in your vehicle.
  - Mud on personal clothing, hair, and skin can also contaminate. On a best effort basis, wash and dry your person and clothing
- Removing mud and sediment before decontamination makes the process more effective (Shelley et al. 2013); efforts should be made to limit muck once you've emerged from the cave, and before equipment is sealed for transport.

....Continued on page 6

Continued from page 5

Gear – Ropes and tackle can be dedicated to a cave, so they do not require frequent decontamination. If this method is chosen, be conscientious of cross contamination during storage. Most ropes and nylon products have not been tested for impact of chemicals; Sterling brand ropes may be soaked in a quaternary ammonium solution for 15 min and rinsed with water. The ***50 for 20*** method is generally preferable due to lack of knowledge of the impact of chemicals on equipment.

Refer to provincial/federal regulatory or land management agencies to determine additional requirements for site visits.

The process of decontamination is about reducing the risk of transferring spores. Anything that is muddy or porous, such as helmet straps, needs to be decontaminated because they could be carrying spores.

Swap It

Under no circumstances should equipment or clothing used in a WNS affected area be used in Western Canada because there is a **high risk** of spore build-up on equipment/clothing in WNS positive caves. The implications of transferring spores are too great and the decontamination is not guaranteed effective.

Cavers who cave outside of western North America can choose from the following options 1) borrow gear while in a WNS area, 2) use old gear and not bring it back or 3) have a set of gear dedicated to use outside of western North America which must be isolated from other gear while in storage to avoid cross contamination.
By swapping gear, cavers greatly reduce the risk of being the vector that causes the giant leap of the P.d. fungus to western North America. When WNS arrives to western Canada the restrictions to cavers will increase and protocols will become more onerous.

It is in the cavers best interest to be diligent in handling and choosing equipment and they must be cognisant of the threat of WNS.

Stay Informed

This is a living document; it will be revised as new research and developments come available. It is recommended you refer to documents online to ensure you are reviewing the most up to date version.

Below are some links for further information on White Nose Syndrome:

White Nose Syndrome.org https://www.**whitenosesyndrome**.org/

White Nose Syndrome Map of North America and each province: http://www.ccwhc.ca/wns_maps.php

BC Bat Conservation fact sheet: http://www.env.gov.bc.ca/wld/documents/wldhealth/WNS_fact_sheet_BC_General_Public_Jan_2014.pdf

Decontamination procedures from US Fish and Wildlife https://www.whitenosesyndrome.org/.../national_wns_revise_final_6.25

APPENDIX F FISH SALVAGE PLAN

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

Blackwater Project

Fish Salvage and Relocation Plan

Palmer Project #
2006501

Prepared For
BW Gold Ltd.

February 24, 2022

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1. Introduction

This Fish Salvage and Relocation Plan has been developed for the Blackwater Mine Project (the Project) in compliance with Condition 3.2.1 of the Project's Decision Statement, issued under Section 54 of the *Canadian Environmental Assessment Act*, 2012 (CEAA 2012) and in support of the application for a *Fisheries Act* Authorization, submitted to Fisheries and Oceans Canada (DFO). This document also is in support of the Fish Habitat Compensation Plan, submitted to Environment and Climate Change Canada (ECCC) as part of an application for amendment to Schedule 2 of the Metal and Diamond Mining Effluent Regulations.

The *Fisheries Act* prohibits the carrying out of any work, undertaking or activity, other than fishing, that results in the death of fish (Subsection 34.4(1)), and/or harmful alteration, disruption, or destruction (HADD) of fish habitat (Subsection 35(1)). Under Paragraph 35(2)(b) of the *Fisheries Act*, the Minister of Fisheries and Oceans may issue an authorization with terms and conditions in relation to a proposed work, undertaking or activity that may result in HADD or death of fish. This fish salvage plan is proposed to avoid death of fish by salvaging and relocating fish to areas outside the Project footprint.

2. Objectives

The overall objective of this Fish Salvage and Relocation Plan is to avoid killing fish during the Construction phase of the Project. To meet this objective, the salvage and relocation methodology described in this Fish Salvage and Relocation Plan will:

- Employ best practices and methods for fish capture, handling, and relocation that minimize stress on fish and support survival of fish (i.e., minimize lethal or sub-lethal effects on fish).
- Ensure accurate, thorough data collection throughout the fish salvage program.
- Avoid ancillary effects to fish residing in watercourses into which salvaged fish will be released.

3. Background

The Project is a planned open-pit gold and silver mine located 160 km southwest of Prince George and 110 km southwest of Vanderhoof in British Columbia (BC). The Project received the Environmental Assessment Certificate #M19-01 (Certificate) on June 21, 2019, under the *Environmental Assessment Act* (2002) and a Decision Statement on April 15, 2019, under the *Canadian Environmental Assessment Act* (CEAA 2012).

The majority of mine infrastructure (e.g., open pit, tailing storage facilities, waste rock areas, laydown areas, and buildings) falls within the headwaters of the Davidson Creek and Creek 661 watersheds. There will be direct loss of fish habitat under the mine site infrastructure, as well as indirect loss of habitat upstream of the mine site, as this habitat will be isolated and no longer able to support fish.

Affected watercourses requiring fish salvage include those within the Project footprint, potentially isolated upstream, or where downstream flow changes are permanent, including:

- Davidson Creek upstream of the Fresh Water Reservoir (Reaches 6 to 12)
- Davidson Creek headwater tributaries (Creeks 668328, 636713, and 704454 and various unnamed tributaries)
- Creek 661 tributaries (Creek 505659 and various unnamed tributaries)

The distribution of permanently altered or destroyed fish habitat that will be salvaged is shown in Figure 1. Downstream of the mine site, Davidson Creek will be altered due to flow changes, but will continue to support fish habitat and will, therefore, not be salvaged.

The only fish species present in the waters where fish salvage will occur is Rainbow Trout (*Oncorhynchus mykiss*). Outside of the annual spring/early summer period when adults migrate into Davidson Creek to spawn, only juvenile Rainbow Trout will be present in affected stream locations. Baseline studies indicate fish densities in affected streams are low. Mean fish densities (number of fish/100 m^2) in headwater streams in the Davidson Creek and Creek 661 watersheds in summers of 2011 and 2012 ranged from 0.09 (first order streams) to 1.90 (second order streams), and Rainbow Trout in those streams are typically juveniles between the ages of 0 and 3 years (AMEC 2013; AMEC 2014). Additional surveys were conducted in 2021 to corroborate these findings, but the data has not yet been published.

The stream reaches, areas, mean fish densities, and estimated number of fish in the affected streams, with confidence intervals, are shown in Table 1 with source data shown in Table 2. Table 1 has been derived from fisheries baseline data (AMEC 2013) collected at sites within the affected streams, in July and August 2011 and August to October 2012 (Figure 2). These data also informed selection of fish release locations presented in Section 1.7.

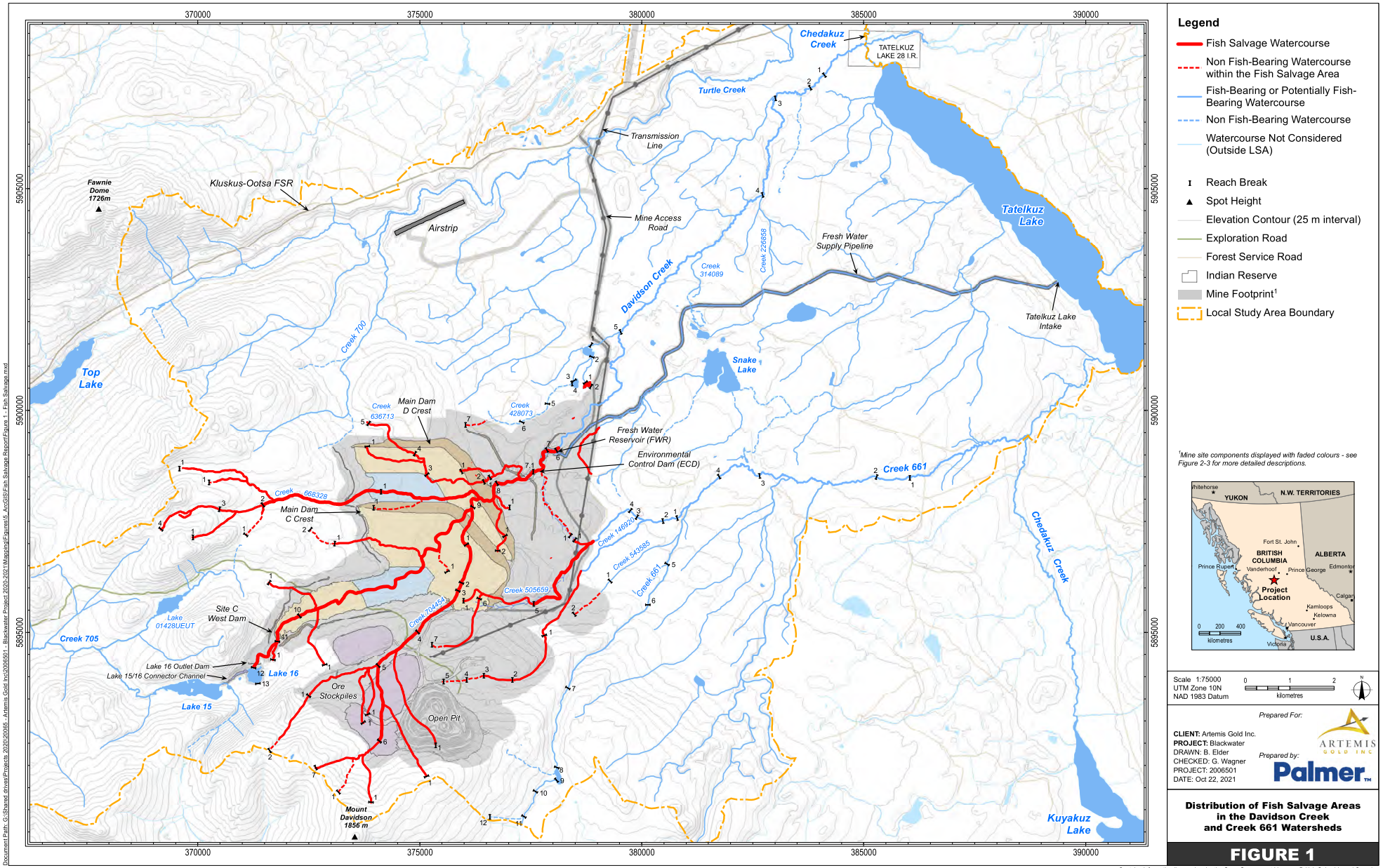
The number of fish within a sub-watershed (e.g., Creek 668328) or stream section (e.g., middle Davidson Creek; Reaches 6 to 10) was estimated by applying the mean density of fish across sampling sites in that area, to the total area of habitat in that sub-watershed or stream section. Reaches were aggregated, to allow for calculation of variance and confidence limits. Fish sampling results from electrofishing were used to make the estimates for fish numbers, as other sampling methods (minnow trapping) did not yield density estimates. An estimated 3,839 ± 2,429 fish reside in the affected areas (Table 1; Figure 1), over a linear distance of approximately 18.7 km and wetted area of 14.1 ha. This number of fish translates to a mean fish density of 2.72 fish/100 m^2 in the affected areas. The sections in lower and middle Davidson Creek

where fish will be relocated have average fish densities ranging from 0.43 fish/100 m^2 (Table 1) to 3.7 fish/100 m^2 (AMEC 2013).

In Davidson Creek, Rainbow Trout come from two closely related populations;

- A migratory population that resides in Tatelkuz Lake/Chedakuz Creek, and migrates into Davidson Creek as far upstream as the cascade barrier in Reach 11 to spawn and rear;
- A resident population in Lake 16 that spawns upstream of an impediment to fish passage (cascade barrier) in Reach 11 of Davidson Creek and/or in a small unmapped inlet stream located on the south side of Lake 16.

Rainbow Trout from Lake 16 (the headwater lake of Davidson Creek) are separated from the downstream adfluvial (i.e., migrating between lakes and streams) population, owing to a partial barrier (i.e., cascade) at the bottom of Reach 11 of Davidson Creek. The barrier impedes upstream passage of fish from the migratory (Tatelkuz Lake) population, however fish from the resident (Lake 16) population can migrate downstream over the cascade and mix with the migratory population.



Legend

- Fish Salvage Watercourse
- Non Fish-Bearing Watercourse within the Fish Salvage Area
- Fish-Bearing or Potentially Fish-Bearing Watercourse
- Non Fish-Bearing Watercourse
- Watercourse Not Considered (Outside LSA)
- Reach Break
- Spot Height
- Elevation Contour (25 m interval)
- Exploration Road
- Forest Service Road
- Indian Reserve
- Mine Footprint[1]
- Local Study Area Boundary

[1]*Mine site components displayed with faded colours - see Figure 2-3 for more detailed descriptions.*

Scale 1:75000
UTM Zone 10N
NAD 1983 Datum

0 1 2
kilometres

Prepared For:

ARTEMIS GOLD INC

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: G. Wagner
PROJECT: 2006501
DATE: Oct 22, 2021

Prepared by:

Palmer

Distribution of Fish Salvage Areas in the Davidson Creek and Creek 661 Watersheds

FIGURE 1

Contains information licensed under the Open Government Licence - British Columbia and Canada.

Document Path: G:\Shared drives\Projects 2020\2006501 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5_ArcGIS\Fish Salvage Report\Figure 1 - Fish Salvage.mxd

Table 1. Watershed, Reach, Stream Order, Fish Density, Area, and Potential Number of Fish for Affected Stream Reaches.

Watershed	Creek/Reach	Area (m^2)	Mean Density (fish / 100 m^2)	N (number of density estimates)	Variance	SE	Margin of Error [2]	Lower CL for Density [3]	Upper CL for Density [3]	Estimated Number of Fish	Lower CL for Number of Fish	Upper CL for Number of Fish
Davidson Creek	Davidson Creek Reaches 6 to 10	44,345	6.32	8	19.60	1.57	3.07	3.25	9.39	2,803	1,443	4,164
Davidson Creek	Davidson Creek Reaches 11 and 12	3,714	14.48	4	246.64	7.85	15.39	0.92	29.87	538	34	1,109
Davidson Creek	Davidson Creek Unnamed Tributaries	11,435	Used mean density for Creek 668328 [1]							60	12	133
Davidson Creek	Creek 636713 Reaches 1 to 5, and tributaries	19,001	Used mean density for Creek 668328 [1]							100	21	221
Davidson Creek	Creek 668328 Reaches 1 to 4, and tributaries	18,524	0.53	5	0.53	0.32	0.64	0.11	1.16	97	20	215
Davidson Creek	Creek 704454 Reaches 1 to 7, and tributaries	36,843	0.43	8	0.19	0.15	0.30	0.13	0.73	159	49	269
Creek 661	Creek 505659 Reaches 5 to 7, and named and unnamed tributaries	7,223	1.13	5	1.43	0.53	1.05	0.08	2.17	81	6	157
Totals:		141,085								3,838	1,410	6,267

Notes on Table 1:

SE = Standard Error; CL = Confidence Limit

[1] Density estimates for Davidson Creek Tributaries and Creek 636713 were zero fish / 100 m^2, hence the mean density and confidence levels for Creek 668328 was used for these areas, as Creek 668328 is one of the larger tributaries (hence more conservative) of Davidson Creek and had the highest mean density of the two nearby Davidson Creek tributary creeks (668328 and 704454).

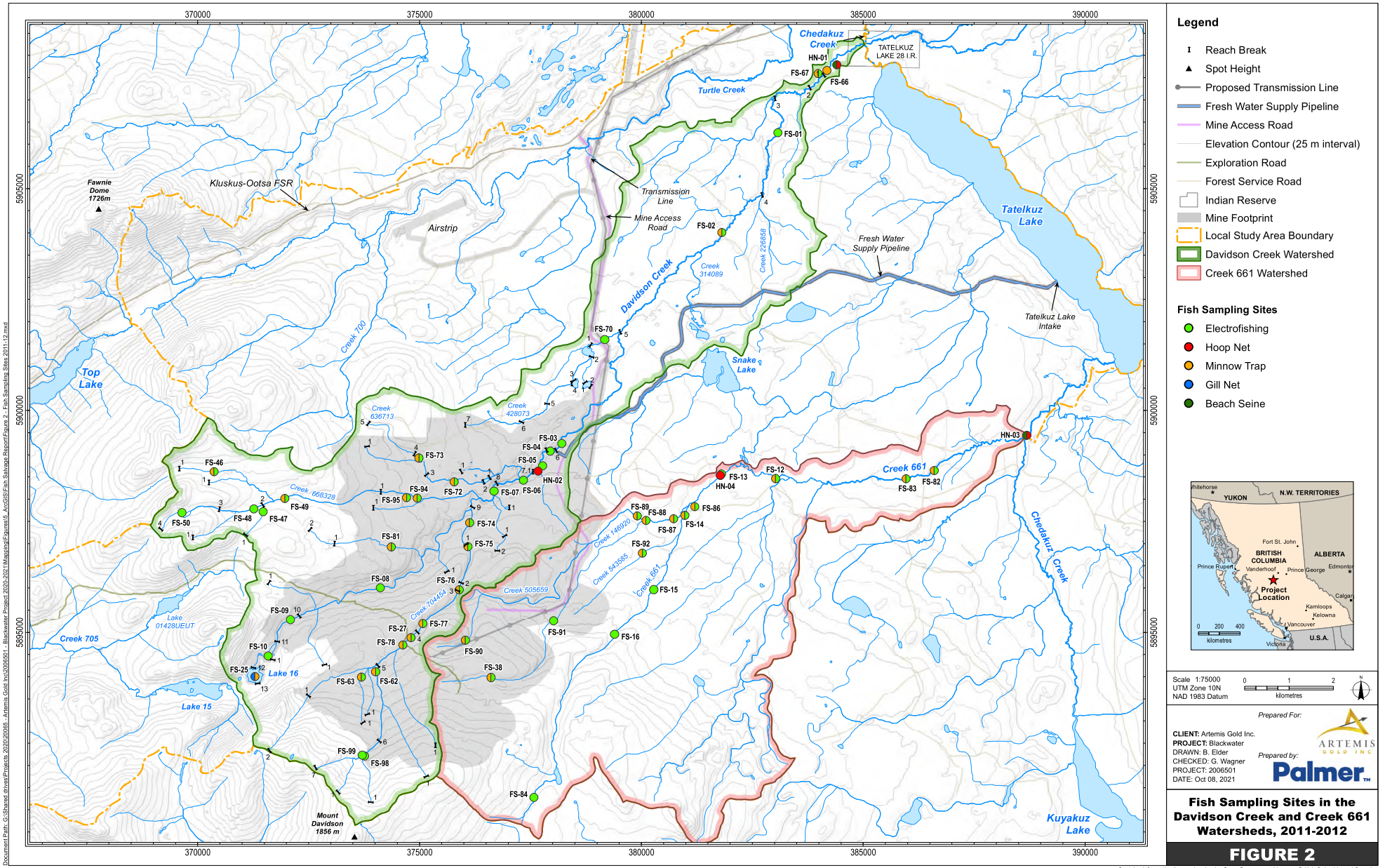
[2] The margin of error is 1.96 times the Standard Error (1.96 is the critical value for a 95% confidence interval).

[3] Confidence Limit calculated as: mean ± margin of error.

Table 2. Fish Sampling Results in Stream Reaches within the Areas to be Salvaged.

Watershed	Stream	Site ID	Reach	Gear Type	Date	Site Length (m)	Site Width (m)	Site Area (m^2)	Effort (s)	Species	Fish Catch	CPUE (fish/100 seconds)	Density (No./100 m^2)
Davidson Creek	Davidson Creek	FS-03	6	EF	17-08-11	100	4.75	475	1,637	RB	27	1.65	5.68
Davidson Creek	Davidson Creek	FS-03	6	EF	10-08-12	100	4.75	475	1,853	RB	24	1.30	5.05
Davidson Creek	Davidson Creek	FS-04	7	EF	17-08-11	100	4.74	474	2,007	RB	23	1.15	4.85
Davidson Creek	Davidson Creek	FS-05	7.1	EF	19-08-11	100	4.86	486	1,888	RB	41	2.17	8.44
Davidson Creek	Davidson Creek	FS-06	8	EF	11-08-11	100	2.02	202	1,746	RB	19	1.09	9.41
Davidson Creek	Davidson Creek	FS-07	9	EF	18-08-11	100	5.01	501	1,617	RB	3	0.19	0.60
Davidson Creek	Davidson Creek	FS-07	9	EF	9-08-12	100	4.00	400	2,142	RB	8	0.37	2.00
Davidson Creek	Davidson Creek	FS-08	10	EF	20-08-11	100	2.27	227	1,875	RB	33	1.76	14.54
Davidson Creek	Davidson Creek	FS-09	11	EF	13-08-11	100	1.42	142	1,481	RB	54	3.65	38.03
Davidson Creek	Davidson Creek	FS-09	11	EF	8-08-12	100	1.50	150	1,378	RB	10	0.73	6.67
Davidson Creek	Davidson Creek	FS-10	12	EF	13-08-11	100	2.62	262	1,264	RB	18	1.42	6.87
Davidson Creek	Davidson Creek	FS-10	12	EF	8-08-12	100	3.00	300	1,107	RB	19	1.72	6.33
Davidson Creek	Creek 636713	FS-72	3	EF	1-08-12	100	3.00	300	845	NFC	0	0.00	0.00
Davidson Creek	Creek 636713	FS-73	4	EF	1-08-12	100	0.50	50	523	NFC	0	0.00	0.00
Davidson Creek	Creek 688328	FS-94	1	EF	1-08-12	100	2.50	250	669	RB	3	0.45	1.20
Davidson Creek	Creek 688328	FS-49	2	EF	7-08-12	100	2.10	210	624	RB	3	0.48	1.43
Davidson Creek	Creek 688328	FS-49	2	EF	15-09-12	100	2.00	200	401	NFC	0	0.00	0.00
Davidson Creek	Creek 688328	FS-48	3	EF	8-08-12	100	1.10	110	785	NFC	0	0.00	0.00
Davidson Creek	Creek 688328	FS-50	4	EF	8-08-12	100	0.90	90	486	NFC	0	0.00	0.00
Davidson Creek	Creek 704454	FS-74	1	EF	9-08-12	100	3.50	350	1,370	RB	4	0.29	1.14
Davidson Creek	Creek 704454	FS-75	2	EF	7-08-12	100	3.20	320	929	NFC	0	0.00	0.00
Davidson Creek	Creek 704454	FS-76	3	EF	7-08-12	100	3.20	320	1,014	NFC	0	0.00	0.00
Davidson Creek	Creek 704454	FS-77	4	EF	5-08-12	100	2.60	260	852	RB	1	0.12	0.38
Davidson Creek	Creek 704454	FS-27	5	EF	20-08-11	100	2.24	224	1,060	NFC	0	0.00	0.00
Davidson Creek	Creek 704454	FS-27	5	EF	22-08-11	100	2.24	224	888	RB	2	0.23	0.89
Davidson Creek	Creek 704454	FS-78	5	EF	5-08-12	100	2.20	220	956	RB	1	0.10	0.45
Davidson Creek	Creek 704454	FS-62	6	EF	5-08-12	100	1.70	170	1,000	RB	1	0.10	0.59
Creek 661	Creek 505659	FS-86	1	EF	3-08-12	100	2.20	220	1,243	RB	6	0.48	2.73
Creek 661	Creek 505659	FS-87	2	EF	3-08-12	100	2.00	200	755	RB	2	0.26	1.00
Creek 661	Creek 505659	FS-88	3	EF	3-08-12	100	2.10	210	672	RB	4	0.60	1.90
Creek 661	Creek 505659	FS-89	4	EF	3-08-12	100	10.00	1,000	1,104	NFC	0	0.00	0.00
Creek 661	Creek 505659	FS-90	7	EF	2-08-12	100	0.70	70	464	NFC	0	0.00	0.00

Notes on Table 2:
CPUE = Catch-Per-Unit-Effort; NFC = no fish captured, EF = backpack electrofishing
Source: Table 5.10-10 of Appendix 5.1.2.6A (Fisheries Baseline) of the Application/EIS (AMEC 2014).



Legend

- Reach Break
- Spot Height
- Proposed Transmission Line
- Fresh Water Supply Pipeline
- Mine Access Road
- Elevation Contour (25 m interval)
- Exploration Road
- Forest Service Road
- Indian Reserve
- Mine Footprint
- Local Study Area Boundary
- Davidson Creek Watershed
- Creek 661 Watershed

Fish Sampling Sites

- Electrofishing
- Hoop Net
- Minnow Trap
- Gill Net
- Beach Seine

Scale 1:75000
UTM Zone 10N
NAD 1983 Datum

0 1 2
kilometres

N

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CHECKED: G. Wagner
PROJECT: 2006501
DATE: Oct 08, 2021

Prepared by:

Palmer

Fish Sampling Sites in the Davidson Creek and Creek 661 Watersheds, 2011-2012

FIGURE 2

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Document Path: G:\Shared drives\Projects 2020\2006501 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5_ArcGIS\Fish Salvage Report\Figure 2 - Fish Sampling Sites 2011-12.mxd

4. Roles and Responsibilities

A lead Registered Professional Biologist with experience in fish salvage and relocation will oversee implementation of the Fish Salvage and Relocation Plan. They will be responsible for ensuring planned field methods follow best practices, data and reporting undergo quality assurance and quality control (QA/QC), and communication is maintained with regulators and Indigenous groups.

Field crews reporting to the lead biologist will oversee fish capture and removal, data collection, and health and safety for field crew members. Field crews will conduct the fish salvages and data collection under the direction of a field crew lead. Field crew leads will be experienced in fish sampling methods (e.g., electrofishing, hoop nets, seine netting), fish handling and processing, and all crew members will have the necessary certification and training (e.g., electrofishing operator certification from a WorkSafe BC approved course).

An appropriate provincial Scientific Fish Collection Permit will be obtained prior to commencement of the fish salvage activities (approximately 4 weeks). All work will follow the conditions of the permit.

5. Timing

Construction of the Blackwater Project is scheduled over two years (Year -2 to Year 0). Fish salvage efforts will be staged according to the construction schedule and will take place during the open water season. Rainbow Trout spawning and incubation in the Project area occurs from mid-May to mid-August. Therefore, fish barriers (e.g., permanent fish fences, barrier nets) will be erected immediately downstream of all planned construction activities in Reach 6 of Davidson Creek, Creek 661 tributaries (Creek 505659 - Reach 5; Creek 146920 - Reach 3; Creek 543585 - Reach 2), and the outlet of Lake 16. These barriers will be erected after spring freshet ends and water levels are low enough to construct temporary and permanent fences. This timing will prevent adult Rainbow Trout from migrating upstream from Lake Tatelkuz or downstream from Lake 16 to spawn in areas where fish are to be removed and relocated.

The preferred timing for fish salvages in the mainstems of Davidson Creek and Creek 661 will be in mid-July to September when stream temperatures are above 5°C, due to temperature-related restrictions for electrofishing (FLNR 2021) and beneficial summer low flow conditions. However, fish salvages in the smaller tributaries of these streams may begin earlier in the open water season (e.g., July) due to site conditions likely allowing for complete salvage activities. Timing also will be dependent on construction stage timing, and the ability for field crews to gain access (i.e., ATVs for transporting fish) to some of the stream locations currently without access points or with difficult terrain. New roads and associated trails will be cut to access the upper reaches for Davidson Creek, Creek 661, and their tributaries.

Following fish salvages, a field and data summary report will be prepared, and data will undergo QA/QC and be secured. Data analysis and reporting, consistent with any permit requirements, will be conducted following the completion of salvage programs.

While the majority of the required fish salvage and relocation plan will take place during the Construction phase, all effects to Creek 505659 catchment in the Creek 661 Watershed will not occur until the end of the operations phase (i.e., spillway construction). However, for the purposes of this plan, it is assumed all water bodies requiring fish salvage will be salvaged during the Construction phase of the Project with the majority of the salvage occurring in Year -2. Potential for requiring fish salvage over multiple years depending on the construction plan.

6. Field Methods

There are no specific provincial or federal guidelines for carrying out fish salvage programs in streams lost due to mining activities. Existing federal guidance is for lakes and impoundments (DFO 2008; DFO 2011). As such, this plan is based on the existing guidance for lakes, where applicable, as well as general guidance and best practices for capturing, handling, and releasing fish. There are some wetland/pond locations in the Project area that may require fish salvage as well. Each individual fish salvage event in streams and wetland/ponds will be divided into three phases: isolation, collection/removal, and relocation.

The purpose of the fish collection and removal phase will be to expend reasonable effort to remove fish from streams and wetlands/ponds to be dewatered, by removing fish until catch-per-unit-effort reaches near-zero, as determined by the lead biologist. The approach to the fish salvage for each section of stream will be determined by the lead biologist and generally conform to the following steps:

- Gain access to the stream sections to be salvaged.
- Isolate the salvage area
    - Area to be fished will be isolated and fished in sections depending on the construction schedule.
    - Large areas will be subdivided into smaller reaches and fish fences/stop nets will be installed and maintained to continue fish isolation.
    - Use of discrete sections will allow for a monitoring of catch per unit effort (CPUE) and success of fish salvage.
- Capture fish using methods appropriate for the habitat and site based on efficiency and fish health.
    - Techniques may include a combination of multiple electrofishing passes, and hoop nets or seine netting of deeper pools.
    - Three pass methods for electrofishing and seining will be used in each stream section prior to moving on to the next section.
- Collect data on sampling effort, fish species, and biological data as outlined below.
- Relocate fish to appropriate release sites.

Captured fish will be enumerated and identified to species and life history stage. Length and weight measurements will be taken from a subsample. All captured fish will be temporarily held in clean containers holding water from the watercourse where the fish were captured. *In situ* water quality data (e.g., temperature, pH, dissolved oxygen, conductivity) will be collected during salvages. Captured fish will be visually monitored for signs of stress, and where necessary, measures will be applied to ensure fish health such as aeration, changing the water, expedited release at release location, and provision of cover within holding containers.

Captured/collected fish will be transferred and released at designated locations in lower Davidson Creek, lower Creek 661, and Lake 16 based on available access (Section 1.7). The duration for which fish are held in containment will be minimized and adjusted, as required based on fish health. Precautions will be taken to ensure fish are minimally affected by the transfer process (e.g., driving slowly and ensuring road surface is in good condition so as to avoid shaking/vibration of fish tanks, cooling water with ice during hot weather, and aerating fish tanks to ensure adequate dissolved oxygen). Fish will be released in suitable locations based on habitat suitability, fish density and other considerations as discussed below (Section 1.7).

Given the length of stream distance to be salvaged, the level of effort required to achieve near-zero catch-per-unit-effort will be extensive. It is likely to require up to four field teams of four members each, approximately 1 to 2 months to salvage the entire upper reaches of Davidson Creek, Creek 661, and their tributaries. Dewatering will occur once each section to be affected has been approved having fish salvage completed. During the dewatering process, deep pools will be inspected and, where necessary, any remaining fish collected and transferred.

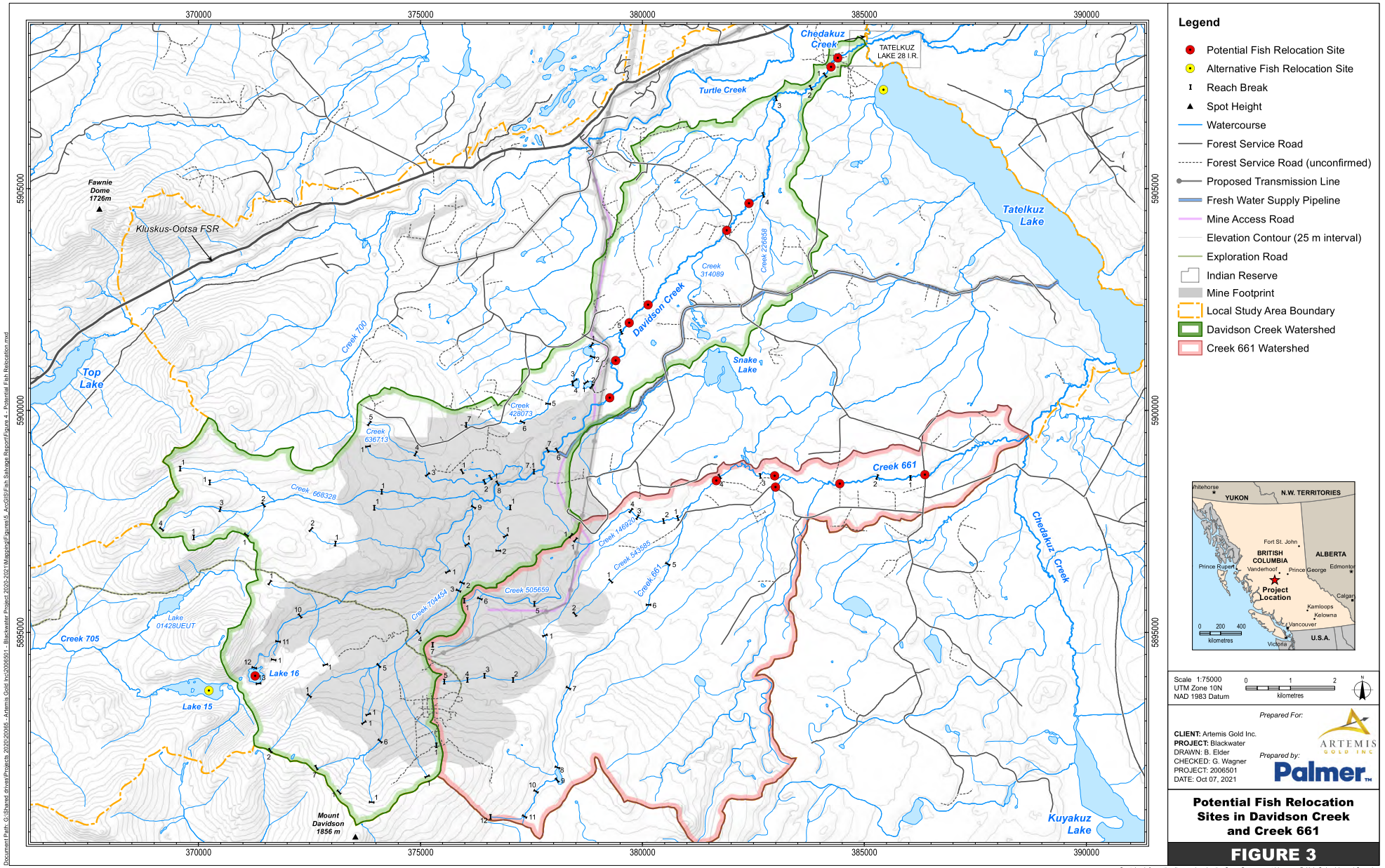
7. Determination of Suitable Fish Release Locations

Suitable fish release locations have been identified in consideration of known Rainbow Trout population genetics, fish movements, habitat, and life history. Sites were selected to avoid ancillary effects, such as genetic material or parasite transfer by releasing fish into waters which they would use over their life history. Selected release locations are presented in Figure 3.

Rainbow Trout captured in the upper Davidson Creek and its tributaries, below the cascade barrier at the bottom of Reach 11, will be released downstream at multiple locations within lower Davidson Creek. The mine access road crossing location in Reach 6 of Davidson Creek marks the mine footprint boundary, and fish will be released downstream of this crossing, in Reach 5 or lower. As Rainbow Trout densities in lower Davidson Creek are low (3.7 fish/100 m^2; AMEC 2013) compared with provincial biostandards, competition for resources and likelihood of additional stress on relocated fish due to pressure from resident Rainbow Trout is expected to be low, as long as habitat availability is high. The estimated population of Rainbow Trout in lower Davidson Creek (Reaches 1-5) is approximately 1,757 fish. This estimate is produced based on CPUE electrofishing data, and the total area of these reaches, combined (AMEC 2013). Provincial biostandards suggest pre-restored Rainbow Trout habitat can maintain a density of 3.6 fish per 100 m^2 and restored habitat (i.e., fully functional) can maintain a density of 9.7 fish per 100 m^2 (Slaney and Zaldokas 1997). This upper range for functional Rainbow Trout habitat suggests further capacity exists in lower Davidson Creek for 2,867 of the potential additional 3,839 fish requiring relocation (see Section 3.0). It is important to use several release sites in Davidson Creek to avoid potential issues with local increased competition for food and increased predation by birds and mammals if relocation sites do not have enough available habitat. Salvaged Rainbow Trout numbers above the estimated upper capacity will be relocated to an alternative relocation site in Tatelkuz Lake (Figure 3).

Fish captured in Davidson Creek upstream of the cascade barrier in Reaches 11 and 12 will be released into Lake 16. Stop nets will be placed across the stream to prevent fish re-entry to salvaged areas that have not yet been dewatered. Lake 16 has limited surface water flow connectivity to Davidson Creek outside of freshet and is, therefore, a natural barrier to fish during seasonal low-flow periods. This potential natural barrier coupled with a stop net will provide isolation of the downstream work area. Once fish salvage is complete, a semi-permanent fish barrier will be erected immediately downstream of the Lake 16 outlet to prevent fish movement downstream until the lake is isolated during construction. The Lake 16 Rainbow Trout population is not expected to be affected by the addition of any fish captured and relocated from Sections 11 or 12 downstream of the lake. A fish survey performed in 2021 showed the previous estimate of 1,200 individuals in Lake 16 (AMEC 2013) to be potentially an order of magnitude too low. Therefore, the expected addition of approximately 538 ± 572 fish from the upper sections of Davidson Creek will not have adverse effects to the population in Lake 16.

Fish captured in the Creek 661 Watershed will be relocated to several locations downstream (Figure 3). Approximately 81 ± 76 fish are to be relocated within Creek 661 from the Creek 505659 catchment. Rainbow Trout density in Reaches 3, 4 and 5 range from 0.2 to 2.9 fish/100m^2 which is below provincial biostandards (3.6 fish per 100 m^2). Therefore, there is capacity to accept these fish without measurable adverse effects to Rainbow Trout present in the system. Multiple locations with available access points have been selected to reduce competition with fish already located in these stream sections.



Legend

- Potential Fish Relocation Site
- Alternative Fish Relocation Site
- Reach Break
- Spot Height
- Watercourse
- Forest Service Road
- Forest Service Road (unconfirmed)
- Proposed Transmission Line
- Fresh Water Supply Pipeline
- Mine Access Road
- Elevation Contour (25 m interval)
- Exploration Road
- Indian Reserve
- Mine Footprint
- Local Study Area Boundary
- Davidson Creek Watershed
- Creek 661 Watershed

Scale 1:75000
UTM Zone 10N
NAD 1983 Datum

0 1 2
kilometres

N

Prepared For:

ARTEMIS GOLD INC

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: G. Wagner
PROJECT: 2006501
DATE: Oct 07, 2021

Prepared by:

Palmer

Potential Fish Relocation Sites in Davidson Creek and Creek 661

FIGURE 3

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Document Path: G:\Shared drives\Projects 2020\2006501 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5_ArcGIS\Fish Salvage Report\Figure 4 - Potential Fish Relocation.mxd

Table 3 shows the suggested release locations for captured fish, the timing for capture and release, as well as alternate release locations. Areas and potential number of fish are taken from Table 1. A summary of the rationales for suggested timing and release locations also is provided in Table 3.

Specific release locations in lower Davidson Creek will be determined based on access and physical conditions, including flow levels, velocity, turbidity, and available habitat. Ideally fish will be released in slow-moving areas such as pools and back eddies to allow them time to acclimatize. Water quality will be measured *in situ* at release locations, to ensure conditions are similar to the capture locations and holding tanks.

Table 3. Areas to be Salvaged, Potential Fish Numbers, Timing, Release Locations, and Rationale.

Creek/Reaches	Area (m^2)	Potential Number of Fish		Preferred Timing for fish salvage	Suggested Release Location	Alternate Release Location	Further Rationale / Considerations
Davidson Creek Reaches 6 to 10	44,345	2803.2 ± 1360.3		July-August (after fence installed to prevent migration and spawning, and lower flows)	Lower reaches of Davidson Creek (1 to 5)	Lower Davidson Creek Overwintering Ponds or Tatelkuz Lake	Proportionally high fish numbers expected in these reaches of Davidson Creek. Fish will be released downstream at multiple locations in lower Davidson Creek. Davidson Creek overwintering ponds to be used as secondary release locations if available at the time of the fish salvage.
Davidson Creek Reaches 11 and 12	3,714	537.6 ± 571.6		June-July (after fence installed to prevent migration and spawning)	Lake 16	Lake 15	Reach 11 of Davidson Creek has 9 m^2 of potential spawning habitat, there is no spawning habitat in Reach 12. The 9 m^2 currently represents one third of the spawning habitat available to the Lake 16 Rainbow Trout population. Fish salvaged from Reach 11 of Davidson Creek are assumed to have been spawned by adults residing in Lake 16 and will be moved to Lake 16.
Davidson Creek Tributaries	11,435	60.1 ± 72.7		Open water season – unlikely to be spawning in this area, hence larger sampling window.	Reach 5 or 4 of Davidson Creek, or Lake 16, depending on confluence with Davidson Creek.	Further downstream in Davidson Creek or Lake 15 depending on confluence with Davidson Creek.	Davidson Creek unnamed headwater tributaries are 1st and 2nd order streams and are expected to have few fish during late-summer low flows. Fish captured in dewatered areas of these streams will be released into Lake 16 for those tributaries that enter Davidson Creek upstream of the cascade barrier at the bottom of Reach 11. For tributaries that enter Davidson Creek below the barrier, fish will be released into Reaches 4 and 5 of Davidson Creek or further downstream.
Creek 636713 Reaches 1 to 5, and tributaries. (Drains into Reach 8 of Davidson Creek)	19,001	99.9 ± 120.7		Open water season – unlikely to be spawning in this area, hence larger sampling window.	Reach 5 or 4 of Davidson Creek.	Further downstream in Davidson Creek e.g., Reach 2 or Tatelkuz Lake	Creek 636713 is a relatively small stream containing low-gradient wetland sections with predominantly fine substrates. Riffle-pool sections are present, but there are limited amounts of gravels suitable for spawning. Habitat in this stream is suitable mostly for summer rearing of juvenile rainbow trout. No overwintering habitat is available due to shallow water depths.
Creek 668328 Reaches 1 to 4, and tributaries. (Drains into Reach 9 of Davidson Creek)	18,524	97.4 ± 117.7		Open water season – unlikely to be spawning in this area, hence larger sampling window.	Reach 5 or 4 of Davidson Creek.	Further downstream in Davidson Creek e.g., Reach 2 or Tatelkuz Lake	Habitat conditions in Reaches 1 and 2 of Creek 688328 provide good summer rearing opportunities for fry and juvenile rainbow trout. Suitable gravels and spawning habitat are also present. However, no spawning activity or fry have been observed or captured, and juvenile Rainbow Trout densities were low in Reaches 1 and 2 during summer baseline sampling. Overwintering habitat quality is limited by low winter flows and shallow pool depths. Reach 5 of Creek 636713 is non fish bearing.
Creek 704454 Reaches 1 to 7 (Drains into lower Reach 10 of DC)	36,843	158.9 ± 110.0		Open water season – unlikely to be spawning in this area, hence larger sampling window.	Reach 5 or 4 of Davidson Creek.	Further downstream in Davidson Creek e.g., Reach 2 or Tatelkuz Lake	Creek 704454 had the lowest summer stream temperatures recorded in the Davidson Creek Watershed. The creek drains from Mt Davidson into lower Reach 10 of Davidson Creek. Habitat quality for all salmonid life histories is rated either good or fair in Reaches 1 through 5 of Creek 704454. Overwintering and spawning habitat quality dropped due to minimal residual pool depths and poor spawning gravels in Reaches 5 and 6, and the stream was dry in Reach 7 at the time of assessment (early August 2012).
Creek 505659 Reaches 5 to 7, and tributaries. (Drains into Reach 5 of Creek 661)	7,223	81.3 ± 75.7		Open water season – spawning unlikely in this area, hence larger sampling window.	Reach 4 of Creek 661.	Reach 1 of Creek 661 or Tatelkuz Lake	No visible channel is present in Reach 4 of Creek 505659. Habitat quality in the upper reaches provides some suitable rearing and migrating habitat, but poor to no overwintering and spawning habitat. In Reaches 6 and 7, the dominant substrate type is fines and the mean residual pool depth is less than 0.10 m. Higher quality habitat in Reaches 1 to 4, including spawning and rearing habitat. Access to Creek 661 downstream.

8. Reporting

A reporting protocol will be established based on conditions of the *Fisheries Act* Authorization and scientific fish collection permit. Reporting will provide: 1) a summary of fish salvage activities; 2) the fish catch (including any fish mortalities); 3) fish salvage effort data; and 4) a table detailing location of release sites cross-reference to associated baseline habitat data (if available) and the maximum number of fish (by life stage) that can be released at each site. Additionally, details will be provided on how data collected in preparation for and during the salvage will be used to update the current state of knowledge of the local study area and inform ongoing effects monitoring programs.

Following each year of fish salvage, an annual report will be prepared which will include all biological and water quality data, CPUE population estimates, QA/QC information, and discussion relating to how the objectives of the program are being met.

Prepared By: <original signed by>

Ian MacLeod, B.Sc., R.P.Bio., P.Biol.
Senior Fisheries Biologist

Reviewed By: <original signed by>

Glenn Wagner, Ph.D., R.P.Bio.
Senior Fisheries Biologist

Approved By: <original signed by>

Rick Palmer, M.Sc., R.P.Bio.
CEO

9. References

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APPENDIX G ARCHAEOLOGICAL AND CULTURAL HERITAGE CHANCE FIND PROCEDURE

BW GOLD LTD
a subsidiary company of Artemis Gold Inc

Blackwater Gold Project: Archaeological and Cultural Heritage Chance Find Procedure

APPLICATION

This procedure applies to previously unidentified physical or cultural heritage features or structures, sites, or things of historical, archaeological, paleontological, or architectural significance and provides mitigation measure to avoid or reduce adverse effects.

PROCEDURE

All those responsible for the management, implementation, and operation of any aspect of this procedure will be adequately trained for their role. Prior to the commencement of Project work, all workers will:

1. Have received training on the use of this procedure;
2. Have reviewed and be aware of the requirements of this procedure;
3. Have reviewed and understood information pertaining to Chance Find Procedures appropriate for the work activity being undertaken.

If in the course of your work you discover what you suspect may be a possible archaeological, historic, cultural, spiritual and/or paleontological site, the following procedures apply:

Upon Discovery

1. Immediately halt work at the location of the discovery, except work required to be undertaken to protect the integrity of the discovery.
2. Delineate an area of at least 50 metres around the discovery as a ‘no work’ zone.
3. Note the location (GPS coordinates) and take photographs.
4. Inform your supervisory, Environmental Manager (EM) or Mine Manager immediately.
5. Prepare an initial Chance Find Form (attached).

Post-Discovery

- Within 24 hours of the discovery, the EM contacts the Project archaeologist and informs Indigenous groups and the Impact Assessment Agency (Table 1 provides key contact information).
- The EM invites Indigenous groups to monitor any work related to the discovery.
- The Project archaeologist conducts an assessment at the location of the discovery subject to BC’s Archaeological Impact Assessment Guidelines and protocols that are in place with Indigenous groups respecting the discovery, handling, recognition, recording, transferring and safekeeping of previously unidentified structures, sites or things of historical, archaeological, paleontological or architectural significance and the confidentiality of a discovery.
    - If the discovery is an archaeological site, the Project archaeologist contacts the BC Archaeology Branch. The Project archaeologist, in consultation with the Archaeology Branch, conducts an investigation, and provides updates to the Archaeology Branch and Indigenous groups on the progress of the investigation. The Project Archaeologist works with the EM and Indigenous groups to prepare Site Report, which includes Instruction to recommence work in the area. The Site Report is submitted to the EM, Indigenous groups (and the Archaeology Branch).

    - If the discovery is a historic site, the Project archaeologist contacts Indigenous groups and local communities to determine site significance.
    - If the discovery is a cultural or spiritual site, the Project archaeologist contacts Indigenous groups to determine site significance.
    - If the discovery is a paleontological site, the Project archaeologist contacts BC's Fossil Management Office.
- Subject to protocols with Indigenous groups, any material discovered on the Project site is stored in a secure location with limited access as follows:
    - If the material is archaeological, the artifact is held by the Project archaeologist until the *Heritage Conservation Act* (HCA) Section 12 permit has expired and the artifact(s) is submitted to the repository designated in the permit.
    - If the material is historical, the repository is determined in consultation with Indigenous nations and local communities.
    - If the material is cultural and/or spiritual, the repository is determined by Indigenous nations.
    - If the material is paleontological, the repository is determined by the Fossil Management Office.
- The handling and storage of material, apart from material outlined in the HCA Section 12 permit, is determined in consultation with Indigenous Nations.

Suspected Human Remains Discovery

If in the course of your work you discover what you suspect may be human remains, the follow procedures apply:

- Immediately halt work in the area of the discovery.
- Do not disturb or move the possible human remains.
- Note the location (GPS coordinates) and take photographs.
- Report your discovery to your supervisor, EM or Mine Manager.
- If you are unable to contact a BW Gold representative, and the suspected human remains appear to be current, contact the Vanderhoof RCMP.

The following steps will generally be followed.

- The Coroners Service (Northern Region) in Prince George and Vanderhoof RCMP will be notified and the Coroners Service will determine whether the matter is of contemporary forensic concern.
- If the remains are not of forensic concern, the Archaeology Branch will attempt to facilitate disposition of the remains.
- If a cultural affiliation for the remains can be determined, the Archaeology Branch will contact an organization representing that cultural group. If the remains are of Indigenous ancestry, the Branch will contact the relevant Indigenous communities.
- If remains are buried and under no immediate threat of further disturbance, they will not be excavated or removed. If the remains are partially buried or uncovered, the Archaeology Branch will facilitate disposition.

Table 1: Key Contacts

Name	Email	Phone Number
Archaeology Branch	Archaeology@gov.bc.ca	1 (250) 953-3334
Blackwater Gold	office.blackwater@artemisgoldinc.com	1 (250) 567-3276
Fossil Management Office	Fossil.Management@gov.bc.ca	1 (250) 356-7506
Ulkatcho First Nation	chief@ulkatcho.ca	1 (250) 742-3260
Lhoosk'uz Dené Nation	admin@lhooskuz.com	1 (250) 992-3290
Nadleh Whut'en First Nation	TBC	1 (250) 690-7211
Stellat'en First Nation	TBC	1 (250) 699-8747
Saik'uz First Nation	TBC	1 (250) 567-9293
Nazko First Nation	TBC	1 (250) 992-7982
Skin Tyee Nation	TBC	1 (250) 694-3517
Tŝilhqot'in Nation	TBC	1 (778) 799-2145 or (250) 392-3918
Métis Nation British Columbia	Communications@mnbc.ca	1 (604) 557-5851
Nee-Tahi-Buhn Band	TBC	1 (250) 694-3494
Impact Assessment Agency	iaac.vancouver.aeic@canada.ca	1 (604) 666-2431
BC Coroners Service Northern Region (Prince George)	N/A	1 (888) 991-2111 (toll free) 1 (250) 861 7429
Vanderhoof RCMP	N/A	1 (250) 567-2222
Prince George RCMP	N/A	1 (250) 562-3300

Cultural Heritage Chance Find Report Form

Recorder's Name/Affiliation:_____

Date:_____

Location of chance find (Location description,
UTM coordinates, development, depth below surface):_____

Description of find:_____

Method used to mark and protect find:_____

Distribution:

☐ BW Gold	☐ Site Archaeologist	☐ Indigenous Nations	☐ Archaeology Branch	☐ Fossil Management Office

Sketch Map	Photo

APPENDIX H ENVIRONMENTAL INCIDENT REPORT FORM

Blackwater Gold Project **Environment Incident Report**

Date (YYYY-MM-DD)	
Time:	
Reported By	
Photo Taken (Y/N)	
Location (Name of location)	
UTM East:	
UTM North:	

Incident Description / Extent / Magnitude or Quantity of Material or Area Affected: (Append maps if required, refer to photos etc)	
Incident Response:	
Incident Response Actions:	
Action (Owner)	Date Completed
Follow-up Tasks:	
Action (Owner)	Date Completed
Notification: (List all individuals to be notified)	

Photos and Description:
Photo #1 (Brief Description, Add labels)
Photo #2 (Brief Description)
Photo #3 (Brief Description)

APPENDIX I WILDLIFE INCIDENT REPORT FORM

Blackwater Gold Project **Wildlife Incident Report**

Date (YYYY-MM-DD)	
Reported By	
Photo Taken (Y/N)	
Location (Name of location)	
UTM East:	
UTM North:	

Species (BT=bat; CB=caribou; MT=marten; FS=fisher; WV=wolverine; WF=wolf; WT =western toad; GB=grizzly; MO=moose; OT=other)	
Number Observed	
Sex (M=male, F=female, MF=male and female, FF=female and female, U=unknown, UUU = 3 unknown, etc., X=No Data	
Age (A=adult; C=cub; AC=adult and cub; CC=cub and cub; U=unknown; etc. X=No Data	
Condition (H=healthy; P=poor condition; W=wounded; U=Unknown, X= No Data)	
Comments (i.e., unusual observation; health of animal)	

Type of Incident (INT=interaction with field crew; V=vehicle; A= aircraft; MIF=mine infrastructure; M=mortality, X=no Incident)	
Deterrent Used (Y/N)	
Type of Deterrent (H=Heli; V=vehicle; B=bangers; S=screamers; R=rubber bullet; BB=bean bag; N=other noise deterrent, X=no incident)	
# of deterrents used (X=No deterent used)	

Incident Description / Communications / Response

Photos and Description:
Photo #1 (Brief Description)
Photo #2 (Brief Description)
Photo #3 (Brief Description)

Appendix I

Fish Salvage Plan

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

Blackwater Project

Fish Salvage and Relocation Plan

Palmer Project #
2006501

Prepared For
BW Gold Ltd.

February 24, 2022

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1. Introduction

This Fish Salvage and Relocation Plan has been developed for the Blackwater Mine Project (the Project) in compliance with Condition 3.2.1 of the Project's Decision Statement, issued under Section 54 of the *Canadian Environmental Assessment Act*, 2012 (CEAA 2012) and in support of the application for a *Fisheries Act* Authorization, submitted to Fisheries and Oceans Canada (DFO). This document also is in support of the Fish Habitat Compensation Plan, submitted to Environment and Climate Change Canada (ECCC) as part of an application for amendment to Schedule 2 of the Metal and Diamond Mining Effluent Regulations.

The *Fisheries Act* prohibits the carrying out of any work, undertaking or activity, other than fishing, that results in the death of fish (Subsection 34.4(1)), and/or harmful alteration, disruption, or destruction (HADD) of fish habitat (Subsection 35(1)). Under Paragraph 35(2)(b) of the *Fisheries Act*, the Minister of Fisheries and Oceans may issue an authorization with terms and conditions in relation to a proposed work, undertaking or activity that may result in HADD or death of fish. This fish salvage plan is proposed to avoid death of fish by salvaging and relocating fish to areas outside the Project footprint.

2. Objectives

The overall objective of this Fish Salvage and Relocation Plan is to avoid killing fish during the Construction phase of the Project. To meet this objective, the salvage and relocation methodology described in this Fish Salvage and Relocation Plan will:

- Employ best practices and methods for fish capture, handling, and relocation that minimize stress on fish and support survival of fish (i.e., minimize lethal or sub-lethal effects on fish).
- Ensure accurate, thorough data collection throughout the fish salvage program.
- Avoid ancillary effects to fish residing in watercourses into which salvaged fish will be released.

3. Background

The Project is a planned open-pit gold and silver mine located 160 km southwest of Prince George and 110 km southwest of Vanderhoof in British Columbia (BC). The Project received the Environmental Assessment Certificate #M19-01 (Certificate) on June 21, 2019, under the *Environmental Assessment Act* (2002) and a Decision Statement on April 15, 2019, under the *Canadian Environmental Assessment Act* (CEAA 2012).

The majority of mine infrastructure (e.g., open pit, tailing storage facilities, waste rock areas, laydown areas, and buildings) falls within the headwaters of the Davidson Creek and Creek 661 watersheds. There will be direct loss of fish habitat under the mine site infrastructure, as well as indirect loss of habitat upstream of the mine site, as this habitat will be isolated and no longer able to support fish.

Affected watercourses requiring fish salvage include those within the Project footprint, potentially isolated upstream, or where downstream flow changes are permanent, including:

- Davidson Creek upstream of the Fresh Water Reservoir (Reaches 6 to 12)
- Davidson Creek headwater tributaries (Creeks 668328, 636713, and 704454 and various unnamed tributaries)
- Creek 661 tributaries (Creek 505659 and various unnamed tributaries)

The distribution of permanently altered or destroyed fish habitat that will be salvaged is shown in Figure 1. Downstream of the mine site, Davidson Creek will be altered due to flow changes, but will continue to support fish habitat and will, therefore, not be salvaged.

The only fish species present in the waters where fish salvage will occur is Rainbow Trout (*Oncorhynchus mykiss*). Outside of the annual spring/early summer period when adults migrate into Davidson Creek to spawn, only juvenile Rainbow Trout will be present in affected stream locations. Baseline studies indicate fish densities in affected streams are low. Mean fish densities (number of fish/100 m^2) in headwater streams in the Davidson Creek and Creek 661 watersheds in summers of 2011 and 2012 ranged from 0.09 (first order streams) to 1.90 (second order streams), and Rainbow Trout in those streams are typically juveniles between the ages of 0 and 3 years (AMEC 2013; AMEC 2014). Additional surveys were conducted in 2021 to corroborate these findings, but the data has not yet been published.

The stream reaches, areas, mean fish densities, and estimated number of fish in the affected streams, with confidence intervals, are shown in Table 1 with source data shown in Table 2. Table 1 has been derived from fisheries baseline data (AMEC 2013) collected at sites within the affected streams, in July and August 2011 and August to October 2012 (Figure 2). These data also informed selection of fish release locations presented in Section 1.7.

The number of fish within a sub-watershed (e.g., Creek 668328) or stream section (e.g., middle Davidson Creek; Reaches 6 to 10) was estimated by applying the mean density of fish across sampling sites in that area, to the total area of habitat in that sub-watershed or stream section. Reaches were aggregated, to allow for calculation of variance and confidence limits. Fish sampling results from electrofishing were used to make the estimates for fish numbers, as other sampling methods (minnow trapping) did not yield density estimates. An estimated 3,839 ± 2,429 fish reside in the affected areas (Table 1; Figure 1), over a linear distance of approximately 18.7 km and wetted area of 14.1 ha. This number of fish translates to a mean fish density of 2.72 fish/100 m^2 in the affected areas. The sections in lower and middle Davidson Creek

where fish will be relocated have average fish densities ranging from 0.43 fish/100 m^2 (Table 1) to 3.7 fish/100 m^2 (AMEC 2013).

In Davidson Creek, Rainbow Trout come from two closely related populations;

- A migratory population that resides in Tatelkuz Lake/Chedakuz Creek, and migrates into Davidson Creek as far upstream as the cascade barrier in Reach 11 to spawn and rear;
- A resident population in Lake 16 that spawns upstream of an impediment to fish passage (cascade barrier) in Reach 11 of Davidson Creek and/or in a small unmapped inlet stream located on the south side of Lake 16.

Rainbow Trout from Lake 16 (the headwater lake of Davidson Creek) are separated from the downstream adfluvial (i.e., migrating between lakes and streams) population, owing to a partial barrier (i.e., cascade) at the bottom of Reach 11 of Davidson Creek. The barrier impedes upstream passage of fish from the migratory (Tatelkuz Lake) population, however fish from the resident (Lake 16) population can migrate downstream over the cascade and mix with the migratory population.

370000 375000 380000 385000 390000

5905000 5900000 5895000

Fawnie Dome 1726m

Kluskus-Ootsa FSR

Airstrip

Transmission Line

Mine Access Road

Chedakuz Creek

TATELKUZ LAKE 28 I.R.

Turtle Creek

Tatelkuz Lake

Fresh Water Supply Pipeline

Tatelkuz Lake Intake

Creek 226858

Creek 314089

Davidson Creek

Creek 700

Top Lake

Snake Lake

Creek 636713

Main Dam D Crest

Creek 428073

Fresh Water Reservoir (FWR)

Environmental Control Dam (ECD)

Creek 668326

Main Dam C Crest

Creek 661

Creek 146920

Creek 543585

Creek 661

Chedakuz Creek

Creek 505659

Creek 704454

Site C West Dam

Lake 01428UEUT

Creek 705

Lake 16 Outlet Dam

Lake 15/16 Connector Channel

Lake 16

Lake 15

Ore Stockpiles

Open Pit

Mount Davidson 1856 m

Kuyakuz Lake

Legend

- Fish Salvage Watercourse
- Non Fish-Bearing Watercourse within the Fish Salvage Area
- Fish-Bearing or Potentially Fish-Bearing Watercourse
- Non Fish-Bearing Watercourse
- Watercourse Not Considered (Outside LSA)
- Reach Break
- Spot Height
- Elevation Contour (25 m interval)
- Exploration Road
- Forest Service Road
- Indian Reserve
- Mine Footprint[1]
- Local Study Area Boundary

[1]*Mine site components displayed with faded colours - see Figure 2-3 for more detailed descriptions.*

Scale 1:75000
UTM Zone 10N
NAD 1983 Datum

0 1 2 kilometres

N

Prepared For:

ARTEMIS GOLD INC

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: G. Wagner
PROJECT: 2006501
DATE: Oct 22, 2021

Prepared by:

Palmer™

Distribution of Fish Salvage Areas in the Davidson Creek and Creek 661 Watersheds

FIGURE 1

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Table 1. Watershed, Reach, Stream Order, Fish Density, Area, and Potential Number of Fish for Affected Stream Reaches.

Watershed	Creek/Reach	Area (m^2)	Mean Density (fish / 100 m^2)	N (number of density estimates)	Variance	SE	Margin of Error [2]	Lower CL for Density [3]	Upper CL for Density [3]	Estimated Number of Fish	Lower CL for Number of Fish	Upper CL for Number of Fish
Davidson Creek	Davidson Creek Reaches 6 to 10	44,345	6.32	8	19.60	1.57	3.07	3.25	9.39	2,803	1,443	4,164
Davidson Creek	Davidson Creek Reaches 11 and 12	3,714	14.48	4	246.64	7.85	15.39	0.92	29.87	538	34	1,109
Davidson Creek	Davidson Creek Unnamed Tributaries	11,435	Used mean density for Creek 668328 [1]							60	12	133
Davidson Creek	Creek 636713 Reaches 1 to 5, and tributaries	19,001	Used mean density for Creek 668328 [1]							100	21	221
Davidson Creek	Creek 668328 Reaches 1 to 4, and tributaries	18,524	0.53	5	0.53	0.32	0.64	0.11	1.16	97	20	215
Davidson Creek	Creek 704454 Reaches 1 to 7, and tributaries	36,843	0.43	8	0.19	0.15	0.30	0.13	0.73	159	49	269
Creek 661	Creek 505659 Reaches 5 to 7, and named and unnamed tributaries	7,223	1.13	5	1.43	0.53	1.05	0.08	2.17	81	6	157
Totals:		141,085								3,838	1,410	6,267

Notes on Table 1:

SE = Standard Error; CL = Confidence Limit

[1] Density estimates for Davidson Creek Tributaries and Creek 636713 were zero fish / 100 m^2, hence the mean density and confidence levels for Creek 668328 was used for these areas, as Creek 668328 is one of the larger tributaries (hence more conservative) of Davidson Creek and had the highest mean density of the two nearby Davidson Creek tributary creeks (668328 and 704454).

[2] The margin of error is 1.96 times the Standard Error (1.96 is the critical value for a 95% confidence interval).

[3] Confidence Limit calculated as: mean ± margin of error.

Table 2. Fish Sampling Results in Stream Reaches within the Areas to be Salvaged.

Watershed	Stream	Site ID	Reach	Gear Type	Date	Site Length (m)	Site Width (m)	Site Area (m^2)	Effort (s)	Species	Fish Catch	CPUE (fish/100 seconds)	Density (No./100 m^2)
Davidson Creek	Davidson Creek	FS-03	6	EF	17-08-11	100	4.75	475	1,637	RB	27	1.65	5.68
Davidson Creek	Davidson Creek	FS-03	6	EF	10-08-12	100	4.75	475	1,853	RB	24	1.30	5.05
Davidson Creek	Davidson Creek	FS-04	7	EF	17-08-11	100	4.74	474	2,007	RB	23	1.15	4.85
Davidson Creek	Davidson Creek	FS-05	7.1	EF	19-08-11	100	4.86	486	1,888	RB	41	2.17	8.44
Davidson Creek	Davidson Creek	FS-06	8	EF	11-08-11	100	2.02	202	1,746	RB	19	1.09	9.41
Davidson Creek	Davidson Creek	FS-07	9	EF	18-08-11	100	5.01	501	1,617	RB	3	0.19	0.60
Davidson Creek	Davidson Creek	FS-07	9	EF	9-08-12	100	4.00	400	2,142	RB	8	0.37	2.00
Davidson Creek	Davidson Creek	FS-08	10	EF	20-08-11	100	2.27	227	1,875	RB	33	1.76	14.54
Davidson Creek	Davidson Creek	FS-09	11	EF	13-08-11	100	1.42	142	1,481	RB	54	3.65	38.03
Davidson Creek	Davidson Creek	FS-09	11	EF	8-08-12	100	1.50	150	1,378	RB	10	0.73	6.67
Davidson Creek	Davidson Creek	FS-10	12	EF	13-08-11	100	2.62	262	1,264	RB	18	1.42	6.87
Davidson Creek	Davidson Creek	FS-10	12	EF	8-08-12	100	3.00	300	1,107	RB	19	1.72	6.33
Davidson Creek	Creek 636713	FS-72	3	EF	1-08-12	100	3.00	300	845	NFC	0	0.00	0.00
Davidson Creek	Creek 636713	FS-73	4	EF	1-08-12	100	0.50	50	523	NFC	0	0.00	0.00
Davidson Creek	Creek 688328	FS-94	1	EF	1-08-12	100	2.50	250	669	RB	3	0.45	1.20
Davidson Creek	Creek 688328	FS-49	2	EF	7-08-12	100	2.10	210	624	RB	3	0.48	1.43
Davidson Creek	Creek 688328	FS-49	2	EF	15-09-12	100	2.00	200	401	NFC	0	0.00	0.00
Davidson Creek	Creek 688328	FS-48	3	EF	8-08-12	100	1.10	110	785	NFC	0	0.00	0.00
Davidson Creek	Creek 688328	FS-50	4	EF	8-08-12	100	0.90	90	486	NFC	0	0.00	0.00
Davidson Creek	Creek 704454	FS-74	1	EF	9-08-12	100	3.50	350	1,370	RB	4	0.29	1.14
Davidson Creek	Creek 704454	FS-75	2	EF	7-08-12	100	3.20	320	929	NFC	0	0.00	0.00
Davidson Creek	Creek 704454	FS-76	3	EF	7-08-12	100	3.20	320	1,014	NFC	0	0.00	0.00
Davidson Creek	Creek 704454	FS-77	4	EF	5-08-12	100	2.60	260	852	RB	1	0.12	0.38
Davidson Creek	Creek 704454	FS-27	5	EF	20-08-11	100	2.24	224	1,060	NFC	0	0.00	0.00
Davidson Creek	Creek 704454	FS-27	5	EF	22-08-11	100	2.24	224	888	RB	2	0.23	0.89
Davidson Creek	Creek 704454	FS-78	5	EF	5-08-12	100	2.20	220	956	RB	1	0.10	0.45
Davidson Creek	Creek 704454	FS-62	6	EF	5-08-12	100	1.70	170	1,000	RB	1	0.10	0.59
Creek 661	Creek 505659	FS-86	1	EF	3-08-12	100	2.20	220	1,243	RB	6	0.48	2.73
Creek 661	Creek 505659	FS-87	2	EF	3-08-12	100	2.00	200	755	RB	2	0.26	1.00
Creek 661	Creek 505659	FS-88	3	EF	3-08-12	100	2.10	210	672	RB	4	0.60	1.90
Creek 661	Creek 505659	FS-89	4	EF	3-08-12	100	10.00	1,000	1,104	NFC	0	0.00	0.00
Creek 661	Creek 505659	FS-90	7	EF	2-08-12	100	0.70	70	464	NFC	0	0.00	0.00

Notes on Table 2:
CPUE = Catch-Per-Unit-Effort; NFC = no fish captured, EF = backpack electrofishing
Source: Table 5.10-10 of Appendix 5.1.2.6A (Fisheries Baseline) of the Application/EIS (AMEC 2014).

370000 375000 380000 385000 390000

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Fawnie Dome 1726m

Kluskus-Ootsa FSR

Airstrip

Transmission Line

Mine Access Road

Chedakuz Creek

TATELKUZ LAKE 28 I.R.

HN-01

FS-67

FS-66

Turtle Creek

FS-01

FS-02

Tatelkuz Lake

Fresh Water Supply Pipeline

Tatelkuz Lake Intake

Davidson Creek

Creek 314089

Creek 226858

Creek 700

Top Lake

FS-70

Snake Lake

Creek 636713

Creek 428073

FS-03

FS-04

FS-05

FS-06

FS-07

HN-02

FS-73

FS-72

FS-94

FS-95

FS-46

FS-49

FS-48

FS-47

FS-50

Creek 668328

FS-81

FS-74

FS-75

FS-08

FS-76

Creek 505659

Creek 704454

FS-09

FS-27

FS-77

FS-78

FS-10

FS-25

Lake 16

FS-63

FS-62

FS-90

FS-38

Lake 01428UEUT

Creek 705

Lake 15

FS-99

FS-98

FS-84

Mount Davidson 1856 m

HN-03

FS-13

HN-04

FS-12

Creek 661

FS-82

FS-83

FS-89

FS-88

FS-87

FS-86

FS-14

Creek 148920

Creek 543585

Creek 661

FS-92

FS-15

FS-91

FS-16

Chedakuz Creek

Kuyakuz Lake

Legend

- Reach Break
- Spot Height
- Proposed Transmission Line
- Fresh Water Supply Pipeline
- Mine Access Road
- Elevation Contour (25 m interval)
- Exploration Road
- Forest Service Road
- Indian Reserve
- Mine Footprint
- Local Study Area Boundary
- Davidson Creek Watershed
- Creek 661 Watershed

Fish Sampling Sites

- Electrofishing
- Hoop Net
- Minnow Trap
- Gill Net
- Beach Seine

Scale 1:75000
UTM Zone 10N
NAD 1983 Datum

0 1 2
kilometres

N

Prepared For:

ARTEMIS GOLD INC

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: G. Wagner
PROJECT: 2006501
DATE: Oct 08, 2021

Prepared by:

Palmer™

Fish Sampling Sites in the Davidson Creek and Creek 661 Watersheds, 2011-2012

FIGURE 2

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4. Roles and Responsibilities

A lead Registered Professional Biologist with experience in fish salvage and relocation will oversee implementation of the Fish Salvage and Relocation Plan. They will be responsible for ensuring planned field methods follow best practices, data and reporting undergo quality assurance and quality control (QA/QC), and communication is maintained with regulators and Indigenous groups.

Field crews reporting to the lead biologist will oversee fish capture and removal, data collection, and health and safety for field crew members. Field crews will conduct the fish salvages and data collection under the direction of a field crew lead. Field crew leads will be experienced in fish sampling methods (e.g., electrofishing, hoop nets, seine netting), fish handling and processing, and all crew members will have the necessary certification and training (e.g., electrofishing operator certification from a WorkSafe BC approved course).

An appropriate provincial Scientific Fish Collection Permit will be obtained prior to commencement of the fish salvage activities (approximately 4 weeks). All work will follow the conditions of the permit.

5. Timing

Construction of the Blackwater Project is scheduled over two years (Year -2 to Year 0). Fish salvage efforts will be staged according to the construction schedule and will take place during the open water season. Rainbow Trout spawning and incubation in the Project area occurs from mid-May to mid-August. Therefore, fish barriers (e.g., permanent fish fences, barrier nets) will be erected immediately downstream of all planned construction activities in Reach 6 of Davidson Creek, Creek 661 tributaries (Creek 505659 - Reach 5; Creek 146920 - Reach 3; Creek 543585 - Reach 2), and the outlet of Lake 16. These barriers will be erected after spring freshet ends and water levels are low enough to construct temporary and permanent fences. This timing will prevent adult Rainbow Trout from migrating upstream from Lake Tatelkuz or downstream from Lake 16 to spawn in areas where fish are to be removed and relocated.

The preferred timing for fish salvages in the mainstems of Davidson Creek and Creek 661 will be in mid-July to September when stream temperatures are above 5°C, due to temperature-related restrictions for electrofishing (FLNR 2021) and beneficial summer low flow conditions. However, fish salvages in the smaller tributaries of these streams may begin earlier in the open water season (e.g., July) due to site conditions likely allowing for complete salvage activities. Timing also will be dependent on construction stage timing, and the ability for field crews to gain access (i.e., ATVs for transporting fish) to some of the stream locations currently without access points or with difficult terrain. New roads and associated trails will be cut to access the upper reaches for Davidson Creek, Creek 661, and their tributaries.

Following fish salvages, a field and data summary report will be prepared, and data will undergo QA/QC and be secured. Data analysis and reporting, consistent with any permit requirements, will be conducted following the completion of salvage programs.

While the majority of the required fish salvage and relocation plan will take place during the Construction phase, all effects to Creek 505659 catchment in the Creek 661 Watershed will not occur until the end of the operations phase (i.e., spillway construction). However, for the purposes of this plan, it is assumed all water bodies requiring fish salvage will be salvaged during the Construction phase of the Project with the majority of the salvage occurring in Year -2. Potential for requiring fish salvage over multiple years depending on the construction plan.

6. Field Methods

There are no specific provincial or federal guidelines for carrying out fish salvage programs in streams lost due to mining activities. Existing federal guidance is for lakes and impoundments (DFO 2008; DFO 2011). As such, this plan is based on the existing guidance for lakes, where applicable, as well as general guidance and best practices for capturing, handling, and releasing fish. There are some wetland/pond locations in the Project area that may require fish salvage as well. Each individual fish salvage event in streams and wetland/ponds will be divided into three phases: isolation, collection/removal, and relocation.

The purpose of the fish collection and removal phase will be to expend reasonable effort to remove fish from streams and wetlands/ponds to be dewatered, by removing fish until catch-per-unit-effort reaches near-zero, as determined by the lead biologist. The approach to the fish salvage for each section of stream will be determined by the lead biologist and generally conform to the following steps:

- Gain access to the stream sections to be salvaged.
- Isolate the salvage area
    - Area to be fished will be isolated and fished in sections depending on the construction schedule.
    - Large areas will be subdivided into smaller reaches and fish fences/stop nets will be installed and maintained to continue fish isolation.
    - Use of discrete sections will allow for a monitoring of catch per unit effort (CPUE) and success of fish salvage.
- Capture fish using methods appropriate for the habitat and site based on efficiency and fish health.
    - Techniques may include a combination of multiple electrofishing passes, and hoop nets or seine netting of deeper pools.
    - Three pass methods for electrofishing and seining will be used in each stream section prior to moving on to the next section.
- Collect data on sampling effort, fish species, and biological data as outlined below.
- Relocate fish to appropriate release sites.

Captured fish will be enumerated and identified to species and life history stage. Length and weight measurements will be taken from a subsample. All captured fish will be temporarily held in clean containers holding water from the watercourse where the fish were captured. *In situ* water quality data (e.g., temperature, pH, dissolved oxygen, conductivity) will be collected during salvages. Captured fish will be visually monitored for signs of stress, and where necessary, measures will be applied to ensure fish health such as aeration, changing the water, expedited release at release location, and provision of cover within holding containers.

Captured/collected fish will be transferred and released at designated locations in lower Davidson Creek, lower Creek 661, and Lake 16 based on available access (Section 1.7). The duration for which fish are held in containment will be minimized and adjusted, as required based on fish health. Precautions will be taken to ensure fish are minimally affected by the transfer process (e.g., driving slowly and ensuring road surface is in good condition so as to avoid shaking/vibration of fish tanks, cooling water with ice during hot weather, and aerating fish tanks to ensure adequate dissolved oxygen). Fish will be released in suitable locations based on habitat suitability, fish density and other considerations as discussed below (Section 1.7).

Given the length of stream distance to be salvaged, the level of effort required to achieve near-zero catch-per-unit-effort will be extensive. It is likely to require up to four field teams of four members each, approximately 1 to 2 months to salvage the entire upper reaches of Davidson Creek, Creek 661, and their tributaries. Dewatering will occur once each section to be affected has been approved having fish salvage completed. During the dewatering process, deep pools will be inspected and, where necessary, any remaining fish collected and transferred.

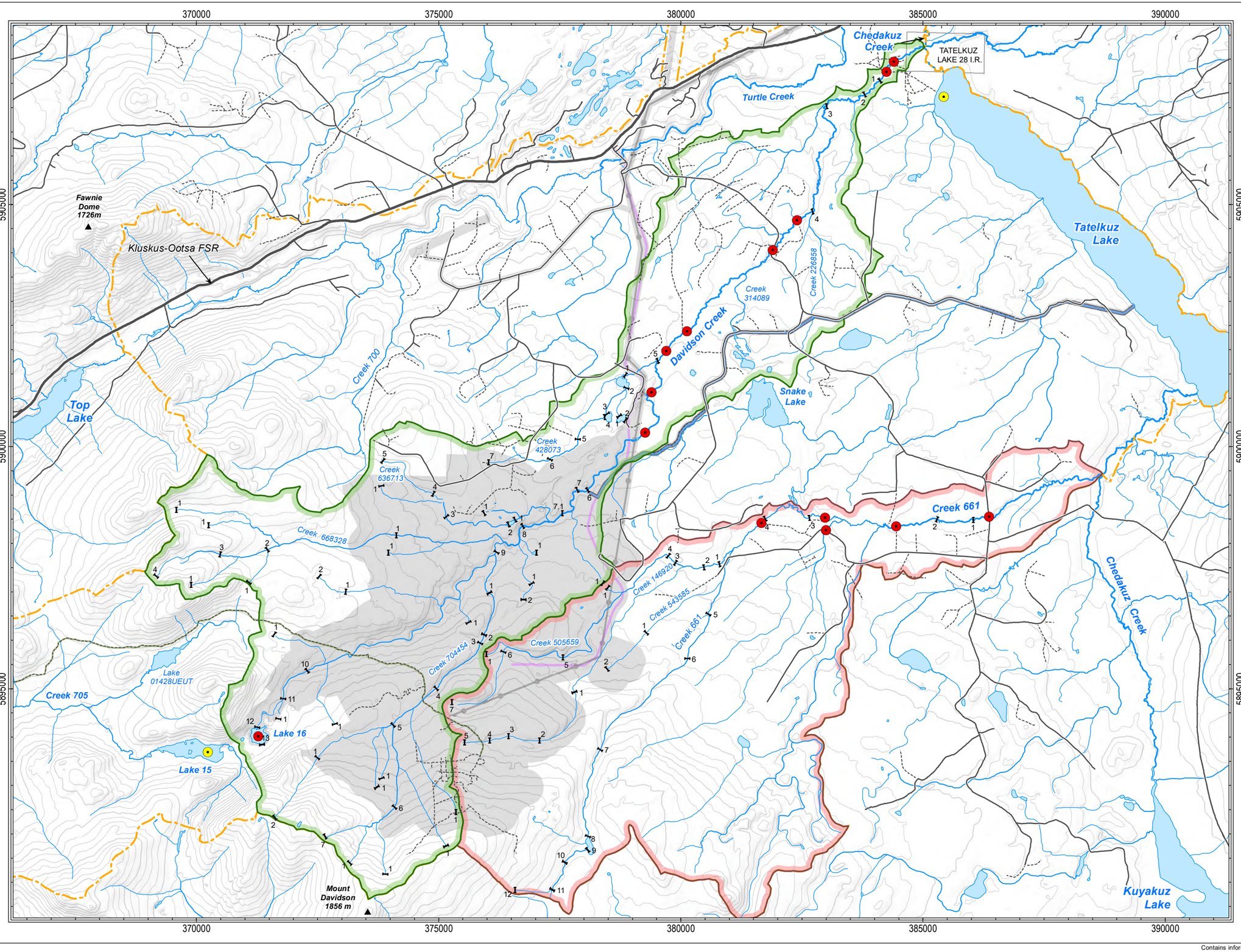
7. Determination of Suitable Fish Release Locations

Suitable fish release locations have been identified in consideration of known Rainbow Trout population genetics, fish movements, habitat, and life history. Sites were selected to avoid ancillary effects, such as genetic material or parasite transfer by releasing fish into waters which they would use over their life history. Selected release locations are presented in Figure 3.

Rainbow Trout captured in the upper Davidson Creek and its tributaries, below the cascade barrier at the bottom of Reach 11, will be released downstream at multiple locations within lower Davidson Creek. The mine access road crossing location in Reach 6 of Davidson Creek marks the mine footprint boundary, and fish will be released downstream of this crossing, in Reach 5 or lower. As Rainbow Trout densities in lower Davidson Creek are low (3.7 fish/100 m^2; AMEC 2013) compared with provincial biostandards, competition for resources and likelihood of additional stress on relocated fish due to pressure from resident Rainbow Trout is expected to be low, as long as habitat availability is high. The estimated population of Rainbow Trout in lower Davidson Creek (Reaches 1-5) is approximately 1,757 fish. This estimate is produced based on CPUE electrofishing data, and the total area of these reaches, combined (AMEC 2013). Provincial biostandards suggest pre-restored Rainbow Trout habitat can maintain a density of 3.6 fish per 100 m^2 and restored habitat (i.e., fully functional) can maintain a density of 9.7 fish per 100 m^2 (Slaney and Zaldokas 1997). This upper range for functional Rainbow Trout habitat suggests further capacity exists in lower Davidson Creek for 2,867 of the potential additional 3,839 fish requiring relocation (see Section 3.0). It is important to use several release sites in Davidson Creek to avoid potential issues with local increased competition for food and increased predation by birds and mammals if relocation sites do not have enough available habitat. Salvaged Rainbow Trout numbers above the estimated upper capacity will be relocated to an alternative relocation site in Tatelkuz Lake (Figure 3).

Fish captured in Davidson Creek upstream of the cascade barrier in Reaches 11 and 12 will be released into Lake 16. Stop nets will be placed across the stream to prevent fish re-entry to salvaged areas that have not yet been dewatered. Lake 16 has limited surface water flow connectivity to Davidson Creek outside of freshet and is, therefore, a natural barrier to fish during seasonal low-flow periods. This potential natural barrier coupled with a stop net will provide isolation of the downstream work area. Once fish salvage is complete, a semi-permanent fish barrier will be erected immediately downstream of the Lake 16 outlet to prevent fish movement downstream until the lake is isolated during construction. The Lake 16 Rainbow Trout population is not expected to be affected by the addition of any fish captured and relocated from Sections 11 or 12 downstream of the lake. A fish survey performed in 2021 showed the previous estimate of 1,200 individuals in Lake 16 (AMEC 2013) to be potentially an order of magnitude too low. Therefore, the expected addition of approximately 538 ± 572 fish from the upper sections of Davidson Creek will not have adverse effects to the population in Lake 16.

Fish captured in the Creek 661 Watershed will be relocated to several locations downstream (Figure 3). Approximately 81 ± 76 fish are to be relocated within Creek 661 from the Creek 505659 catchment. Rainbow Trout density in Reaches 3, 4 and 5 range from 0.2 to 2.9 fish/100m^2 which is below provincial biostandards (3.6 fish per 100 m^2). Therefore, there is capacity to accept these fish without measurable adverse effects to Rainbow Trout present in the system. Multiple locations with available access points have been selected to reduce competition with fish already located in these stream sections.



Legend

- Potential Fish Relocation Site
- Alternative Fish Relocation Site
- Reach Break
- Spot Height
- Watercourse
- Forest Service Road
- Forest Service Road (unconfirmed)
- Proposed Transmission Line
- Fresh Water Supply Pipeline
- Mine Access Road
- Elevation Contour (25 m interval)
- Exploration Road
- Indian Reserve
- Mine Footprint
- Local Study Area Boundary
- Davidson Creek Watershed
- Creek 661 Watershed

Scale 1:75000
UTM Zone 10N
NAD 1983 Datum

0 1 2
kilometres

N

Prepared For:

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: G. Wagner
PROJECT: 2006501
DATE: Oct 07, 2021

Prepared by:

Palmer

Potential Fish Relocation Sites in Davidson Creek and Creek 661

FIGURE 3

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Table 3 shows the suggested release locations for captured fish, the timing for capture and release, as well as alternate release locations. Areas and potential number of fish are taken from Table 1. A summary of the rationales for suggested timing and release locations also is provided in Table 3.

Specific release locations in lower Davidson Creek will be determined based on access and physical conditions, including flow levels, velocity, turbidity, and available habitat. Ideally fish will be released in slow-moving areas such as pools and back eddies to allow them time to acclimatize. Water quality will be measured *in situ* at release locations, to ensure conditions are similar to the capture locations and holding tanks.

Table 3. Areas to be Salvaged, Potential Fish Numbers, Timing, Release Locations, and Rationale.

Creek/Reaches	Area (m^2)	Potential Number of Fish		Preferred Timing for fish salvage	Suggested Release Location	Alternate Release Location	Further Rationale / Considerations
Davidson Creek Reaches 6 to 10	44,345	2803.2 ± 1360.3		July-August (after fence installed to prevent migration and spawning, and lower flows)	Lower reaches of Davidson Creek (1 to 5)	Lower Davidson Creek Overwintering Ponds or Tatelkuz Lake	Proportionally high fish numbers expected in these reaches of Davidson Creek. Fish will be released downstream at multiple locations in lower Davidson Creek. Davidson Creek overwintering ponds to be used as secondary release locations if available at the time of the fish salvage.
Davidson Creek Reaches 11 and 12	3,714	537.6 ± 571.6		June-July (after fence installed to prevent migration and spawning)	Lake 16	Lake 15	Reach 11 of Davidson Creek has 9 m^2 of potential spawning habitat, there is no spawning habitat in Reach 12. The 9 m^2 currently represents one third of the spawning habitat available to the Lake 16 Rainbow Trout population. Fish salvaged from Reach 11 of Davidson Creek are assumed to have been spawned by adults residing in Lake 16 and will be moved to Lake 16.
Davidson Creek Tributaries	11,435	60.1 ± 72.7		Open water season – unlikely to be spawning in this area, hence larger sampling window.	Reach 5 or 4 of Davidson Creek, or Lake 16, depending on confluence with Davidson Creek.	Further downstream in Davidson Creek or Lake 15 depending on confluence with Davidson Creek.	Davidson Creek unnamed headwater tributaries are 1st and 2nd order streams and are expected to have few fish during late-summer low flows. Fish captured in dewatered areas of these streams will be released into Lake 16 for those tributaries that enter Davidson Creek upstream of the cascade barrier at the bottom of Reach 11. For tributaries that enter Davidson Creek below the barrier, fish will be released into Reaches 4 and 5 of Davidson Creek or further downstream.
Creek 636713 Reaches 1 to 5, and tributaries. (Drains into Reach 8 of Davidson Creek)	19,001	99.9 ± 120.7		Open water season – unlikely to be spawning in this area, hence larger sampling window.	Reach 5 or 4 of Davidson Creek.	Further downstream in Davidson Creek e.g., Reach 2 or Tatelkuz Lake	Creek 636713 is a relatively small stream containing low-gradient wetland sections with predominantly fine substrates. Riffle-pool sections are present, but there are limited amounts of gravels suitable for spawning. Habitat in this stream is suitable mostly for summer rearing of juvenile rainbow trout. No overwintering habitat is available due to shallow water depths.
Creek 668328 Reaches 1 to 4, and tributaries. (Drains into Reach 9 of Davidson Creek)	18,524	97.4 ± 117.7		Open water season – unlikely to be spawning in this area, hence larger sampling window.	Reach 5 or 4 of Davidson Creek.	Further downstream in Davidson Creek e.g., Reach 2 or Tatelkuz Lake	Habitat conditions in Reaches 1 and 2 of Creek 688328 provide good summer rearing opportunities for fry and juvenile rainbow trout. Suitable gravels and spawning habitat are also present. However, no spawning activity or fry have been observed or captured, and juvenile Rainbow Trout densities were low in Reaches 1 and 2 during summer baseline sampling. Overwintering habitat quality is limited by low winter flows and shallow pool depths. Reach 5 of Creek 636713 is non fish bearing.
Creek 704454 Reaches 1 to 7 (Drains into lower Reach 10 of DC)	36,843	158.9 ± 110.0		Open water season – unlikely to be spawning in this area, hence larger sampling window.	Reach 5 or 4 of Davidson Creek.	Further downstream in Davidson Creek e.g., Reach 2 or Tatelkuz Lake	Creek 704454 had the lowest summer stream temperatures recorded in the Davidson Creek Watershed. The creek drains from Mt Davidson into lower Reach 10 of Davidson Creek. Habitat quality for all salmonid life histories is rated either good or fair in Reaches 1 through 5 of Creek 704454. Overwintering and spawning habitat quality dropped due to minimal residual pool depths and poor spawning gravels in Reaches 5 and 6, and the stream was dry in Reach 7 at the time of assessment (early August 2012).
Creek 505659 Reaches 5 to 7, and tributaries. (Drains into Reach 5 of Creek 661)	7,223	81.3 ± 75.7		Open water season – spawning unlikely in this area, hence larger sampling window.	Reach 4 of Creek 661.	Reach 1 of Creek 661 or Tatelkuz Lake	No visible channel is present in Reach 4 of Creek 505659. Habitat quality in the upper reaches provides some suitable rearing and migrating habitat, but poor to no overwintering and spawning habitat. In Reaches 6 and 7, the dominant substrate type is fines and the mean residual pool depth is less than 0.10 m. Higher quality habitat in Reaches 1 to 4, including spawning and rearing habitat. Access to Creek 661 downstream.

8. Reporting

A reporting protocol will be established based on conditions of the *Fisheries Act* Authorization and scientific fish collection permit. Reporting will provide: 1) a summary of fish salvage activities; 2) the fish catch (including any fish mortalities); 3) fish salvage effort data; and 4) a table detailing location of release sites cross-reference to associated baseline habitat data (if available) and the maximum number of fish (by life stage) that can be released at each site. Additionally, details will be provided on how data collected in preparation for and during the salvage will be used to update the current state of knowledge of the local study area and inform ongoing effects monitoring programs.

Following each year of fish salvage, an annual report will be prepared which will include all biological and water quality data, CPUE population estimates, QA/QC information, and discussion relating to how the objectives of the program are being met.

Prepared By: <original signed by>

Ian MacLeod, B.Sc., R.P.Bio., P.Biol.
Senior Fisheries Biologist

Reviewed By: <original signed by>

Glenn Wagner, Ph.D., R.P.Bio.
Senior Fisheries Biologist

Approved By: <original signed by>

Rick Palmer, M.Sc., R.P.Bio.
CEO

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Appendix J

Habitat Evaluation Procedure (HEP) Memo

Habitat Evaluation Procedure (HEP) for Blackwater Project – Fisheries Offsetting Plan

Memo # and Date: 20180207PECG, First Draft October 10, 2017
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Project: Blackwater Mine

Client: Palmer

Office: Vancouver, BC
Canada

Submitted by: Thomas Gast & Associates Environmental Consultants
P.O. Box 1137
Arcata, CA 95518

Contact Person: Thomas Gast, Principal Scientist
Phone: 707-822-8544
Email: tgast@tgaec.com
Website: www.tgaec.com

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Introduction

Artemis Gold Inc. is proposing to construct and operate the Blackwater Gold Project (the Project), an open pit gold/silver mine located approximately 110 kilometres (km) southwest of Vanderhoof, British Columbia, Canada. Despite implementation of best management practices, and avoidance and mitigation measures applied to all Project phases, potential residual "serious harm to fish" will be an unavoidable consequence of this Project being constructed and operated. The Project activities will result in the permanent alteration or destruction of fish habitat in the Davidson Creek and Creek 661 watersheds during construction, operation, and closure phases (AMEC 2014).

Offsetting projects are proposed to offset the residual "serious harm to fish" caused by the Blackwater Project. Offsetting projects target the creation, restoration, or enhancement of fish habitat, promote the recovery of sensitive fish species, and are recognized by the community, local First Nations, and/or government agencies as regionally important priorities (AMEC 2014).

Offsetting measures are proposed near the mine site and within the Vanderhoof region. The proposed measures, include:

- Lake 15/16 Connector Channel (On-site);
- Creek 661 Watershed Overwintering Pond (On-site);
- Ranchland Stream Restoration and Fish Habitat Enhancement within the Nechako Watershed (Off-site):
    - Murray Creek
    - Greer (Lower Greer, Middle Greer, and Upper Greer)

The primary purpose of habitat offsetting projects is "to ensure that any Project-related reduction in fish production due to the permanent alteration or destruction of habitat is offset by habitat created, enhanced, or restored" (AMEC 2014). In order to assess the adequacy of proposed offsetting measures, an accounting method is required that allows comparison of habitats lost and gained, while also taking into consideration the varying quality of habitats lost and gained for different fish species and life-stages of evaluation species.

The U.S. Fish and Wildlife Service Habitat Evaluation Procedure (HEP) was used to quantify fish habitat (USFWS 1980; USFWS 1981) lost through mine construction and operation as well as fish habitat gained by stream restoration. This memorandum describes the Habitat Evaluation Procedure metric, habitat variables, and calculation methods.

Proposed Offsetting Measures Evaluated

1. **Ranchland Stream Restoration**
    - Murray Creek including tributaries known as West Murray and East Murray
    - Greer Creek (Lower Greer, Middle Greer, Upper Greer, and a tributary to Middle Greer)
2. **Lake 16 Enlargement and Connector Channel**
3. **Creek 661 Overwintering Pond**

Methods

HEP allows the comparison of relative habitat quality and quantity either spatially (*i.e*. different locations at same point in time) or temporally (*i.e.* same location at different point in time). The combination of these two analyses allows the impact of proposed land management activities on habitat quality and quantity to be quantified (USFWS 1980).

The HEP is based on the concept that habitat value for a selected species/life stage can be described by a Habitat Suitability Index (HSI), with HSI being a habitat quality rating that is assigned on a scale of 0 (no value) to 1 (optimum value) for a given species/life stage of interest (USFWS 1980). Additional assumptions of the HEP include:

1) An area of interest typically possesses different habitat types and classes;
2) That each habitat type/class has a measurable area;
3) Each habitat type/class may have a different suitability for each species and life-stage of animal that utilizes that area; and
4) HSI models are based on the assumption that there is a positive relationship between the suitability index and habitat carrying capacity (USFWS 1981).

Habitat Evaluation Procedure

HEP analyses are based on the calculation of dimensionless habitat units (HU) for each evaluation species. The number of HUs in a given reach of interest is determined by multiplying the total area of available habitat (m^2) by a species- and life stage-specific HSI (quantity * quality) (USFWS 1980).

HUs were calculated in a consistent manner to describe habitats in the Project area that will be affected by mine construction, operation, and closure activities, as well as for habitats that will be constructed and/or enhanced through implementation of offsetting measures.

Use of a consistent accounting system to assess existing and future habitat conditions facilitates the quantitative comparison between HU losses due to Project actions and HU gains through the implementation of the above-named offsetting measures.

Selection of Evaluation Species and Life-stage

HEP evaluation species are used "to quantify habitat suitability and determine the changes in the number of available HU's" (USFWS 1980). An evaluation species can be a one species or a group of species, as well as one or more species life stage (USFWS 1980).

Two primary approaches for selecting an evaluation species include 1) choosing species with high public interest, economic value, or both; and/or 2) selection of species based on ecosystem importance (USFWS 1980). Wherever practicable, evaluation species that represent both economic and ecological importance should be selected, as land management activities typically impact both realms. Rainbow trout and kokanee are present in the mine impact area while multiple species are present in the restoration areas. Kokanee is only present in lower Davidson Creek, an area that will be affected by mine activities, but addressed with instream flow modeling rather than HEP. Therefore, rainbow trout and Chinook salmon were selected for the restoration sites, which typify the combined ecological and economic significance.

- Rainbow Trout
  Rainbow trout were chosen to be the key indicator species because of their high abundance and dominance in regional fish communities, their significance to local and First Nations fisheries, and their presence upstream, within and downstream of the mine site (AMEC 2014). In addition, rainbow trout are also abundant and provide a significant fishery in ranchland streams chosen for offsetting measures near Vanderhoof, B.C.

  Rainbow trout life stages that will be affected by the Project were selected based on results of baseline field studies and include all life stage of this species: spawning/egg incubation, fry summer rearing, juvenile summer rearing, adult summer foraging, and overwintering life stages (AMEC 2014).

- Chinook Salmon
  Chinook salmon, while not present in any streams draining the mine site, were also selected as a key indicator species because of their widespread utilization of ranchland streams chosen for offsetting measures near Vanderhoof, BC, and significance to First Nations and local fisheries.

  Chinook salmon life stages that utilize ranchland streams near Vanderhoof, B.C., or are likely to utilize these habitats post-restoration, include spawning/egg incubation, fry summer rearing, juvenile summer rearing, and overwintering life stages. The life history pattern of Chinook salmon in British Columbia does not typically include adult summer foraging in tributaries, and thus this life stage was not analyzed.

Habitat Classification system- Types and Classes

AMEC (2014) developed a habitat classification system to support the use of HSI models for rainbow trout (Table 1). Field studies in Davidson Creek and Creek 661 (both of which flow through the mine

site) helped to identify the seven mesohabitat types present in these creeks within the mine site as well as the habitat classes assigned to each habitat type (AMEC 2014).

Identified stream habitat types included the following mesohabitats: cascades, riffles, glides, and pools. Three additional habitat types were utilized to describe the remaining diversity of fish habitat "not represented by the four mesohabitat types" (AMEC 2014). A "tributary" type was used to describe small first-, second-, and third-order tributaries to mainstem creeks; an "other" type that describes habitats afforded by off-channel areas such as back-flooded beaver dams, and wetlands; and a "lake" category that describes different lake habitats (AMEC 2014).

Each of the identified seven habitat types were then further categorized into habitat classes to describe the diversity of habitats present in waterbodies within the mine site area as well as "all habitats that will be protected, constructed, rehabilitated or enhanced as part of the mitigation and offsetting measures" AMEC (2014). AMEC initially identified 19 discrete habitat classes to be included in the habitat classification system. In addition, unique aquatic habitats found in several ranchland streams selected for offsetting measures necessitated defining two additional habitat classes to better describe existing conditions:

Glide 4	Areas of slow flowing, moderately shallow water with fine substrates, low habitat complexity
Other 3	Shallow, low gradient (near zero) habitat, wetland-like with undefined channel, or multiple-thread channels, fine sediment dominated substrates, low cover, LWD lacking or absent, overhead canopy lacking.

Palmer/TGAEC subsequently added these two new habitat classes to the existing classification system resulting in a total of 21 unique habitat classes (Table 1).

Table 1. Definitions for Habitat types and classes

Habitat Type	Habitat Class	Definition and Habitat Characteristics
Cascade	1	Steep, stepped riffles of bedrock or emergent cobbles/boulders, fast-flowing water, turbulent, shallow, gradients >4%
Riffle	1	Turbulent, fast-flowing water, shallow, moderate gradient, spawning gravels extensive, dominant substrate are gravels, low cover and habitat complexity.
	2	Turbulent, fast-flowing water, shallow, moderate gradient, pockets of spawning gravels, dominant substrates are cobbles or boulders, moderate cover and habitat complexity.
	3	Turbulent, fast-flowing water, shallow, moderate gradient, no spawning gravels, dominate substrates are cobbles or boulders, high cover and habitat complexity
Glide	1	Fast-flowing, non-turbulent water, pool tailouts, moderately-shallow, spawning gravels extensive, dominant substrates are gravels, low cover and habitat complexity
	2	Fast-flowing, non-turbulent water, pool tailouts, moderately-shallow, pockets of spawning gravels, dominant substrates are cobbles or boulders, moderate cover and habitat complexity
	3	Fast-flowing, non-turbulent water, pool tailouts, moderately-shallow, no spawning gravels, dominant substrates are cobbles or boulders, high cover and habitat complexity or areas of slow flowing, deep water with fine substrates
	4	Areas of slow flowing, moderately shallow water with fine substrates, low habitat complexity
Pool	1	Areas of slower, deeper water, concave bottom profile, deposition of fines, water gradient near 0%, good pool depth (>0.50 m), abundant cover, high LWD and overhead cover
	2	Areas of slower, deeper water, concave bottom profile, deposition of fines, water gradient near 0%, moderate pool depth (0.3 to 0.5 m), moderate cover, moderate LWD and overhead cover
	3	Areas of slower, deeper water, concave bottom profile, deposition of fines, water gradient near 0%, low pool depth (<0.3 m), low cover, low LWD and overhead cover
Other	1	Off-channel habitat, >2 m deep, abundant cover, high LWD and overhead cover abundance, substrates widely variable
	2	Beaver dams, open water wetland complexes, shallow <2 m, low gradient, fine substrates, variable cover
	3	Shallow, low gradient (near zero) habitat, wetland-like with undefined channel, or multiple-thread channels, fine sediment dominated substrates, low cover, LWD lacking or absent, overhead canopy lacking.
Tributary	1	Second or third-order headwater streams or tributaries with riffle-pool morphology, variable cover, juvenile rearing habitat only
	2	First-order headwater streams or tributaries with riffle-pool morphology, variable cover, juvenile rearing habitat only
	3	First- or second-order headwater streams or tributaries, or small third-order tributaries (lower valley) with large channel morphology, low gradient wetland habitats, intermittent channel features, fine substrates, juvenile rearing habitat only

	4	Ephemeral, headwater or tributary streams, no visible channel and/or non-classified drainage, non-fish-bearing
Lake	1	Shallow littoral habitat, <3 m deep, greatest light penetration, high productivity (benthic and aquatic macrophyte communities), juvenile rearing and adult foraging habitat
	2	Deep littoral habitat, 3 m to 6 m deep, low light penetration, moderate to low productivity, juvenile rearing and adult foraging habitat
	3	Pelagic habitat, deep water habitat >6 m deep, low productivity, juvenile rearing and adult foraging habitat

Habitat Suitability Index Models

An HSI model predicts the capacity of a given habitat to support a selected species/species life-stage. HSI models use a combination of quantitative and qualitative information, synthesized from published literature and site-specific professional observations, to describe how different habitat variables influence habitat quality for each species/life stage of interest. HSI models are composite scores of the suitability of multiple habitat variables, and for each habitat variable, suitability ranges from 0 (unsuitable) to 1 (fully supporting of the species). A five-point suitability rating system was used with shifts in habitat suitability measured in increments of 0.25 (Table 2). As part of applying HEP, AMEC (2014) established HSI values for rainbow trout for each identified habitat class, using guidance from Raleigh et al. (1984).

Chinook salmon were selected as a second evaluation species for the Ranchland streams where restoration activities are targeted to benefit Chinook salmon in addition to rainbow trout and other species. Palmer/TGAEC established the HSI values for juvenile Chinook salmon by using the same mesohabitat-based HSI model as for rainbow trout (AMEC 2014) with additional information from peer-reviewed scientific literature (Raleigh et al. 1986) (Table 3). Tables 4 and 5 provide habitat suitability ratings for all habitat types and classes for each life stage of rainbow trout and juvenile Chinook salmon.

We applied the same HSI models to evaluate the value of habitats lost or altered due to construction and operation of the Project and the value of habitats that will be gained or constructed as part of the proposed offsetting measures in order to maintain consistency of analyses.

Habitat Mapping

During 2016 and 2017, Palmer field crews conducted physical habitat mapping on stream reaches selected for offsetting measures in order to describe pre-restoration habitat conditions and quantify the number of existing habitat units. Current conditions in ranchland stream corridors, however, are severely degraded/altered, with trampled/unstable banks, excessive sedimentation, lack of coarse substrates, and lack of riparian vegetation (Palmer 2016). Quantification of the habitat value for existing stream habitats, therefore, required an additional index to reflect the degraded conditions.

Table 2. Habitat Suitability Ratings and Definitions (AMEC 2014).

Habitat Suitability Rating	Definition
0	Unsuitable
0.25	Below Average Quality
0.50	Average Quality
0.75	Above-average Quality
1.0	Optimal Quality

Table 3. Comparison of AMEC (2014) Rainbow trout HSI values to Chinook salmon juvenile HSI values.

Habitat Type/Class	Life Stage	Rainbow Trout HSI value	Modified Chinook HSI value	Justification
Riffle 2	Spawning/Egg	0.25	0.50	Chinook salmon prefer larger substrates than RBT for spawning (Raleigh et al 1984; Raleigh et al. 1986); Riffle 2 is characterized as "…pockets of spawning gravels, dominant substrates are cobbles or boulders, moderate cover and habitat complexity."
Riffle 1	Fry Rearing	0.5	0.0	Chinook salmon fry seek areas of low velocities and high cover such as pools; do not preferentially select riffles (Roper et al. 1994).
Riffle 2	Fry Rearing	0.75	0.0	Chinook salmon fry seek areas of low velocities and high cover such as pools; do not preferentially select riffles (Roper et al. 1994).
Riffle 3	Fry Rearing	0.5	0.25	Riffle 3 habitats possess "high cover and habitat complexity," so while not preferred habitats for Chinook salmon fry, these areas do possess some suitability.
Pool 1	Fry Rearing	0.75	1.0	Juvenile Chinook salmon seek out pools with complex cover structure (Raleigh et al. 1986); Pool 1's are defined as having "good pool depth (>0.50 m), abundant cover, high LWD and overhead cover."
Pool 2	Fry Rearing	0.5	0.75	Juvenile Chinook salmon seek out pools with complex cover structure (Raleigh et al. 1986); Pool 2's are defined as having "moderate pool depth (0.3 to 0.5 m), moderate cover, moderate LWD and overhead cover."

Tributary Streams 1	Fry Rearing	0	0.25	Tributary 1 streams defined as having "tributaries with riffle-pool morphology, variable cover, juvenile rearing habitat only." Pools are preferred habitat for juvenile Chinook salmon.
Riffle 2	Juvenile Summer Rearing	0.25	0.0	Juvenile chinook salmon do not preferentially rear in riffles, nor in habitats with "low to moderate cover."
Riffle 3	Juvenile Summer Rearing	0.75	0.25	Juvenile chinook salmon do not preferentially select riffle habitat, however, Riffle 3's possess "high cover and habitat complexity," thus some value for larger juveniles.
Other 2	Juvenile Summer Rearing	0.25	0.50	Chinook salmon typically do not preferentially rear in habitats with fine sediment dominated substrates, but there is additional habitat value from rearing in pools associated with "Beaver dams, and open water wetland complexes"
Tributary 3	Juvenile Summer Rearing	0.25	0.0	Tributary 3's are defined as "first-or second-order headwater streams or tributaries…with large channel morphology…intermittent channel features, fine substrates…." Lack of pools and fine sediment dominated substrates are not preferred rearing habitats for juveniles (Raleigh et al 1986).
Riffle 2	Overwintering	0.25	0.0	High velocity habitats are not preferred overwintering habitats for chinook salmon
Riffle 3	Overwintering	0.25	0.0	High velocity habitats are not preferred overwintering habitats for chinook salmon
Glide 2	Overwintering	0.25	0.0	Higher velocity habitats are not preferred overwintering habitats for chinook salmon
Glide 3	Overwintering	0.25	0.0	Higher velocity habitats are not preferred overwintering habitats for chinook salmon
Other 2	Overwintering	0.25	0.75	While Chinook salmon do not preferentially rear in areas with fine sediment dominated substrates, there is preference for overwintering habitat with woody debris cover (Hillman 1987) …pools associated with "Beaver dams, and open water wetland

				complexes", especially for non-natal overwintering (Murray and Rosenau 1989)

Table 4. Habitat suitability ratings for different life stages of Rainbow Trout (AMEC 2014); Glide "4" and Other "3" habitat classes with defined habitat suitability ratings added by Palmer/TGAEC 2017.

		Rainbow Trout Lifestage				
Habitat Type	**Class**	**Spawning / Egg Incubation**	**Fry Summer Rearing**	**Juvenile Summer Rearing**	**Adult Summer Foraging**	**Overwintering**
Cascade	3	0.00	0.00	0.00	0.00	0.00
Riffle	1	0.50	0.50	0.00	0.00	0.00
	2	0.25	0.75	0.25	0.00	0.25
	3	0.00	0.50	0.75	0.00	0.25
Glide	1	1.00	0.25	0.00	0.00	0.00
	2	0.50	0.50	0.25	0.00	0.25
	3	0.00	0.25	0.50	0.00	0.25
	4	0.00	0.25	0.00	0.00	0.00
Pool	1	0.00	0.25	1.00	0.00	0.75
	2	0.00	0.25	0.75	0.00	0.25
	3	0.00	0.25	0.25	0.00	0.00
Other	O1	0.00	0.25	1.00	0.00	1.00
	O2	0.00	0.25	0.25	0.00	0.25
	O3	0.00	0.00	0.00	0.00	0.00
Tributary Streams	T1	0.00	0.00	0.50	0.00	0.00
	T2	0.00	0.00	0.25	0.00	0.00
	T3	0.00	0.00	0.25	0.00	0.00
	T4	0.00	0.00	0.00	0.00	0.00
Lake	L1	0.00	0.00	0.75	0.50	0.75
	L2	0.00	0.00	0.75	0.75	1.00
	L3	0.00	0.00	0.50	0.75	1.00

Table 5. Habitat suitability ratings for four different life stages of Chinook salmon Palmer/TGAEC 2017; modified from habitat suitability ratings for different life stages of Rainbow Trout (AMEC 2014).

		Chinook Salmon Lifestage			
Habitat Type	**Class**	**Spawning / Egg Incubation**	**Fry Summer Rearing**	**Juvenile Summer Rearing**	**Overwintering**
Cascade	3	0.00	0.00	0.00	0.00
Riffle	1	0.50	0.00	0.00	0.00
	2	0.50	0.00	0.00	0.00
	3	0.00	0.25	0.25	0.00
Glide	1	1.00	0.25	0.00	0.00
	2	0.75	0.25	0.00	0.00
	3	0.00	0.50	0.50	0.00
	4	0.00	0.00	0.00	0.00
Pool	1	0.00	1.00	1.00	1.00
	2	0.00	0.75	0.75	0.50
	3	0.00	0.25	0.25	0.25
Other	O1	0.00	0.25	1.00	1.00
	O2	0.00	0.25	0.50	0.50
	O3	0.00	0.00	0.00	0.00
Tributary Streams	T1	0.00	0.25	0.50	0.00
	T2	0.00	0.00	0.25	0.00
	T3	0.00	0.00	0.00	0.00
	T4	0.00	0.00	0.00	0.00
Lake	L1	0.00	0.00	0.75	1.00
	L2	0.00	0.00	0.75	1.00
	L3	0.00	0.00	0.50	1.00

Palmer/TGAEC developed an Index of Alteration (IA) that describes the relative level of habitat alteration in stream habitats utilized by rainbow trout and Chinook salmon. The IA assessment considers five habitat parameters: 1) riparian vegetation; 2) riparian stream banks; 3) stream channel stability; 4) stream substrate; and 5) cover.

The five habitat parameters are scored for each identified stream habitat unit. The IA is the mean score and is multiplied by each unaltered HSI value for each affected life stage of rainbow trout and Chinook salmon to determine the degraded habitat unit value.

Existing Conditions Surveys

Field crews conducted HEP habitat mapping on all stream reaches identified in 2017 for offsetting measures in order to quantitatively document existing conditions before the implementation of restoration treatments. Field survey procedures and a field data sheet were developed to collect the pertinent information needed to run the HEP habitat calculator.

Restoration reaches in Murray Creek and Greer Creek were assessed in 2017 to document existing conditions for the purposes of applying HEP. 100% of stream habitats in most reaches were surveyed, and all habitat parameters were measured for each identified stream habitat unit. In Greer Creek, field crews did not survey a short reach of the tributary draining from Harlow Lake. As a solution, desktop habitat mapping methods were applied to account for existing habitat conditions. The desktop assessment used Google Earth Pro (version 7.3.0.3832), photographs of the tributary taken by field crews, and observations recorded in field notebooks to describe the existing habitat in the relatively short restoration segment. No ground-truthing of the desktop generated existing conditions in Harlow Lake tributary data has been conducted to date. The Upper Greer Reach was added to the restoration reaches in 2021; however, existing aerial photography was not of sufficient resolution to be useful to determine habitat quality. An estimation of the restoration potential for Upper Greer was therefore made using a representative reach approach. Palmer will conduct ground-truthing and collect new aerial imagery in 2021 when conditions allow.

Restored Conditions Survey (Future Conditions) - Ranchland Streams

Standard Approach

A fisheries biologist predicted future restored habitat conditions for all reaches within the proposed offsetting areas. This entailed a desktop approach to repeat the HEP habitat mapping surveys while visualizing habitat conditions after implementation of restoration measures. This desktop HEP method relied on several data sources for each restoration reach:

1) The same HEP data sheet used by field crews;
2) Spreadsheet files containing the existing conditions HEP survey data entered from the field data sheets;

3) A geo-referenced set of aerial photos ("map-book") showing the locations of each existing conditions habitat unit

4) The locations for each specific restoration prescription (numbered "segments"), and the locations within habitat units for various instream habitat enhancements (e.g.: placements of large woody debris (LWD), boulders, and gravel); and

4) A set of engineering-level design plans for all restoration segments.

Proposed restoration for each reach typically included multiple actions drawn from a suite of restoration prescriptions. Prescriptions included: reconstruction of the stream channel bed, and/or bank regrading; restoration of natural channel width; LWD placement for channel narrowing; LWD and rootwad placement for channel deflection; woody debris placement for habitat enhancement; installation of live willow stakes on stream banks; installation of brush layers on stream banks; riparian tree plantings; and, boulder-cluster and gravel placements in channel.

Each restored conditions desktop survey proceeded upstream through the previously delineated habitat, considering each habitat unit in sequence. For each habitat unit, the existing conditions data were assessed, alongside the proposed restoration treatments on design sheets (if any segments were designated for no restoration). The locations of specific on-the-ground measures were then cross-referenced, using the map-book and restoration design sheets. Professional judgement was used to predict changes to the existing habitat (e. g.: depth, width, spawning quality, canopy closure, etc.) that would likely occur at an arbitrary future time (~10 years) post-restoration. Estimates for restored habitat parameters were then entered onto the HEP field data sheet unit by unit.

In some cases, implementation of restoration appeared likely to create multiple new habitat units where there was a single existing unit identified. In order to locate the newly formed units (post-restoration), we used Google Earth Pro and the UTM coordinates from the existing habitat surveys to locate the stream reach of interest. Google Earth place-marks were used to demarcate the new habitat unit boundaries, and the Google Earth path-measuring tool was used to discern the new unit lengths.

Deviations from Standard Approach

Upper Greer

The restoration potential for Upper Greer was estimated using a representative reach approach. This method utilized the following steps:

1. Determined the length of the Upper Greer Reach
2. Determined a geomorphically similar section of the Middle Greer Reach (Habitat units 1-18) as a representative reach
3. Used the HEP Calculator to determine the existing and restored habitat value for the Representative Reach in the manner described for the other reaches
4. Used the length ratio of Upper Greer to the Representative Reach to determine the Upper Greer existing and restored habitat value
5. Subtracted the existing condition habitat value from the restored condition habitat value to estimate the compensation habitat value for Upper Greer Reach

Murray Creek

Channel reaches and bankfull dimensions along Murray Creek were established based on a combination of cross-sectional surveys at representative sites, field observations during reconnaissance walks (documented with ground-based photographs), and scrutiny of high-resolution imagery and topographic data sources. The cross-sectional survey data and associated field observations were used to calibrate desktop-based interpretation of (i) UAV-acquired orthophotography from 2016, 2020, and 2021, during low-flow conditions; (ii) Google Earth satellite imagery from various years, most notably during a moderate flood (bankfull to partial inundation of floodplain) in 2013; and (iii) a UAV-based digital surface model (DSM) from 2016, during low-flow conditions. Bankfull dimensions, assumed to represent 'channel-forming' flow conditions (i.e., high water mark), were based on indicators defining the principal limit of scour, including abrupt changes in bank vegetation, material, and slope (Harrelson et al., 1994).

The bankfull channel geometry of Murray Creek is poorly defined, impacted and irregularly reconfigured by historic and ongoing agricultural activities (e.g., cattle trampling, fords, localized bank armouring, etc.), such that typical field indicators of bankfull dimensions are missing or unreliable. Systematic interpretation of remotely sensed data, field-checked at various locations, enabled more realistic and accurate characterization of bankfull dimensions. Bankfull width measurements were completed at regular intervals along Murray Creek West Branch (20 m intervals) and Mainstem (50 m intervals) to establish reach-averaged estimates. Reach-averaged bankfull widths account for natural variability in channel width and anthropogenic influence that compromise meaningful site-specific measurement. It is important to acknowledge that one or more low-flow channels with better definition have formed along portions of the bankfull channel, but their characteristics are more irregular, controlled by vegetation and transient. Actual bankfull dimensions form the basis for the design of channel restoration and establishment of a more stable, self-sustaining channel.

Restored Conditions Survey (Future Conditions) - Newly Constructed Habitats

The HEP was also applied to proposed offsetting measures that will create new habitats: the over-wintering pond to be constructed in the Creek 661 watershed, and the Lake 15/16 connector channel. None of these proposed features have been built to date; thus, only the future restored conditions analyses are applicable. The same HEP field data sheet as was developed for the Ranchland streams analyses was used to assess post-construction habitat conditions of the proposed Creek 661 overwintering pond and the Lake 15/16 connector channel.

Habitat Assessment of Altered Habitat

Literature Review

A prerequisite to assessing degraded ranchland stream habitats for the purposes of planning restoration is understanding which habitat variables are most important to each life stage of rainbow trout and Chinook salmon. Livestock grazing is a common land management activity in the low gradient ranchland streams selected for offsetting measures near Vanderhoof, B.C. Over time grazing "can affect the riparian environment by changing, reducing, or eliminating vegetation, and/or entire riparian areas through channel widening, channel aggrading, or lowering of the water table" (Platts 1991). "Generally

in grazed areas, stream channels contain more fine sediment, streambanks are more unstable, [and] banks are less undercut….than for streams in ungrazed areas"(Armour 1977; Benke and Zarn 1976; Platts 1983).

Rainbow trout habitat in streams flowing through grazed areas can become degraded, "with lack of instream cover, lack of overhead canopy and stream aggradation being common problems" (Flosi et al. 2010). The lack of instream cover components negatively affects both juveniles and adults, as "juvenile steelhead and chinook abundance in streams has been directly correlated with the abundance and quality of cover" (Bjornn and Reiser 1991).

In addition to cover complexity, Raleigh et al. (1984) described other key habitat parameters for adult and juvenile rainbow trout being pool habitat availability, pool class (because pools differ in the amount and quality of escape cover, winter cover, and resting areas that they provide), and average depth (although depth is not as critical habitat parameter for juveniles).

The lower reaches of mainstem river tributaries (such as the ranchland streams which are tributaries to the Nechako River) are also important habitats for Chinook salmon (Murray and Rosenau 1989; Flosi et al. 2010). These reaches provide holding areas for adults and rearing areas for juveniles. Raleigh et al. (1986) delineated important habitat variables for juvenile Chinook salmon as including pool habitat availability, pool class, amount of fine sediments, amount of cover and amount of substrate-derived cover.

Following a literature review for habitat requirements of stream-dwelling salmonids, five habitat assessment categories were identified based on their significance to the evaluation species rainbow trout and Chinook salmon: instream cover, stream substrate, riparian vegetation, riparian banks, and stream channel stability.

Index of Alteration

Fourteen distinct variables were developed for scoring within five essential habitat parameters in order for the HEP to be applied to both existing and future restored conditions in each stream reach of interest (Table 6).

- Riparian Vegetation consisted of two scoring variables: Canopy Closure and Dominant Vegetation Type. The presence (or lack) of a well formed vegetative canopy in ranchland streams is an overall indicator of riparian zone health and is a feature that impacts water temperatures (shade), terrestrial food inputs, and cover from avian and terrestrial predators. Dominant vegetation type can further characterize the relative degree of riparian zone impairment from grazing practices.
- Riparian Bank assessments considered three variables: Percent Vegetated Banks, Sediment Transport, and Bank Composition. Relative stream bank stability was assessed from the amount of vegetative cover present, the type of substrate forming the stream banks, and whether there is active sediment transport occurring in the stream channel.

- Channel Stability assessed three variables: Number of Active Channels, Bank-full Width/depth Ratio, and Anthropogenic Disturbance. The relative degree of channel alteration/channel stability was assessed by measuring width/depth ratios at bank-full stage, observing whether there was a braided (multiple thread) channel versus a single thread channel, and the presence/absence of land management or other human activities that could destabilize the stream channel such as recent grazing activity, the presence of road crossings, instream livestock watering areas, inorganic debris in the stream, etc.
- Stream Substrate scored three variables: Percent of Fine Sediment, Dominant Particle Size, and Spawning Habitat Quality. The relative deposition of fine sediments and dominant particle size are key indicators of watershed health and spawning habitat quality, especially in the low-gradient, heavily grazed ranchland streams. Chronic fine sediment sources such as eroding stream banks caused by livestock trampling can negatively impact multiple different life stages of rainbow trout and Chinook salmon.
- Instream Cover consisted of three variables: Percent Unit Covered, Shelter Rating, and Off-Channel Habitat Access. The relative amounts and types of structural cover present were identified by Raleigh et al. (1984 & 1986) as one of the more critical habitat features for multiple life stages of both rainbow trout and Chinook salmon. Percent unit covered is a parameter that assumes an overhead view to estimate the proportion of the overall habitat unit with structural cover. "A cover area of ~ 25% of the total stream area provides adequate cover for adult trout; a cover area of ~ 15% is adequate for juveniles (Raleigh 1984). Shelter rating is a qualitative index to describe the relative complexity of cover types present, ranging from 0 (none), 1 (low), 2 (medium), to 3 (high).

Table 6. Habitat variables and HSI scores used in the Index of Alteration.

VARIABLES	SCORING FROM RAW HABITAT DATA	POINTS	TOTAL
	1. Riparian Vegetation		8 points possible
V1	Canopy Closure: (0-20% = 0 pt.; 20-40%= 1 pt.; 40-60% = 2 pt.; 60-80% = 3 pt.; 80-100% = 4 pt.)	0-4	
V2	Dominant Veg Type (determine for each bank): none/grasses=0 pt.; shrubs/brush = 1 pt.; hardwoods/conifer= 2 pt.	0-2 (x 2) = 4	
	2. Riparian Banks		18 points possible
V3	Percent banks vegetated (L+R banks): (0-20% = 0 points; 20-40%= 1 point; 40-60% = 2 pt.; 60-80% = 3 pt.; 80-100% = 4 pt.)	0-4 (x 2)= 8	

V4	Sediment inputs (for each L + R bank): yes = 0 pt.; no = 4 points	0-4 (x 2)= 8	
V5	Bank Composition dominant particle size (L & R banks): (artificial or fines = 0 pt.; gravel/cobble, boulder, bedrock/hardpan = 1 pt.)	0-1 (x 2) = 2	
	3. Channel stability		8 points possible
V6	Single thread (= 1 pt.) vs multiple thread (= 0 pt.)	0-1	
V7	Bank-full width/depth ratio: (>60 - Very High, = 0 pt.; 40-60 - High, = 0 pt.; 12-40 - Medium, = 1 pt.; < 12 - Low, = 3 pt.).	0-3	
V8	Disturbance types- Yes = 0, No = 4	0-4	
	4. Substrate		8 points possible
V9	Estimate percent fines: < 5 % = 4 pt.; 5-25%= 3 pt.; 25-50% = 2 pt.; 50-75% = 1 pt.; > 75% = 0 pt.	0-4	
V10	Spawning quality (none = 0 pt.; poor = 1 pt.; good = 2 pt.)	0-2	
V11	Dominant particle size (Fines/Sand= 0; Gravel= 1; Cobble/Boulder/Bedrock = 2)	0-2	
	5. Cover		10 points possible
V12	Shelter Rating (0= 0 pt.; 1 = 1 pt.; 2=3 pt.; 3 = 3 pt.)	0-3	
V13	Percent Unit covered: (0%=0 pt., 0-5%=1 pt., 5-10%=2 pt., 10-15%=3 pt., 15-20%=4 pt., >20%=5 pt.)	0-5	
V14	Off channel habitat- (Yes, perennial access = 2 pt.; yes seasonal access = 1 pt.; no= 0 pt.)	0-2	

The presence of, and access to, off-channel rearing habitats is included in the cover assessment for the ranchland streams due to the frequent presence of beaver activity. Beaver dams can create opportunities for high quality rearing and refugia habitat in wetland-like areas adjacent to and overlapping the stream channel (Bryant 1984).

Habitat Value

The habitat value of each mesohabitat unit was calculated by multiplying the HSI of the species and life-stages of interest times the length of the unit times the bankfull width times the Index of Alteration (Equation 1).

Equation 1

$$HU_{u_i,sp_j,ls_k} = HSI_{u_i,sp_j,ls_k} * L_{u_i} * W_{u_i} * IA_{u_i}$$

Where:

HU = Habitat unit

HSI = Habitat Suitability Index

L = Unit Length

W = Unit Bankfull Width

IA = Index of Alteration

u_i = Habitat mapping mesohabitat unit i

sp_j= species j

ls_k= life-stage k

The Index of Alteration is calculated as the sum of the habitat parameters divided by 5 (Equation 2).

Equation 2

$$IA_{u_i} = (RV_{u_i} + RB_{u_i} + CC_{u_i} + S_{u_i} + C_{u_i})/5$$

Where:

RV = Riparian Vegetation score

RB = Riparian Bank score

CC = Channel Condition score

S = Substrate score

C = Cover score

Each of the habitat parameter values are calculated using the scoring from the habitat variables in Table 6 (Equations 3-7).

Riparian Vegetation

Equation 3

$$RA_{u_i} = (V1_{u_i} + V2lb_{u_i} + V2rb_{u_i})/8$$

Where:

lb = left bank

rb = right bank

Riparian Bank

Equation 4

$$RB_{u_i} = (V3lb_{u_i} + V3rb_{u_i} + V4lb_{u_i} + V4rb_{u_i} + V5lb_{u_i} + V5rb_{u_i})/18$$

Channel Condition

Equation 5

$$CC_{u_i} = (V6_{u_i} + V7_{u_i} + V8_{u_i})/8$$

Substrate

Equation 6

$$S_{u_i} = (V9_{u_i} + V10_{u_i} + V11_{u_i})/8$$

Cover

Equation 7

$$C_{u_i} = (V12_{u_i} + V13_{u_i} + V14_{u_i})/10$$

The total habitat value of each reach was calculated by summing the combined HU of each mesohabitat (Equation 8).

Equation 8

$$HU_{reach} = \sum_{i=1}^{n} HU_{u_i} \sum_{j,k} HU_{u_i,sp_j,ls_k}$$

Where:

n = the total number of mesohabitat units in the reach

For habitats that are destroyed or newly constructed the HU_{reach} is the habitat loss or gain. Where the restoration is an improvement of existing degraded habitat, the gains are calculated by difference between restored and existing conditions (Equation 9).

Equation 9

$$HU_{gains} = HU_{restored} - HU_{existing}$$

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Appendix K

Value of Headwater Drainages (DFO IR #10 Memo)

Stantec

Memo

To:	Ryan Todd, Travis Desormeaux Black Water Gold	From:	Lacey AuCoin, Brad Horne Stantec Consulting Ltd.
File:	123222037	Date:	March 24, 2022

Reference: Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project

CONTEXT

Stantec has been retained by Blackwater Gold (BW Gold) to provide environmental services support during the regulatory permitting phase of the Blackwater Mine Project (the Project). As part of the work plan, Stantec is pleased to provide assistance to BW Gold for the development of responses to Information Requests (IRs) provided by Fisheries and Oceans Canada (DFO). Stantec has been working collaboratively with BW Gold's consultant, Palmer Environmental Consulting Group (Palmer), to develop strategies to respond to DFO's IRs based on the previously filed Application for Authorization under the *Fisheries Act*, previous responses to IRs submitted by Indigenous Nations and the federal government, and the Environmental Impact Statement (EIS) material.

This memo has been prepared to provide a response to IR 10 from DFO, which can be integrated into BW Gold's overall submission to DFO.

INFORMATION REQUEST 10

Information Request from DFO

"The described Habitat Evaluation Procedure approach appears to undervalue the fish habitat contribution of headwater streams and wetlands, despite these systems providing value to downstream areas. In Table 8-4, headwater streams and wetlands such as WFID W96 are presented as having no fish habitat value. Clarify or revise as necessary to reflect the contribution of headwater systems to fish and fish habitat."

Proposed Response

Habitat alteration, disruption, and destruction (HADD) of fish habitat is presented as two forms of 'currency' in the Application for Authorization: habitat units (HUs) for instream habitat and spatial area (m^2) for riparian habitat. These two currencies were carried forward to quantify the unavoidable habitat losses and habitat offsets to reflect fish-bearing streams (i.e., habitat units or HUs for instream HADD and area in m^2 for riparian HADD). HUs provide an instream habitat area weighted by habitat suitability index (HSI) values for different life stages of rainbow trout while the spatial area (m^2) of riparian habitat provides an unweighted estimate of the services provided to instream habitat by the surrounding riparian vegetation.

A non-fish bearing HSI index called the "Food and Nutrient Production HSI" had been initially proposed in the Fisheries Mitigation and Offsetting Plan (FMOP) to calculate the unavoidable HADD of non-fish-bearing habitat in headwater areas. The Food and Nutrient HSI was intended to reflect fish production by integrating primary (i.e., periphyton) and secondary (i.e., benthic invertebrates) production from the aquatic environment with allochthonous inputs from the riparian zone (e.g,. terrestrial insects, leaf litter, fine organic debris). Following consultation with regulators, including DFO, the Food and Nutrient Production HSI was omitted from the analysis, as this instream and riparian productivity was assumed to be reflected through HUs. The

Reference: Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project

overall approach to calculating HADD of non-fish-bearing habitat was accepted in principle by DFO through previous discussions with the Project team.

Non-fish bearing waterbodies in the headwater regions of the Project footprint were accounted for in the HADD estimates by considering riparian area (m^2) as a reflection of allochthonous inputs to downstream habitats. Riparian zones contribute to fish productivity through bioenergetic links between the aquatic and terrestrial food webs (Ramey and Richardson 2017; Pusey and Arhington 2003; Harrison et al. 1999). Riparian habitat also supports water quality parameters that are required for aquatic life through sediment and thermal stability (Ramey and Richardson 2017).

BW Gold acknowledges that the current HADD calculations may not fully capture the services provided by non-fish-bearing headwater streams within the Project footprint to fish-bearing habitats downstream. Therefore, BW Gold proposes to re-introduce the Food and Nutrient HSI to quantify the autochthonous (i.e., periphyton) contributions that non-fish bearing streams provide to downstream fish habitat as an additional metric to riparian areas in the calculation of unavoidable HADD of fish habitat within the Project footprint. This change results in inclusion of Food and Nutrient HUs for three S6 streams (i.e., non-fish-bearing, <3 m wide); no S5 streams (i.e., non-fish-bearing, >3 m wide) were identified within the Project footprint. Table 1 attached includes revisions to the HADD calculations that were submitted as part of the Application for Authorization updated to reflect this change.

The Food and Nutrient HSI is used exclusively for the non-fish bearing streams (i.e., S6 streams). The Food and Nutrient HSI was not applied to non-visible channels (NVC) or non-classified drainages (NCD) because these features are hydraulically disconnected from fish habitat, and the associated inputs from these features do not have the potential to benefit fish and fish habitat downstream. In BW Gold's opinion, no further revisions to the HADD calculations are required for fish-bearing streams (i.e., S1 through S4), because the contribution of food and nutrients in fish-bearing streams is assumed to be inherently accounted for through the fish species and life stage HSIs.

Reference: **Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project**

CLOSING

We trust that the information contained in this memo can serve to support a discussion with DFO regarding the IRs and can be integrated into a revised submission of the Application for Authorization under the Fisheries Act. Stantec would be pleased to assist BW Gold with revisions or an expansion on the material that has been presented herein.

Stantec Consulting Ltd.

Lacey AuCoin, M.Sc., P.Biol.
Senior Fisheries Biologist
Phone: 403-837-6342
Lacey.aucoin@stantec.com

Brad Horne, M.Sc., R.P.Bio.
Senior Fisheries Biologist
Freshwater Ecology Technical Leader - Canada
Phone: (778) 331-0201
Brad.horne@stantec.com

Attachment: Table 1 – Revised HADD Calculations by Segment

Reference: Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project

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Reference: **Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project**

Table 1 Revised HADD Calculations by Segment

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
Downstream Flow Loss	Creek 661	Creek 146920	1	Confirmed Fish-Bearing	2870	S3	1,979	3,265	0	0	816	0	0	0		59,366
	Creek 661	Creek 505659	1	Confirmed Fish-Bearing	2790	S3	463	1,951	1,699	614	0	0	0	0		13,895
	Creek 661	Creek 505659	2	Confirmed Fish-Bearing	2800	S3	358	1,333	763	354	529	0	397	0		10,730
	Creek 661	Creek 505659	3	Confirmed Fish-Bearing	2810	S3	636	3,144	1,093	2,050	786	0	786	0		19,065
	Creek 661	Creek 505659	4	Confirmed Fish-Bearing	2820	S3	219	411	0	0	103	0	0	0		6,557
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	3450	S3	1,180	2,218	0	0	1,109	0	0	0		35,394
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	2831	S3	6	9	0	0	4	0	0	0		172
Mine Footprint	Creek 661	Creek 146920	1	Unconfirmed Fish-Bearing	3730	S3	1,794	2,907	0	0	727	0	0	0		17,943
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	3731	S3	534	865	0	0	216	0	0	0		5,340
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2880	S3	160	259	0	0	65	0	0	0		1,600
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	3720	S3	617	999	0	0	250	0	0	0		6,165
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2891	S3	82	133	0	0	33	0	0	0		823
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2892	S3	53	86	0	0	21	0	0	0		529
	Creek 661	Creek 146920	3	Unconfirmed Fish-Bearing	2900	S4	660	938	0	0	234	0	0	0		6,603
	Creek 661	Creek 146920	4	Non-Fish-Bearing	2910	NCD	406	0	0	0	0	0	0	0		0
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2930	NCD	69	0	0	0	0	0	0	0		0
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2920	NCD	348	0	0	0	0	0	0	0		0
	Creek 661	Creek 146920	5	Non-Fish-Bearing		NCD	107	0	0	0	0	0	0	0		0
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2860	NCD	32	0	0	0	0	0	0	0		0
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	2832	S3	2,378	3,615	0	0	1,807	0	0	0		71,348
	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	2840	S4	668	648	0	0	324	0	0	0		6,681
	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	3440	S4	357	347	0	0	173	0	0	0		3,573
	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	2850	S4	147	143	0	0	71	0	0	0		1,471
	Creek 661	Creek 505659	7	Unconfirmed Fish-Bearing	3432	S4	107	72	0	0	18	0	0	0		1,071
	Creek 661	Creek 505659	7	Unconfirmed Fish-Bearing	2770	S4	1138	762	0	0	191	0	0	0		11,376
	Creek 661	Creek 505659	7	Non-Fish-Bearing	2760	NVC	317	0	0	0	0	0	0	0		0
	Creek 661	Creek 505659 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	2940	-	135	163	0	0	41	0	0	0		1,346
	Creek 661	Creek 505659 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	2950	-	235	284	0	0	71	0	0	0		2,348

Reference: **Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project**

Table 1 Revised HADD Calculations by Segment

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
Mine Footprint (cont'd)	Creek 661	Creek 505659 Tributary	-	Non-Fish-Bearing	W104	-	137	1,218	0	0	0	0	0	0		763
	Creek 661	Creek 661 Tributary	2	Non-Fish-Bearing	2990	NVC	794	0	0	0	0	0	0	0		0
	Davidson Creek	Creek 428073	-	Unconfirmed Fish-Bearing	W41	-	632	22,047	0	5,512	5,512	0	5,512	0		3,235
	Davidson Creek	Creek 636713	1	Unconfirmed Fish-Bearing	1370	S3	123	189	0	0	94	0	0	0		1,233
	Davidson Creek	Creek 636713	1	Unconfirmed Fish-Bearing	1412	S3	1,027	1,571	0	0	785	0	0	0		10,267
	Davidson Creek	Creek 636713	2	Unconfirmed Fish-Bearing	1380	S3	33	50	0	0	25	0	0	0		325
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	1390	S4	9	12	0	0	6	0	0	0		94
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	1391	S4	72	96	0	0	48	0	0	0		724
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	3880	S4	210	279	0	0	139	0	0	0		2,098
	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	1362	S4	70	81	0	0	20	0	0	0		696
	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	3840	S4	311	364	0	0	91	0	0	0		3,110
	Davidson Creek	Creek 636713	-	Unconfirmed Fish-Bearing	W44	-	461	10,722	0	2,681	2,681	0	2,681	0		2,382
	Davidson Creek	Creek 636713 Tributary	0	No Data (Default Unconfirmed Fish-Bearing)	1470	-	28	22	0	0	6	0	0	0		280
	Davidson Creek	Creek 636713 Tributary	0	No Data (Default Unconfirmed Fish-Bearing)	1479	-	40	32	0	0	8	0	0	0		404
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1430	-	52	42	0	0	10	0	0	0		524
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1440	-	65	52	0	0	13	0	0	0		649
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1450	-	362	289	0	0	72	0	0	0		3,617
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1460	-	183	146	0	0	37	0	0	0		1,831
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3850	-	12	10	0	0	2	0	0	0		121
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1449	-	44	36	0	0	9	0	0	0		444
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1459	-	89	71	0	0	18	0	0	0		885
	Davidson Creek	Creek 636713 Tributary	1	Unconfirmed Fish-Bearing	1482	S4	15	15	0	0	4	0	0	0		154
	Davidson Creek	Creek 636713 Tributary	-	Non-Fish-Bearing	W96	-	142	1,355	0	0	0	0	0	0		789
	Davidson Creek	Creek 636713 Tributary	-	Non-Fish-Bearing	W100	-	57	232	0	0	0	0	0	0		365

Reference: **Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project**

Table 1 Revised HADD Calculations by Segment

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
Mine Footprint (cont'd)	Davidson Creek	Creek 688328	1	Confirmed Fish-Bearing	1571	S3	234	612	168	367	205	0	153	0		7,012
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1581	S3	251	461	153	260	115	0	99	0		7,536
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1592	S3	443	813	270	459	203	0	175	0		13,297
	Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1602	NVC	1,120	0	0	0	0	0	0	0		0
	Davidson Creek	Creek 704454	1	Confirmed Fish-Bearing	1732	S3	279	1,105	33	516	771	0	268	0		8,385
	Davidson Creek	Creek 704454	4	Confirmed Fish-Bearing	1772	S3	265	725	0	286	494	0	171	0		7,957
	Davidson Creek	Creek 704454	4	Confirmed Fish-Bearing	1760	S3	767	2,095	0	827	1,428	0	495	0		23,010
	Davidson Creek	Creek 704454	5	Confirmed Fish-Bearing	1780	S3	462	2,879	771	1,761	952	0	720	0		13,846
	Davidson Creek	Creek 704454	5	Confirmed Fish-Bearing	1781	S3	117	480	129	293	159	0	120	0		3,511
	Davidson Creek	Creek 704454	6	Unconfirmed Fish-Bearing	3382	S3	25	43	0	0	21	0	0	0		254
	Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1721	S4	18	11	0	0	6	0	0	0		185
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1800	S4	1,059	1,239	0	0	310	0	0	0		10,587
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3420	S4	801	857	0	0	214	0	0	0		8,009
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1882	S4	366	340	0	0	85	0	0	0		3,661
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1883	S4	160	149	0	0	37	0	0	0		1,600
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3371	S4	357	332	0	0	83	0	0	0		3,570
	Davidson Creek	Creek 704454 Tributary	2	Unconfirmed Fish-Bearing	1831	S4	125	134	0	0	33	0	0	0		1,250
	Davidson Creek	Davidson Creek Mainstem	6	Confirmed Fish-Bearing	813	S3	84	437	150	275	121	0	117	0		2,523
	Davidson Creek	Davidson Creek Mainstem	7	Confirmed Fish-Bearing	820	S2	231	1,154	0	460	761	0	288	0		6,945
	Davidson Creek	Davidson Creek Mainstem	7.1	Confirmed Fish-Bearing	830	S2	788	4,415	1,005	1,767	950	0	763	0		23,652
	Davidson Creek	Davidson Creek Mainstem	8	Confirmed Fish-Bearing	842	S3	48	337	99	199	124	0	111	0		1,446
	Davidson Creek	Davidson Creek Mainstem	8	Confirmed Fish-Bearing	843	S3	8	53	16	31	20	0	17	0		228
	Davidson Creek	Davidson Creek Mainstem	8	Confirmed Fish-Bearing	851	S3	19	132	39	78	49	0	43	0		568
	Davidson Creek	Davidson Creek Mainstem	8	Confirmed Fish-Bearing	860	S3	384	2,686	786	1,583	987	0	882	0		11,526
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	731	S3	72	395	110	235	147	0	131	0		2,169
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	870	S3	113	615	172	365	228	0	203	0		3,376
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	880	S3	12	64	18	38	24	0	21	0		353
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	890	S3	586	3,201	894	1,903	1,188	0	1,058	0		17,584
	Davidson Creek	Davidson Creek Mainstem	9	Confirmed Fish-Bearing	3800	S3	38	208	58	124	77	0	69	0		1,144

Reference: **Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project**

Table 1 Revised HADD Calculations by Segment

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
Mine Footprint (cont'd)	Davidson Creek	Davidson Creek Mainstem	10	Confirmed Fish-Bearing	3812	S3	293	869	666	245	140	0	105	0		8,780
	Davidson Creek	Davidson Creek Mainstem	11	Confirmed Fish-Bearing	712	S4	158	324	0	109	185	0	71	0		4,727
	Davidson Creek	Davidson Creek Mainstem	11	Confirmed Fish-Bearing	3830	S4	51	105	0	35	60	0	23	0		1,533
	Davidson Creek	Davidson Creek Mainstem	12	Confirmed Fish-Bearing	670	S3	900	1,837	0	542	858	0	316	0		27,005
	Davidson Creek	Davidson Creek Mainstem	12	Confirmed Fish-Bearing	680	S3	17	35	0	10	16	0	6	0		507
	Davidson Creek	Davidson Creek Mainstem	12	Confirmed Fish-Bearing	690	S3	45	91	0	27	43	0	16	0		1,339
	Davidson Creek	Davidson Creek Tributary	1	Non-Fish-Bearing	1320	NVC	1,816	0	0	0	0	0	0	0		0
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1330	S4	39	57	0	0	14	0	0	0		388
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1500	-	83	66	0	0	17	0	0	0		829
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3780	-	60	48	0	12	12	0	12	0		602
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3790	-	264	211	0	0	53	0	0	0		2,641
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3799	-	40	32	0	0	8	0	0	0		404
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1510	S4	1,020	765	0	0	191	0	0	0		10,203
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1922	S4	228	219	0	0	55	0	0	0		2,277
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1961	S4	362	565	0	0	141	0	0	0		3,622
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1972	S4	79	124	0	0	31	0	0	0		793
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1981	S4	273	322	0	0	80	0	0	0		2,729
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1992	S4	114	135	0	0	34	0	0	0		1,142
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2000	S4	299	346	0	0	87	0	0	0		2,985
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2010	S4	19	22	0	0	5	0	0	0		189
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2009	S4	105	122	0	0	31	0	0	0		1,053
	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	1521	-	40	30	0	0	7	0	0	0		397
	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	1523	-	51	39	0	0	10	0	0	0		514

Reference: **Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project**

Table 1 Revised HADD Calculations by Segment

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
Mine Footprint (cont'd)	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	3860	-	94	70	0	0	18	0	0	0		0
	Davidson Creek	Davidson Creek Tributary	7	Non-Fish-Bearing	1222	S6	154	169	0	0	0	0	0	0	42	1,538
	Davidson Creek	Davidson Creek Tributary	7	Non-Fish-Bearing	1223	S6	370	407	0	0	0	0	0	0	102	3,696
	Davidson Creek	Davidson Creek Tributary	-	Unconfirmed Fish-Bearing	W50	-	236	3,361	0	840	840	0	840	0		1,258
	Davidson Creek	Davidson Creek Tributary	-	Non-Fish-Bearing	W102	-	208	2,631	0	0	0	0	0	0		1,119
	Tatelkuz Lake Tributary	Tatelkuz Lake Tributary	1	Non-Fish-Bearing	2342	-	1,365	0	0	0	0	0	0	0		13,647
Upstream Area	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	1350	S4	770	901	0	0	225	0	0	0		7,705
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1540	S3	282	517	172	292	129	0	112	0		8,466
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1582	S3	1,522	2,790	926	1,576	697	0	601	0		45,655
	Davidson Creek	Creek 688328	3	Unconfirmed Fish-Bearing	1550	S4	1,026	1,436	0	0	359	0	0	0		10,258
	Davidson Creek	Creek 688328	4	Unconfirmed Fish-Bearing	1530	S4	907	780	0	0	195	0	0	0		9,068
	Davidson Creek	Creek 688328	4	Unconfirmed Fish-Bearing	1560	S4	677	582	0	0	146	0	0	0		6,773
	Davidson Creek	Creek 688328 Tributary	0	Unconfirmed Fish-Bearing	1699	-	42	30	0	0	7	0	0	0		425
	Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1610	NVC	156	0	0	0	0	0	0	0		0
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1620	S4	1,556	1,338	0	0	334	0	0	0		15,555
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1630	S4	850	731	0	0	366	0	0	0		8,502
	Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1640	NVC	161	0	0	0	0	0	0	0		0
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1650	S4	728	655	0	0	164	0	0	0		7,278
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1670	S4	197	151	0	0	38	0	0	0		1,966
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1680	S4	1,188	962	0	0	241	0	0	0		11,879
	Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1690	S4	320	224	0	0	56	0	0	0		3,198
	Davidson Creek	Creek 688328 Tributary	2	Non-Fish-Bearing	1660	NVC	647	0	0	0	0	0	0	0		0
	Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1722	S4	409	246	0	0	123	0	0	0		4,092
	Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1700	S4	889	533	0	0	133	0	0	0		8,885
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1890	S3	1,137	3,332	0	0	833	0	0	0		11,370
	Davidson Creek	Creek 704454 Tributary	1	Non-Fish-Bearing	1900	S6	876	911	0	0	0	0	0	0	228	8,761
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3372	S4	243	226	0	0	57	0	0	0		2,433
	Davidson Creek	Creek 704454 Tributary	2	Unconfirmed Fish-Bearing	1832	S4	1,048	1,121	0	0	280	0	0	0		10,475

Reference: **Response to DFO Information Request #10 Related to the Section 35(2)(b) Fisheries Act Authorization for the Blackwater Mine Project**

Table 1 Revised HADD Calculations by Segment

Impact Type	Watershed	Section	Reach[1]	Fish-Bearing Status	Unique Water Feature Identifier (WFID)[2]	Stream Class[3]	Length (m)[4]	Instream Area (m^2)[4]	Rainbow Trout Habitat Units					Kokanee Habitat Units	Food and Nutrient Production	Riparian Area (m^2)
									Spawning / Egg Incubation	Fry Summer Rearing	Juvenile Summer Rearing	Adult Summer Foraging	Over-wintering	Spawning / Egg Incubation		
Upstream Area (cont'd)	Davidson Creek	Creek 704454 Tributary	3	Non-Fish-Bearing	1820	NVC	346	0	0	0	0	0	0	0		0
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1923	S4	493	473	0	0	118	0	0	0		4,929
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1962	S4	638	995	0	0	249	0	0	0		6,377
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1982	S4	381	450	0	0	112	0	0	0		3,812
	Davidson Creek	Davidson Creek Tributary	2	Non-Fish-Bearing	1940	NVC	616	0	0	0	0	0	0	0		0
	Davidson Creek	Davidson Creek Tributary	2	Non-Fish-Bearing	1950	NVC	75	0	0	0	0	0	0	0		0
Total							**56,349**	**121,837**	**10,189**	**26,727**	**34,758**	**0**	**17,381**	**0**	**372**	**798,283**

NOTES:

1 Reach numbers are based on the Reach Breaks defined in Appendix 5.1.2.6A of the EA Submission (New Gold 2014)

2 The Water Feature Identifier (WFID) is a unique number assigned to identify a water feature segment (including streams, ponds, and lakes)

3 Stream Class ratings are based on those assigned in Appendix 5.1.2.6A of the EA Submission (New Gold 2014) following the BC Forest Practices Code classification system. S3 streams are fish-bearing with a channel width of 1.5 ≥ 5 m. S4 streams are fish-bearing with a channel width < 1.5 m. S6 streams are non-fish-bearing with a width < 3 m. NVC refers to non-visible channels that do not support fish habitat. NCD refers to a non-classified drainage that does not support fish habitat. A dash "-" indicates that no stream classification was assigned in the EA dataset.

4 Channel lengths and areas rounded to the nearest metre

Appendix L

Habitat Loss by Individual Stream Segments Quantified Using HEP

								Instream Area (m2)								Habitat Units (HU)																			
																Riffle		Glide		Pool		Tributary		Other		Food and Nutrients									
Impact Type	Watershed	Section	Reach	Fish-Bearing Status	Unique Water Feature Identifier (WFID)2	Stream Class	Length (m)	Riffle	Glide	Pool	Tributary	Cascade	Other	TOTAL	Habitat Type	Lifestage	HSI Value	Riffle HU [Riffle Area* Value]	HSI Value	Glide HU [Glide Area* Value]	HSI Value	Pool HU [Pool Area* Value]	HSI Value	Tributary HU [Tributary Area* Value]	HSI Value	Tributary HU [Other Area* Value]	HSI Value	Food and Nutrients HU [Total Area* HSI Value]	Total Habitat Units/ Lifestage	Riparian Area (m2)
Downstream Flow Loss	Creek 661	Creek 146920	1	Confirmed Fish-Bearing	2870	S3	1,979	0	0	0	3,265	0	0	3,265	T2	Spawning							0.00	0					0	59,366
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	816		NA		NA	816	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 505659	1	Confirmed Fish-Bearing	2790	S3	463	504	1447	0	0	0	0	1,951	R1; G1	Spawning	0.50	252	1.00	1,447									1,699	13,895
																Fry	0.50	252	0.25	362									614	
																Juvenile	0.00	0	0.00	0		NA		NA		NA		NA	0	
																Adult	0.00	0	0.00	0									0	
																Overwintering	0.00	0	0.00	0									0	
	Creek 661	Creek 505659	2	Confirmed Fish-Bearing	2800	S3	358	84	721	529	0	0	0	1,333	R1; G1; P1	Spawning	0.50	42	1.00	721	0.00	0							763	10,730
																Fry	0.50	42	0.25	180	0.25	132							354	
																Juvenile	0.00	0	0.00	0	1.00	529		NA		NA		NA	529	
																Adult	0.00	0	0.00	0	0.00	0							0	
																Overwintering	0.00	0	0.00	0	0.75	397							397	
	Creek 661	Creek 505659	3	Confirmed Fish-Bearing	2810	S3	636	1914	1230	0	0	0	0	3,144	R2; G2	Spawning	0.25	478	0.50	615									1,093	19,065
																Fry	0.75	1,435	0.50	615									2,050	
																Juvenile	0.25	478	0.25	307		NA		NA		NA		NA	786	
																Adult	0.00	0	0.00	0									0	
																Overwintering	0.25	478	0.25	307									786	
	Creek 661	Creek 505659	4	Confirmed Fish-Bearing	2820	S3	219	0	0	0	411	0	0	411	T2	Spawning							0.00	0					0	6,557
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	103		NA		NA	103	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	3450	S3	1,180	0	0	0	2,218	0	0	2,218	T1	Spawning							0.00	0					0	35,394
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.50	1,109		NA		NA	1,109	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	2831	S3	6	0	0	0	9	0	0	9	T1	Spawning							0.00	0					0	172
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.50	4		NA		NA	4	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
Mine Footprint	Creek 661	Creek 146920	1	Unconfirmed Fish-Bearing	3730	S3	1,794	0	0	0	2,907	0	0	2,907	T2	Spawning							0.00	0					0	17,943
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	727		NA		NA	727	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	3731	S3	534	0	0	0	865	0	0	865	T2	Spawning							0.00	0					0	5,340
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	216		NA		NA	216	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2880	S3	160	0	0	0	259	0	0	259	T2	Spawning							0.00	0					0	1,600
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	65		NA		NA	65	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	3720	S3	617	0	0	0	999	0	0	999	T2	Spawning							0.00	0					0	6,165
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	250		NA		NA	250	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2891	S3	82	0	0	0	133	0	0	133	T2	Spawning							0.00	0					0	823
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	33		NA		NA	33	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 146920	2	Unconfirmed Fish-Bearing	2892	S3	53	0	0	0	86	0	0	86	T2	Spawning							0.00	0					0	529
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	21		NA		NA	21	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 146920	3	Unconfirmed Fish-Bearing	2900	S4	660	0	0	0	938	0	0	938	T3	Spawning							0.00	0					0	6,603
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.25	234		NA		NA	234	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 146920	4	Non-Fish-Bearing	2910	NCD	406	0	0	0	0	0	0	0	NA	Spawning													0	0
																Fry													0	
																Juvenile		NA		NA		NA		NA		NA		NA	0	
																Adult													0	
																Overwintering													0	
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2930	NCD	69	0	0	0	0	0	0	0	NA	Spawning													0	0
																Fry													0	
																Juvenile		NA		NA		NA		NA		NA		NA	0	
																Adult													0	
																Overwintering													0	
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2920	NCD	348	0	0	0	0	0	0	0	NA	Spawning													0	0
																Fry													0	
																Juvenile		NA		NA		NA		NA		NA		NA	0	
																Adult													0	
																Overwintering													0	
	Creek 661	Creek 146920	5	Non-Fish-Bearing		NCD	107	0	0	0	0	0	0	0	NA	Spawning													0	0
																Fry													0	
																Juvenile		NA		NA		NA		NA		NA		NA	0	
																Adult													0	
																Overwintering													0	
	Creek 661	Creek 146920	5	Non-Fish-Bearing	2860	NCD	32	0	0	0	0	0	0	0	NA	Spawning													0	0
																Fry													0	
																Juvenile		NA		NA		NA		NA		NA		NA	0	
																Adult													0	
																Overwintering													0	
	Creek 661	Creek 505659	5	Confirmed Fish-Bearing	2832	S3	2,378	0	0	0	3615	0	0	3,615	T1	Spawning							0.00	0					0	71,348
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.50	1,807		NA		NA	1,807	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	2840	S4	668	0	0	0	648	0	0	648	T1	Spawning							0.00	0					0	6,681
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.50	324		NA		NA	324	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	
	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	3440	S4	357	0	0	0	347	0	0	347	T1	Spawning							0.00	0					0	3,573
																Fry							0.00	0					0	
																Juvenile		NA		NA		NA	0.50	173		NA		NA	173	
																Adult							0.00	0					0	
																Overwintering							0.00	0					0	

Mine Footprint	Creek 661	Creek 505659	6	Unconfirmed Fish-Bearing	2850	S4	147	0	0	0	143	0	0	143	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 71 0.00 0 0.00 0	NA	NA	0 0 71 0 0	1,471
	Creek 661	Creek 505659	7	Unconfirmed Fish-Bearing	3432	S4	107	0	0	0	72	0	0	72	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 18 0.00 0 0.00 0	NA	NA	0 0 18 0 0	1,071
	Creek 661	Creek 505659	7	Unconfirmed Fish-Bearing	2770	S4	1138	0	0	0	762	0	0	762	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 191 0.00 0 0.00 0	NA	NA	0 0 191 0 0	11,376
	Creek 661	Creek 505659	7	Non-Fish-Bearing	2760	NVC	317	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	0
	Creek 661	Creek 505659 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	2940	-	135	0	0	0	163	0	0	163	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 41 0.00 0 0.00 0	NA	NA	0 0 41 0 0	1,346
	Creek 661	Creek 505659 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	2950	-	235	0	0	0	284	0	0	284	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 71 0.00 0 0.00 0	NA	NA	0 0 71 0 0	2,348
	Creek 661	Creek 505659 Tributary	-	Non-Fish-Bearing	W104	-	137	0	0	0	0	0	1218	1,218	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	763
	Creek 661	Creek 661 Tributary	2	Non-Fish-Bearing	2990	NVC	794	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	0
	Davidson Creek	Creek 428073	-	Unconfirmed Fish-Bearing	W41	-	632	0	0	0	0	0	22047	22,047	O2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	0.00 0 0.25 5512 0.25 5512 0.00 0 0.25 5512	NA	0 5,512 5,512 0 5,512	3,235
	Davidson Creek	Creek 636713	1	Unconfirmed Fish-Bearing	1370	S3	123	0	0	0	189	0	0	189	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 94 0.00 0 0.00 0	NA	NA	0 0 94 0 0	1,233
	Davidson Creek	Creek 636713	1	Unconfirmed Fish-Bearing	1412	S3	1,027	0	0	0	1,571	0	0	1,571	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 785 0.00 0 0.00 0	NA	NA	0 0 785 0 0	10,267
	Davidson Creek	Creek 636713	2	Unconfirmed Fish-Bearing	1380	S3	33	0	0	0	50	0	0	50	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 25 0.00 0 0.00 0	NA	NA	0 0 25 0 0	325
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	1390	S4	9	0	0	0	12	0	0	12	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 6 0.00 0 0.00 0	NA	NA	0 0 6 0 0	94
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	1391	S4	72	0	0	0	96	0	0	96	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 48 0.00 0 0.00 0	NA	NA	0 0 48 0 0	724
	Davidson Creek	Creek 636713	3	Unconfirmed Fish-Bearing	3880	S4	210	0	0	0	279	0	0	279	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 139 0.00 0 0.00 0	NA	NA	0 0 139 0 0	2,098
	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	1362	S4	70	0	0	0	81	0	0	81	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 20 0.00 0 0.00 0	NA	NA	0 0 20 0 0	696
	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	3840	S4	311	0	0	0	364	0	0	364	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 91 0.00 0 0.00 0	NA	NA	0 0 91 0 0	3,110
	Davidson Creek	Creek 636713	-	Unconfirmed Fish-Bearing	W44	-	461	0	0	0	0	0	10722	10,722	O2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	0.00 0 0.25 2681 0.25 2681 0.00 0 0.25 2681	NA	0 2,681 2,681 0 2,681	2,382
	Davidson Creek	Creek 636713 Tributary	0	No Data (Default Unconfirmed Fish-Bearing)	1470	-	28	0	0	0	22	0	0	22	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 6 0.00 0 0.00 0	NA	NA	0 0 6 0 0	280
	Davidson Creek	Creek 636713 Tributary	0	No Data (Default Unconfirmed Fish-Bearing)	1479	-	40	0	0	0	32	0	0	32	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 8 0.00 0 0.00 0	NA	NA	0 0 8 0 0	404
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1430	-	52	0	0	0	42	0	0	42	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 10 0.00 0 0.00 0	NA	NA	0 0 10 0 0	524
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1440	-	65	0	0	0	52	0	0	52	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 13 0.00 0 0.00 0	NA	NA	0 0 13 0 0	649
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1450	-	362	0	0	0	289	0	0	289	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 72 0.00 0 0.00 0	NA	NA	0 0 72 0 0	3,617

Mine Footprint	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1460	-	183	0	0	0	146	0	0	146	T2	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 37 0 0	NA		NA		0 0 37 0 0	1,831
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3850	-	12	0	0	0	10	0	0	10	T2	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 2 0 0	NA		NA		0 0 2 0 0	121
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1449	-	44	0	0	0	36	0	0	36	T3	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 9 0 0	NA		NA		0 0 9 0 0	444
	Davidson Creek	Creek 636713 Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	1459	-	89	0	0	0	71	0	0	71	T3	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 18 0 0	NA		NA		0 0 18 0 0	885
	Davidson Creek	Creek 636713 Tributary	1	Unconfirmed Fish-Bearing	1482	S4	15	0	0	0	15	0	0	15	T3	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 4 0 0	NA		NA		0 0 4 0 0	154
	Davidson Creek	Creek 636713 Tributary	-	Non-Fish-Bearing	W96	-	142	0	0	0	0	0	1355	1,355	NA	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		NA		NA		NA		0 0 0 0 0	789
	Davidson Creek	Creek 636713 Tributary	-	Non-Fish-Bearing	W100	-	57	0	0	0	0	0	232	232	NA	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		NA		NA		NA		0 0 0 0 0	365
	Davidson Creek	Creek 688328	1	Confirmed Fish-Bearing	1571	S3	234	346	162	103	0	0	0	612	R2; G2; P2	Spawning Fry Juvenile Adult Overwintering	0.25 0.75 0.25 0.00 0.25	86 259 86 0 86	0.50 0.50 0.25 0.00 0.25	81 81 41 0 41	0.00 0.25 0.75 0.00 0.25	0 26 77 0 26	NA		NA		168 367 205 0 153	7,012
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1581	S3	251	183	214	63	0	0	0	461	R2; G2; P3	Spawning Fry Juvenile Adult Overwintering	0.25 0.75 0.25 0.00 0.25	46 137 46 0 46	0.50 0.50 0.25 0.00 0.25	107 107 54 0 54	0.00 0.25 0.25 0.00 0.00	0 16 16 0 0	NA		NA		153 260 115 0 99	7,536
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1592	S3	443	322	378	112	0	0	0	813	R2; G2; P3	Spawning Fry Juvenile Adult Overwintering	0.25 0.75 0.25 0.00 0.25	81 242 81 0 81	0.50 0.50 0.25 0.00 0.25	189 189 95 0 95	0.00 0.25 0.25 0.00 0.00	0 28 28 0 0	NA		NA		270 459 203 0 175	13,297
	Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1602	NVC	1,120	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		NA		NA		NA		0 0 0 0 0	0
	Davidson Creek	Creek 704454	1	Confirmed Fish-Bearing	1732	S3	279	927	67	79	0	33	0	1,105	R3; G2; P2	Spawning Fry Juvenile Adult Overwintering	0.00 0.50 0.75 0.00 0.25	0 463 695 0 232	0.50 0.50 0.25 0.00 0.25	33 33 17 0 17	0.00 0.25 0.75 0.00 0.25	0 20 59 0 20	NA		NA		33 516 771 0 268	8,385
	Davidson Creek	Creek 704454	4	Confirmed Fish-Bearing	1772	S3	265	459	77	147	0	40	0	725	R3; G3; P2	Spawning Fry Juvenile Adult Overwintering	0.00 0.50 0.75 0.00 0.25	0 230 345 0 115	0.00 0.25 0.50 0.00 0.25	0 19 39 0 19	0.00 0.25 0.75 0.00 0.25	0 37 111 0 37	NA		NA		0 286 494 0 171	7,957
	Davidson Creek	Creek 704454	4	Confirmed Fish-Bearing	1760	S3	767	1329	224	426	0	117	0	2,095	R3; G3; P2	Spawning Fry Juvenile Adult Overwintering	0.00 0.50 0.75 0.00 0.25	0 664 997 0 332	0.00 0.25 0.50 0.00 0.25	0 56 112 0 56	0.00 0.25 0.75 0.00 0.25	0 107 320 0 107	NA		NA		0 827 1,428 0 495	23,010
	Davidson Creek	Creek 704454	5	Confirmed Fish-Bearing	1780	S3	462	1747	669	464	0	0	0	2,879	R2; G2; P2	Spawning Fry Juvenile Adult Overwintering	0.25 0.75 0.25 0.00 0.25	437 1,310 437 0 437	0.50 0.50 0.25 0.00 0.25	334 334 167 0 167	0.00 0.25 0.75 0.00 0.25	0 116 348 0 116	NA		NA		771 1,761 952 0 720	13,846
	Davidson Creek	Creek 704454	5	Confirmed Fish-Bearing	1781	S3	117	291	111	77	0	0	0	480	R2; G2; P2	Spawning Fry Juvenile Adult Overwintering	0.25 0.75 0.25 0.00 0.25	73 218 73 0 73	0.50 0.50 0.25 0.00 0.25	56 56 28 0 28	0.00 0.25 0.75 0.00 0.25	0 19 58 0 19	NA		NA		129 293 159 0 120	3,511
	Davidson Creek	Creek 704454	6	Unconfirmed Fish-Bearing	3382	S3	25	0	0	0	43	0	0	43	T1	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.50 0.00 0.00	0 0 21 0 0	NA		NA		0 0 21 0 0	254
	Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1721	S4	18	0	0	0	11	0	0	11	T1	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.50 0.00 0.00	0 0 6 0 0	NA		NA		0 0 6 0 0	185
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1800	S4	1,059	0	0	0	1,239	0	0	1,239	T2	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 310 0 0	NA		NA		0 0 310 0 0	10,587
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3420	S4	801	0	0	0	857	0	0	857	T2	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 214 0 0	NA		NA		0 0 214 0 0	8,009
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1882	S4	366	0	0	0	340	0	0	340	T2	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 85 0 0	NA		NA		0 0 85 0 0	3,661
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1883	S4	160	0	0	0	149	0	0	149	T2	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 37 0 0	NA		NA		0 0 37 0 0	1,600
	Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3371	S4	357	0	0	0	332	0	0	332	T2	Spawning Fry Juvenile Adult Overwintering	NA		NA		NA		0.00 0.00 0.25 0.00 0.00	0 0 83 0 0	NA		NA		0 0 83 0 0	3,570

Mine Footprint

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Mine Footprint	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3790	-	264	0	0	0	211	0	0	211	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 53 0.00 0 0.00 0	NA	NA	0 0 53 0 0	2,641
	Davidson Creek	Davidson Creek Tributary	1	No Data (Default Unconfirmed Fish-Bearing)	3799	-	40	0	0	0	32	0	0	32	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 8 0.00 0 0.00 0	NA	NA	0 0 8 0 0	404
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1510	S4	1,020	0	0	0	765	0	0	765	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 191 0.00 0 0.00 0	NA	NA	0 0 191 0 0	10,203
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1922	S4	228	0	0	0	219	0	0	219	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 55 0.00 0 0.00 0	NA	NA	0 0 55 0 0	2,277
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1961	S4	362	0	0	0	565	0	0	565	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 141 0.00 0 0.00 0	NA	NA	0 0 141 0 0	3,622
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1972	S4	79	0	0	0	124	0	0	124	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 31 0.00 0 0.00 0	NA	NA	0 0 31 0 0	793
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1981	S4	273	0	0	0	322	0	0	322	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 80 0.00 0 0.00 0	NA	NA	0 0 80 0 0	2,729
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1992	S4	114	0	0	0	135	0	0	135	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 34 0.00 0 0.00 0	NA	NA	0 0 34 0 0	1,142
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2000	S4	299	0	0	0	346	0	0	346	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 87 0.00 0 0.00 0	NA	NA	0 0 87 0 0	2,985
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2010	S4	19	0	0	0	22	0	0	22	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 5 0.00 0 0.00 0	NA	NA	0 0 5 0 0	189
	Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	2009	S4	105	0	0	0	122	0	0	122	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 31 0.00 0 0.00 0	NA	NA	0 0 31 0 0	1,053
	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	1521	-	40	0	0	0	30	0	0	30	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 7 0.00 0 0.00 0	NA	NA	0 0 7 0 0	397
	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	1523	-	51	0	0	0	39	0	0	39	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 10 0.00 0 0.00 0	NA	NA	0 0 10 0 0	514
	Davidson Creek	Davidson Creek Tributary	2	No Data (Default Unconfirmed Fish-Bearing)	3860	-	94	0	0	0	70	0	0	70	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 18 0.00 0 0.00 0	NA	NA	0 0 18 0 0	937
	Davidson Creek	Davidson Creek Tributary	7	Non-Fish-Bearing	1222	S6	154	0	0	0	169	0	0	169	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	0.25 42	0 0 0 0 0	1,538
	Davidson Creek	Davidson Creek Tributary	7	Non-Fish-Bearing	1223	S6	370	0	0	0	407	0	0	407	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	0.25 102	0 0 0 0 0	3,696
	Davidson Creek	Davidson Creek Tributary	-	Unconfirmed Fish-Bearing	W50	-	236	0	0	0	0	0	3361	3,361	O2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	0.00 0 0.25 840 0.25 840 0.00 0 0.25 840	NA	0 840 840 0 840	1,258
	Davidson Creek	Davidson Creek Tributary	-	Non-Fish-Bearing	W102	-	208	0	0	0	0	0	2631	2,631	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	1,119
	Tatelkuz Lake Tributary	Tatelkuz Lake Tributary	1	Non-Fish-Bearing	2342	-	1,365	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	13,647
Upstream Area	Davidson Creek	Creek 636713	5	Unconfirmed Fish-Bearing	1350	S4	770	0	0	0	901	0	0	901	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 225 0.00 0 0.00 0	NA	NA	0 0 225 0 0	7,705
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1540	S3	282	205	241	71	0	0	0	517	R2; G2; P3	Spawning Fry Juvenile Adult Overwintering	0.25 51 0.75 154 0.25 51 0.00 0 0.25 51	0.50 120 0.50 120 0.25 60 0.00 0 0.25 60	0.00 0 0.25 18 0.25 18 0.00 0 0.00 0	NA	NA	NA	172 292 129 0 112	8,466
	Davidson Creek	Creek 688328	2	Confirmed Fish-Bearing	1582	S3	1,522	1,107	1,299	384	0	0	0	2,790	R2; G2; P3	Spawning Fry Juvenile Adult Overwintering	0.25 277 0.75 830 0.25 277 0.00 0 0.25 277	0.50 649 0.50 649 0.25 325 0.00 0 0.25 325	0.00 0 0.25 96 0.25 96 0.00 0 0.00 0	NA	NA	NA	926 1,576 697 0 601	45,655
	Davidson Creek	Creek 688328	3	Unconfirmed Fish-Bearing	1550	S4	1,026	0	0	0	1,436	0	0	1,436	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 359 0.00 0 0.00 0	NA	NA	0 0 359 0 0	10,258

Upstream Area

Davidson Creek	Creek 688328	4	Unconfirmed Fish-Bearing	1530	S4	907	0	0	0	780	0	0	780	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 195 0.00 0 0.00 0	NA	NA	0 0 195 0 0	9,068
Davidson Creek	Creek 688328	4	Unconfirmed Fish-Bearing	1560	S4	677	0	0	0	582	0	0	582	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 146 0.00 0 0.00 0	NA	NA	0 0 146 0 0	6,773
Davidson Creek	Creek 688328 Tributary	0	Unconfirmed Fish-Bearing	1699	-	42	0	0	0	30	0	0	30	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 7 0.00 0 0.00 0	NA	NA	0 0 7 0 0	425
Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1610	NVC	156	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	0
Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1620	S4	1,556	0	0	0	1,338	0	0	1,338	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 334 0.00 0 0.00 0	NA	NA	0 0 334 0 0	15,555
Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1630	S4	850	0	0	0	731	0	0	731	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 366 0.00 0 0.00 0	NA	NA	0 0 366 0 0	8,502
Davidson Creek	Creek 688328 Tributary	1	Non-Fish-Bearing	1640	NVC	161	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	0
Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1650	S4	728	0	0	0	655	0	0	655	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 164 0.00 0 0.00 0	NA	NA	0 0 164 0 0	7,278
Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1670	S4	197	0	0	0	151	0	0	151	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 38 0.00 0 0.00 0	NA	NA	0 0 38 0 0	1,966
Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1680	S4	1,188	0	0	0	962	0	0	962	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 241 0.00 0 0.00 0	NA	NA	0 0 241 0 0	11,879
Davidson Creek	Creek 688328 Tributary	1	Unconfirmed Fish-Bearing	1690	S4	320	0	0	0	224	0	0	224	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 56 0.00 0 0.00 0	NA	NA	0 0 56 0 0	3,198
Davidson Creek	Creek 688328 Tributary	2	Non-Fish-Bearing	1660	NVC	647	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	0
Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1722	S4	409	0	0	0	246	0	0	246	T1	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.50 123 0.00 0 0.00 0	NA	NA	0 0 123 0 0	4,092
Davidson Creek	Creek 704454	7	Unconfirmed Fish-Bearing	1700	S4	889	0	0	0	533	0	0	533	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 133 0.00 0 0.00 0	NA	NA	0 0 133 0 0	8,885
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	1890	S3	1,137	0	0	0	3332	0	0	3,332	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 833 0.00 0 0.00 0	NA	NA	0 0 833 0 0	11,370
Davidson Creek	Creek 704454 Tributary	1	Non-Fish-Bearing	1900	S6	876	0	0	0	911	0	0	911	T4	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.00 0 0.00 0 0.00 0	NA	0.25 228	0 0 0 0 0	8,761
Davidson Creek	Creek 704454 Tributary	1	Unconfirmed Fish-Bearing	3372	S4	243	0	0	0	226	0	0	226	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 57 0.00 0 0.00 0	NA	NA	0 0 57 0 0	2,433
Davidson Creek	Creek 704454 Tributary	2	Unconfirmed Fish-Bearing	1832	S4	1,048	0	0	0	1,121	0	0	1,121	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 280 0.00 0 0.00 0	NA	NA	0 0 280 0 0	10,475
Davidson Creek	Creek 704454 Tributary	3	Non-Fish-Bearing	1820	NVC	346	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	0
Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1923	S4	493	0	0	0	473	0	0	473	T3	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 118 0.00 0 0.00 0	NA	NA	0 0 118 0 0	4,929
Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1962	S4	638	0	0	0	995	0	0	995	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 249 0.00 0 0.00 0	NA	NA	0 0 249 0 0	6,377
Davidson Creek	Davidson Creek Tributary	1	Unconfirmed Fish-Bearing	1982	S4	381	0	0	0	450	0	0	450	T2	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	0.00 0 0.00 0 0.25 112 0.00 0 0.00 0	NA	NA	0 0 112 0 0	3,812
Davidson Creek	Davidson Creek Tributary	2	Non-Fish-Bearing	1940	NVC	616	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	0

Upstream Area	Davidson Creek	Davidson Creek Tributary	2	Non-Fish-Bearing	1950	NVC	75	0	0	0	0	0	0	0	NA	Spawning Fry Juvenile Adult Overwintering	NA	NA	NA	NA	NA	NA	0 0 0 0 0	0
TOTAL:							**56,349**							**121,837**							Spawning Fry Juvenile Adult Overwintering	**372**	**10,189** **26,727** **34,758** **0** **17,381**	**798,283**

Appendix M

Offsetting Aerial Maps

M1. Murray Creek
M2. Lower Greer Creek
M3. Middle Greer Creek
M4. Upper Greer Creek
M5. Creek 661
M.6 Lake 15 and 16

5990250 5990000 5989750 5989500 5989250 5989000 5988750

430750 430500 430250 430000

Upstream extent of work

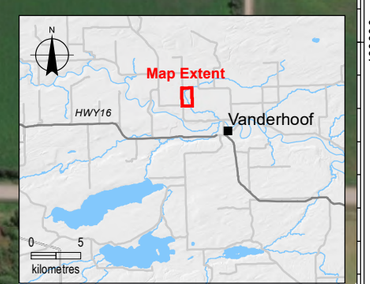
Downstream extent of work

MURRAY CREEK

SNELL ROAD EAST

LOOP ROAD

Upstream extent of work



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

5990250 5990000 5989750 5989500 5989250 5989000 5988750

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5_ArcGIS\DFO Report\Appendix\D1_MurrayCreek.mxd

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Aug 03, 2021

0 25 50 75 100
metres

Scale 1:4500
UTM Zone 10 North
NAD 1983 Datum

N

Legend

Watercourse Centreline

Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer

Murray Creek Offsetting

Appendix M1

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394000 394500 395000 395500 396000 396500

5962000

5961500

5961000

5960500

NECHAKO RIVER

KENNEY DAM ROAD

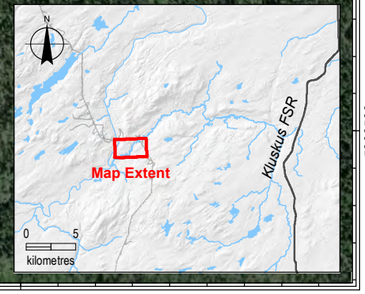
GREER CREEK

Upstream extent of work

Downstream extent of work

SNELL ROAD

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5_ArcGIS\DFO Report\Appendix\D2_LowerGreer.mxd

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Aug 03, 2021

ARTEMIS GOLD INC
Palmer

0 50 100 150 200
metres

Scale 1:8000
UTM Zone 10 North
NAD 1983 Datum

N

Legend

Watercourse Centreline

Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer
2) Imagery (Extent Area, 2017) - DWB Consulting Services Ltd.

Lower Greer Creek Offsetting

Appendix M2

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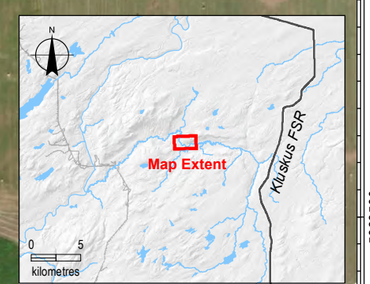
402500 402750 403000 403250 403500 403750 404000 404250 404500

5964500 5964250 5964000 5963750 5963500

Downstream extent of work

Upstream extent of work

GREER CREEK



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5. ArcGIS\DFO Report\Appendix\D3_MidGreer.mxd

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Aug 03, 2021

ARTEMIS GOLD INC
Palmer

0 50 100 150
metres

Scale 1:5500
UTM Zone 10 North
NAD 1983 Datum

N

Legend

- Watercourse Centreline
- Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer
2) Imagery (Extent Area, 2017) - DWB Consulting Services Ltd.

Middle Greer Creek Offsetting

Appendix D3

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404000 405000 406000 407000

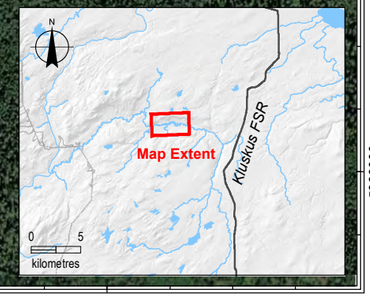
5964000

5963000

GREER CREEK

Downstream extent of work

Upstream extent of work



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Aug 03, 2021

ARTEMIS GOLD INC
Palmer

0 100 200 300
metres

Scale 1:9500
UTM Zone 10 North
NAD 1983 Datum

N

Legend

Watercourse Centreline

Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer

Upper Greer Creek Offsetting

Appendix M4

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Document Path: G:\Shared drives\Projects 2020\2006501 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5_ArcGIS\DFO Report\Appendix\D4_UpperGreer.mxd

385600 385700 385800 385900

5898500

5898400

CREEK 661

Kluskus-Ootsa FSR

Map Extent

Mine Footprint

0 5
kilometres

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Aug 03, 2021

0 10 20 30
metres

Scale 1:1000
UTM Zone 10 North
NAD 1983 Datum

N

Legend
- Watercourse Centreline
- Pond Outline (Approximate)
- Flow Direction (White Arrow)

Data Sources:
1) Watercourse - Palmer

Creek 661 Off-channel Overwintering Pond

Appendix M5

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Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5_ArcGIS\DFO Report\Appendix\D5_Creek661.mxd

370250 370500 370750 371000 371250 371500 371750

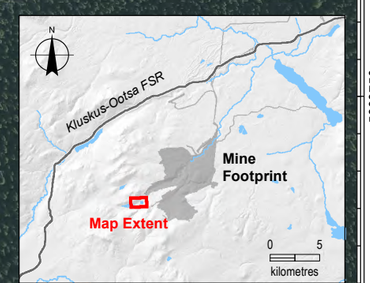
5894500 5894250 5894000 5893750

LAKE 16 OUTLET DAM

LAKE 16

APPROXIMATE EXTENT OF
CONNECTOR CHANNEL CONSTRUCTION

LAKE 15



370250 370500 370750 371000 371250 371500 371750

Document Path: G:\Shared drives\Projects 2020\20065 - Artemis Gold Inc\2006501 - Blackwater Project 2020-2021\Mapping\Figures\5_ArcGIS\DFO Report\Appendix\D6_Lake1516.mxd

CLIENT: Artemis Gold Inc.
PROJECT: Blackwater
DRAWN: B. Elder
CHECKED: I. MacLeod
PROJECT: 2006501
DATE: Aug 03, 2021

0 25 50 75 100
metres

Scale 1:4000
UTM Zone 10 North
NAD 1983 Datum

N

Legend

Watercourse Centreline

Flow Direction (White Arrow)

Lake 15/16 Connector Channel

Appendix M6

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Appendix N

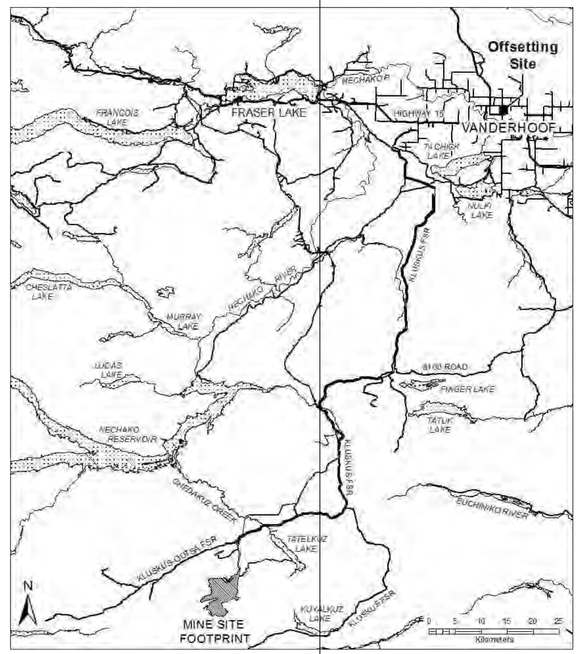
Offsetting Detailed Design Drawings

BW GOLD LTD

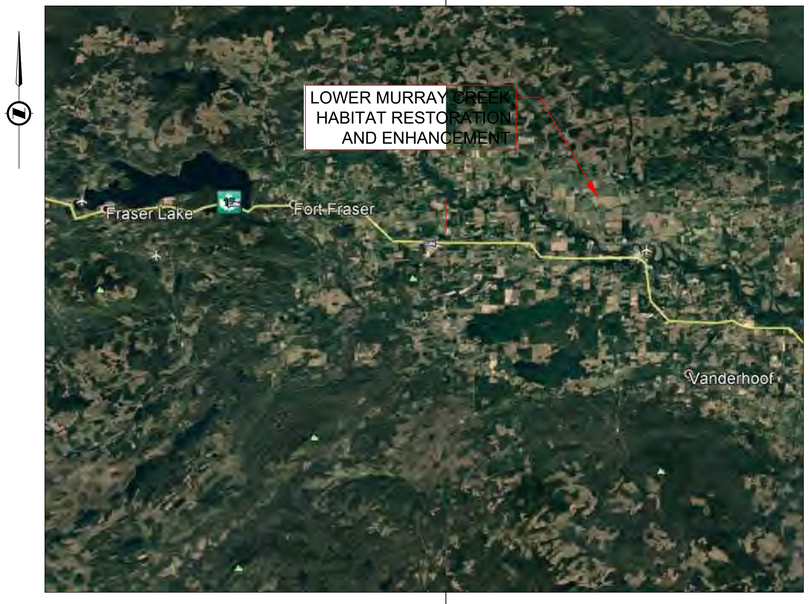
BLACKWATER PROJECT -
SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER MURRAY CREEK HABITAT
RESTORATION AND ENHANCEMENT

ISSUED FOR PERMIT APPROVAL

DRAWING INDEX	
SHEET No.	SHEET TITLE
1824-4-8-001	TITLE PAGE
1824-4-8-002	GENERAL NOTES
1824-4-8-003	OVERALL PLAN SHEET 1 OF 3
1824-4-8-004	OVERALL PLAN SHEET 2 OF 3
1824-4-8-005	OVERALL PLAN SHEET 3 OF 3
1824-4-8-006	STANDARD DETAILS SHEET 1 OF 2
1824-4-8-007	STANDARD DETAILS SHEET 2 OF 2 & PLANTING NOTES FOR CHANNEL WORKS
1824-4-8-008	ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS
1824-4-8-009	SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR CHANNEL WORKS
1824-4-8-010	WORK AREA ISOLATION MEASURES
1824-4-8-011	TYPICAL CROSSING DESIGN SHEET 1 OF 3
1824-4-8-012	TYPICAL CROSSING DESIGN SHEET 2 OF 3
1824-4-8-013	TYPICAL CROSSING DESIGN SHEET 3 OF 3



KEY PLAN
NTS



LOCATION PLAN
NTS

BW GOLD LTD
a subsidiary company of Artemis Gold Inc

Palmer™
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
www.onsite-engineering.ca

U:\Projects\1824\4\9\8 - Lower Murray OS Design\AutoCAD\1824-4-8- Lower Murray Creek.dwg
DATE: 2022-6-7 11:07 PM BY: Jesse Lutz

NOT FOR CONSTRUCTION

LAYDOWNS & ACCESS ROADS

- ALL LAYDOWNS AND ACCESS ROADS ARE TEMPORARY IN NATURE AND ARE ONLY REQUIRED FOR THE DURATION OF CHANNEL WORKS. GRASS AND PATHS DISTURBED DURING CONSTRUCTION ARE TO BE RESTORED TO THEIR ORIGINAL CONDITION PRE-CONSTRUCTION TO THE BEST OF THE CHOSEN CONTRACTOR'S ABILITIES AFTER ALL WORKS ARE COMPLETED.
- FINAL LOCATION, SIZE, AND SPECIFICATIONS OF THE PROPOSED LAYDOWN AREA AND ACCESS ROADS ARE TO BE REFINED BY THE SELECTED CONTRACTOR AS REQUIRED. DEPENDING ON CONDITIONS AT THE TIME OF CONSTRUCTION ACCESS MAY BE A VARIETY OF RIG MATS, FROZEN GROUND, OR BUILT UP GRAVEL ACCESS ROADS WITH GEOGRID.
- AVOID DISTURBANCE TO ANY EXISTING HERITAGE FEATURES
- AVOID DISTURBANCE TO ADJACENT PRIVATE PROPERTY

GENERAL STREAM NOTES

- BASED ON THE ONLINE TOOL (https://OWT.BCWATERTOOL.CA) THE WINTERTIME LOW FLOW IS ESTIMATED TO BE 0.1m3/sec WITH A MEAN ANNUAL DISCHARGE OF ~0.3m3/sec
- WATER SURFACE ELEVATIONS IN THE CHANNEL WERE ESTIMATED BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND UNMANNED AERIAL VEHICLE (I.E. DRONE) SURVEY, CONDUCTED BY DWB CONSULTING SERVICES LTD
- NOTE THAT THERE IS BEAVER ACTIVITY, ALONG MURRAY CREEK. AS SUCH, WATER DEPTHS MAY BE LOCALLY HIGHER THAN EXPECTED BASED SOLELY ON LOCAL FLOW CONDITIONS.
- NOTE THAT THE GROUNDWATER TABLE IS RELATIVELY HIGH ACROSS THE FLAT VALLEY BOTTOM OF MURRAY CREEK, CONTROLLED IN THE ALLUVIUM COMPRISING THE FLOODPLAIN BY THE WATER SURFACE ELEVATION ALONG THE CHANNEL (WHICH MAY BE LOCALLY AFFECTED BY BEAVER ACTIVITY).

FLOODPLAIN SOILS

- NO DRILLING OR TEST PITTING HAS BEEN COMPLETED TO INVESTIGATE SOILS WITHIN THE VALLEY BOTTOM FLOODPLAIN SEDIMENTS WHERE CHANNEL WORKS ARE PROPOSED.
- OPPORTUNISTIC EXAMINATION OF FLOODPLAIN SOILS IN ERODED CREEK BANKS AND HAND AUGER HOLES (<1.2m DEEP) INDICATES ALLUVIAL SEDIMENTS TYPICAL OF RECURRENT FLOODPLAIN DEPOSITION: FINE SAND AND SILT WITH LOCALIZED GRAVELS AND ORGANICS.

SURVEY NOTES

DATUM: NAD 83 (CSRS) 2002.0

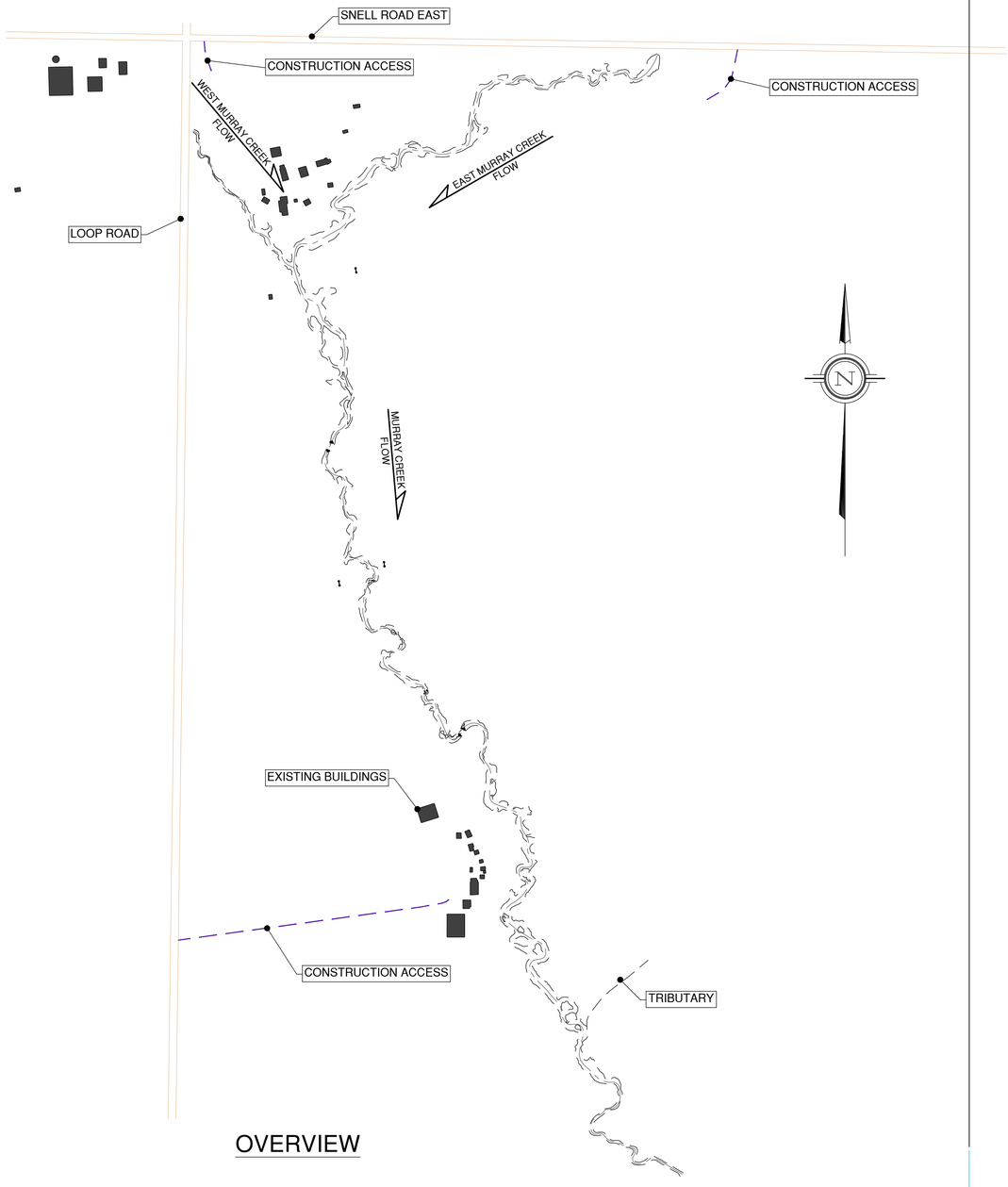
UTM ZONE: 10

THE SURVEY DATA USED TO CREATE THE TIN SURFACE FOR THIS DESIGN WAS PROVIDED TO ONSITE ENGINEERING LTD. BY PALMER. ALL SURVEY DATA WAS COLLECTED BY DWB CONSULTING SERVICES LTD. OCTOBER 22-23, 2016 AND JUNE 19-22, 2017.

DESIGN TEAM

ENGINEERING - ONSITE ENGINEERING LTD. MICHAEL FOSTER, P.ENG.

GEOMORPHOLOGY/ENVIRONMENTAL/SEDIMENT AND EROSION CONTROL - PALMER ROBIN MCKILLOP, MSc, P.GEO. AND DAN MCPARLAND, MSc, P.GEO.



OVERVIEW

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 26, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 13, 2021	JL	MF
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SURVEYED:	-
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER MURRAY CREEK HABITAT RESTORATION AND ENHANCEMENT
GENERAL NOTES

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-8
DRAWING NO. 002
SHEET: 2 OF 13
REV E

BC 1C
1-800-474-6886

U:\Projects\1824\4\9\8 - Lower Murray OS Design\AutoCAD\1824-4-8- Lower Murray Creek.dwg
DATE: 16/02/2021 4:55 PM BY: Jesse Lutz

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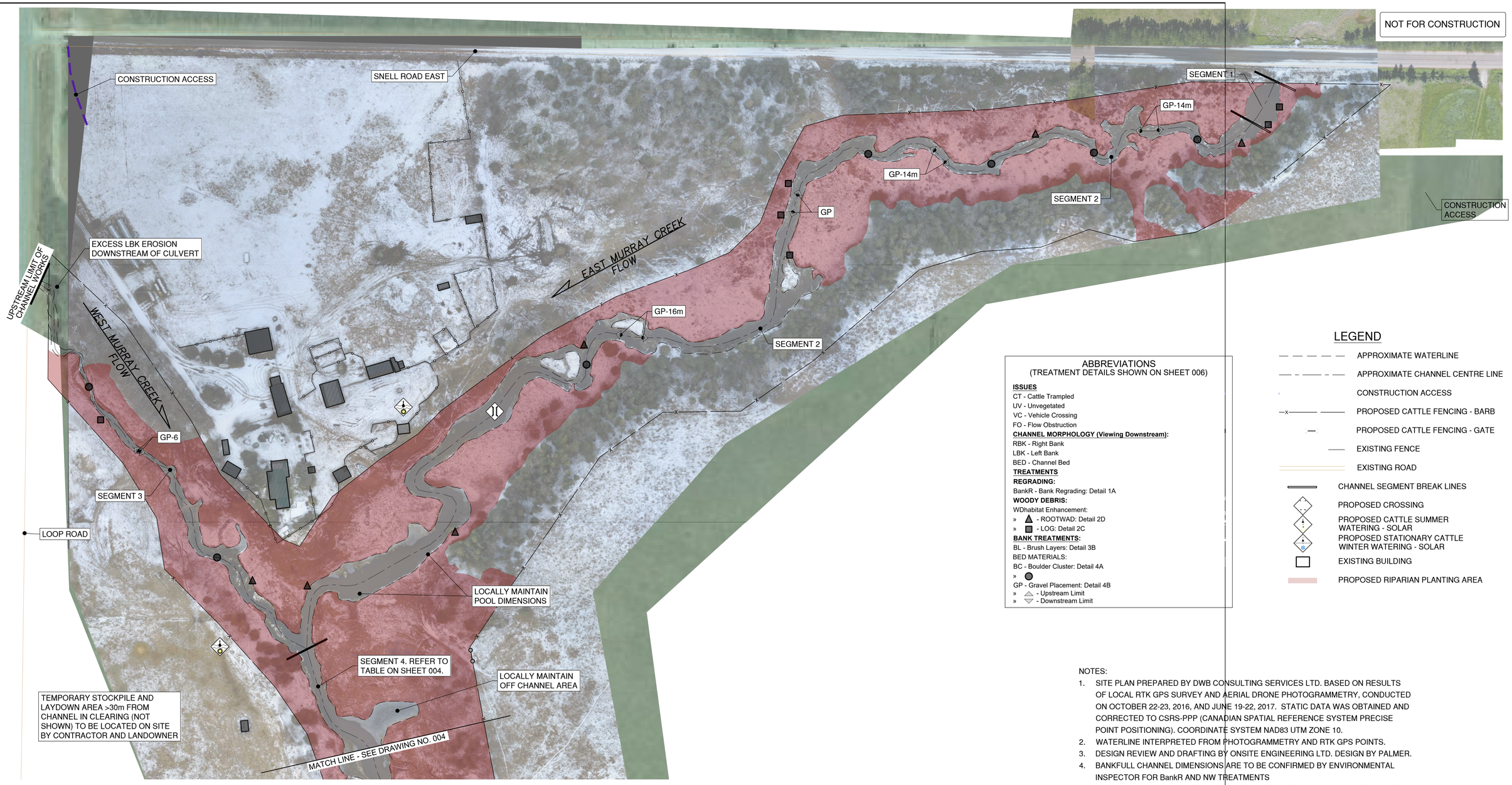

ABBREVIATIONS
(TREATMENT DETAILS SHOWN ON SHEET 006)

ISSUES
CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

CHANNEL MORPHOLOGY (Viewing Downstream):
RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

TREATMENTS
REGRADING:
BankR - Bank Regrading: Detail 1A
WOODY DEBRIS:
WDhabitat Enhancement:
» ▲ - ROOTWAD: Detail 2D
» ■ - LOG: Detail 2C
BANK TREATMENTS:
BL - Brush Layers: Detail 3B
BED MATERIALS:
BC - Boulder Cluster: Detail 4A
» ●
GP - Gravel Placement: Detail 4B
» △ - Upstream Limit
» ▽ - Downstream Limit

LEGEND

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- PROPOSED RIPARIAN PLANTING AREA

MURRAY CREEK - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT EASTING	UPSTREAM LIMIT NORTHING	DOWNSTREAM LIMIT EASTING	DOWNSTREAM LIMIT NORTHING	SEGMENT LENGTH (m)	CHANNEL MORPHOLOGY & ISSUES	PROPOSED TREATMENTS	BRANCH	SPECIFICATIONS	NOTES
1	430574.241	5990303.034	430562.103	5990280.676	25.6	RBK: CT & UV LBK: CT & UV	RBK: BankR & VBR LBK: BankR, VBR & Wdhabitat	East		MAINTAIN POOL DIMENSIONS DOWNSTREAM OF ROAD CROSSING
2	430562.103	5990280.676	430056.583	5989999.159	757.0	RBK: CT & UV LBK: CT & UV BED: CT	RBK: NW, BL & Wdhabitat LBK: NW, BL & Wdhabitat BED: GP & BC	East	RIFFLE BANKFULL WIDTH: 7.0m POOL BANKFULL WIDTH: 9.0m	LOCALLY MAINTAIN EXISTING POOL DIMENSIONS UPSTREAM OF CONFLUENCE PROPOSED CROSSING IN SEGMENT
3	429913.725	5990194.546	430056.583	5989999.159	265.2	RBK: CT & UV LBK: CT & UV BED: CT	RBK: NW, BL & Wdhabitat LBK: NW, BL & Wdhabitat BED: GP & BC	West	RIFFLE BANKFULL WIDTH: 6.0m POOL BANKFULL WIDTH: 7.5m	

NOTES:
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9. SUMMER AND WINTER OFF-CHANNEL WATERING. DETAILS ARE PROVIDED ON DRAWING 007.

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OVERALL PLAN SHEET 1 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-8
DRAWING NO. 003
SHEET: 3 OF 13
REV E

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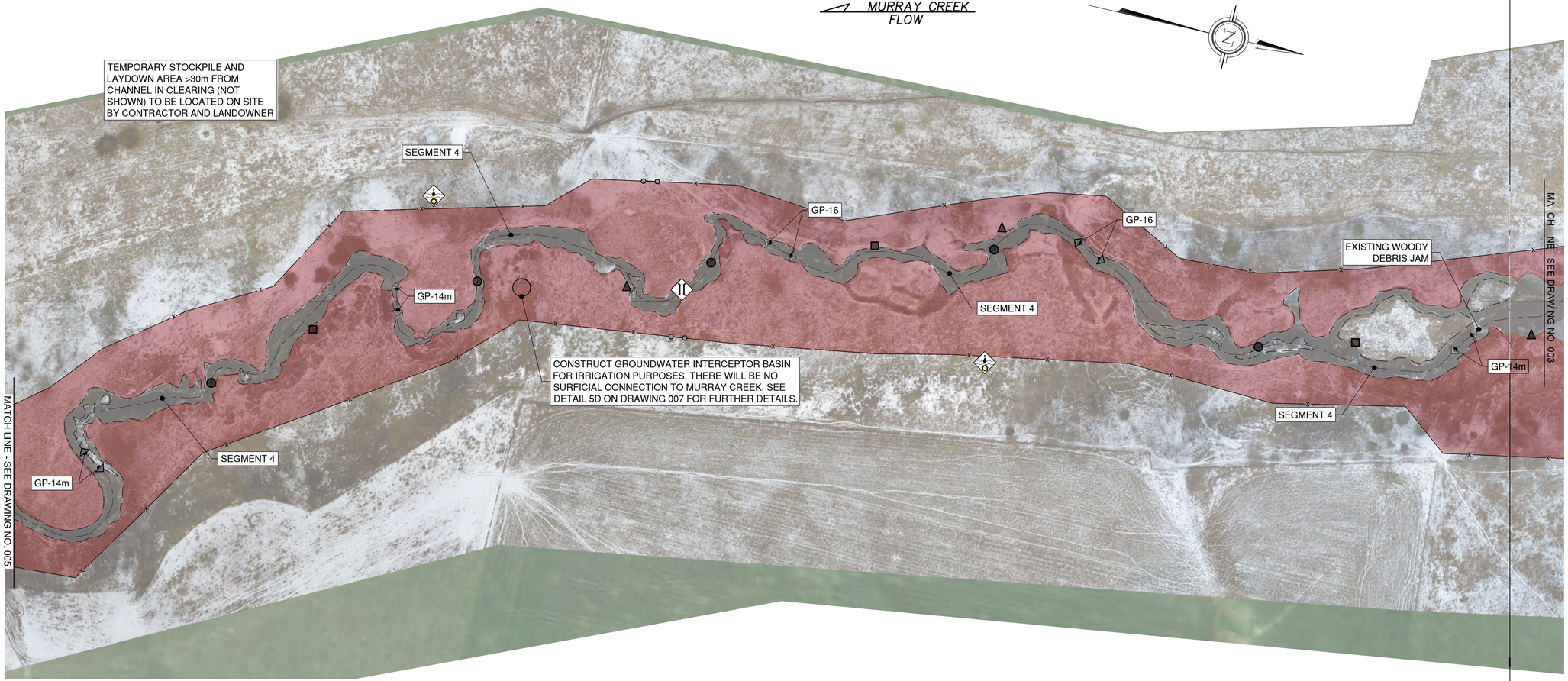

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(TREATMENT DETAILS SHOWN ON SHEET 006)

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER MURRAY CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL PLAN SHEET 2 OF 3

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-8
DRAWING NO.	004
SHEET:	4 OF 13
REV	E

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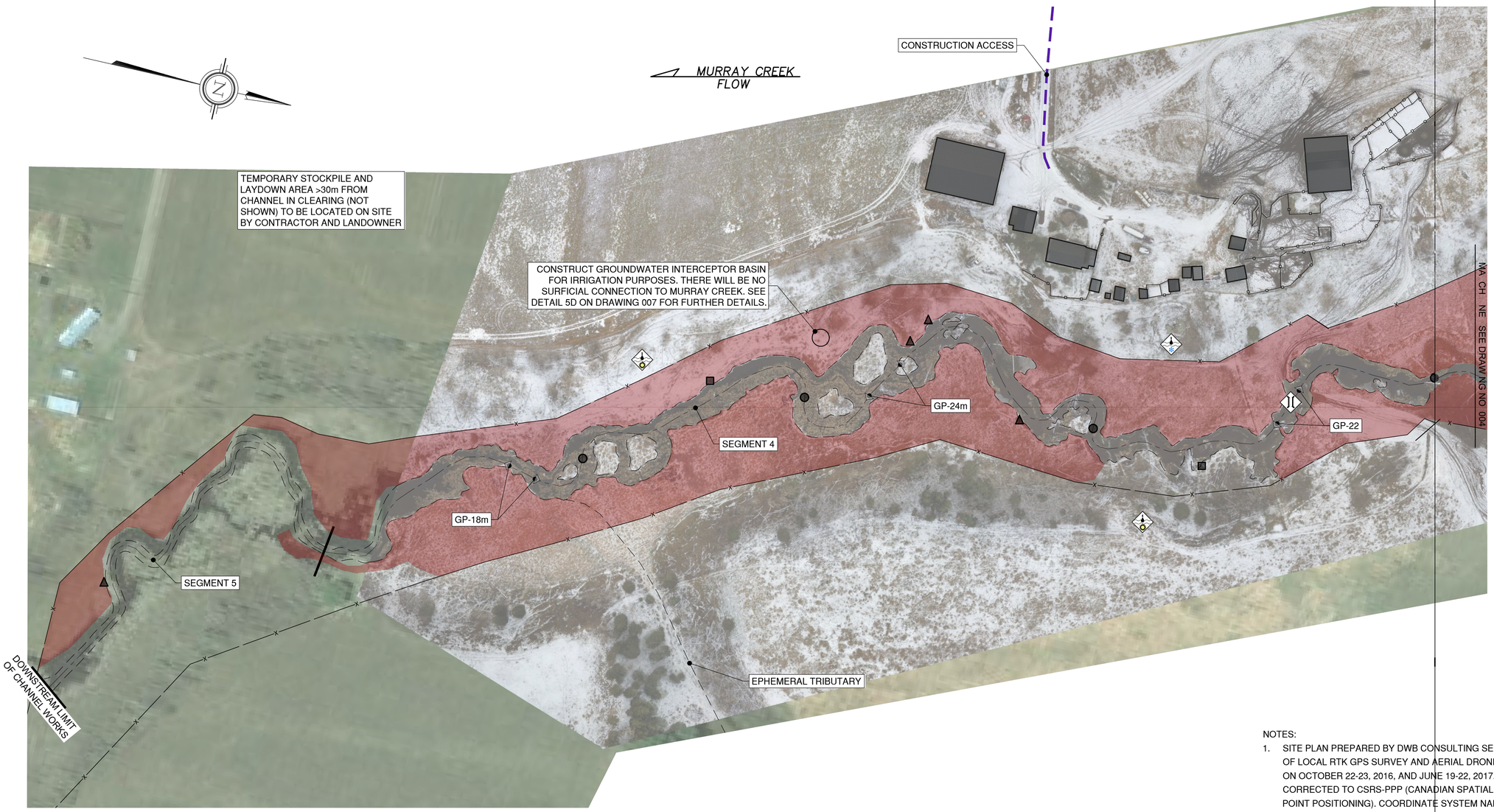

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5	**430520.792**	**5988818.598**	**430608.845**	**5988710.246**	**238.2**	**RBK: CT & UV**	**RBK: BankR, BL & Wdhabitat**	**Main**		

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OVERALL PLAN SHEET 3 OF 3

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-8
DRAWING NO.	005
SHEET:	5 OF 13
REV	E

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DATE: 16/02/2021 4:55 PM BY: Jesse Lutz

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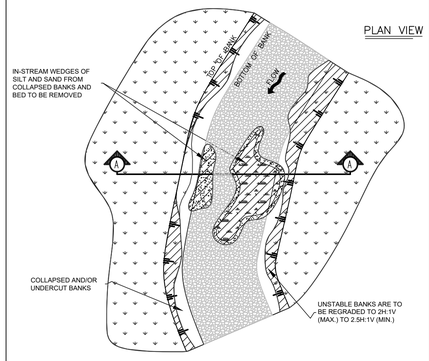
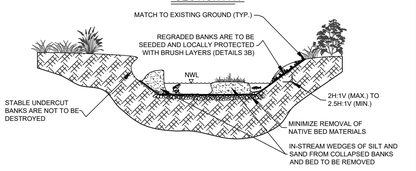
DETAIL 1A
RECONSTRUCTION OF CHANNEL BED AND/OR BANK REGRADING (BankR)
N.T.S.

PLAN VIEW

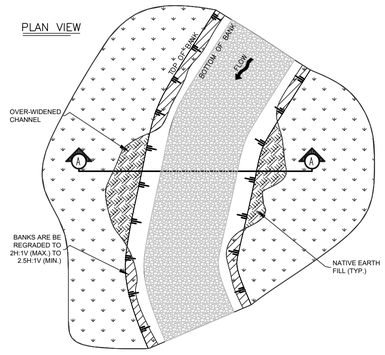


SECTION A-A



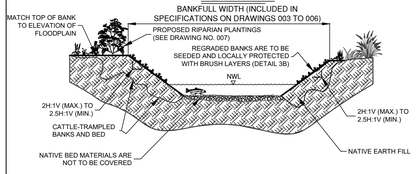
DETAIL 1B
RESTORATION OF NATURAL CHANNEL WIDTH (NW)
N.T.S.

PLAN VIEW



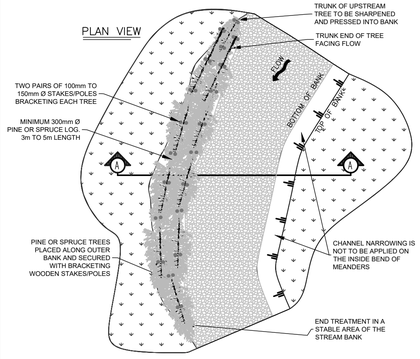
PROPOSED RIPARIAN PLANTINGS (SEE DRAWING NO. 003 TO 006)

SECTION A-A



DETAIL 2A
WOODY DEBRIS CHANNEL NARROWING (WDnarrow)
N.T.S.

PLAN VIEW



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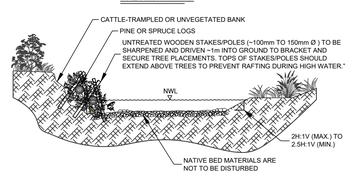
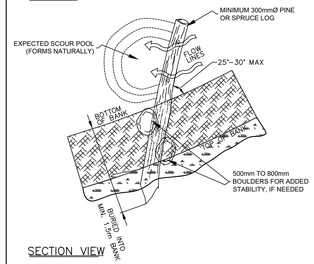
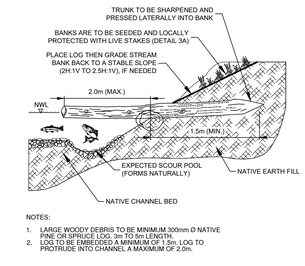


DETAIL 2B
WOODY DEBRIS CHANNEL DEFLECTION (WDdeflect)
N.T.S.

PLAN VIEW



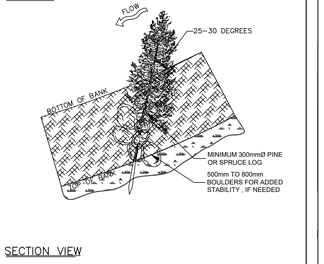
SECTION VIEW



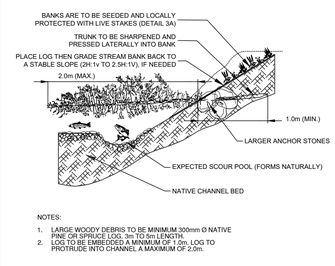
NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.5m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 2C
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): LOG
N.T.S.

PLAN VIEW



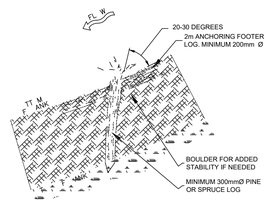
SECTION VIEW



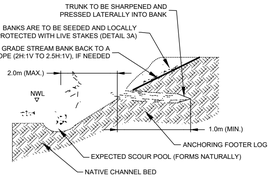
NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.0m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 2D
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): ROOTWAD
N.T.S.

LAN VIEW



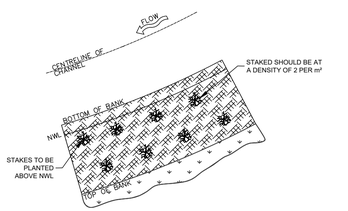
ELEVATION VIEW



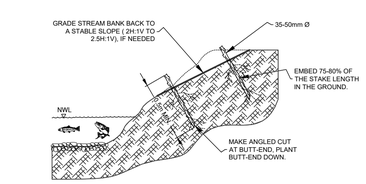
NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.0m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 3A
BANK TREATMENT: LIVE STAKES (LS)
N.T.S.

PLAN VIEW



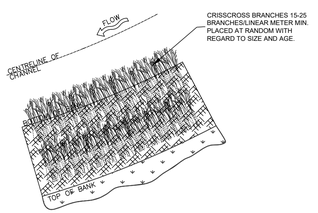
SECTION VIEW



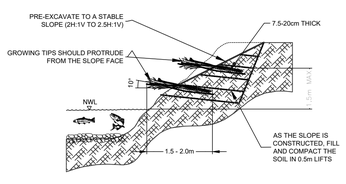
NOTES:
1. LIVE STAKINGS TO BE: -DORMANT LIVE STAKE CUTTING, (LIVE DOGWOOD AND WILLOW) -35-50mm DIA., WITH ANGLE CUT BASE, AND BLUNT CUT TOP. STAKE LENGTH TO BE 600-800mm.
2. TAMP ANGLE CUT BASE INTO SOIL AT RIGHT ANGLE TO SLOPE. ENSURE 75-80% OF LENGTH OF CUTTING IS EMBEDDED INTO SOIL. -TAMP TOPSOIL FIRMLY AROUND BASE.
3. SOAK LIVE STAKES FOR MINIMUM OF 24 HOURS PRIOR TO INSTALLATION.

DETAIL 3B
BANK TREATMENT: BRUSH LAYERS (BL)
N.T.S.

PLAN VIEW



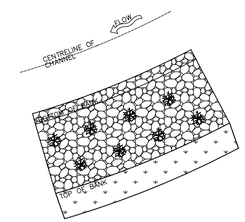
SECTION VIEW



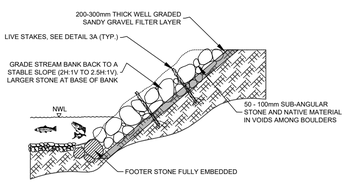
NOTES:
1. COVER BRUSHLAYER IMMEDIATELY WITH 0.15m (6") OF FILL SOIL, WATER AND COMPACT USING A VIBRATORY TAMPER.
2. BRUSH LAYERS WILL BE NATIVE WILLOW AND DOGWOOD SPECIES.
3. THE NUMBER OF LAYERS (I.E. LIFTS) WILL BE CONFIRMED BY THE INSPECTOR IN THE FIELD. IN GENERAL, BANKS <1m HIGH REQUIRE ONE LAYER, BANKS 1m TO 2m HIGH REQUIRE TWO LAYERS, AND BANKS >2m REQUIRE THREE LAYERS.

DETAIL 3C
BANK TREATMENT: VEGETATED BOULDER REVETMENT (VBR)
N.T.S.

PLAN VIEW

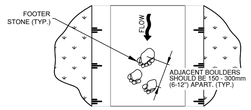


SECTION VIEW

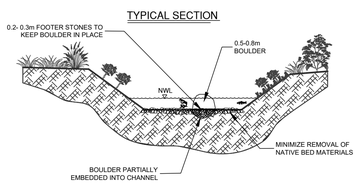


NOTES:
1. BOULDERS SHOULD BE ROUNDED TO SUB-ANGULAR.
2. GRADATION SHOULD BE WELL GRADED AND ANDERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE CLASS 25kg (MEDIAN GRAIN SIZE OF 260mm, MAXIMUM GRAIN SIZE OF 450mm).
3. INSTALLATION SHOULD ADHERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE GUIDANCE " RIPRAP INSTALLATION GUIDE"
4. BOULDERS ARE TO BE INDIVIDUALLY PLACED (I.E. NO DUMPING) TO MAXIMIZE INTERLOCKING. VOIDS ARE TO BE FILLED WITH SMALLER GRAVELS AND NATIVE MATERIALS.
5. THE BOULDER REVETMENT CAN BE FORMED IN LIFTS OR LIVE STAKE CAN BE INSERTED IF CARE IS TAKEN TO LEAVE SUFFICIENT VOIDS.
6. FILTER FABRIC SHOULD NOT BE USED.

DETAIL 4A
BED TREATMENT: BOULDER CLUSTERS (BC)
N.T.S.



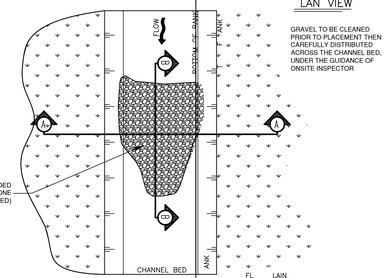
TYPICAL SECTION



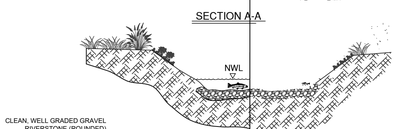
NOTES:
1. BOULDER SHOULD BE 0.5-0.8m STONE.
2. BOULDERS ARE NOT TO BE PLACED IN DEPOSITIONAL ZONES.
3. BOULDERS SHOULD OCCUPY LESS THAN 1/3 OF THE CHANNEL WIDTH AFTER PARTIAL EMBEDMENT.
4. BOULDERS SHOULD BE A MINIMUM OF TWO STONE SIZES AWAY FROM THE CHANNEL'S BANKS.

DETAIL 4B
BED TREATMENT: GRAVEL PLACEMENT (GP)
N.T.S.

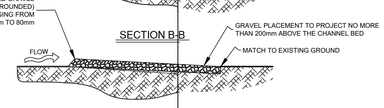
LAN VIEW



SECTION A-A



SECTION B-B



NOTES:
1. ONSITE INSPECTOR WILL NEED TO ENSURE NO FISH OR EGGS ARE PRESENT PRIOR TO PLACEMENT.
2. GRAVEL PLACEMENT SHOULD BE COMPLETED AT LOW FLOWS.

REMOVAL OR REGRADING
NATIVE VEGETATION
NWL NORMAL WATER LEVEL
NATIVE BED MATERIAL
NATIVE EARTH
SILT AND SAND

BC — 1C
1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 26, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 13, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 16, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 26, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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CHECKED:	MF
SURVEYED:	-
DATE:	JUNE 2022

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470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER MURRAY CREEK HABITAT RESTORATION AND ENHANCEMENT
STANDARD DETAILS SHEET 1 OF 2

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-8
DRAWING NO.	006
SHEET:	6 OF 13
REV	E

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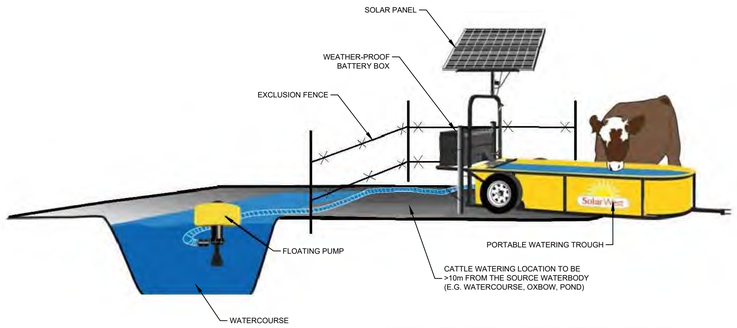
DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

NOT FOR CONSTRUCTION

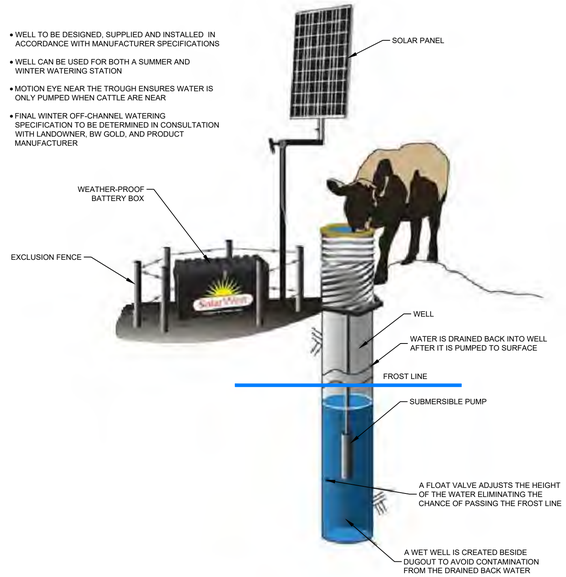
DETAIL 5A - SUMMER (MAY THROUGH OCTOBER) OFF-CHANNEL CATTLE WATERING
N.T.S



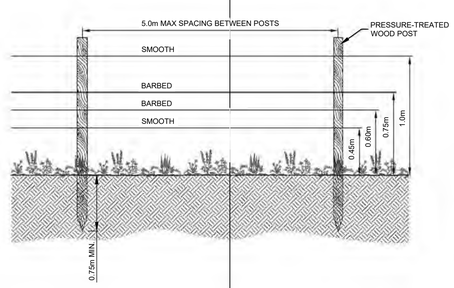
- PORTABLE WATERING STATION CAN EXTRACT WATER FROM WATERCOURSE, OXBOW AND/ OR ESTABLISHED WELL
- PORTABLE WATERING STATION CAN BE USED FOR BOTH SUMMER AND WINTER SEASON (IF GEOTHERMAL)
- PORTABLE WATERING STATION TO BE DESIGNED, SUPPLIED, AND INSTALLED BASED ON MANUFACTURER SPECIFICATIONS
- FLOAT SWITCH IN TROUGH MAINTAINS WATER LEVEL
- FINAL SUMMER OFF-CHANNEL WATERING SPECIFICATIONS TO BE DETERMINED IN CONSULTATION WITH LANDOWNER, BW GOLD, AND PRODUCT MANUFACTURER

DETAIL 5B - WINTER (NOVEMBER THROUGH APRIL) OFF-CHANNEL CATTLE WATERING
N.T.S

- WELL TO BE DESIGNED, SUPPLIED AND INSTALLED IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS
- WELL CAN BE USED FOR BOTH A SUMMER AND WINTER WATERING STATION
- MOTION EYE NEAR THE TROUGH ENSURES WATER IS ONLY PUMPED WHEN CATTLE ARE NEAR
- FINAL WINTER OFF-CHANNEL WATERING SPECIFICATION TO BE DETERMINED IN CONSULTATION WITH LANDOWNER, BW GOLD, AND PRODUCT MANUFACTURER

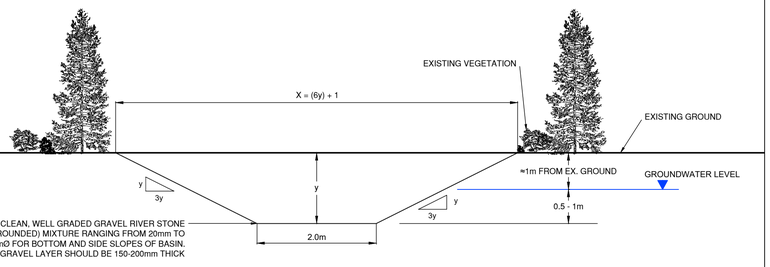


DETAIL 5C - CATTLE EXCLUSION FENCING - BARBED WIRE
N.T.S



- POSTS ARE TO BE 0.1m TO 0.15m IN DIAMETER AND 2m IN HEIGHT (MINIMUM)
- WIRE TO BE 12.5 GALVANIZED (CLASS 1 GALVANIZING MINIMUM), 4-POINT BARBS
- WIRE TO HAVE MINIMUM 950-LB BREAKING STRENGTH
- SMOOTH TOP AND BOTTOM WIRE TO FACILITATE WILDLIFE PASSAGE
- WIRE EXCLUSION FENCE DESIGN REFERENCES THE FENCING FACTSHEET 307.260-1 REVISED DECEMBER 15, 2015, BC MINISTRY OF AGRICULTURE, LIVESTOCK CONTROL - NON-ELECTRIC FENCE DESIGNS. FENCE TO BE SUPPLIED AND INSTALLED ACCORDING TO SPECIFICATIONS WITHIN THE FACTSHEET. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/farm-management/structures-and-mechanization/300-series/307260-1_livestock_contol_-_non-electric_fence.pdf

DETAIL 5D - GROUNDWATER INTERCEPTOR BASIN SECTION VIEW
N.T.S.



PROVISIONAL PLANTING NOTES

SITE PREPARATION:

- EXISTING WOODY VEGETATION TO BE RETAINED AND PROTECTED TO THE GREATEST EXTENT FEASIBLE.
- EXISTING HERBACEOUS VEGETATION IS TO BE MOWED OR SCYTHED TO 15cm IN HEIGHT BEFORE PLANTING AND / OR SEEDING.

PLANT MATERIAL:

- PLANT MATERIAL MUST BE LOCALLY SOURCED AND SPECIES MUST BE NATIVE TO THE REGION.
- PLANT STOCK MUST BE INSPECTED UPON DELIVERY TO ENSURE THAT THE MATERIAL CONSISTS OF APPROPRIATE NATIVE SPECIES IN GOOD CONDITION
- TREES TO BE CONTAINER GROWN OR BAREROOT STOCK RANGING FROM 1.0m TO 1.5m IN HEIGHT.
- SHRUBS TO BE CONTAINER GROWN OR BARE ROOT AND RANGING FROM 0.4m TO 1.0m IN HEIGHT.
- LIVE STAKES TO BE 35 TO 50mm IN DIAMETER AND 1 TO 1.5m IN LENGTH. SOAKED FOR A MINIMUM OF 24 HOURS BEFORE INSTALLATION. TIPS OF LIVE STAKES CAN BE SEALED TO MINIMIZE RISK OF DISEASE.
- BRUSH LAYERING CUTTINGS TO BE A MINIMUM OF 10mm IN DIAMETER AND 1.5 TO 2.0m IN LENGTH.
- GRASSES AND SHRUBS TO BE PLANTED IN RIPARIAN AREA ABOVE HIGH WATER MARK (ABOVE STREAM BANK) IF CURRENTLY BARREN. PLANT GRASSES ONLY IF SHRUBS ARE PRESENT.

PLANTING DENSITY:

- TREES TO BE PLANTED 1 TREE PER 36m² (APPROXIMATELY 6m ON CENTER)
- SHRUBS TO BE PLANTED 1 SHRUB PER m² IN CLUSTERS OF 6 INDIVIDUAL SHRUBS. EACH SHRUB CLUSTER SHOULD COMPRISE A MINIMUM OF 2 SPECIES. SHRUB CLUSTERS ARE TO BE SCATTERED APPROXIMATELY 12m APART.
- LIVE STAKES TO BE PLANTED 2 LIVE STAKES PER m².
- BRUSH LAYER CUTTINGS TO BE DENSELY PACKED, SIDE-BY-SIDE, TO A THICKNESS OF 20cm TO FORM A CONTINUOUS LAYER ACROSS THE FULL LENGTH OF THE LIFT.

TIMING:

- PLANTING OF WOODY MATERIAL SHOULD BE COMPLETED IN THE SPRING (APRIL TO MAY) OR FALL (SEPTEMBER TO OCTOBER).
- SEEDING SHOULD BE COMPLETED IMMEDIATELY AFTER THE PLANTING OF WOODY VEGETATION.

TENDING:

- ALL PLANTINGS SHOULD BE WATERED IMMEDIATELY AFTER INSTALLATION.
- ALL PLANTINGS SHOULD BE WATERED DURING PERIODS OF NATURAL DROUGHT CONDITIONS (ESPECIALLY FROM LATE SPRING TO THE END OF SUMMER) FOR THE FIRST GROWING SEASON.

PROVISIONAL PLANTING LIST - CHANNEL RIPARIAN AREAS

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
Shrub Cluster Moist	Saskatoon	Amelanchier alnifolia	264
	Soopolallie	Shepherdia canadensis	264
	Prickly Rose	Rosa acicularis	264
	Red Raspberry	Rubus ideaus	264
	Highbush-cranberry	Viburnum edule	280
	Black Twinberry	Lonicera involucrata	280
Tree Cluster Dry/Moist	White Spruce	Picea glauca	104
	Lodgepole Pine	Pinus contorta	104
	Trembling Aspen	Populus tremuloides	104
Live Stakes (LS)	Red-Osier Dogwood	Cornus stolonifera	153
	Scouler's Willow	Salix scouleriana	153
	Coyote Willow	Salix exigua	153
	Geyer's Willow	Salix geyeriana	153
Brush Layer Cuttings (BL)	Red-osier Dogwood	Cornus stolonifera	55,660
	Pacific Willow	Salix lasiandra	55,660
	Hooker's Willow	Salix hookeriana	55,660
	Coyote Willow	Salix exigua	55,660

A DETAILED PLANTING PLAN TO INCORPORATE UPDATED SITE INFORMATION AND FIRST NATION COMMENTS WILL BE DEVELOPED FOLLOWING THE COMPLETION OF VEGETATION SURVEYS DURING THE SUMMER OF 2022.PLEASE REFER TO THE VEGETATION WORK PLAN PRESENTED IN THE FISHERIES ACT AUTHORIZATION APPLICATION FOR ADDITIONAL DETAILS.

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 26, 2021	JL	MF
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PH.: 604-629-9075

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER MURRAY CREEK HABITAT RESTORATION AND ENHANCEMENT
STANDARD DETAILS SHEET 2 OF 2
& PLANTING NOTES FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-8
DRAWING NO. 007
SHEET: 7 OF 13
REV E

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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CHANNEL WORKS - EROSION & SEDIMENT CONTROL AND WORK AREA ISOLATION - NOTES:

INTRODUCTORY STATEMENT

- THE EROSION & SEDIMENT CONTROL PLAN HAS BEEN DEVELOPED TO ENSURE ESTABLISHMENT AND MAINTENANCE OF ALL NECESSARY ENVIRONMENTAL PROTECTION MEASURES BEFORE, DURING AND AFTER CHANNEL RESTORATION AND ENHANCEMENT WORKS. IT ALSO ALLOWS THE CONTRACTOR, OVERSEEN BY AN ENVIRONMENTAL INSPECTOR, THE FLEXIBILITY TO OPTIMIZE THE MEASURES FOR THE MOST EFFECTIVE SEQUENCE AND APPROACH FOR IMPLEMENTATION. RATHER THAN PRESCRIBING EXACTLY WHERE AND WHEN DIFFERENT MEASURES ARE TO BE USED, TYPICAL LAYOUTS FOR ENVIRONMENTAL PROTECTION AND WORK-AREA SITE ISOLATION ARE PROVIDED TO MAKE CLEAR WHAT OPTIONS ARE AVAILABLE TO THE CONTRACTOR. AN ENVIRONMENTAL INSPECTOR FAMILIAR WITH THE EROSION & SEDIMENT CONTROL PLAN WILL BE AVAILABLE ON SITE TO ANSWER QUESTIONS AND PROVIDE GUIDANCE TO THE CONTRACTOR.

SECTION 1: SITE MANAGEMENT

1. EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING THE CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER, ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED AND / OR REPLACED WITHIN 48 HOURS OF INSPECTION.
2. DISTURBED AREAS WILL BE MINIMIZED TO THE EXTENT POSSIBLE, AND TEMPORARILY OR PERMANENTLY STABILIZED OR RESTORED AS THE WORK PROGRESSES.
3. ALL IN-WATER AND NEAR WATER EARTHWORKS WILL BE CONDUCTED IN THE DRY AND / OR WITHIN AN ISOLATED WORK AREA WITH APPROPRIATE EROSION AND SEDIMENT CONTROLS. SPECIFIED PLACEMENTS OF BOULDERS, GRAVEL, AND LARGE WOOD MAY BE MADE IN / NEAR WATER WITHOUT COMPLETE ISOLATION IF NOT ASSOCIATED WITH EARTHWORK.
4. THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED / AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREAS. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF DELETERIOUS SUBSTANCE, INCLUDING SEDIMENT, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY.
5. AN ENVIRONMENTAL MONITOR WILL ATTEND THE SITE TO INSPECT ALL NEW CONTROLS, AS WELL AS ON A REGULAR BASIS, OR FOLLOWING RAIN / SNOW MELT EVENTS, TO MONITOR ALL WORKS, AND IN PARTICULAR WORKS RELATED TO EROSION AND SEDIMENT CONTROLS, DE-WATERING, RESTORATION, AND IN / NEAR-WATER WORKS. SHOULD CONCERNS ARISE ON SITE, THE ENVIRONMENTAL MONITOR WILL CONTACT THE APPROPRIATE REGULATORY OFFICER AS WELL AS THE PROPONENT.
6. ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT THE ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE, OR OTHER DELETERIOUS SUBSTANCES INTO THE WATER. VEHICULAR REFUELING AND MAINTENANCE WILL BE CONDUCTED A MINIMUM OF 30 METERS FROM THE WATER.
7. THE PROPONENT / CONTRACTOR SHALL MONITOR THE WEATHER FOR THE DURATION OF CONSTRUCTION TO ENSURE THAT THE WORKS WILL BE CONDUCTED DURING FAVORABLE WEATHER CONDITIONS. SHOULD AN UNEXPECTED STORM OR SNOWMELT ARISE, THE CONTRACTOR WILL REMOVE ALL UNFIXED ITEMS FROM THE CHANNEL AND FLOOD PLAIN THAT WOULD HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW, E.G., FUEL TANKS, PORTA-POTTIES, MACHINERY, EQUIPMENT, CONSTRUCTION MATERIALS, ETC.
8. ALL DE-WATERING SHALL BE TREATED AND RELEASED TO THE ENVIRONMENT AT LEAST 15 METERS FROM A WATERCOURSE OR POND AND ALLOWED TO DRAIN THROUGH A FILTER BAG AND WELL-VEGETATED AREA. NO DE-WATERING EFFLUENT SHALL BE SENT DIRECTLY TO ANY WATERCOURSE, POND, FOREST, OR ALLOWED TO DRAIN ONTO DISTURBED SOILS WITHIN THE WORK AREA. THESE CONTROL MEASURES SHALL BE MONITORED FOR EFFECTIVENESS AND MAINTAINED OR REVISED TO MEET THE OBJECTIVE OF PREVENTING THE RELEASE OF SEDIMENT-LADEN WATER.
9. ESC MEASURES ARE TO REMAIN IN PLACE AND IN WORKING ORDER UNTIL ALL ON-SITE CONSTRUCTION IS COMPLETED.
10. AREAS WHICH REMAIN DISTURBED FOR MORE THAN 30 DAYS SHALL BE STABILIZED USING SEED, APPROVED EROSION CONTROL BLANKETS, OR SIMILAR APPROVED EQUIVALENT. IF CONDITIONS AREN'T SUITABLE FOR SEED APPLICATION, AN EROSION CONTROL BLANKET WILL BE USED IN ITS PLACE. SEE EROSION CONTROL BLANKET TYPICAL DETAIL ON SHEET 009.
11. NO EROSION AND SEDIMENT CONTROL MEASURE SHALL CONTAIN ANY PLASTIC, EVEN IF IT IS BIODEGRADABLE.
12. THE CONTRACTOR MUST HAVE SUITABLE PUMPING CAPABILITIES ON SITE AT ALL TIMES TO FACILITATE CONSTRUCTION ACTIVITIES IN THE DRY.
13. WORKS SHOULD BE COMPLETED IN STAGES TO REDUCE THE DURATION OF DISTURBED AREAS.
14. CONTRACTOR IS NOT TO DISPOSE OF ANY OF THE MATERIAL USED IN THE PEA GRAVEL METER BAGS INTO THE CHANNEL OR SURROUNDING AREA. ALL PEA GRAVEL BAGS ARE TO BE REMOVED OFF OF SITE.
15. TEMPORARY STAGING AREAS ARE TO BE SITUATED MORE THAN 15 METERS FROM THE WATERCOURSE. ALL MAJOR OVERNIGHT STAGING / STOCKPILING AREAS WILL BE A MINIMUM OF 30 METERS AWAY FROM THE WATERCOURSE. CONTRACTOR TO MONITOR WEATHER FORECASTS TO ENSURE MACHINES AND MATERIALS ARE REMOVED WHEN THE INCLEMENT WEATHER IS ANTICIPATED. STOCKPILE HEIGHTS WILL BE KEPT BELOW 1.5 METERS IN HEIGHT.

SECTION 2: CONSTRUCTION TIMING

16. TO PROTECT LOCAL FISH POPULATIONS DURING THEIR SPAWNING, NURSERY AND MIGRATORY PERIODS, IN-WATER ACTIVITIES SHOULD OCCUR DURING THE TIME PERIOD OF JULY 15 TO APRIL 15 (OF THE FOLLOWING YEAR), IN ACCORDANCE WITH THE OMINECA REGION LEAST-RISK TIMING WINDOW FOR RAINBOW TROUT. CHANNEL WORKS ARE BEST COMPLETED IN LATE SUMMER / EARLY FALL, WHEN FLOWS ARE LOW AND THERE IS NO ICE. TIMING SUBJECT TO CONFIRMATION FROM PROVINCIAL REGULATORS.

SECTION 3: FISH RELOCATION

17. FISH STRANDED WITHIN THE WORK AREA SHALL BE CAPTURED AND RELEASED LIVE IN SUITABLE HABITAT DOWNSTREAM OF THE WORK AREA UNDER THE SUPERVISION OF A QUALIFIED AQUATIC BIOLOGIST. A PERMIT FROM MOFLNRORD IS REQUIRED.

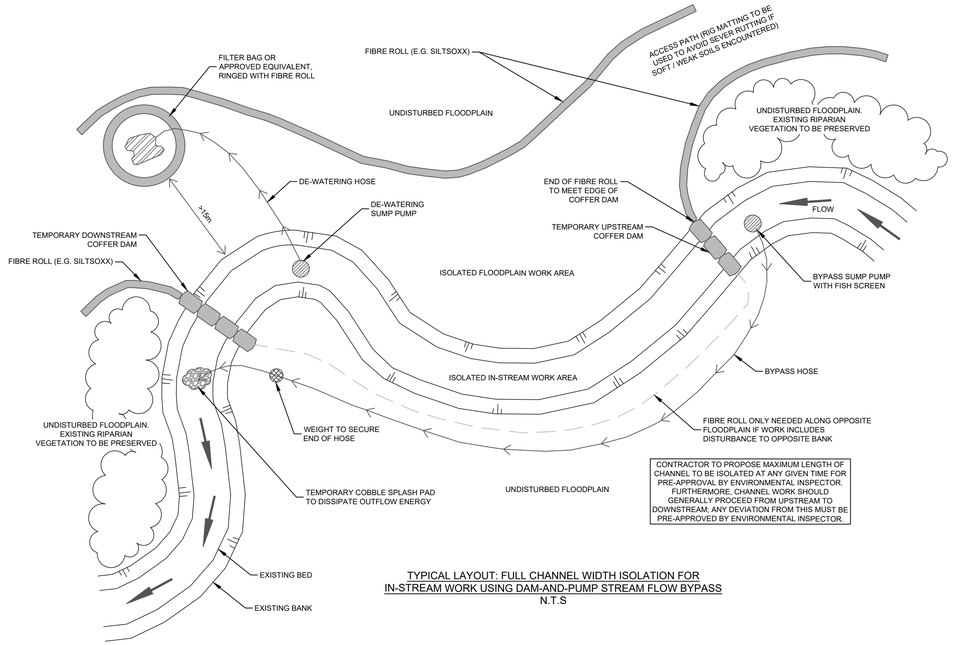
GENERAL STAGING PLAN FOR IN-CHANNEL WORK:

1. INSTALL FIBRE ROLLS ALONG ACCESS ROAD WHEN IT IS WITHIN 15m OF THE WATERCOURSE. ENSURE ENDS OF FIBRE ROLLS ARE POSITIONED TO TIE-IN WITH EDGES OF COFFER DAMS.
2. LAY DOWN RIG MATS ALONG ANY PORTIONS OF THE FLOODPLAIN ACCESS ROUTE WHERE THE SOILS ARE OBSERVED OR EXPECTED TO BE SOFT / WEAK, PRIOR TO EQUIPMENT ACCESS.
3. INSTALL UPSTREAM AND DOWNSTREAM COFFER DAMS IN A CONTROLLED MANNER TO REDUCE DISTURBANCE OF CHANNEL BED / BANKS AND RELEASE OF SEDIMENTS INTO CHANNEL.
4. INSTALL BYPASS PUMP AND HOSE TO BYPASS STREAM FLOW AROUND ISOLATED WORK AREA.
5. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
6. INSTALL DE-WATERING PUMP, HOSE, AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
7. PERFORM REQUIRED CHANNEL / BANK RESTORATION AND ENHANCEMENT WORKS, AS PER DESIGN SPECIFICATIONS.
8. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO REINTRODUCE FLOW GRADUALLY BACK INTO THE RESTORED CHANNEL.
9. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING DOWNSTREAM TO THE NEXT IN-CHANNEL WORK AREA.
10. REPEAT FROM STEP 1, AS NECESSARY, AS CHANNEL WORKS ARE COMPLETED FROM UPSTREAM TO DOWNSTREAM.

***NOTE: TEMPORARY EROSION & SEDIMENT CONTROL MEASURES TO BE REMOVED ONCE AREA STABILIZED. ALL DISTURBED RIPARIAN/FLOODPLAIN AREAS, INCLUDING BUT NOT LIMITED TO ACCESS ROADS AND LAYDOWN AREAS, TO BE SEEDED/RESTORED AS NEEDED TO PRE-EXISTING CONDITIONS OR BETTER.

WORK AREA ISOLATION NOTES

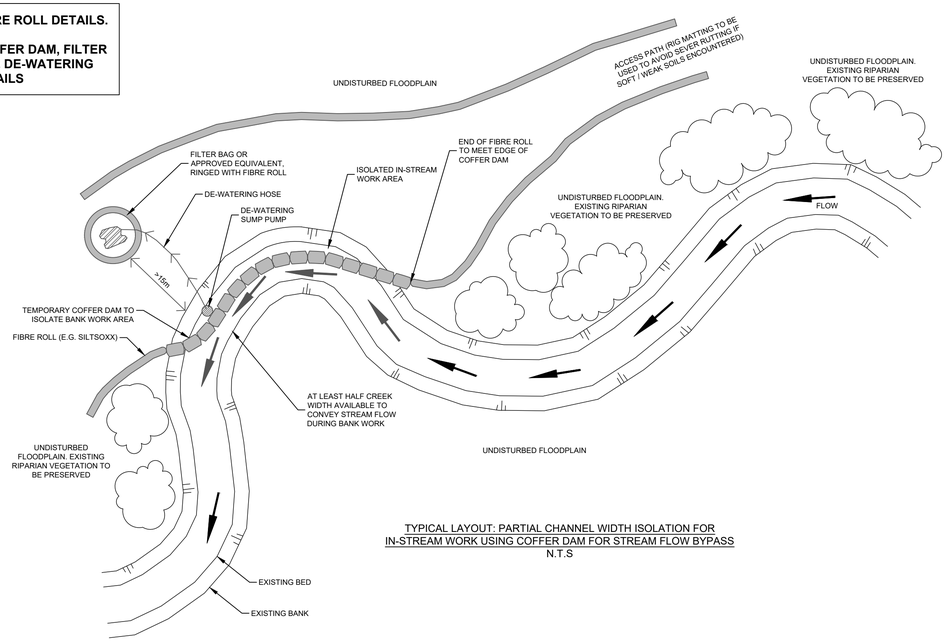
- INSTALL IN-STREAM PUMP OR INTAKE LINE OF REMOTE PUMP IN POOL LOCATED UPSTREAM OF WORK AREA. PROVIDE SCREENING TO PREVENT FISH FROM ENTERING INTO PUMP INTAKE . GO TO https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html FOR APPROPRIATE SIZING OF FISH SCREEN. DIG TEMPORARY SUMP UPSTREAM IF NO NATURAL POOL EXISTS. DISCHARGE WATER THROUGH OR INTO AN ENERGY DISSIPATER INTO THE WATERCOURSE SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- INSTALL UPSTREAM COFFER DAM WITH IMPERVIOUS LINER ACROSS WATERCOURSE AND MATCH WITH EXISTING CREEK BANKS. CENTER OF COFFER DAM TO BE DEPRESSED 0.150m
- WATER COLLECTED WITHIN THE ISOLATED WORK AREA TO BE PUMPED AROUND THE CONSTRUCTION SITE, DISCHARGED THROUGH A FILTER BAG LOCATED WITHIN THE FLOODPLAIN AS REMOTE FROM THE WATERCOURSE AS POSSIBLE AND SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- AT THE END OF THE DAY THE STREAM MUST BE STABILIZED AND FREE FLOWING OR PUMPING MUST BE SUPERVISED.
- IN GENERAL ALL IN-STREAM CONSTRUCTION TO BE COMPLETED IN THE DRY. FISH EVACUATION PLAN MUST BE SUBMITTED AND APPROVED BY MOFLNRORD PRIOR TO COMMENCEMENT OF THE PROJECT. FISH RESCUE SHALL BE CONDUCTED FROM ISOLATED WORK AREAS BY A QUALIFIED INDIVIDUAL WITH A VALID PERMIT IN ACCORDANCE WITH THE BRITISH COLUMBIA STANDARDS AND BEST PRACTICES FOR IN-STREAM WORKS.
- INSTALL UPSTREAM COFFER DAM CONSISTING OF DOUBLE LINE WALL OF PEA GRAVEL BAGS COMPLETE WITH A LAYER OF IMPERMEABLE LINER SECURED BETWEEN THEM ACROSS WATERCOURSE AND MATCH EXISTING BANKS. DOWNSTREAM PEA GRAVEL BAGS SHALL BE INSTALLED TO PREVENT MIGRATION OF SILT AND SEDIMENT INTO THE ACTIVE STREAM FLOW. ENSURE COFFER DAM INSTALLATION IS EFFECTIVELY ISOLATING THE WORK AREA.
- IN-STREAM WORK IS TO START AT THE UPSTREAM LIMIT OF CONSTRUCTION AND BE COMPLETED SIMULTANEOUSLY WITH EXCAVATION SUCH THAT UNPROTECTED EXPOSURE IS MINIMIZED.
- DISTURBANCE CAUSED BY CONSTRUCTION EQUIPMENT ALONG THE BANK OR EDGE OF CREEK SHALL BE MINIMIZED BY THE USE OF RUBBER TRACKED EQUIPMENT, WOODEN MATS, OR OTHER APPROVED PROTECTIVE MEASURES.



TYPICAL LAYOUT: FULL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING DAM-AND-PUMP STREAM FLOW BYPASS
N.T.S

REFER TO SHEET 009 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 010 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS



TYPICAL LAYOUT: PARTIAL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING COFFER DAM FOR STREAM FLOW BYPASS
N.T.S

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REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 26, 2021	AB	MF
B	ISSUED FOR REVIEW	APR 13, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 16, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 26, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
www.onsite-engineering.ca

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN

LOWER MURRAY CREEK HABITAT RESTORATION AND ENHANCEMENT

ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501

OEL PROJECT NO. 1824-4-8

DRAWING NO. 008

SHEET: 8 OF 13 REV E

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

NOT FOR CONSTRUCTION

SEDIMENT CONTROL BARRIERS

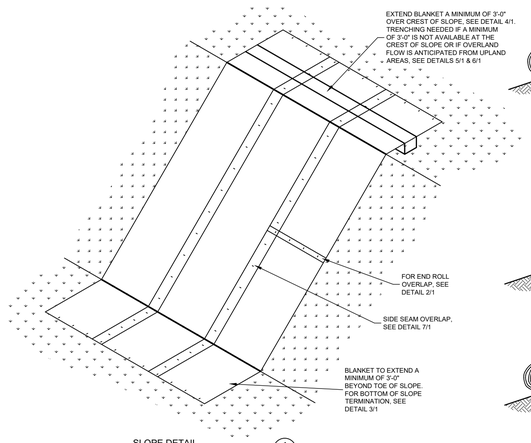
OPTION 1 - FIBRE ROLL

- FIBRE ROLL (E.G FILTREXX SILTSOXX OR APPROVED EQUIVALENT), FILLED WITH WOOD CHIPS, ARE THE PREFERRED TYPE OF SEDIMENT CONTROL BARRIER.
- MIN. DIAMETER = 300mm
- FIBRE ROLLS TO BE REGULARLY INSPECTED FOR TEARS OR HOLES, AND REPAIRED / REPLACED AS NEEDED TO MAINTAIN FUNCTION.
- FIBRE ROLLS MAY BE RE-USED IN A DIFFERENT LOCATION, ONLY IF THEY REMAIN FREE OF TEARS / HOLES, HAVE NOT LOST ANY OF THEIR CONTENTS, AND STILL MAINTAIN THE MINIMUM DIAMETER.
- REMOVE ALL SURFACE OBSTRUCTIONS GREATER THAN 50mm FROM THE GROUND PRIOR TO PLACING FIBRE ROLLS.
- TYPICAL FIBRE ROLL INSTALLATION DETAILS ARE SHOWN ON THIS SHEET FOR A FILTREXX SILTSOXX FIBRE ROLL. THE CONTRACTOR MAY USE THIS BRAND OF FIBRE ROLL OR AN APPROVED EQUIVALENT.

OPTION 2 - SEDIMENT CONTROL FENCE

- SEDIMENT CONTROL FENCE SUPPLIES SHOULD BE AVAILABLE ON SITE FOR USE IN CASES WHERE SURFACE PONDING OCCURS AND ADDITIONAL SILTATION CONTROL IS WARRANTED BEYOND WHAT THE FIBRE ROLLS CAN PROVIDE.
- GEOTEXTILE TO BE NON-WOVEN WITH A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
- NON-WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1 METER AT JOINTS.
- TYPICAL SEDIMENT CONTROL FENCE INSTALLATION DETAILS ARE SHOWN ON THIS SHEET. THESE DETAILS REPRESENT IDEAL SCENARIOS. ACTUAL SITE CONDITIONS MAY VARY AND SEDIMENT CONTROL FENCE INSTALLATION SHOULD BE TAILORED FOR EACH SITE.

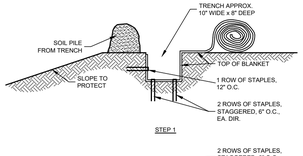
EROSION CONTROL BLANKET - TYPICAL DETAILS

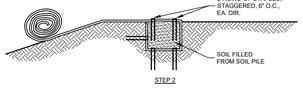


SLOPE DETAIL
NO SCALE — 1/1

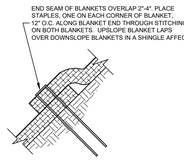
OVER SLOPE
CREST METHOD
NO SCALE — 4/1

DO NOT NEED TO TRENCH BLANKET IN IF IT CAN BE EXTENDED A MINIMUM OF 3'-0" OVER THE CREST OF THE SLOPE.

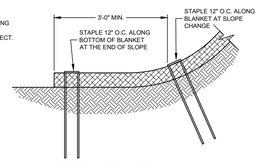




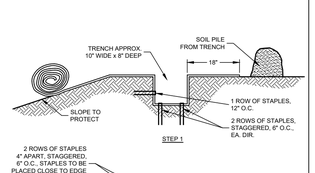
SLOPE TRENCHING
METHOD "A"
NO SCALE — 5/1

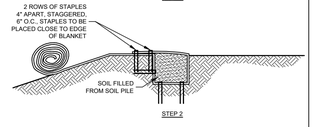


END ROLL OVERLAP
NO SCALE — 2/1



BOTTOM OF SLOPE
TERMINATION
NO SCALE — 3/1

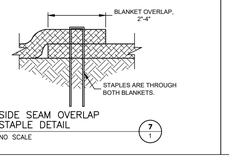




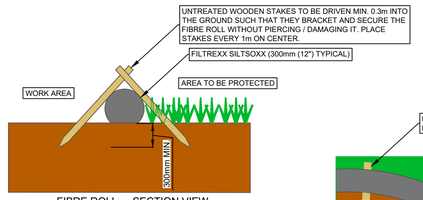
SLOPE TRENCHING
METHOD "B"
NO SCALE — 6/1

EROSION CONTROL BLANKETS

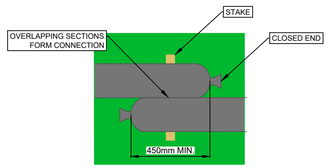
- BIODEGRADABLE EROSION CONTROL BLANKETS (E.G WOVEN JUTE, COIR MESH, GREAT LAKES ASPEN, ETC) TO BE AVAILABLE ON SITE IN CASE THEY ARE NEEDED TO HELP MITIGATE EROSION OF TEMPORARILY EXPOSED SOILS ON THE FLOODPLAIN
- DRAWINGS SHOWN ON THIS SHEET ILLUSTRATE TYPICAL INSTALLATION DETAILS FOR AN AMERICAN EXCELSIOR CURLEX NETFREE SLOPE PROTECTION EROSION CONTROL BLANKET. THE CONTRACTOR MAY USE THIS BRAND OF EROSION CONTROL BLANKET OR AN APPROVED EQUIVALENT.



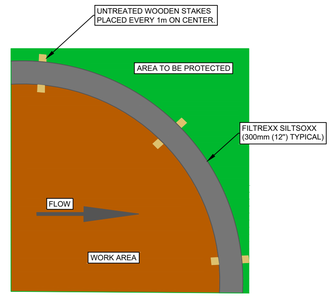
SIDE SEAM OVERLAP
STAPLE DETAIL
NO SCALE — 7/1



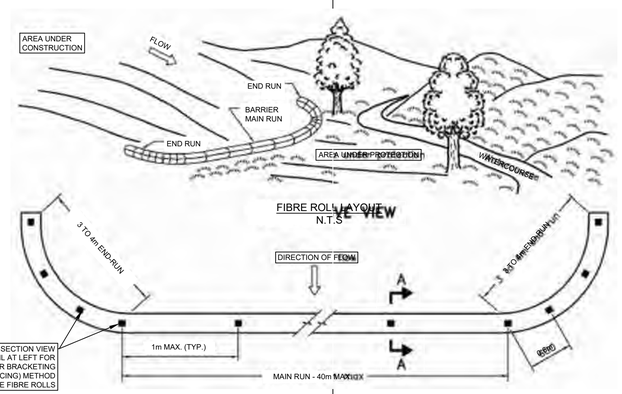
FIBRE ROLL - SECTION VIEW
N.T.S



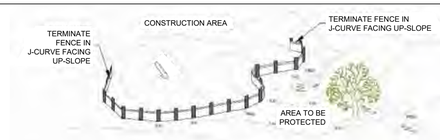
FIBRE ROLL - END CONNECTION DETAIL
N.T.S



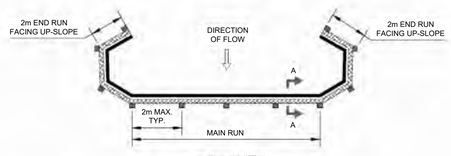
FIBRE ROLL - PLAN VIEW
N.T.S



FIBRE ROLL LAYOUT - PLAN VIEW
N.T.S



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
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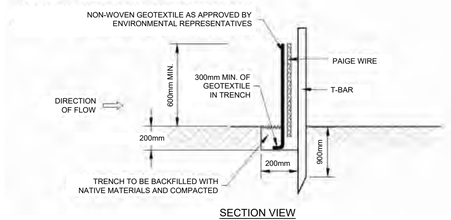
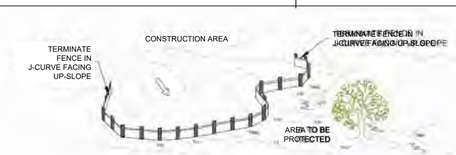
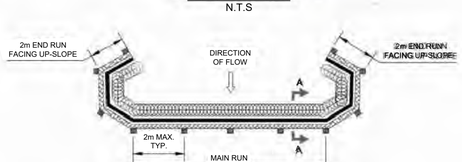


SECTION VIEW
N.T.S

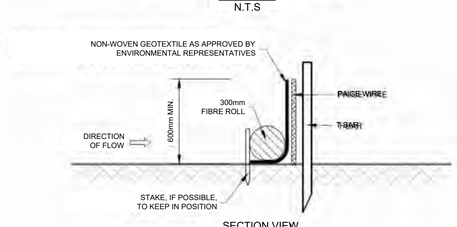
SEDIMENT CONTROL FENCE - UNFROZEN CONDITIONS



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
N.T.S



SECTION VIEW
N.T.S

SEDIMENT CONTROL FENCE - FROZEN CONDITIONS

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER MURRAY CREEK HABITAT RESTORATION AND ENHANCEMENT
SEDIMENT CONTROL BARRIERS & EROSION CONTROL
BLANKET DETAILS FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-8
DRAWING NO. 009
SHEET: 9 OF 13
REV E

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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WORK AREA ISOLATION MEASURES

METRE BAG COFFER DAM

- FOR ISOLATION OF THE FULL CHANNEL WIDTH (DAM-AND-PUMP STREAM-FLOW BYPASS) OR ONLY A PORTION OF THE CHANNEL WIDTH (PASSIVE STREAM-FLOW BYPASS FOR SINGLE-BANK WORK) FOR IN-CHANNEL WORK.
- 1-2 TIER, SINGLE-STACK METRE BAG COFFER DAM PREFERRED GIVEN MINIMAL DISTURBANCE; PYRAMID-STACK METRE BAG COFFER DAM MAY BE NECESSARY IN DEEPER-WATER SCENARIOS.
- METRE BAGS SHOULD BE FILLED WITH PEA GRAVEL AND SHOULD NOT BE OVER-FILLED.
- A WATERPROOF MEMBRANE IS REQUIRED OVER THE PEA-GRAVEL METRE BAGS. THE WATERPROOF MEMBRANE MUST BE KEYED IN UNDER THE BARRIER TO MINIMIZE LEAKAGE.
- COFFER DAM MAY BE CONSTRUCTED OF SMALLER PEA-GRAVEL SANDBAGS OR OTHER SUITABLE EQUIVALENT. SEE BELOW FOR DETAILS.

PEA GRAVEL COFFER DAM

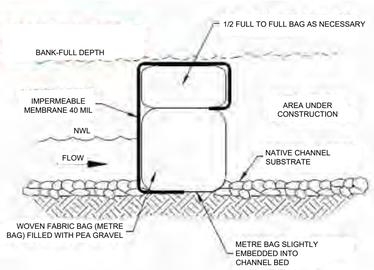
- CAN BE USED AT THE DISCRETION OF THE ENVIRONMENTAL REPRESENTATIVE FOR ISOLATION OF CHANNELS IN LOW-FLOW, SHALLOW WATER CONDITIONS WHEN LOCAL WORKS CAN BE COMPLETED WITHIN A FAVORABLE WEATHER WINDOW AND / OR THE CHANNEL IS LOCALLY TOO NARROW OR AWKWARD FOR THE USE OF METRE BAGS.

DE-WATERING SUMP PUMP

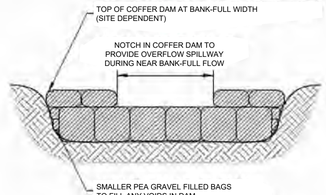
- FOR TEMPORARY MAINTENANCE OF DRY OR SHALLOWER CONDITIONS WITHIN AN ISOLATED IN-CHANNEL WORK AREA.
- A PUMP WITH A MINIMUM RECOMMENDED PUMPING CAPACITY OF 2000GPM MUST BE USED.
- DURING ELEVATED FLOWS APPROACHING BANK-FULL DEPTH, ALL PUMPING WILL BE STOPPED AND COFFER DAMS WILL BE TEMPORARILY REMOVED TO ALLOW FLOWS TO PASS UNOBSTRUCTED.

DE-WATERING FILTER BAG RINGED WITH FILTREXX SILTSOXX (OR APPROVED EQUIVALENT)

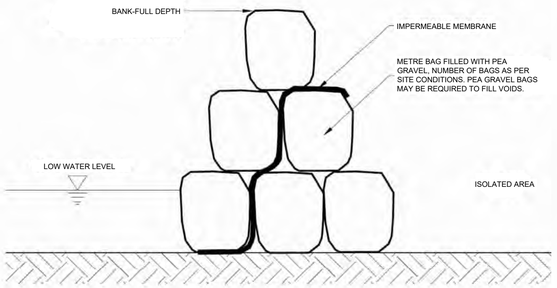
- FOR CONTROLLED DEPOSITION OF FINE SEDIMENT PUMPED OUT OF AN ISOLATED IN-CHANNEL WORK AREA, AWAY FROM THE WATERCOURSE.
- PLACE FILTER BAG (3.5m X 5.0m TERRAFIX ENVIROBAG OR APPROVED EQUIVALENT) ON A LEVEL, STABILIZED AREA OF THE FLOODPLAIN, ON VEGETATED GROUND > 15m AWAY FROM THE CHANNEL. FILTREXX SILTSOXX (300mm (12") DIAMETER) OR APPROVED EQUIVALENT TO BE PLACED AROUND THE FILTER BAG.
- ISOLATED SECTION OF CHANNEL TO BE PUMPED AND DE-WATERED INTO FILTER BAG.
- REPLACE UNIT WHEN HALF FULL OF SEDIMENT OR WHEN SEDIMENT HAS SIGNIFICANTLY REDUCED THE FLOW RATE OF PUMP DISCHARGE.
- ALLOW SEDIMENT BAG TO DRY IN DESIGNATED SEDIMENT DRYING AREA AND THEN RE-USE THE SEDIMENT AS PART OF BANK RESTORATION OR DISPOSE OF IT OFF SITE UNDER DIRECTION OF THE ON-SITE ENVIRONMENTAL REPRESENTATIVE.



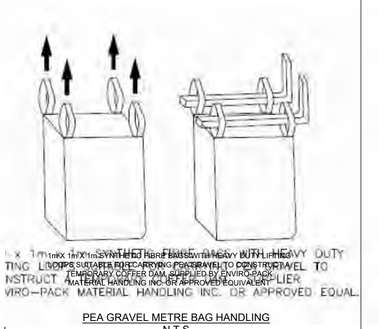
METRE BAG COFFER DAM - SECTION
N.T.S



METRE BAG COFFER DAM - PROFILE
N.T.S



METRE BAG WATERPROOF ISOLATION BARRIER - SECTION
N.T.S



PEA GRAVEL METRE BAG HANDLING
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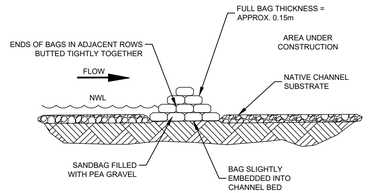

PEA GRAVEL BAG COFFER DAM - SECTION
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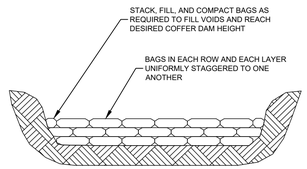

PEA GRAVEL BAG COFFER DAM - PROFILE
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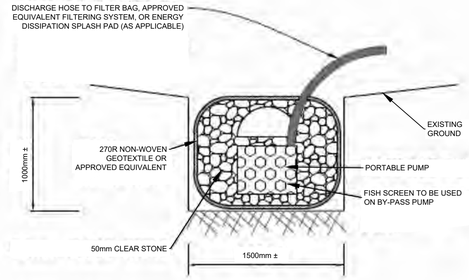
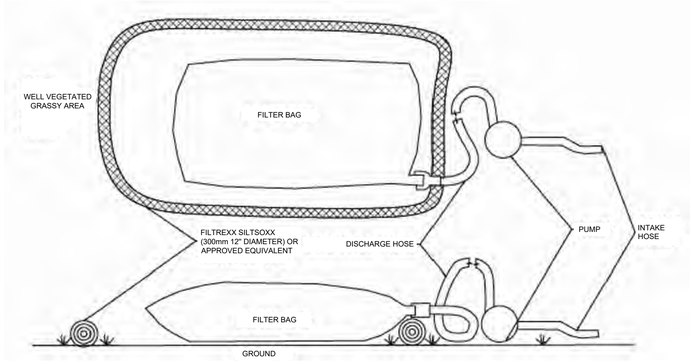


DE-WATERING SUMP PUMP DETAIL
N.T.S



DE-WATERING FILTER BAG WITH FILTREXX SILTSOXX - PLAN & PROFILE
N.T.S

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VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

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INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
www.onsite-engineering.ca

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER MURRAY CREEK HABITAT RESTORATION AND ENHANCEMENT
WORK AREA ISOLATION MEASURES

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-8
DRAWING NO. 010
SHEET: 10 OF 13
REV E

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DATE: 2021.12.20 5:12 PM BY: Jesse Lutz

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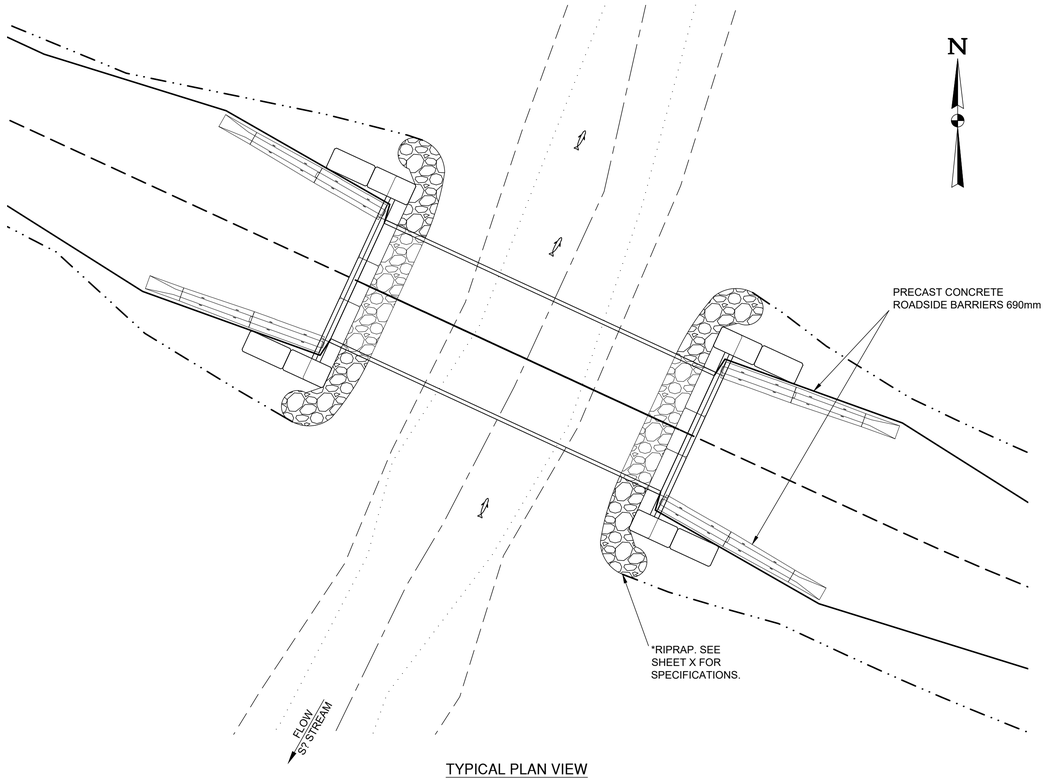


TYPICAL PLAN VIEW

10:1

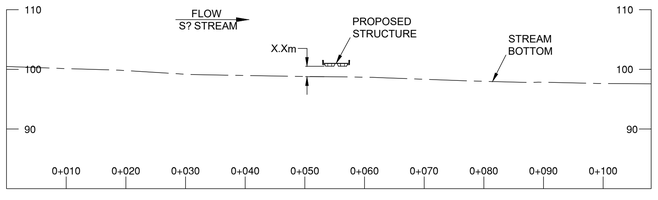
OBJECTIVE:
CROSSINGS ARE PROPOSED AT STRATEGIC LOCATIONS TO ALLOW FOR THE SAFE PASSAGE OF MACHINERY AND LIVESTOCK ACROSS THE CHANNEL AND TO AVOID EXCESS DISTURBANCE TO THE CREEK (E.G. CATTLE TRAMPLING, MACHINERY FORDS). CLEAR SPAN BRIDGES WERE CHOSEN TO ENSURE FISH AND WILDLIFE PASSAGE AND TO ACCOMMODATE NATURAL CREEK PROCESSES. THE PROPOSED CROSSING LOCATIONS WERE CHOSEN BASED ON GEOMORPHIC, ECOLOGICAL, AND AGRICULTURAL CONSIDERATIONS. CROSSINGS ARE NOT POSITIONED NEAR SHARP MEANDER BENDS.

A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.

LEGEND	
DESIGNED ROAD EDGES	
DESIGNED ROAD CENTRELINE	
APPROXIMATE EXTENT OF CUT/FILL SLOPE	
HIGH WATER LEVEL	
STREAM THALWEG	
PRESENT WATER LEVEL	

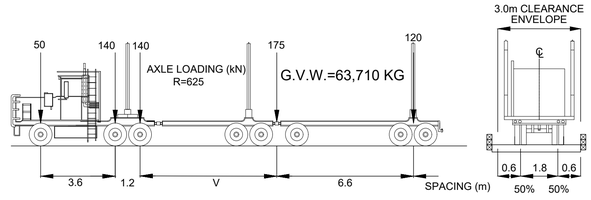
NOTES:

1. **DURATION:**
   - 1.1. FOR THE PURPOSE OF THIS DESIGN THE TERM PERMANENT AS IT REFERS TO DURATION OF THE INSTALL MEANS FORTY-FIVE (45) YEARS OR LESS. AS TREATED SILL AND BALLAST WALL TIMBERS ARE TO BE USED, REPLACEMENT OF TIMBER COMPONENTS IS EXPECTED AFTER TWENTY FIVE (25) YEARS. ROUTINE BRIDGE INSPECTIONS ARE TO BE COMPLETED TO DETERMINE THE ACTUAL LIFE OF TIMBER COMPONENTS AND WHEN THEY ARE TO BE REPLACED.
2. **DESIGN LIVE LOAD:**
   - 2.1. DESIGN VEHICLE: BCL-625 AS PER MOFLNRORD (STD-EC-000-001 TO 002).
3. **STRUCTURE:**
   - 3.1. SUPERSTRUCTURE TO BE PROVIDED BY OTHERS. SUPERSTRUCTURE DESIGN TO BE IN ACCORDANCE WITH CAN/CSA-S6 (MODIFIED AS PER MOFLNRORD INTERIM BRIDGE DESIGN GUIDELINES JULY 23-2010) AND IS TO TAKE INTO ACCOUNT LOGGING TRUCKS WITH UNBALANCED LOADS AND OFF-CENTER DRIVING.
   - 3.2. EXCEPT AS NOTED, SPECIFICATIONS TO BE AS PER MOFLNRORD STANDARD DRAWINGS FOR ALL STEEL PORTABLE BRIDGES (STD-E-090-01 TO 02), LOCK BLOCK ABUTMENT (STD-EC-050-01 AND STD-EC-050-012), CONSTRUCTION PAD (STD-EC-050-15), AND NO POST BARRIERS/GUIDE LOGS (STD-E-010-05).
   - 3.3. IF SUPERSTRUCTURE HAS BEEN USED PREVIOUSLY AT ANOTHER LOCATION IT MUST BE INSPECTED BY A PROFESSIONAL ENGINEER PRIOR TO USE AT THIS SITE. IF A NEW STRUCTURE IS PLANNED, OEL IS TO REVIEW FABRICATION DRAWINGS PRIOR TO FABRICATION OF SUPERSTRUCTURE FOR COMPLIANCE WITH THIS DESIGN.
   - 3.4. CHECK REQUIRED BEARING TO BEARING DISTANCE AND DEPTH OF ACTUAL STRUCTURE PRIOR TO CONSTRUCTION OF THE ABUTMENTS. BOTTOM OF GIRDER ELEVATIONS TO GOVERN.
   - 3.5. GENERAL ARRANGEMENT DRAWING. SOME SUPERSTRUCTURE COMPONENTS NOT SHOWN. REFER TO FABRICATION DRAWINGS.
4. **DESIGN OF ROAD APPROACHES AND DECK WIDTH:**
   - 4.1. HORIZONTAL ALIGNMENT AND ROAD WIDTHS TO PERMIT W-19 TRUCKS WITH 0.5m CLEARANCE INSIDE CURBS.
5. **CREEK NOTES:**
   - 5.1. STREAM RIPARIAN CLASS IS TO BE DETERMINED FOR EACH SITE BASED ON STREAM WIDTH AND FISH PRESENCE/ACCESS.
   - 5.2. STREAM BED MATERIAL IS TO BE DETERMINED FOR EACH SITE.
   - 5.3. THE DESIGN FLOOD IS EXPECTED TO BE: ■ CLEARWATER FLOOD ☐ DEBRIS FLOOD ☐ DEBRIS FLOW
   - 5.4. DESIGN FLOOD: TO BE DETERMINED FOR EACH SITE. THE PEAK FLOW FOR DESIGN PURPOSES WILL BE DETERMINED BASED ON REVIEW OF CHANNEL CHARACTERISTICS, PREVIOUS HIGH FLOW EVIDENCE, AND REVIEW OF THE RESULTS OF PEAK FLOW EMPIRICAL MODELS SUCH AS THE RATIONAL METHOD AND A REGIONAL ANALYSIS. WATERSHED CHARACTERISTICS, AND OTHER RELEVANT INFORMATION ARE ALSO USED TO ESTIMATE PEAK FLOW.
   - 5.5. LOW LIKELIHOOD OF WOODY DEBRIS MOVEMENT.
   - 5.6. CLIMATE CHANGE: CLIMATE CHANGE WILL BE CONSIDERED IN THE DESIGN FLOOD ASSESSMENT.
6. **GEOTECHNICAL:**
   - 6.1. FOUNDATION DESIGN REFERENCES THE CANADIAN FOUNDATION ENGINEERING MANUAL. SUBSURFACE INFORMATION WILL BE INFERRED FROM SITE OBSERVATIONS OF SOIL EXPOSURES IN ROAD CUTS AND ALONG STREAMBANKS AND FROM SHALLOW HAND DUG TEST PITS AND PROBES (SEE DESCRIPTION ON SHEET 4). NO DETAILED SUBSURFACE FIELD INVESTIGATION WAS CONDUCTED (LARGE TEST PITS OR BORE HOLES). FIELD CONDITIONS MAY VARY FROM THOSE INFERRED. IF, UPON EXCAVATION, FIELD CONDITIONS VARY FROM THOSE INFERRED, THEN CHANGES TO THE FOUNDATION DESIGN OR INSTALLATION MAY BE REQUIRED.
   - 6.2. FOOTING DESIGN BASED ON ASSUMED SOIL BEARING CAPACITY OF 200kPa.
7. **FIELD REVIEWS:**
   - 7.1. A PROFESSIONAL ENGINEER OR THEIR DESIGNATE IS REQUIRED TO INSPECT THE FOLLOWING ACTIVITIES PRIOR TO PROVIDING RECORD DRAWINGS AND A CROSSING ASSURANCE STATEMENT:
     - LAYOUT OF RIPRAP/ABUTMENT LOCATION PRIOR TO INITIAL EXCAVATION
     - FOUNDATION SOILS FOLLOWING EXCAVATION
     - RIPRAP AND ABUTMENT CONSTRUCTION
     - BACKFILL MATERIAL AND TECHNIQUE
     - OTHER SITE INSPECTIONS AT THE DISCRETION OF THE PROFESSIONAL
9. **INSTALLATION NOTES:**
   - 9.1. RIPRAP SOURCE HAS NOT BEEN IDENTIFIED.
   - 9.2. NOTE THAT WHERE EXCAVATION SPECIFICATIONS ON THESE DRAWINGS CONFLICT WITH WORKSAFEBC REGULATIONS, WORKSAFEBC REGULATIONS ARE TO GOVERN.
   - 9.3. PLAN TO DEWATER FOOTING AREAS.



TYPICAL STREAM PROFILE VIEW

2:1



BCL-625 DESIGN TRUCK LOADING DIAGRAM

V = VARIABLE SPACING - 6.6m TO 18m INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES THE MAXIMUM STRESSES.

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OEL PROJECT NO. 1824-4-8
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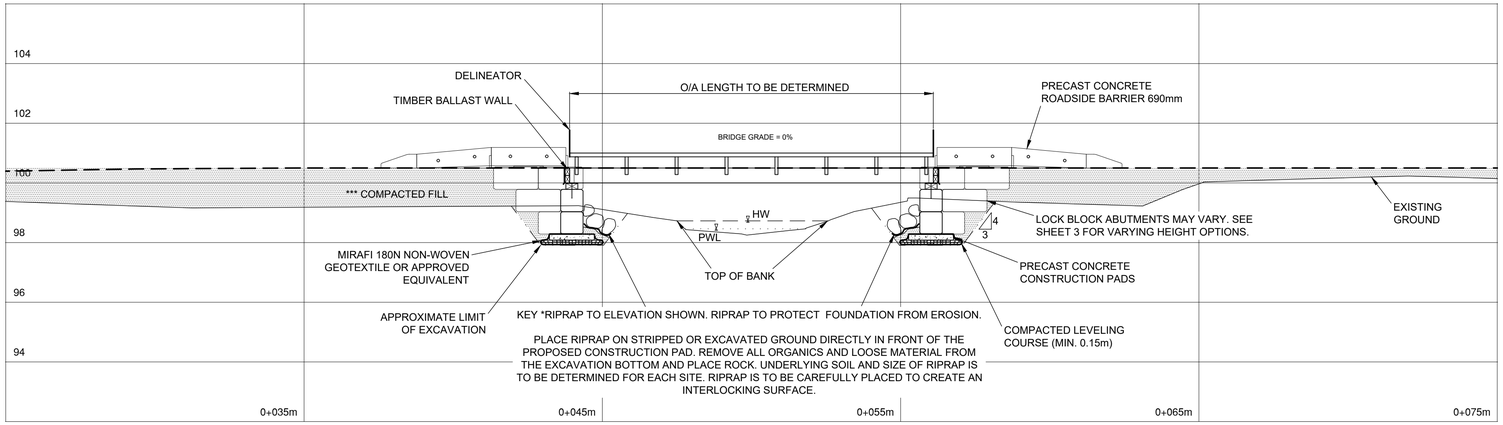

TYPICAL ELEVATION VIEW

10:1

PARTIAL MATERIALS LIST	
QTY	ITEM DESCRIPTION
TBD	ROLLS NON-WOVEN GEOTEXTILE: MIRAFI 180N OR EQUIVALENT
TBD	ROLLS OF GEOGRID: MIRAFI 7XT OR EQUIVALENT
Xm³	LEVELING COURSE (SANDY GRAVEL OR 19mm CLEAR CRUSH) - CRUSH RECOMMENDED WHERE WATER EXPECTED IN FOOTING AREA
4	PRECAST CONCRETE CONSTRUCTION PADS: 0.2m X 1.5m X 4.6m [15']
TBD	STD CONCRETE BLOCKS (INTERLOCKING): 0.75m X 0.75m X 1.5m (TYP.)
TBD	FLAT TOP CONCRETE BLOCKS (INTERLOCKING): 0.75m X 0.75m X 1.5m (TYP.)
2	TREATED TIMBER SILLS: 0.2m X 0.4m X 4.9m [16']
6	STEEL PINS: 25mmØ [1"] TO ATTACH SILL TO LOCK BLOCKS
8	LAG BOLTS: 19mmØ [¾"] X 200mm TO ATTACH STEEL GIRDERS TO SILL
TBD	TIMBER BALLAST WALL: 0.15m X 0.3m X 6.0m [20'] LONG TIMBERS
4	GUIDE LOGS: 0.6m Ø X 6m LENGTH (TYP.)
4	W-054 SERIES DELINEATORS (2 LEFT, 2 RIGHT)
2	W-051 SERIES NARROW STRUCTURE SIGNS
2	POSTS FOR NARROW STRUCTURE SIGNS: 0.2m X 4.0m LENGTH LOG POSTS OR 0.1m X 0.1m X 3.0m LENGTH TREATED TIMBERS
1	BAG ROADSIDE GRASS SEED MIX
	RIPRAP: SEE SPECIFICATIONS ON THIS SHEET

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 50kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 5(155)
50% 50(330)
85% 150(475)
NOMINAL THICKNESS OF RIPRAP
550mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 100kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 10(195)
50% 100(415)
85% 300(600)
NOMINAL THICKNESS OF RIPRAP
700mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 250kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 25(260)
50% 250(565)
85% 750(815)
NOMINAL THICKNESS OF RIPRAP
1000mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

LEGEND	
DESIGNED ROAD GRADE	
APPROXIMATE LIMIT OF EXCAVATION	
HIGH WATER LEVEL	
PRESENT WATER LEVEL	
MIRAFI 180N GEOTEXTILE (OR APPROVED EQUIVALENT)	

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**SOIL DENSITY	
VERY LOOSE	EASILY EXCAVATED WITH A SPADE
LOOSE	SOME RESISTANCE TO SPADE
COMPACT	CONSIDERABLE RESISTANCE TO SPADE
DENSE	REQUIRES PICK FOR EXCAVATION
VERY DENSE	HIGH RESISTANCE TO PICK

***COMPACTED FILL
GRANULAR FILL TO BE COMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY.

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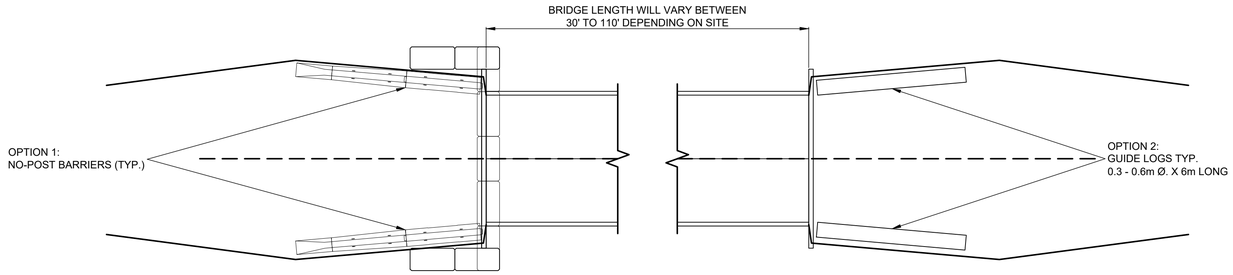
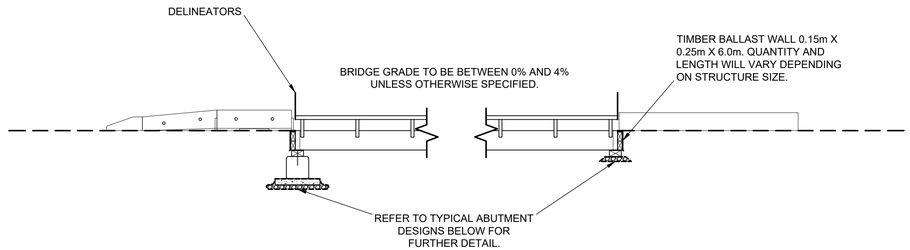




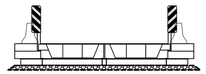
A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.

LEGEND	
DESIGNED ROAD EDGES	———
DESIGNED ROAD GRADE	— — —
MIRAFI 7XT GEOGRID (OR APPROVED EQUIVALENT)	— — —
MIRAFI 180N GEOTEXTILE (OR APPROVED EQUIVALENT)	- - - - -

SPECIFICATIONS FOR CONCRETE BLOCKS (INTERLOCKING):

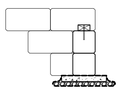
- CONCRETE MUST HAVE A 28 DAY STRENGTH OF 20MPa MINIMUM UNLESS OTHERWISE SPECIFIED.
- BLOCKS SHALL BE CAST MONOLITHICALLY (I.E., NO COLD JOINTS ALLOWED).
- THE FINISH SHALL MEET CLASS 1.
- CLASS 1 - CLASS 1 FINISH IS THE BASIC FINISH TO BE PRODUCED ON ALL FORMED SURFACES NOT EXPOSED TO VIEW UNLESS A BETTER FINISH IS SPECIFIED OR REQUIRED BY THE DRAWINGS OR SPECIAL PROVISIONS.
  - IN ORDER TO PRODUCE A CLASS 1 FINISH, THE FORMWORK SHALL BE MORTAR TIGHT. PANEL MARKS AND TEXTURE ARE OF NO IMPORTANCE.
  - ALL TIES, BOLTS, NAILS AND OTHER METAL SPECIFICALLY REQUIRED FOR CONSTRUCTION PURPOSES SHALL BE REMOVED OR CUT BACK TO A DEPTH OF 50mm FROM THE SURFACES OF THE CONCRETE AND THE RESULTING HOLES FILLED.
  - NO DRY TIES SHALL BE PERMITTED; FORM TIE RODS SHALL REMAIN EMBEDDED AND TERMINATE NOT LESS THAN 50mm FROM THE FORMED FACE OF THE CONCRETE. REMOVABLE EMBEDDED FASTENERS ON THE ENDS OF THE RODS SHALL BE SUCH AS TO LEAVE HOLES OF A REGULAR SHAPE FOR REAMING AND FILLING.
  - HONEYCOMBS AND VOIDS OVER 500mm^2 IN AREA SHALL BE FILLED.
- BLOCK SIZE MUST BE 1500x750x750mm.
- DIMENSIONAL TOLERANCE MUST BE ± 20mm FOR LENGTH, WIDTH AND HEIGHT AND THE BLOCKS SHALL BE REASONABLY SQUARE, WITH THE DIAGONALS WITHIN A TOLERANCE OF ± 15mm OF EACH OTHER.
- TOP AND BOTTOM SURFACES MUST BE FLAT TO A TOLERANCE OF ± 3mm UNDER A 600mm STRAIGHT EDGE.
- CONCRETE SHALL BE AIR ENTRAINED 4-7% TO PROTECT THE SURFACE FROM FREEZE THAW DEGRADATION.
- EACH BLOCK MUST CONTAIN A SATISFACTORY EMBEDDED LIFTING DEVICE.
- EDGES SHALL BE CHAMFERED.

TYPICAL ABUTMENT ELEVATION VIEW -
TIMBER SILL

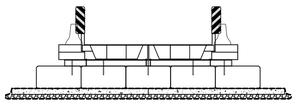


TYPICAL ABUTMENT CROSS SECTION VIEW -
TIMBER SILL

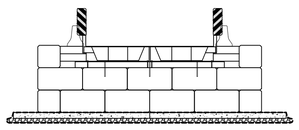
TYPICAL ABUTMENT ELEVATION VIEW -
1 LOCK BLOCK HIGH



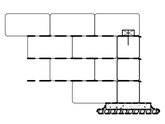
TYPICAL ABUTMENT ELEVATION VIEW -
2 LOCK BLOCK HIGH



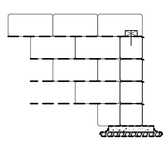
TYPICAL ABUTMENT CROSS SECTION VIEW -
1 LOCK BLOCK HIGH



TYPICAL ABUTMENT CROSS SECTION VIEW -
2 LOCK BLOCK HIGH

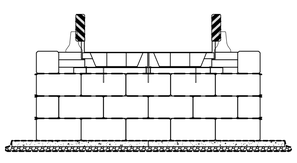


TYPICAL ABUTMENT ELEVATION VIEW -
3 LOCK BLOCK HIGH

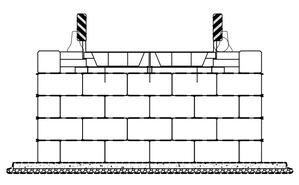


TYPICAL ABUTMENT ELEVATION VIEW -
4 LOCK BLOCK HIGH

GEOGRID TIEBACKS NEEDED ON 3 OR 4 LOCK BLOCK HIGH ABUTMENTS



TYPICAL ABUTMENT CROSS SECTION VIEW -
3 LOCK BLOCK HIGH



TYPICAL ABUTMENT CROSS SECTION VIEW -
4 LOCK BLOCK HIGH

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING. INTENDED TO BE PRINTED ON 22" X 34" PAPER.

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A	ISSUED FOR REVIEW	FEB 26, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 13, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 16, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 26, 2021	JL	MF
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PH.: 604-629-9075

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PRINCE GEORGE, BC V2N 1A3
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER MURRAY CREEK HABITAT RESTORATION AND ENHANCEMENT
TITLE

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-8
DRAWING NO.	013
SHEET:	13 OF 13
REV	E

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BLACKWATER PROJECT -
SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER GREER CREEK HABITAT
RESTORATION AND ENHANCEMENT

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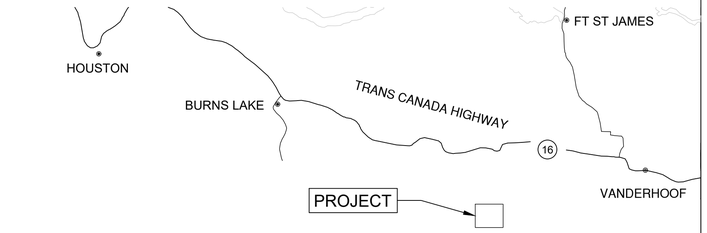
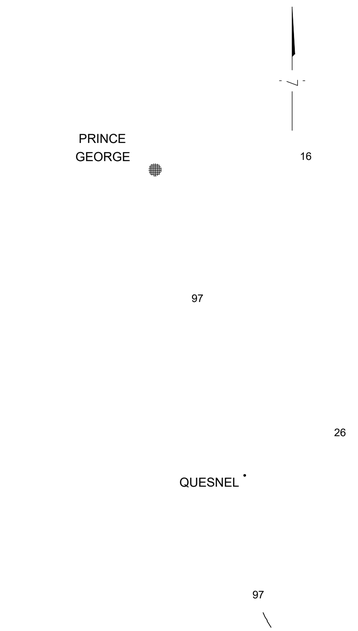
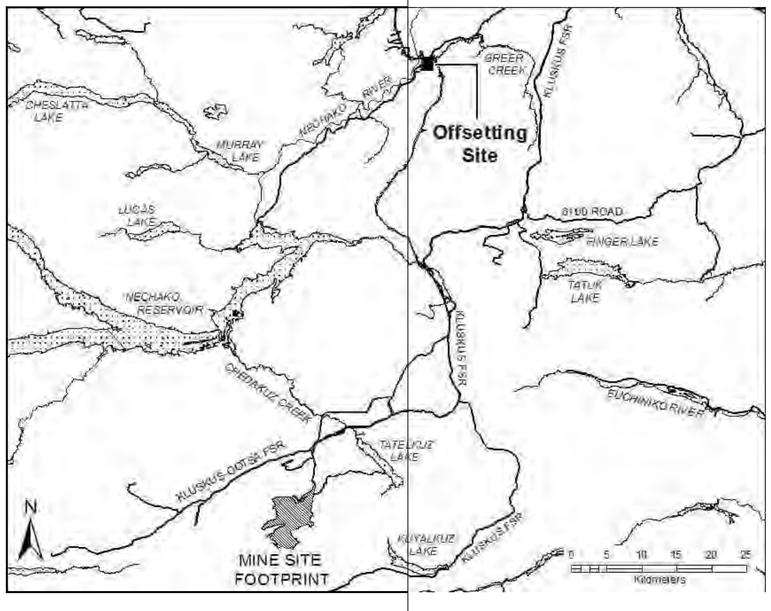
DRAWING INDEX	
SHEET No.	SHEET TITLE
1824-4-5-001	TITLE PAGE
1824-4-5-002	GENERAL NOTES
1824-4-5-003	OVERALL PLAN SHEET 1 OF 4
1824-4-5-004	OVERALL PLAN SHEET 2 OF 4
1824-4-5-005	OVERALL PLAN SHEET 3 OF 4
1824-4-5-006	OVERALL PLAN SHEET 4 OF 4
1824-4-5-007	STANDARD DETAILS SHEET 1 OF 2
1824-4-5-008	STANDARD DETAILS SHEET 2 OF 2 & PLANTING NOTES FOR CHANNEL WORKS
1824-4-5-009	ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS
1824-4-5-010	SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR CHANNEL WORKS
1824-4-5-011	WORK AREA ISOLATION MEASURES
1824-4-5-012	TYPICAL CROSSING DESIGN SHEET 1 OF 3
1824-4-5-013	TYPICAL CROSSING DESIGN SHEET 2 OF 3
1824-4-5-014	TYPICAL CROSSING DESIGN SHEET 3 OF 3



KEY PLAN
NTS





LOCATION PLAN
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LAYDOWNS & ACCESS ROADS

- ALL LAYDOWNS AND ACCESS ROADS ARE TEMPORARY IN NATURE AND ARE ONLY REQUIRED FOR THE DURATION OF CHANNEL WORKS. GRASS AND PATHS DISTURBED DURING CONSTRUCTION ARE TO BE RESTORED TO THEIR ORIGINAL CONDITION PRE-CONSTRUCTION TO THE BEST OF THE CHOSEN CONTRACTOR'S ABILITIES AFTER ALL WORKS ARE COMPLETED.
- FINAL LOCATION, SIZE, AND SPECIFICATIONS OF THE PROPOSED LAYDOWN AREA AND ACCESS ROADS ARE TO BE REFINED BY THE SELECTED CONTRACTOR AS REQUIRED. DEPENDING ON CONDITIONS AT THE TIME OF CONSTRUCTION ACCESS MAY BE A VARIETY OF RIG MATS, FROZEN GROUND, OR BUILT UP GRAVEL ACCESS ROADS WITH GEOGRID.
- AVOID DISTURBANCE TO ANY EXISTING HERITAGE FEATURES
- AVOID DISTURBANCE TO ADJACENT PRIVATE PROPERTY

GENERAL STREAM NOTES

- BASED ON THE ONLINE TOOL (https://OWT.BCWATERTOOL.CA) THE WINTERTIME LOW FLOW IS ESTIMATED TO BE 0.6m3/sec WITH A MEAN ANNUAL DISCHARGE OF ~2.0m3/sec
- WATER SURFACE ELEVATIONS IN THE CHANNEL/PONDS WERE ESTIMATED BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND UNMANNED AERIAL VEHICLE (I.E. DRONE) SURVEY, CONDUCTED BY DWB CONSULTING SERVICES LTD
- NOTE THAT THERE IS BEAVER ACTIVITY ALONG GREER CREEK. AS SUCH, WATER DEPTHS MAY BE LOCALLY HIGHER THAN EXPECTED BASED SOLELY ON LOCAL FLOW CONDITIONS.
- NOTE THAT THE GROUNDWATER TABLE IS RELATIVELY HIGH ACROSS THE FLAT VALLEY BOTTOM OF GREER CREEK, CONTROLLED IN THE ALLUVIUM COMPRISING THE FLOODPLAIN BY THE WATER SURFACE ELEVATION ALONG THE CHANNEL (WHICH MAY BE LOCALLY AFFECTED BY BEAVER ACTIVITY).

FLOODPLAIN SOILS

- NO DRILLING OR TEST PITTING HAS BEEN COMPLETED TO INVESTIGATE SOILS WITHIN THE VALLEY BOTTOM FLOODPLAIN SEDIMENTS WHERE CHANNEL WORKS ARE PROPOSED.
- OPPORTUNISTIC EXAMINATION OF FLOODPLAIN SOILS IN ERODED CREEK BANKS AND HAND AUGER HOLES (<1.2m DEEP) INDICATES ALLUVIAL SEDIMENTS TYPICAL OF RECURRENT FLOODPLAIN DEPOSITION: FINE SAND AND SILT WITH LOCALIZED GRAVELS AND ORGANICS.

SURVEY NOTES

DATUM: NAD 83 (CSRS) 2002.0

UTM ZONE: 10

THE SURVEY DATA USED TO CREATE THE TIN SURFACE FOR THIS DESIGN WAS PROVIDED TO ONSITE ENGINEERING LTD. BY PALMER. ALL SURVEY DATA WAS COLLECTED BY DWB CONSULTING SERVICES LTD. OCTOBER 24-27, 2016.

DESIGN TEAM

ENGINEERING - ONSITE ENGINEERING LTD. MICHAEL FOSTER, P.ENG.

GEOMORPHOLOGY/ENVIRONMENTAL/SEDIMENT AND EROSION CONTROL - PALMER
ROBIN MCKILLOP, MSc, P.GEO. AND DAN MCPARLAND, MSc, P.GEO.

OVERVIEW

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 12, 2021	JL	MF
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GENERAL NOTES

CLIENT PROJECT NO. 2006501
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DRAWING NO. 002
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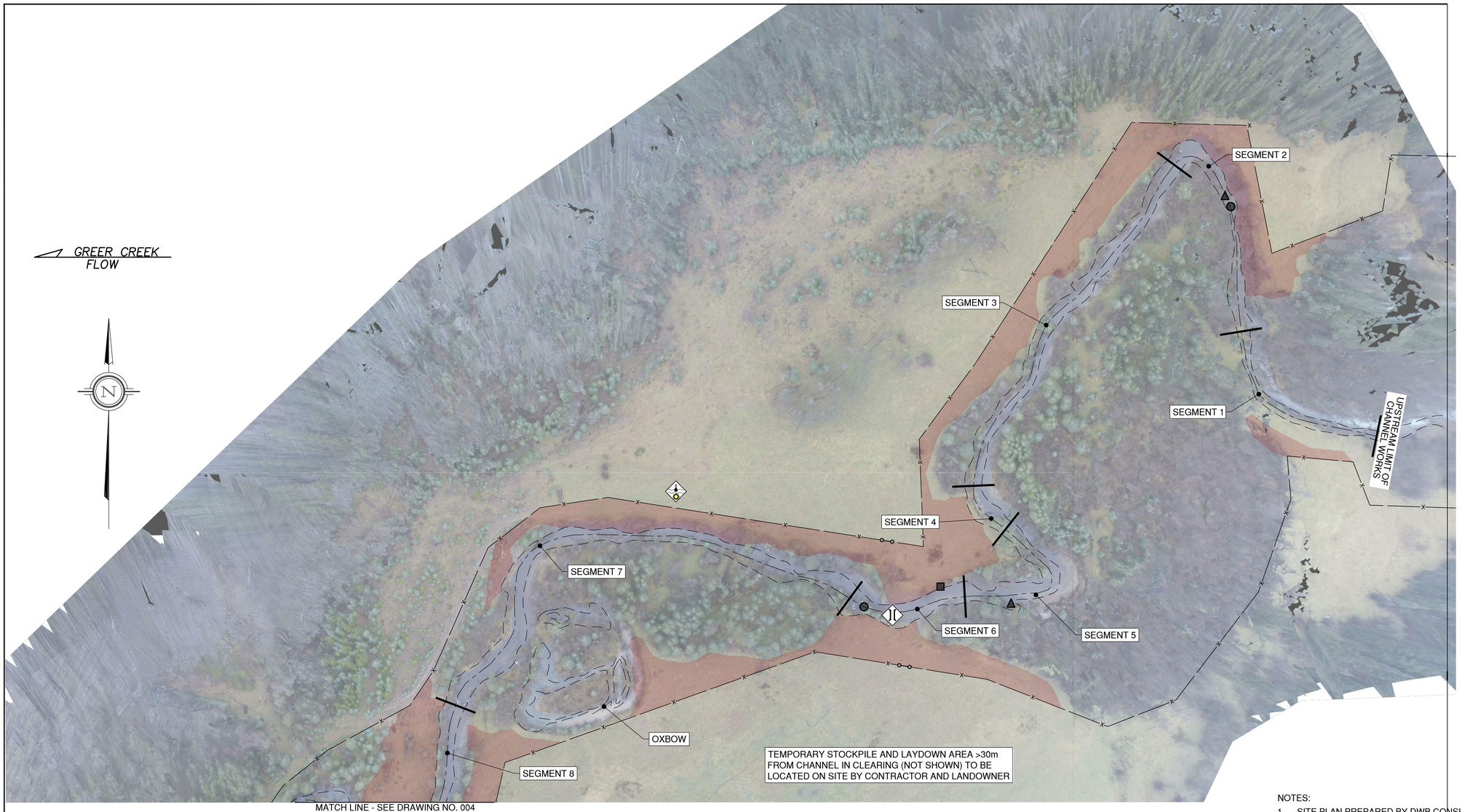

MATCH LINE - SEE DRAWING NO. 004

LEGEND

- APPROXIMATE WATERLINE
- APPROXIMATE CHANNEL CENTRE LINE
- PROPOSED CATTLE FENCING
- PROPOSED CATTLE FENCING - GATE
- CHANNEL SEGMENT BREAK LINES
- PROPOSED CROSSING
- PROPOSED CATTLE SUMMER WATERING - SOLAR
- PROPOSED STATIONARY CATTLE WINTER WATERING - SOLAR
- PROPOSED RIPARIAN PLANTING AREA

ABBREVIATIONS
(TREATMENT DETAILS SHOWN ON SHEET 007)

ISSUES
CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

CHANNEL MORPHOLOGY (Viewing Downstream):
RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

TREATMENTS

REGRADING:
BankR - Bank Regrading: Detail 1A

WOODY DEBRIS:
WDhabitat Enhancement:
» ▲ - ROOTWAD: Detail 2D
» ■ - LOG: Detail 2C

BANK TREATMENTS:
BL - Brush Layers: Detail 3B

BED MATERIALS:
BC - Boulder Cluster: Detail 4A
» ●

GREER CREEK: LOWER - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT EASTING	UPSTREAM LIMIT NORTHING	DOWNSTREAM LIMIT EASTING	DOWNSTREAM LIMIT NORTHING	SEGMENT LENGTH (m)	CHANNEL MORPHOLOGY & ISSUES	PROPOSED TREATMENTS	SPECIFICATIONS	NOTES
1	396188.303	5961785.815	396110.732	5961845.881	110.55	LBK: UV			
2	396110.732	5961845.881	396072.382	5961942.210	122.00	RBK: CT & UV BED: CT	RBK: BankR, WDhabitat & BL BED: BC		
3	396072.382	5961942.210	395956.458	5961756.752	223.56	RBK: UV			
4	395956.458	5961756.752	395975.331	5961731.960	33.14	RBK: CT & UV	RBK: BankR & BL		
5	395975.331	5961731.960	395951.859	5961693.373	94.62	RBK: UV & CT LBK: CT & UV BED: UV	LBK: WDhabitat		
6	395951.859	5961693.373	395884.867	5961692.466	70.05	RBK: CT & UV LBK: CT & UV BED: CT & VC	RBK: BankR, BL & WDhabitat LBK: BankR & BL BED: BC		PROPOSED CROSSING IN SEGMENT
7	395884.867	5961692.466	395658.163	5961630.430	296.72	RBK: UV			
8	395658.163	5961630.430	395630.988	5961525.892	108.91	RBK: UV LBK: UV			

NOTES:
1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND AERIAL DRONE PHOTOGRAMMETRY, CONDUCTED ON OCTOBER 24-27, 2016. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER.
4. BANKFULL CHANNEL DIMENSIONS ARE TO BE CONFIRMED BY ENVIRONMENTAL INSPECTOR FOR BankR AND NW TREATMENTS
5. LOCAL CHANNEL GRADIENTS ARE TO BE MAINTAINED THROUGHOUT STUDY AREA REGARDLESS OF PROPOSED BANK AND BED TREATMENTS
6. REFER TO RIPARIAN RESTORATION AND ENHANCEMENT DETAILS (DRAWING 008) FOR SEGMENTS WHERE UNVEGETATED (UV) HAS BEEN IDENTIFIED AS AN ISSUE
7. REFER TO DRAWING 009, 010 & 011 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS
8. REFER TO DRAWING 008 FOR FENCING DETAILS. REFER TO DRAWING 012, 013 AND 014 FOR CHANNEL CROSSING DETAILS
9. SUMMER AND WINTER OFF-CHANNEL WATERING DETAILS ARE PROVIDED ON DRAWING 008.

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OVERALL PLAN SHEET 1 OF 4

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OEL PROJECT NO. 1824-4-5
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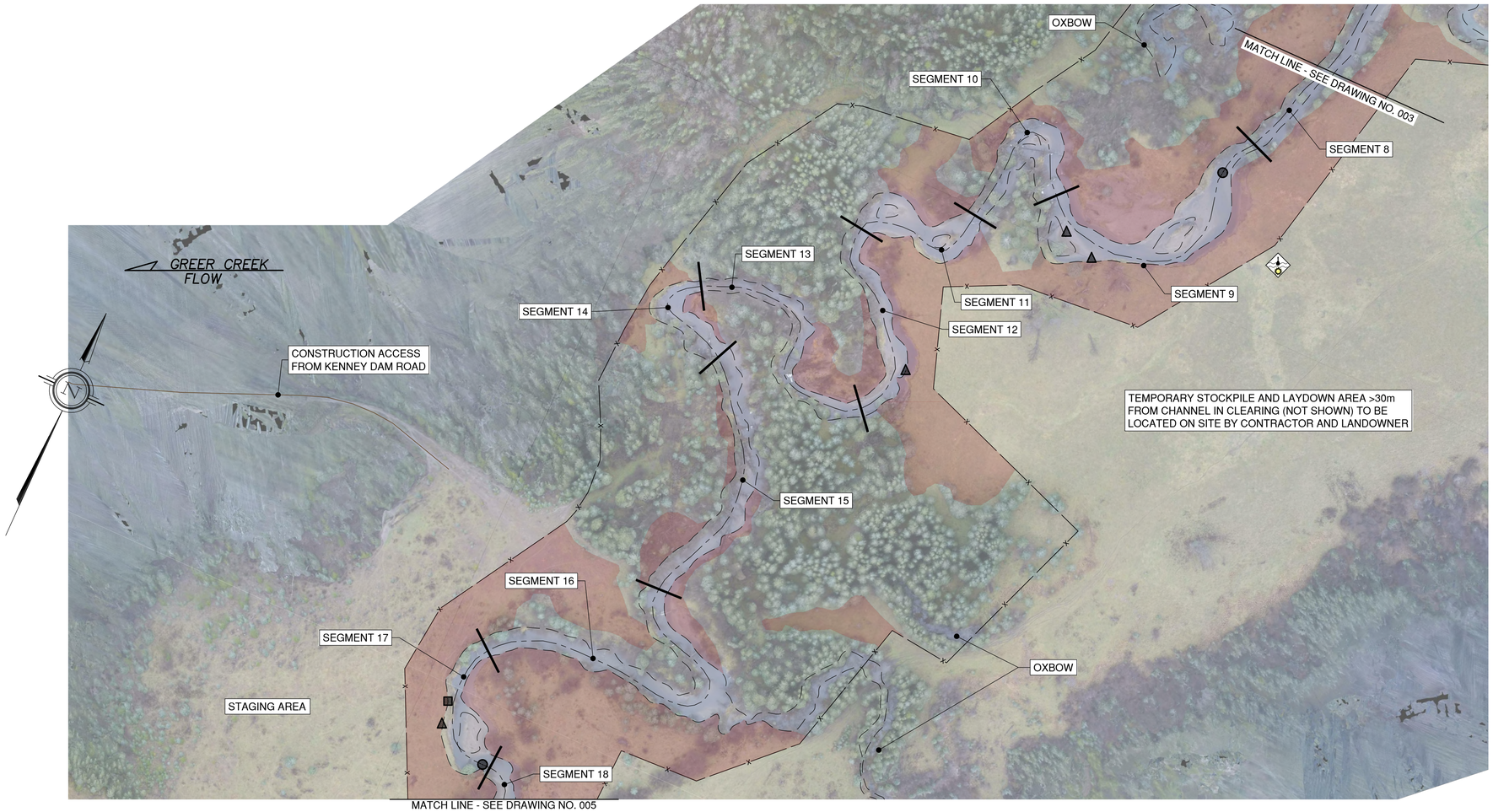

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9	395630.988	5961525.892	395552.421	5961462.266	145.35	RBK: CT & UV LBK: CT & UV BED: CT	RBK: NW LBK: WDhabitat, BL & NW BED: BC	Bankfull width = 13m	
10	395552.421	5961462.266	395519.514	5961437.215	88.00	RBK: CT & UV LBK: UV	RBK: WDnarrow		
11	395519.514	5961437.215	395470.828	5961407.849	70.03	RBK: CT & UV LBK: CT & UV	RBK: NW & BL LBK: NW & BL	Bankfull width = 12m	
12	395470.828	5961407.849	395507.562	5961326.369	103.72	LBK: CT & UV	LBK: BankR, BL & WDhabitat		
13	395507.562	5961326.369	395410.267	5961348.890	127.00				
14	395410.267	5961348.890	395432.408	5961319.732	58.19	RBK: CT & UV	RBK: BankR & BL		
15	395432.408	5961319.732	395452.758	5961202.526	132.96				
16	395452.758	5961202.526	395388.191	5961140.317	183.72	RBK: UV LBK: UV			
17	395388.191	5961140.317	395413.248	5961087.393	74.33	RBK: CT & UV LBK: UV BED: CT	RBK: BL, WDhabitat & NW LBK: NW & BL BED: BC	Bankfull width = 14m	
18	395413.248	5961087.393	395420.317	5961052.480	42.88	RBK: UV LBK: CT & UV	LBK: BankR & BL		

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9. SUMMER AND WINTER OFF-CHANNEL WATERING DETAILS ARE PROVIDED ON DRAWING 008.

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VANCOUVER, BC V6C 1V5
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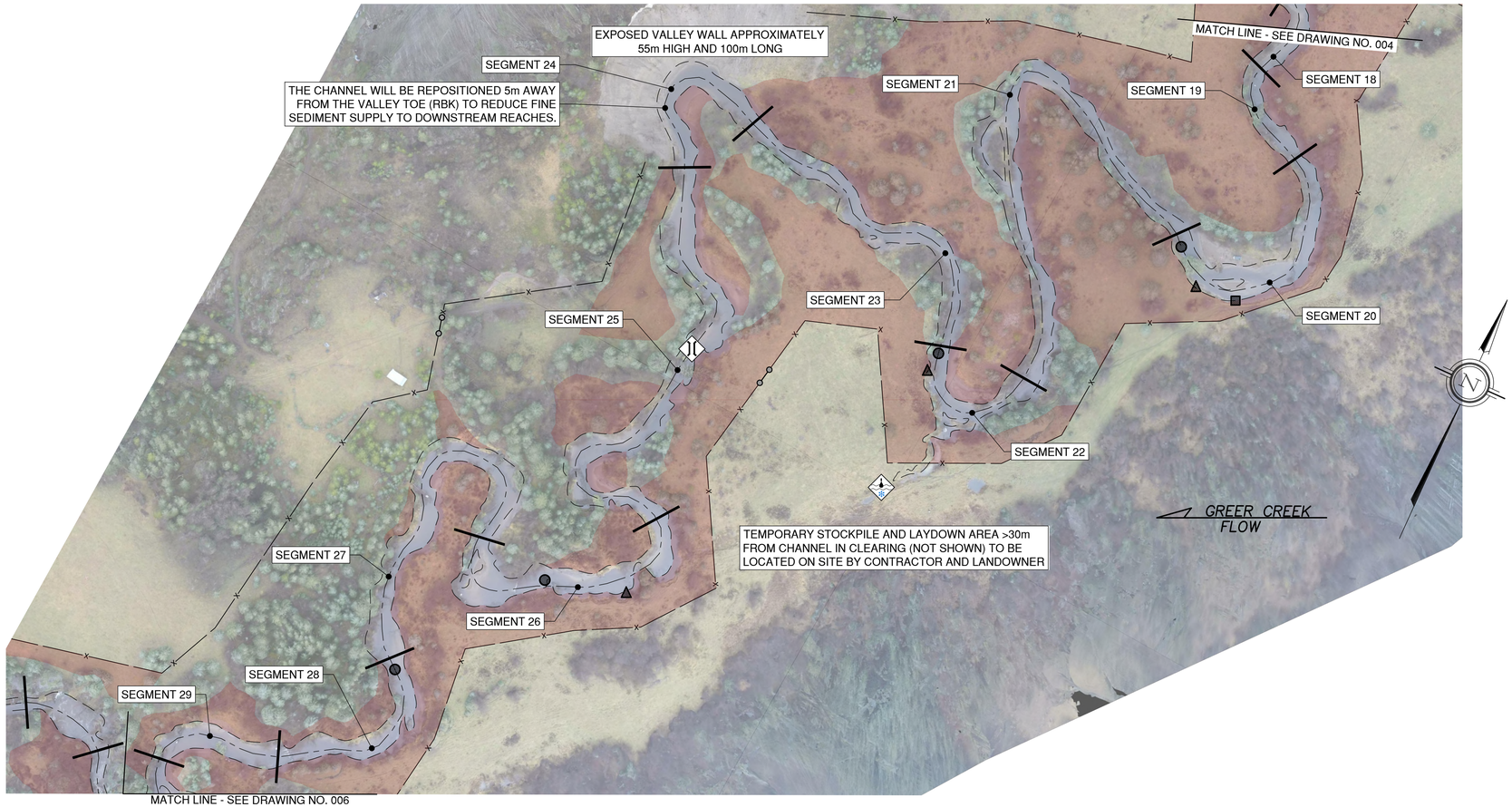
BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL PLAN SHEET 2 OF 4

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-5
DRAWING NO. 004
SHEET: 4 OF 14
REV E

U:\Projects\1824\4\9\5- Lower Greer OS Design\AutoCAD\1824-4-5- Lower Greer Creek.dwg
DATE: 11/02/2021 5:26 PM BY: Jesse Lutz



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LEGEND

- APPROXIMATE WATERLINE
- APPROXIMATE CHANNEL CENTRE LINE
- PROPOSED CATTLE FENCING
- PROPOSED CATTLE FENCING - GATE
- CHANNEL SEGMENT BREAK LINES
- PROPOSED CROSSING
- PROPOSED CATTLE SUMMER WATERING - SOLAR
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- PROPOSED RIPARIAN PLANTING AREA

ABBREVIATIONS
(TREATMENT DETAILS SHOWN ON SHEET 007)

ISSUES
CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

CHANNEL MORPHOLOGY (Viewing Downstream):
RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

TREATMENTS
REGRADING:
BankR - Bank Regrading: Detail 1A
WOODY DEBRIS:
WDhabitat Enhancement:
» ▲ - ROOTWAD: Detail 2D
» ■ - LOG: Detail 2C
BANK TREATMENTS:
BL - Brush Layers: Detail 3B
BED MATERIALS:
BC - Boulder Cluster: Detail 4A
» ●

GREER CREEK: LOWER - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT EASTING	UPSTREAM LIMIT NORTHING	DOWNSTREAM LIMIT EASTING	DOWNSTREAM LIMIT NORTHING	SEGMENT LENGTH (m)	CHANNEL MORPHOLOGY & ISSUES	PROPOSED TREATMENTS	SPECIFICATIONS	NOTES
18	395413.248	5961087.393	395420.317	5961052.480	42.88	RBK: UV LBK: CT & UV	LBK: BankR & BL		
19	395420.317	5961052.480	395454.779	5961023.108	51.08	RBK: UV LBK: UV			
20	395454.779	5961023.108	395423.869	5960966.222	122.48	RBK: CT & UV LBK: CT & UV BED: CT	RBK: NW & BL LBK: BL, WDhabitat & NW BED: BC	Bankfull width = 12m	
21	395423.869	5960966.222	395394.757	5960873.526	254.53	RBK: UV LBK: UV			
22	395394.757	5960873.526	395353.889	5960867.732	71.53	RBK: UV LBK: CT & UV BED: CT	LBK: BankR, BL & WDhabitat BED: BC		
23	395353.889	5960867.732	395299.132	5960901.072	158.23	RBK: UV LBK: UV			
24	395299.132	5960901.072	395254.353	5960810.217	86.92	RBK: CT & UV LBK: CT & UV	RBK: NW & VBR LBK: NW & BL	Bankfull width = 14m	- Relocate RBK 5m from existing toe of slope and backfill with native material - VBR used along outer bank (RBK) to prevent the channel from migrating towards the valley wall. - LBK height should be 0.5m lower than RBK height
25	395254.353	5960810.217	395278.534	5960733.587	227.14	LBK: UV			- Proposed crossing in segment
26	395278.534	5960733.587	395211.135	5960686.204	129.00	RBK: UV LBK: CT & UV BED: CT	LBK: BankR, BL & WDhabitat BED: BC		
27	395211.135	5960686.204	395202.951	5960616.851	168.92	LBK: UV			
28	395202.951	5960616.851	395179.920	5960552.017	92.47	LBK: CT & UV BED: CT	LBK: BankR, BL & WDhabitat BED: BC		
29	395179.920	5960552.017	395132.311	5960524.922	61.10	RBK: CT & UV LBK: UV	RBK: BankR & BL		

NOTES:
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SHEET: 5 OF 14
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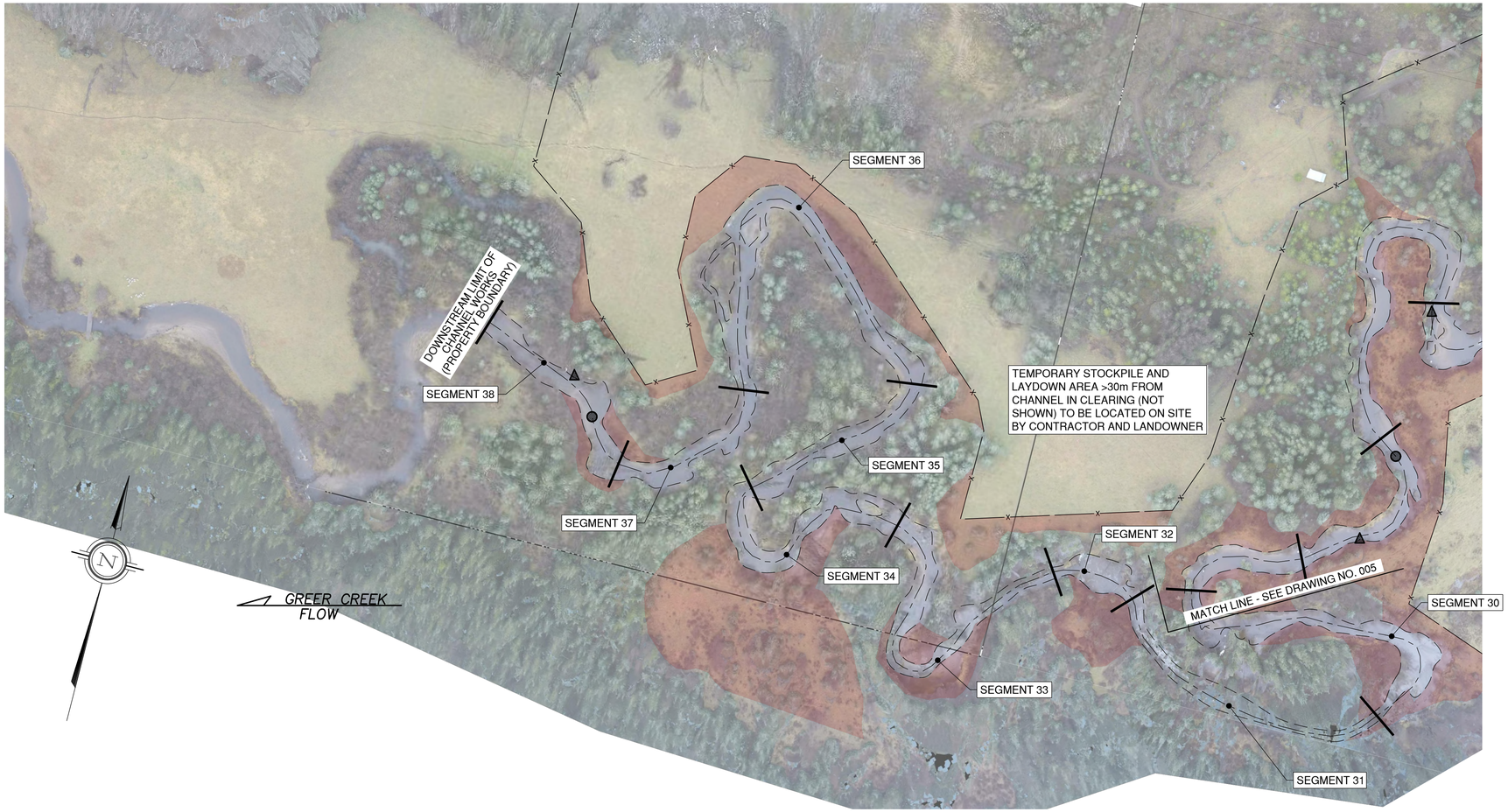

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31	395233.139	5960487.888	395105.978	5960513.751	148.29				
32	395105.978	5960513.751	395066.067	5960516.946	42.32	RBK: UV			
33	395066.067	5960516.946	394988.460	5960520.236	168.71	RBK: UV			
34	394988.460	5960520.236	394916.465	5960521.010	120.02	LBK: UV			
35	394916.465	5960521.010	394978.396	5960588.215	93.96				
36	394978.396	5960588.215	394901.029	5960565.668	213.79	RBK: CT & UV	RBK: BankR & BL		
37	394851.927	5960516.209	394775.442	5960566.925	95.12				
38	394901.029	5960565.668	394851.927	5960516.209	81.96	RBK: CT & UV BED: CT	RBK: BankR, BL & WDhabitat BED: BC		

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SHEET:	6 OF 14
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DATE: 11/02/2021 5:26 PM BY: Jesse Lutz

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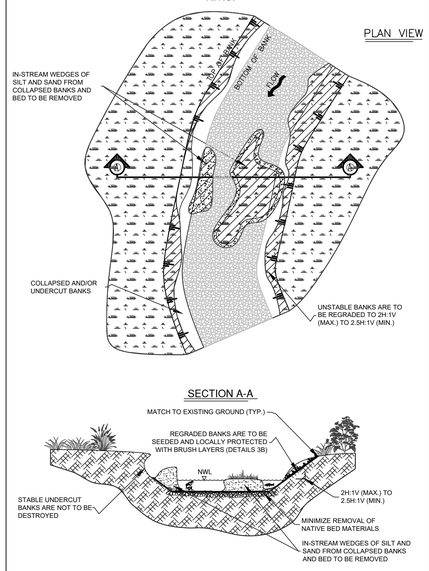
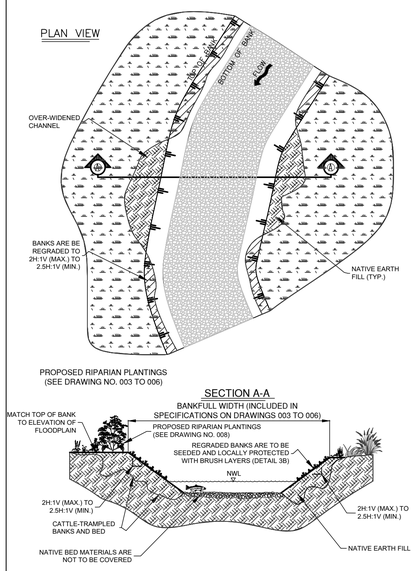
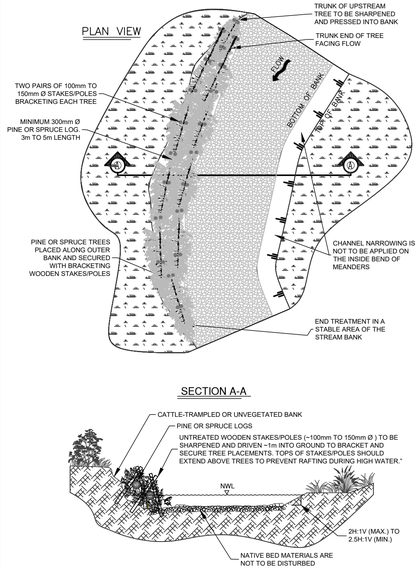
DETAIL 1A
RECONSTRUCTION OF CHANNEL BED AND/OR BANK REGRADING (BankR)
N.T.S.



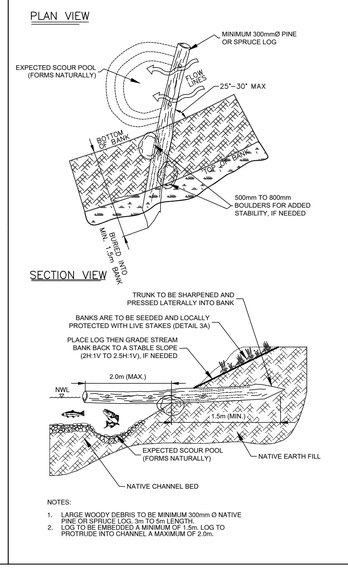
DETAIL 1B
RESTORATION OF NATURAL CHANNEL WIDTH (NW)
N.T.S.



DETAIL 2A
WOODY DEBRIS CHANNEL NARROWING (WDnarrow)
N.T.S.

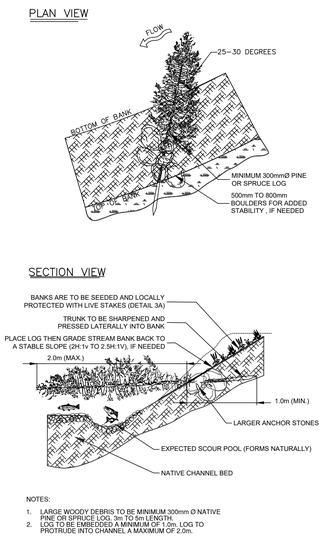


DETAIL 2B
WOODY DEBRIS CHANNEL DEFLECTION (WDdeflect)
N.T.S.



NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.5m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 2C
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): LOG
N.T.S.



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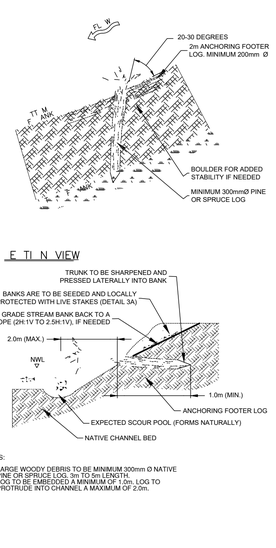
2. LOG TO BE EMBEDDED A MINIMUM OF 1.0m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 2D
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): ROOTWAD
N.T.S.



NOTES:
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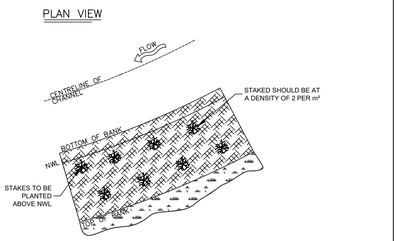
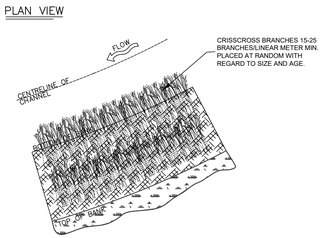
DETAIL 3A
BANK TREATMENT: LIVE STAKES (LS)
N.T.S.



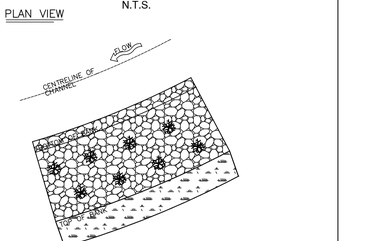
NOTES:
1. LIVE STAKINGS TO BE: -DORMANT LIVE STAKE CUTTING, (LIVE DOGWOOD AND WILLOW) -35-50mm DIA., WITH ANGLE CUT BASE, AND BLUNT CUT TOP. STAKE LENGTH TO BE 600-800mm.
2. TAMP ANGLE CUT BASE INTO SOIL AT RIGHT ANGLE TO SLOPE. ENSURE 75-80% OF LENGTH OF CUTTING IS EMBEDDED INTO SOIL. -TAMP TOPSOIL FIRMLY AROUND BASE.
3. SOAK LIVE STAKES FOR MINIMUM OF 24 HOURS PRIOR TO INSTALLATION.

DETAIL 3B
BANK TREATMENT: BRUSH LAYERS (BL)
N.T.S.



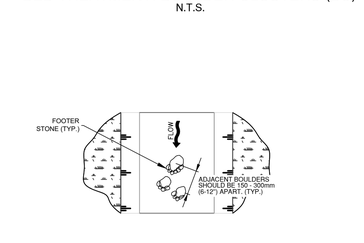
NOTES:
1. COVER BRUSHLAYER IMMEDIATELY WITH 0.15m (6") OF FILL SOIL, WATER AND COMPACT USING A VIBRATORY TAMPER.
2. BRUSH LAYERS WILL BE NATIVE WILLOW AND DOGWOOD SPECIES.
3. THE NUMBER OF LAYERS (I.E. LIFTS) WILL BE CONFIRMED BY THE INSPECTOR IN THE FIELD. IN GENERAL, BANKS <1m HIGH REQUIRE ONE LAYER, BANKS 1m TO 2m HIGH REQUIRE TWO LAYERS, AND BANKS >2m REQUIRE THREE LAYERS.

DETAIL 3C
BANK TREATMENT: VEGETATED BOULDER REVETMENT (VBR)
N.T.S.



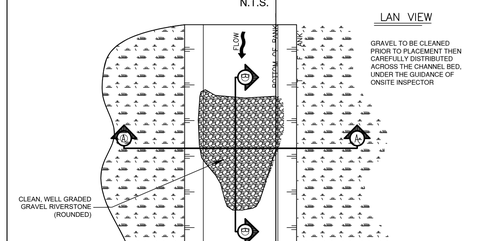
NOTES:
1. BOULDERS SHOULD BE ROUNDED TO SUB-ANGULAR.
2. GRADATION SHOULD BE WELL GRADED AND ANDERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE CLASS 25kg (MEDIAN GRAIN SIZE OF 260mm, MAXIMUM GRAIN SIZE OF 450mm).
3. INSTALLATION SHOULD ADHERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE GUIDANCE " RIPRAP INSTALLATION GUIDE"
4. BOULDERS ARE TO BE INDIVIDUALLY PLACED (I.E. NO DUMPING) TO MAXIMIZE INTERLOCKING. VOIDS ARE TO BE FILLED WITH SMALLER GRAVELS AND NATIVE MATERIALS.
5. THE BOULDER REVETMENT CAN BE FORMED IN LIFTS OR LIVE STAKE CAN BE INSERTED IF CARE IS TAKEN TO LEAVE SUFFICIENT VOIDS.
6. FILTER FABRIC SHOULD NOT BE USED.

DETAIL 4A
BED TREATMENT: BOULDER CLUSTERS (BC)
N.T.S.



NOTES:
1. BOULDER SHOULD BE 0.5-0.8m STONE.
2. BOULDERS ARE NOT TO BE PLACED IN DEPOSITIONAL ZONES.
3. BOULDERS SHOULD OCCUPY LESS THAN 1/5 OF THE CHANNEL WIDTH AFTER PARTIAL EMBEDMENT.
4. BOULDERS SHOULD BE A MINIMUM OF TWO STONE SIZES AWAY FROM THE CHANNEL'S BANKS.

DETAIL 4B
BED TREATMENT: GRAVEL PLACEMENT (GP)
N.T.S.



NOTES:
1. ONSITE INSPECTOR WILL NEED TO ENSURE NO FISH OR EGGS ARE PRESENT PRIOR TO PLACEMENT.
2. GRAVEL PLACEMENT SHOULD BE COMPLETED AT LOW FLOWS.

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LOWER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
STANDARD DETAILS SHEET 1 OF 2

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-5
DRAWING NO. 007
SHEET: 7 OF 14
REV E

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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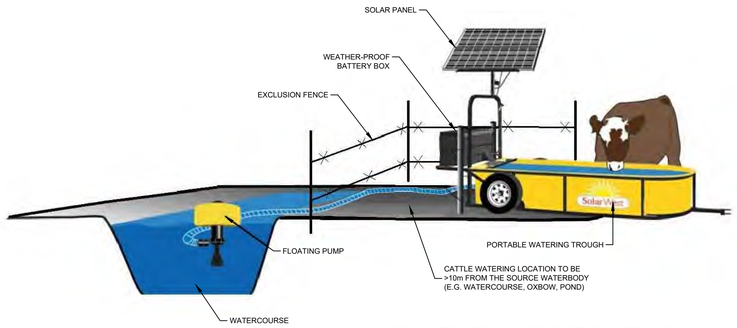
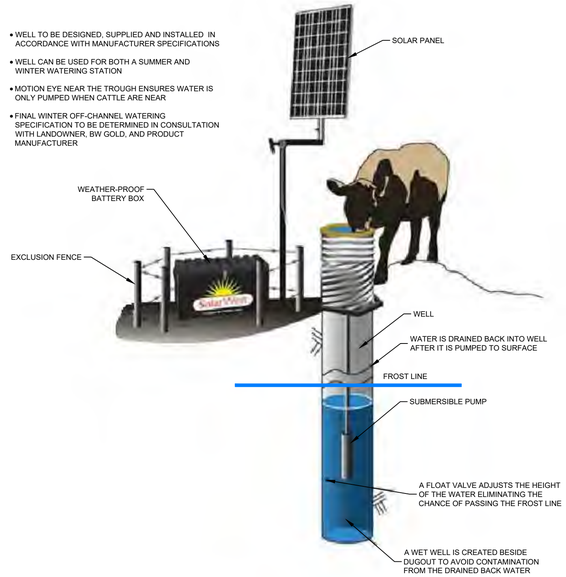
DETAIL 5A - SUMMER (MAY THROUGH OCTOBER) OFF-CHANNEL CATTLE WATERING
N.T.S



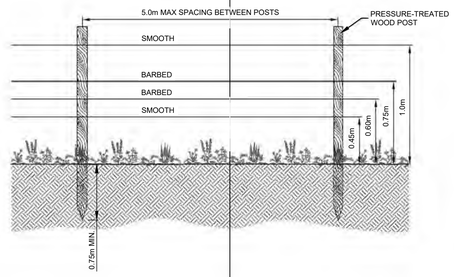
- PORTABLE WATERING STATION CAN EXTRACT WATER FROM WATERCOURSE, OXBOW AND/ OR ESTABLISHED WELL
- PORTABLE WATERING STATION CAN BE USED FOR BOTH SUMMER AND WINTER SEASON (IF GEOTHERMAL)
- PORTABLE WATERING STATION TO BE DESIGNED, SUPPLIED, AND INSTALLED BASED ON MANUFACTURER SPECIFICATIONS
- FLOAT SWITCH IN TROUGH MAINTAINS WATER LEVEL
- FINAL SUMMER OFF-CHANNEL WATERING SPECIFICATIONS TO BE DETERMINED IN CONSULTATION WITH LANDOWNER, BW GOLD, AND PRODUCT MANUFACTURER

DETAIL 5B - WINTER (NOVEMBER THROUGH APRIL) OFF-CHANNEL CATTLE WATERING
N.T.S

- WELL TO BE DESIGNED, SUPPLIED AND INSTALLED IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS
- WELL CAN BE USED FOR BOTH A SUMMER AND WINTER WATERING STATION
- MOTION EYE NEAR THE TROUGH ENSURES WATER IS ONLY PUMPED WHEN CATTLE ARE NEAR
- FINAL WINTER OFF-CHANNEL WATERING SPECIFICATION TO BE DETERMINED IN CONSULTATION WITH LANDOWNER, BW GOLD, AND PRODUCT MANUFACTURER

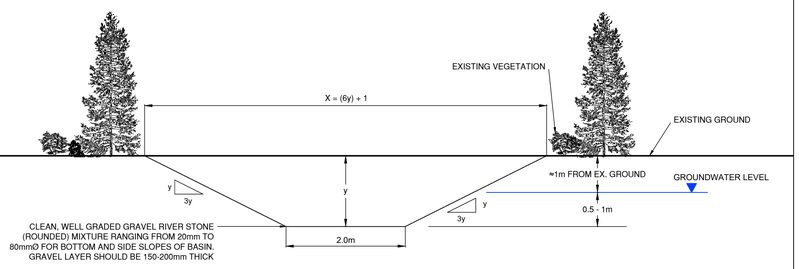


DETAIL 5C - CATTLE EXCLUSION FENCING - BARBED WIRE
N.T.S



- POSTS ARE TO BE 0.1m TO 0.15m IN DIAMETER AND 2m IN HEIGHT (MINIMUM)
- WIRE TO BE 12.5 GALVANIZED (CLASS 1 GALVANIZING MINIMUM), 4-POINT BARBS
- WIRE TO HAVE MINIMUM 950-LB BREAKING STRENGTH
- SMOOTH TOP AND BOTTOM WIRE TO FACILITATE WILDLIFE PASSAGE
- WIRE EXCLUSION FENCE DESIGN REFERENCES THE FENCING FACTSHEET 307.260-1 REVISED DECEMBER 15, 2015, BC MINISTRY OF AGRICULTURE, LIVESTOCK CONTROL - NON-ELECTRIC FENCE DESIGNS. FENCE TO BE SUPPLIED AND INSTALLED ACCORDING TO SPECIFICATIONS WITHIN THE FACTSHEET. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/farm-management/structures-and-mechanization/300-series/307260-1_livestock_contol_-_non-electric_fence.pdf

DETAIL 5D - GROUNDWATER INTERCEPTOR BASIN SECTION VIEW
N.T.S.



PROVISIONAL PLANTING NOTES

SITE PREPARATION:

- EXISTING WOODY VEGETATION TO BE RETAINED AND PROTECTED TO THE GREATEST EXTENT FEASIBLE.
- WHERE WOODY VEGETATE IS NECESSARY, ALL WOODY DEBRIS IS TO BE SCATTERED ON-SITE.
- EXISTING HERBACEOUS VEGETATION IS TO BE MOWED OR SCYTHED TO 15cm IN HEIGHT BEFORE PLANTING AND / OR SEEDING.

PLANT MATERIAL:

- PLANT MATERIAL MUST BE LOCALLY SOURCED AND SPECIES MUST BE NATIVE TO THE REGION.
- PLANT STOCK MUST BE INSPECTED UPON DELIVERY TO ENSURE THAT THE MATERIAL CONSISTS OF APPROPRIATE NATIVE SPECIES IN GOOD CONDITION
- TREES TO BE CONTAINER GROWN OR BAREROOT STOCK RANGING FROM 1.0 TO 1.5m IN HEIGHT
- SHRUBS TO BE CONTAINER GROWN OR BARE ROOT AND RANGING FROM 0.4m TO 1.0m IN HEIGHT.
- SEEDS OF THE SUGGESTED MIXTURE OR SIMILAR BLEND TO BE MIXED BEFORE THE APPLICATION.
- LIVE STAKES TO BE 35 TO 50mm IN DIAMETER AND 1 TO 1.5m IN LENGTH. SOAKED FOR A MINIMUM OF 24 HOURS BEFORE INSTALLATION. TIPS OF LIVE STAKES CAN BE SEALED TO MINIMIZE RISK OF DISEASE.
- BRUSH LAYERING CUTTINGS TO BE A MINIMUM OF 10mm IN DIAMETER AND 1.5 TO 2.0m IN LENGTH.
- GRASSES AND SHRUBS TO BE PLANTED IN RIPARIAN AREA ABOVE HIGH WATER MARK (ABOVE STREAM BANK) IF CURRENTLY BARREN. PLANT GRASSES ONLY IF SHRUBS ARE PRESENT

PLANTING DENSITY:

- TREES TO BE PLANTED 1 TREE PER 36m2 (APPROXIMATELY 6m ON CENTER).
- SHRUBS TO BE PLANTED 1 SHRUB PER 36m² (APPROXIMATELY 6m ON CENTER).
- WOODY SPECIES SHOULD BE MIXED WHEN PLANTED.
- LIVE STAKES TO BE PLANTED 2 LIVE STAKES PER m².
- BRUSH LAYERS CUTTINGS TO BE DENSELY PACKED, SIDE-BY-SIDE, TO FORM A CONTINUOUS LAYER ACROSS THE FULL LENGTH OF THE LIFT. EACH LIFT WILL BE COMPOSED ON 15-25 BRANCHES PER LINEAR METER.

TIMING:

- PLANTING OF WOODY MATERIAL SHOULD BE COMPLETED IN THE SPRING (APRIL TO MAY) OR FALL (SEPTEMBER TO OCTOBER).

TENDING:

- ALL PLANTINGS SHOULD BE WATERED IMMEDIATELY AFTER INSTALLATION.
- ALL PLANTINGS SHOULD BE WATERED DURING PERIODS OF NATURAL DROUGHT CONDITIONS (ESPECIALLY FROM LATE SPRING TO THE END OF SUMMER) FOR THE FIRST GROWING SEASON.

PROVISIONAL PLANTING LIST AND QUANTITIES

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
TREE AND SHRUB CLUSTER DRY/MOIST	White Spruce	Picea glauca	450
	Lodgepole Pine	Pinus contorta	450
	Trembling Aspen	Populus tremuloides	450
	Saskatoon	Amelanchier alnifolia	446
	Soopolallie	Shepherdia canadensis	446
	Prickly Rose	Rosa acicularis	446
	Red Raspberry	Rubus ideaus	446
Live Stakes (LS)	Red-Osier Dogwood	Cornus stolonifera	547
	Scouler's Willow	Salix scouleriana	547
	Coyote Willow	Salix exigua	547
	Geyer's Willow	Salix geyeriana	547
Brush Layer Cuttings (BL)	Red-osier Dogwood	Cornus stolonifera	20,260
	Pacific Willow	Salix lasiandra	20,260
	Hooker's Willow	Salix hookeriana	20,260
	Coyote Willow	Salix exigua	20,260

A DETAILED PLANTING PLAN TO INCORPORATE UPDATED SITE INFORMATION AND FIRST NATION COMMENTS WILL BE DEVELOPED FOLLOWING THE COMPLETION OF VEGETATION SURVEYS DURING THE SUMMER OF 2022. PLEASE REFER TO THE VEGETATION WORK PLAN PRESENTED IN THE FISHERIES ACT AUTHORIZATION APPLICATION FOR ADDITIONAL DETAILS.

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 12, 2021	JL	MF
B	ISSUED FOR REVIEW	MAR 30, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 13, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 18, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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Palmer
470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
www.onsite-engineering.ca

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STANDARD DETAILS SHEET 2 OF 2
& PLANTING NOTES FOR CHANNEL WORKS

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CHANNEL WORKS - EROSION & SEDIMENT CONTROL AND WORK AREA ISOLATION - NOTES:

INTRODUCTORY STATEMENT

- THE EROSION & SEDIMENT CONTROL PLAN HAS BEEN DEVELOPED TO ENSURE ESTABLISHMENT AND MAINTENANCE OF ALL NECESSARY ENVIRONMENTAL PROTECTION MEASURES BEFORE, DURING AND AFTER CHANNEL RESTORATION AND ENHANCEMENT WORKS. IT ALSO ALLOWS THE CONTRACTOR, OVERSEEN BY AN ENVIRONMENTAL INSPECTOR, THE FLEXIBILITY TO OPTIMIZE THE MEASURES FOR THE MOST EFFECTIVE SEQUENCE AND APPROACH FOR IMPLEMENTATION. RATHER THAN PRESCRIBING EXACTLY WHERE AND WHEN DIFFERENT MEASURES ARE TO BE USED, TYPICAL LAYOUTS FOR ENVIRONMENTAL PROTECTION AND WORK-AREA SITE ISOLATION ARE PROVIDED TO MAKE CLEAR WHAT OPTIONS ARE AVAILABLE TO THE CONTRACTOR. AN ENVIRONMENTAL INSPECTOR FAMILIAR WITH THE EROSION & SEDIMENT CONTROL PLAN WILL BE AVAILABLE ON SITE TO ANSWER QUESTIONS AND PROVIDE GUIDANCE TO THE CONTRACTOR.

SECTION 1: SITE MANAGEMENT

1. EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING THE CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER, ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED AND / OR REPLACED WITHIN 48 HOURS OF INSPECTION.
2. DISTURBED AREAS WILL BE MINIMIZED TO THE EXTENT POSSIBLE, AND TEMPORARILY OR PERMANENTLY STABILIZED OR RESTORED AS THE WORK PROGRESSES.
3. ALL IN-WATER AND NEAR WATER EARTHWORKS WILL BE CONDUCTED IN THE DRY AND / OR WITHIN AN ISOLATED WORK AREA WITH APPROPRIATE EROSION AND SEDIMENT CONTROLS. SPECIFIED PLACEMENTS OF BOULDERS, GRAVEL, AND LARGE WOOD MAY BE MADE IN / NEAR WATER WITHOUT COMPLETE ISOLATION IF NOT ASSOCIATED WITH EARTHWORK.
4. THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED / AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREAS. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF DELETERIOUS SUBSTANCE, INCLUDING SEDIMENT, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY.
5. AN ENVIRONMENTAL MONITOR WILL ATTEND THE SITE TO INSPECT ALL NEW CONTROLS, AS WELL AS ON A REGULAR BASIS, OR FOLLOWING RAIN / SNOW MELT EVENTS, TO MONITOR ALL WORKS, AND IN PARTICULAR WORKS RELATED TO EROSION AND SEDIMENT CONTROLS, DE-WATERING, RESTORATION, AND IN / NEAR-WATER WORKS. SHOULD CONCERNS ARISE ON SITE, THE ENVIRONMENTAL MONITOR WILL CONTACT THE APPROPRIATE REGULATORY OFFICER AS WELL AS THE PROPONENT.
6. ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT THE ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE, OR OTHER DELETERIOUS SUBSTANCES INTO THE WATER. VEHICULAR REFUELING AND MAINTENANCE WILL BE CONDUCTED A MINIMUM OF 30 METERS FROM THE WATER.
7. THE PROPONENT / CONTRACTOR SHALL MONITOR THE WEATHER FOR THE DURATION OF CONSTRUCTION TO ENSURE THAT THE WORKS WILL BE CONDUCTED DURING FAVORABLE WEATHER CONDITIONS. SHOULD AN UNEXPECTED STORM OR SNOWMELT ARISE, THE CONTRACTOR WILL REMOVE ALL UNFIXED ITEMS FROM THE CHANNEL AND FLOOD PLAIN THAT WOULD HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW, E.G., FUEL TANKS, PORTA-POTTIES, MACHINERY, EQUIPMENT, CONSTRUCTION MATERIALS, ETC.
8. ALL DE-WATERING SHALL BE TREATED AND RELEASED TO THE ENVIRONMENT AT LEAST 15 METERS FROM A WATERCOURSE OR POND AND ALLOWED TO DRAIN THROUGH A FILTER BAG AND WELL-VEGETATED AREA. NO DE-WATERING EFFLUENT SHALL BE SENT DIRECTLY TO ANY WATERCOURSE, POND, FOREST, OR ALLOWED TO DRAIN ONTO DISTURBED SOILS WITHIN THE WORK AREA. THESE CONTROL MEASURES SHALL BE MONITORED FOR EFFECTIVENESS AND MAINTAINED OR REVISED TO MEET THE OBJECTIVE OF PREVENTING THE RELEASE OF SEDIMENT-LADEN WATER.
9. ESC MEASURES ARE TO REMAIN IN PLACE AND IN WORKING ORDER UNTIL ALL ON-SITE CONSTRUCTION IS COMPLETED.
10. AREAS WHICH REMAIN DISTURBED FOR MORE THAN 30 DAYS SHALL BE STABILIZED USING SEED, APPROVED EROSION CONTROL BLANKETS, OR SIMILAR APPROVED EQUIVALENT. IF CONDITIONS AREN'T SUITABLE FOR SEED APPLICATION, AN EROSION CONTROL BLANKET WILL BE USED IN ITS PLACE. SEE EROSION CONTROL BLANKET TYPICAL DETAIL ON SHEET 010.
11. NO EROSION AND SEDIMENT CONTROL MEASURE SHALL CONTAIN ANY PLASTIC, EVEN IF IT IS BIODEGRADABLE.
12. THE CONTRACTOR MUST HAVE SUITABLE PUMPING CAPABILITIES ON SITE AT ALL TIMES TO FACILITATE CONSTRUCTION ACTIVITIES IN THE DRY.
13. WORKS SHOULD BE COMPLETED IN STAGES TO REDUCE THE DURATION OF DISTURBED AREAS.
14. CONTRACTOR IS NOT TO DISPOSE OF ANY OF THE MATERIAL USED IN THE PEA GRAVEL METER BAGS INTO THE CHANNEL OR SURROUNDING AREA. ALL PEA GRAVEL BAGS ARE TO BE REMOVED OFF OF SITE.
15. TEMPORARY STAGING AREAS ARE TO BE SITUATED MORE THAN 15 METERS FROM THE WATERCOURSE. ALL MAJOR OVERNIGHT STAGING / STOCKPILING AREAS WILL BE A MINIMUM OF 30 METERS AWAY FROM THE WATERCOURSE. CONTRACTOR TO MONITOR WEATHER FORECASTS TO ENSURE MACHINES AND MATERIALS ARE REMOVED WHEN THE INCLEMENT WEATHER IS ANTICIPATED. STOCKPILE HEIGHTS WILL BE KEPT BELOW 1.5 METERS IN HEIGHT.

SECTION 2: CONSTRUCTION TIMING

16. TO PROTECT LOCAL FISH POPULATIONS DURING THEIR SPAWNING, NURSERY AND MIGRATORY PERIODS, IN-WATER ACTIVITIES SHOULD OCCUR DURING THE TIME PERIOD OF JULY 15 TO SEPTEMBER 15, IN ACCORDANCE WITH THE OMINECA REGION LEAST-RISK TIMING WINDOW FOR RAINBOW TROUT AND CHINOOK SALMON. THIS TIMING WINDOW IS SUBJECT TO CONFIRMATION FROM PROVINCIAL REGULATORS. CHANNEL WORKS ARE BEST COMPLETED IN LATE SUMMER, WHEN FLOWS ARE LOW AND THERE IS NO ICE.

SECTION 3: FISH RELOCATION

17. FISH STRANDED WITHIN THE WORK AREA SHALL BE CAPTURED AND RELEASED LIVE IN SUITABLE HABITAT DOWNSTREAM OF THE WORK AREA UNDER THE SUPERVISION OF A QUALIFIED AQUATIC BIOLOGIST. A PERMIT FROM MOFLNRORD IS REQUIRED.

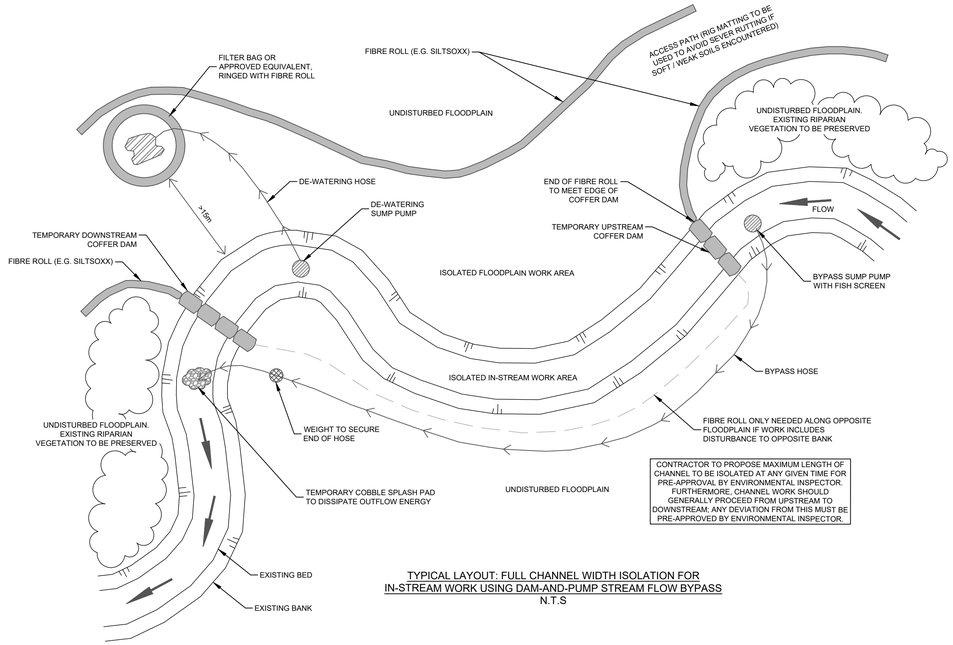
GENERAL STAGING PLAN FOR IN-CHANNEL WORK:

1. INSTALL FIBRE ROLLS ALONG ACCESS ROAD WHEN IT IS WITHIN 15m OF THE WATERCOURSE. ENSURE ENDS OF FIBRE ROLLS ARE POSITIONED TO TIE-IN WITH EDGES OF COFFER DAMS.
2. LAY DOWN RIG MATS ALONG ANY PORTIONS OF THE FLOODPLAIN ACCESS ROUTE WHERE THE SOILS ARE OBSERVED OR EXPECTED TO BE SOFT / WEAK, PRIOR TO EQUIPMENT ACCESS.
3. INSTALL UPSTREAM AND DOWNSTREAM COFFER DAMS IN A CONTROLLED MANNER TO REDUCE DISTURBANCE OF CHANNEL BED / BANKS AND RELEASE OF SEDIMENTS INTO CHANNEL.
4. INSTALL BYPASS PUMP AND HOSE TO BYPASS STREAM FLOW AROUND ISOLATED WORK AREA.
5. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
6. INSTALL DE-WATERING PUMP, HOSE, AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
7. PERFORM REQUIRED CHANNEL / BANK RESTORATION AND ENHANCEMENT WORKS, AS PER DESIGN SPECIFICATIONS.
8. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO REINTRODUCE FLOW GRADUALLY BACK INTO THE RESTORED CHANNEL.
9. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING DOWNSTREAM TO THE NEXT IN-CHANNEL WORK AREA.
10. REPEAT FROM STEP 1, AS NECESSARY, AS CHANNEL WORKS ARE COMPLETED FROM UPSTREAM TO DOWNSTREAM.

***NOTE: TEMPORARY EROSION & SEDIMENT CONTROL MEASURES TO BE REMOVED ONCE AREA STABILIZED. ALL DISTURBED RIPARIAN/FLOODPLAIN AREAS, INCLUDING BUT NOT LIMITED TO ACCESS ROADS AND LAYDOWN AREAS, TO BE SEEDED/RESTORED AS NEEDED TO PRE-EXISTING CONDITIONS OR BETTER.

WORK AREA ISOLATION NOTES

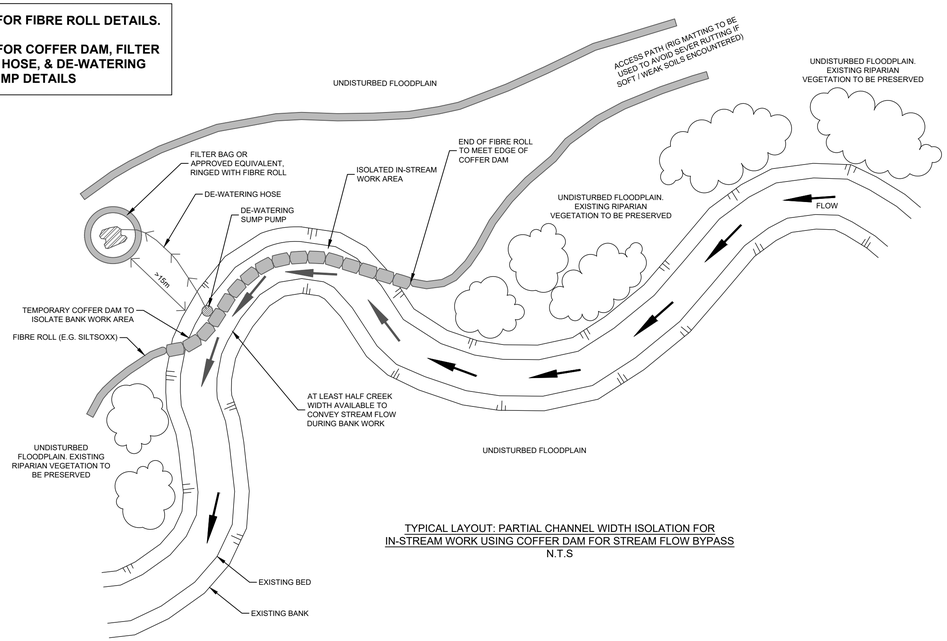
- INSTALL IN-STREAM PUMP OR INTAKE LINE OF REMOTE PUMP IN POOL LOCATED UPSTREAM OF WORK AREA. PROVIDE SCREENING TO PREVENT FISH FROM ENTERING INTO PUMP INTAKE . GO TO https://www.dfo-mpo.gc.ca/pnw-ppa/codes/screen-ecran-eng.html FOR APPROPRIATE SIZING OF FISH SCREEN. DIG TEMPORARY SUMP UPSTREAM IF NO NATURAL POOL EXISTS. DISCHARGE WATER THROUGH OR INTO AN ENERGY DISSIPATER INTO THE WATERCOURSE SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- INSTALL UPSTREAM COFFER DAM WITH IMPERVIOUS LINER ACROSS WATERCOURSE AND MATCH WITH EXISTING CREEK BANKS. CENTER OF COFFER DAM TO BE DEPRESSED 0.150m
- WATER COLLECTED WITHIN THE ISOLATED WORK AREA TO BE PUMPED AROUND THE CONSTRUCTION SITE, DISCHARGED THROUGH A FILTER BAG LOCATED WITHIN THE FLOODPLAIN AS REMOTE FROM THE WATERCOURSE AS POSSIBLE AND SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- AT THE END OF THE DAY THE STREAM MUST BE STABILIZED AND FREE FLOWING OR PUMPING MUST BE SUPERVISED.
- IN GENERAL ALL IN-STREAM CONSTRUCTION TO BE COMPLETED IN THE DRY. FISH EVACUATION PLAN MUST BE SUBMITTED AND APPROVED BY MOFLNRORD PRIOR TO COMMENCEMENT OF THE PROJECT. FISH RESCUE SHALL BE CONDUCTED FROM ISOLATED WORK AREAS BY A QUALIFIED INDIVIDUAL WITH A VALID PERMIT IN ACCORDANCE WITH THE BRITISH COLUMBIA STANDARDS AND BEST PRACTICES FOR IN-STREAM WORKS.
- INSTALL UPSTREAM COFFER DAM CONSISTING OF DOUBLE LINE WALL OF PEA GRAVEL BAGS COMPLETE WITH A LAYER OF IMPERMEABLE LINER SECURED BETWEEN THEM ACROSS WATERCOURSE AND MATCH EXISTING BANKS. DOWNSTREAM PEA GRAVEL BAGS SHALL BE INSTALLED TO PREVENT MIGRATION OF SILT AND SEDIMENT INTO THE ACTIVE STREAM FLOW. ENSURE COFFER DAM INSTALLATION IS EFFECTIVELY ISOLATING THE WORK AREA.
- IN-STREAM WORK IS TO START AT THE UPSTREAM LIMIT OF CONSTRUCTION AND BE COMPLETED SIMULTANEOUSLY WITH EXCAVATION SUCH THAT UNPROTECTED EXPOSURE IS MINIMIZED.
- DISTURBANCE CAUSED BY CONSTRUCTION EQUIPMENT ALONG THE BANK OR EDGE OF CREEK SHALL BE MINIMIZED BY THE USE OF RUBBER TRACKED EQUIPMENT, WOODEN MATS, OR OTHER APPROVED PROTECTIVE MEASURES.



TYPICAL LAYOUT: FULL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING DAM-AND-PUMP STREAM FLOW BYPASS
N.T.S

REFER TO SHEET 010 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 011 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS



TYPICAL LAYOUT: PARTIAL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING COFFER DAM FOR STREAM FLOW BYPASS
N.T.S

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A	ISSUED FOR REVIEW	FEB 12, 2021	AB	MF
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470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
www.onsite-engineering.ca

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LOWER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT

ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS

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OEL PROJECT NO. 1824-4-5

DRAWING NO. 009

SHEET: 9 OF 14

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SEDIMENT CONTROL BARRIERS

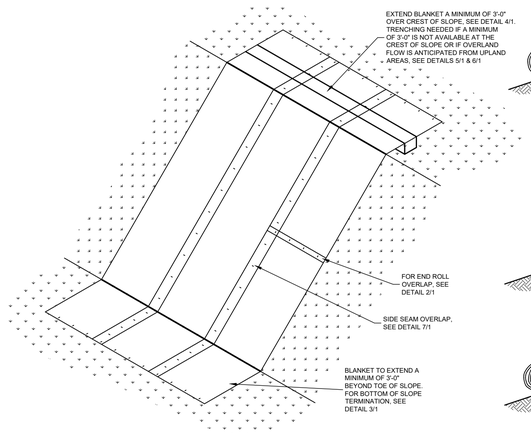
OPTION 1 - FIBRE ROLL

- FIBRE ROLL (E.G FILTREXX SILTSOXX OR APPROVED EQUIVALENT), FILLED WITH WOOD CHIPS, ARE THE PREFERRED TYPE OF SEDIMENT CONTROL BARRIER.
- MIN. DIAMETER = 300mm
- FIBRE ROLLS TO BE REGULARLY INSPECTED FOR TEARS OR HOLES, AND REPAIRED / REPLACED AS NEEDED TO MAINTAIN FUNCTION.
- FIBRE ROLLS MAY BE RE-USED IN A DIFFERENT LOCATION, ONLY IF THEY REMAIN FREE OF TEARS / HOLES, HAVE NOT LOST ANY OF THEIR CONTENTS, AND STILL MAINTAIN THE MINIMUM DIAMETER.
- REMOVE ALL SURFACE OBSTRUCTIONS GREATER THAN 50mm FROM THE GROUND PRIOR TO PLACING FIBRE ROLLS.
- TYPICAL FIBRE ROLL INSTALLATION DETAILS ARE SHOWN ON THIS SHEET FOR A FILTREXX SILTSOXX FIBRE ROLL. THE CONTRACTOR MAY USE THIS BRAND OF FIBRE ROLL OR AN APPROVED EQUIVALENT.

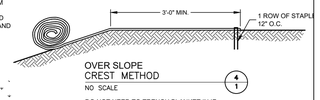
OPTION 2 - SEDIMENT CONTROL FENCE

- SEDIMENT CONTROL FENCE SUPPLIES SHOULD BE AVAILABLE ON SITE FOR USE IN CASES WHERE SURFACE PONDING OCCURS AND ADDITIONAL SILTATION CONTROL IS WARRANTED BEYOND WHAT THE FIBRE ROLLS CAN PROVIDE.
- GEOTEXTILE TO BE NON-WOVEN WITH A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
- NON-WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1 METER AT JOINTS.
- TYPICAL SEDIMENT CONTROL FENCE INSTALLATION DETAILS ARE SHOWN ON THIS SHEET. THESE DETAILS REPRESENT IDEAL SCENARIOS. ACTUAL SITE CONDITIONS MAY VARY AND SEDIMENT CONTROL FENCE INSTALLATION SHOULD BE TAILORED FOR EACH SITE.

EROSION CONTROL BLANKET - TYPICAL DETAILS

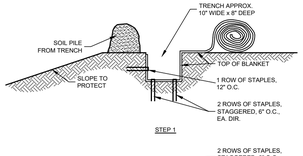


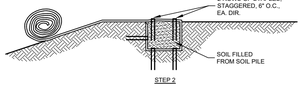
SLOPE DETAIL
NO SCALE
1/1



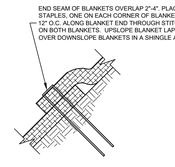
OVER SLOPE
CREST METHOD
NO SCALE
4/1

DO NOT NEED TO TRENCH BLANKET IN IF IT CAN BE EXTENDED A MINIMUM OF 3'-0" OVER THE CREST OF THE SLOPE.

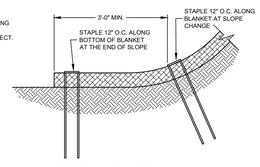




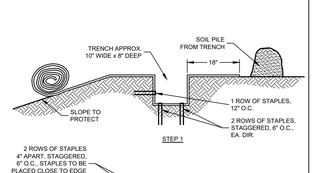
SLOPE TRENCHING
METHOD "A"
NO SCALE
5/1

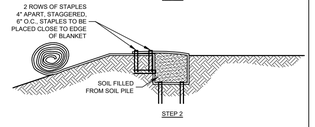


END ROLL OVERLAP
NO SCALE
2/1

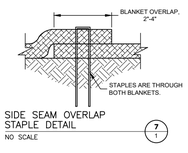


BOTTOM OF SLOPE
TERMINATION
NO SCALE
3/1





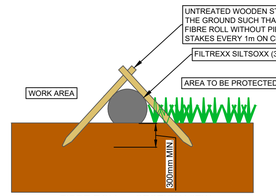
SLOPE TRENCHING
METHOD "B"
NO SCALE
6/1



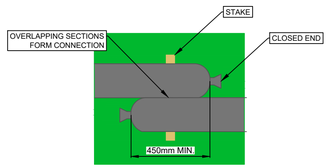
SIDE SEAM OVERLAP
STAPLE DETAIL
NO SCALE
7/1

EROSION CONTROL BLANKETS

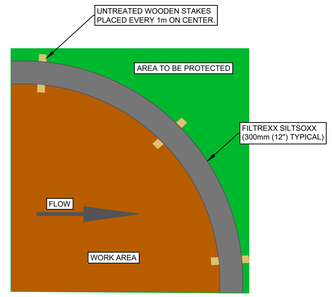
- BIODEGRADABLE EROSION CONTROL BLANKETS (E.G WOVEN JUTE, COIR MESH, GREAT LAKES ASPEN, ETC) TO BE AVAILABLE ON SITE IN CASE THEY ARE NEEDED TO HELP MITIGATE EROSION OF TEMPORARILY EXPOSED SOILS ON THE FLOODPLAIN
- DRAWINGS SHOWN ON THIS SHEET ILLUSTRATE TYPICAL INSTALLATION DETAILS FOR AN AMERICAN EXCELSIOR CURLEX NETFREE SLOPE PROTECTION EROSION CONTROL BLANKET. THE CONTRACTOR MAY USE THIS BRAND OF EROSION CONTROL BLANKET OR AN APPROVED EQUIVALENT.



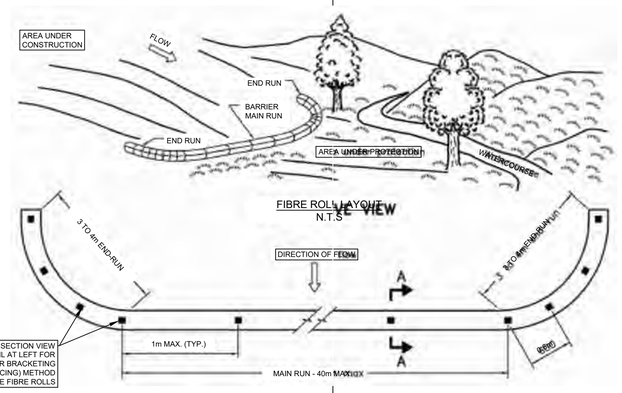
FIBRE ROLL - SECTION VIEW
N.T.S



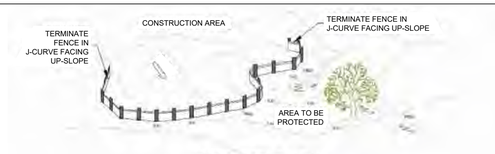
FIBRE ROLL - END CONNECTION DETAIL
N.T.S



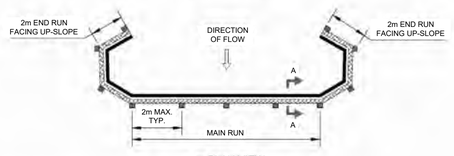
FIBRE ROLL - PLAN VIEW
N.T.S



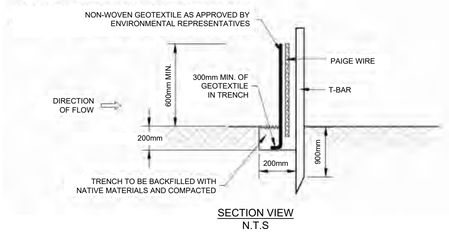
FIBRE ROLL LAYOUT - PLAN VIEW
N.T.S



PERSPECTIVE VIEW
N.T.S

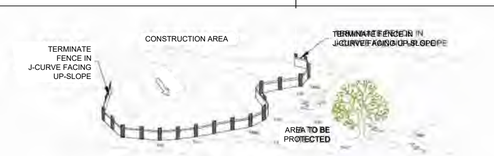


PLAN VIEW
N.T.S

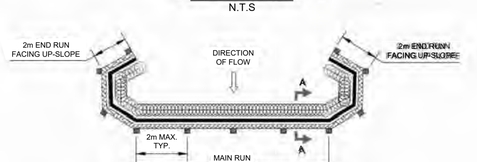


SECTION VIEW
N.T.S

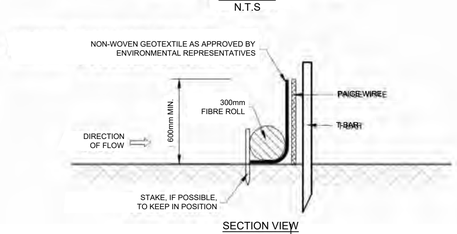
SEDIMENT CONTROL FENCE - UNFROZEN CONDITIONS



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
N.T.S



SECTION VIEW
N.T.S

SEDIMENT CONTROL FENCE - FROZEN CONDITIONS

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 12, 2021	AB	MF
B	ISSUED FOR REVIEW	MAR 30, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 13, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 18, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
SEDIMENT CONTROL BARRIERS & EROSION CONTROL
BLANKET DETAILS FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-5
DRAWING NO. 010
SHEET: 10 OF 14
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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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WORK AREA ISOLATION MEASURES

METRE BAG COFFER DAM

- FOR ISOLATION OF THE FULL CHANNEL WIDTH (DAM-AND-PUMP STREAM-FLOW BYPASS) OR ONLY A PORTION OF THE CHANNEL WIDTH (PASSIVE STREAM-FLOW BYPASS FOR SINGLE-BANK WORK) FOR IN-CHANNEL WORK.
- 1-2 TIER, SINGLE-STACK METRE BAG COFFER DAM PREFERRED GIVEN MINIMAL DISTURBANCE; PYRAMID-STACK METRE BAG COFFER DAM MAY BE NECESSARY IN DEEPER-WATER SCENARIOS.
- METRE BAGS SHOULD BE FILLED WITH PEA GRAVEL AND SHOULD NOT BE OVER-FILLED.
- A WATERPROOF MEMBRANE IS REQUIRED OVER THE PEA-GRAVEL METRE BAGS. THE WATERPROOF MEMBRANE MUST BE KEYED IN UNDER THE BARRIER TO MINIMIZE LEAKAGE.
- COFFER DAM MAY BE CONSTRUCTED OF SMALLER PEA-GRAVEL SANDBAGS OR OTHER SUITABLE EQUIVALENT. SEE BELOW FOR DETAILS.

PEA GRAVEL COFFER DAM

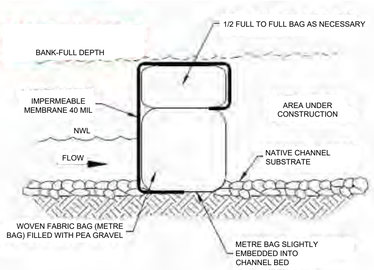
- CAN BE USED AT THE DISCRETION OF THE ENVIRONMENTAL REPRESENTATIVE FOR ISOLATION OF CHANNELS IN LOW-FLOW, SHALLOW WATER CONDITIONS WHEN LOCAL WORKS CAN BE COMPLETED WITHIN A FAVORABLE WEATHER WINDOW AND / OR THE CHANNEL IS LOCALLY TOO NARROW OR AWKWARD FOR THE USE OF METRE BAGS.

DE-WATERING SUMP PUMP

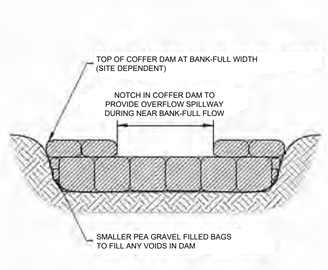
- FOR TEMPORARY MAINTENANCE OF DRY OR SHALLOWER CONDITIONS WITHIN AN ISOLATED IN-CHANNEL WORK AREA.
- A PUMP WITH A MINIMUM RECOMMENDED PUMPING CAPACITY OF 2000GPM MUST BE USED.
- DURING ELEVATED FLOWS APPROACHING BANK-FULL DEPTH, ALL PUMPING WILL BE STOPPED AND COFFER DAMS WILL BE TEMPORARILY REMOVED TO ALLOW FLOWS TO PASS UNOBSTRUCTED.

DE-WATERING FILTER BAG RINGED WITH FILTREXX SILTSOXX (OR APPROVED EQUIVALENT)

- FOR CONTROLLED DEPOSITION OF FINE SEDIMENT PUMPED OUT OF AN ISOLATED IN-CHANNEL WORK AREA, AWAY FROM THE WATERCOURSE.
- PLACE FILTER BAG (3.5m X 5.0m TERRAFIX ENVIROBAG OR APPROVED EQUIVALENT) ON A LEVEL, STABILIZED AREA OF THE FLOODPLAIN, ON VEGETATED GROUND > 15m AWAY FROM THE CHANNEL. FILTREXX SILTSOXX (300mm (12") DIAMETER) OR APPROVED EQUIVALENT TO BE PLACED AROUND THE FILTER BAG.
- ISOLATED SECTION OF CHANNEL TO BE PUMPED AND DE-WATERED INTO FILTER BAG.
- REPLACE UNIT WHEN HALF FULL OF SEDIMENT OR WHEN SEDIMENT HAS SIGNIFICANTLY REDUCED THE FLOW RATE OF PUMP DISCHARGE.
- ALLOW SEDIMENT BAG TO DRY IN DESIGNATED SEDIMENT DRYING AREA AND THEN RE-USE THE SEDIMENT AS PART OF BANK RESTORATION OR DISPOSE OF IT OFF SITE UNDER DIRECTION OF THE ON-SITE ENVIRONMENTAL REPRESENTATIVE.



METRE BAG COFFER DAM - SECTION
N.T.S



METRE BAG COFFER DAM - PROFILE
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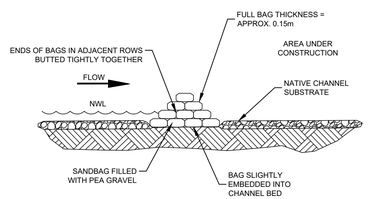

PEA GRAVEL BAG COFFER DAM - SECTION
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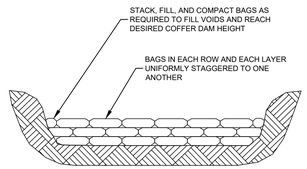

PEA GRAVEL BAG COFFER DAM - PROFILE
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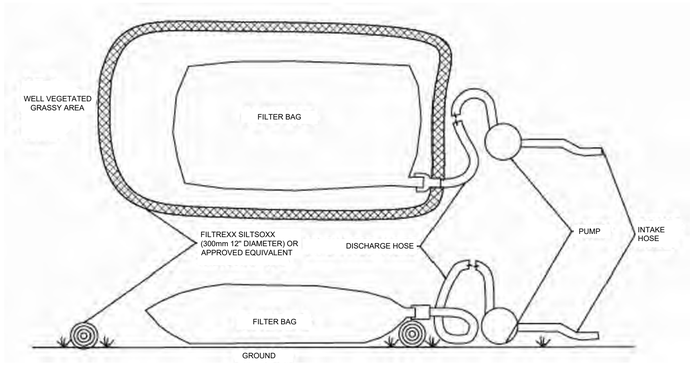

DE-WATERING FILTER BAG WITH FILTREXX SILTSOXX - PLAN & PROFILE
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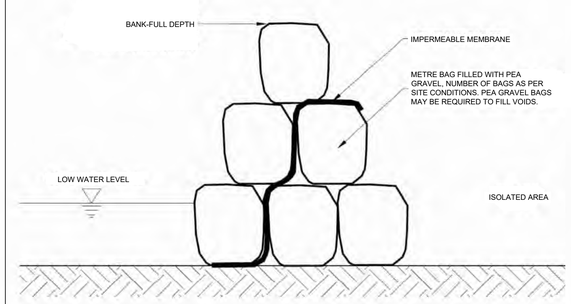

METRE BAG WATERPROOF ISOLATION BARRIER - SECTION
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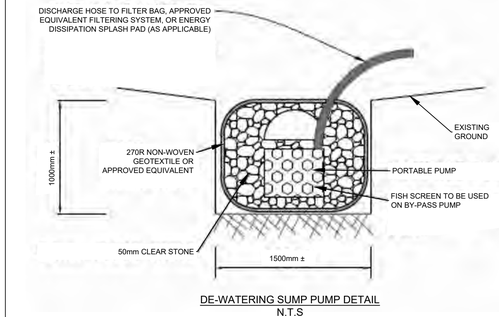
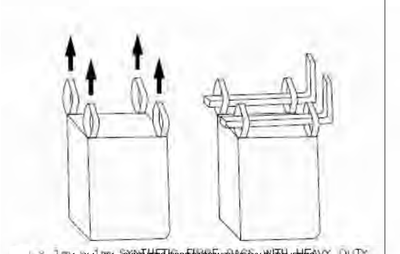


DE-WATERING SUMP PUMP DETAIL
N.T.S



PEA GRAVEL METRE BAG HANDLING
N.T.S

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 12, 2021	AB	MF
B	ISSUED FOR REVIEW	MAR 30, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 13, 2021	JL	MF
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VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

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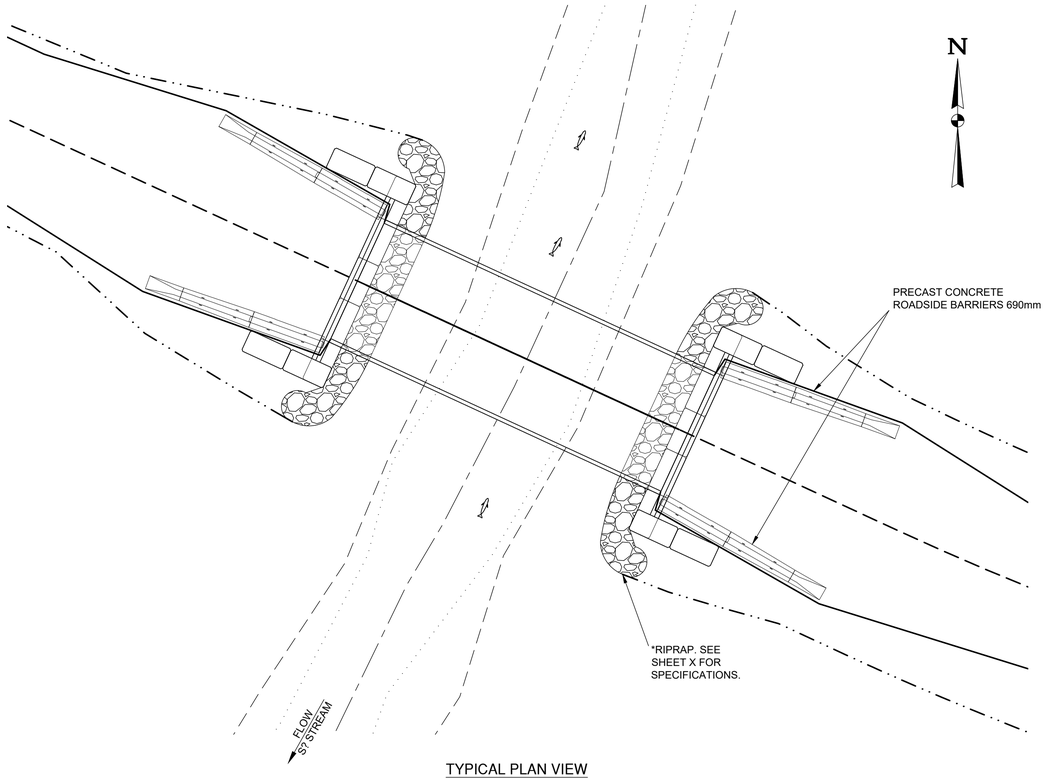


TYPICAL PLAN VIEW

10:1

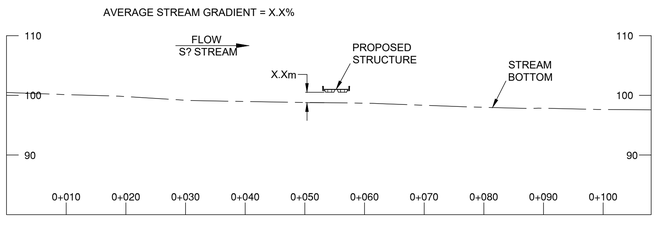
OBJECTIVE:
CROSSINGS ARE PROPOSED AT STRATEGIC LOCATIONS TO ALLOW FOR THE SAFE PASSAGE OF MACHINERY AND LIVESTOCK ACROSS THE CHANNEL AND TO AVOID EXCESS DISTURBANCE TO THE CREEK (E.G. CATTLE TRAMPLING, MACHINERY FORDS). CLEAR SPAN BRIDGES WERE CHOSEN TO ENSURE FISH AND WILDLIFE PASSAGE AND TO ACCOMMODATE NATURAL CREEK PROCESSES. THE PROPOSED CROSSING LOCATIONS WERE CHOSEN BASED ON GEOMORPHIC, ECOLOGICAL, AND AGRICULTURAL CONSIDERATIONS. CROSSINGS ARE NOT POSITIONED NEAR SHARP MEANDER BENDS.

A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.

LEGEND	
DESIGNED ROAD EDGES	
DESIGNED ROAD CENTRELINE	
APPROXIMATE EXTENT OF CUT/FILL SLOPE	
HIGH WATER LEVEL	
STREAM THALWEG	
PRESENT WATER LEVEL	

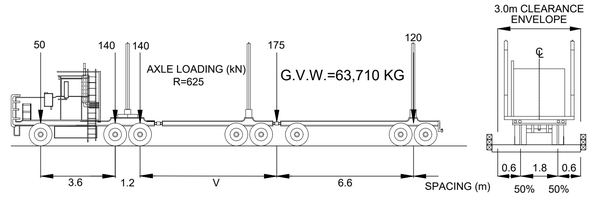
NOTES:

1. **DURATION:**
   - 1.1. FOR THE PURPOSE OF THIS DESIGN THE TERM PERMANENT AS IT REFERS TO DURATION OF THE INSTALL MEANS FORTY-FIVE (45) YEARS OR LESS. AS TREATED SILL AND BALLAST WALL TIMBERS ARE TO BE USED, REPLACEMENT OF TIMBER COMPONENTS IS EXPECTED AFTER TWENTY FIVE (25) YEARS. ROUTINE BRIDGE INSPECTIONS ARE TO BE COMPLETED TO DETERMINE THE ACTUAL LIFE OF TIMBER COMPONENTS AND WHEN THEY ARE TO BE REPLACED.
2. **DESIGN LIVE LOAD:**
   - 2.1. DESIGN VEHICLE: BCL-625 AS PER MOFLNRORD (STD-EC-000-001 TO 002).
3. **STRUCTURE:**
   - 3.1. SUPERSTRUCTURE TO BE PROVIDED BY OTHERS. SUPERSTRUCTURE DESIGN TO BE IN ACCORDANCE WITH CAN/CSA-S6 (MODIFIED AS PER MOFLNRORD INTERIM BRIDGE DESIGN GUIDELINES JULY 23-2010) AND IS TO TAKE INTO ACCOUNT LOGGING TRUCKS WITH UNBALANCED LOADS AND OFF-CENTER DRIVING.
   - 3.2. EXCEPT AS NOTED, SPECIFICATIONS TO BE AS PER MOFLNRORD STANDARD DRAWINGS FOR ALL STEEL PORTABLE BRIDGES (STD-E-090-01 TO 02), LOCK BLOCK ABUTMENT (STD-EC-050-01 AND STD-EC-050-012), CONSTRUCTION PAD (STD-EC-050-15), AND NO POST BARRIERS/GUIDE LOGS (STD-E-010-05).
   - 3.3. IF SUPERSTRUCTURE HAS BEEN USED PREVIOUSLY AT ANOTHER LOCATION IT MUST BE INSPECTED BY A PROFESSIONAL ENGINEER PRIOR TO USE AT THIS SITE. IF A NEW STRUCTURE IS PLANNED, OEL IS TO REVIEW FABRICATION DRAWINGS PRIOR TO FABRICATION OF SUPERSTRUCTURE FOR COMPLIANCE WITH THIS DESIGN.
   - 3.4. CHECK REQUIRED BEARING TO BEARING DISTANCE AND DEPTH OF ACTUAL STRUCTURE PRIOR TO CONSTRUCTION OF THE ABUTMENTS. BOTTOM OF GIRDER ELEVATIONS TO GOVERN.
   - 3.5. GENERAL ARRANGEMENT DRAWING. SOME SUPERSTRUCTURE COMPONENTS NOT SHOWN. REFER TO FABRICATION DRAWINGS.
4. **DESIGN OF ROAD APPROACHES AND DECK WIDTH:**
   - 4.1. HORIZONTAL ALIGNMENT AND ROAD WIDTHS TO PERMIT W-19 TRUCKS WITH 0.5m CLEARANCE INSIDE CURBS.
5. **CREEK NOTES:**
   - 5.1. STREAM RIPARIAN CLASS IS TO BE DETERMINED FOR EACH SITE BASED ON STREAM WIDTH AND FISH PRESENCE/ACCESS.
   - 5.2. STREAM BED MATERIAL IS TO BE DETERMINED FOR EACH SITE.
   - 5.3. THE DESIGN FLOOD IS EXPECTED TO BE: ■ CLEARWATER FLOOD ☐ DEBRIS FLOOD ☐ DEBRIS FLOW
   - 5.4. DESIGN FLOOD: TO BE DETERMINED FOR EACH SITE. THE PEAK FLOW FOR DESIGN PURPOSES WILL BE DETERMINED BASED ON REVIEW OF CHANNEL CHARACTERISTICS, PREVIOUS HIGH FLOW EVIDENCE, AND REVIEW OF THE RESULTS OF PEAK FLOW EMPIRICAL MODELS SUCH AS THE RATIONAL METHOD AND A REGIONAL ANALYSIS. WATERSHED CHARACTERISTICS, AND OTHER RELEVANT INFORMATION ARE ALSO USED TO ESTIMATE PEAK FLOW.
   - 5.5. LOW LIKELIHOOD OF WOODY DEBRIS MOVEMENT.
   - 5.6. CLIMATE CHANGE: CLIMATE CHANGE WILL BE CONSIDERED IN THE DESIGN FLOOD ASSESSMENT.
6. **GEOTECHNICAL:**
   - 6.1. FOUNDATION DESIGN REFERENCES THE CANADIAN FOUNDATION ENGINEERING MANUAL. SUBSURFACE INFORMATION WILL BE INFERRED FROM SITE OBSERVATIONS OF SOIL EXPOSURES IN ROAD CUTS AND ALONG STREAMBANKS AND FROM SHALLOW HAND DUG TEST PITS AND PROBES (TO BE DETERMINED FOR EACH SITE). NO DETAILED SUBSURFACE FIELD INVESTIGATION WAS CONDUCTED (LARGE TEST PITS OR BORE HOLES). FIELD CONDITIONS MAY VARY FROM THOSE INFERRED. IF, UPON EXCAVATION, FIELD CONDITIONS VARY FROM THOSE INFERRED, THEN CHANGES TO THE FOUNDATION DESIGN OR INSTALLATION MAY BE REQUIRED.
   - 6.2. FOOTING DESIGN BASED ON ASSUMED SOIL BEARING CAPACITY OF 200kPa.
7. **FIELD REVIEWS:**
   - 7.1. A PROFESSIONAL ENGINEER OR THEIR DESIGNATE IS REQUIRED TO INSPECT THE FOLLOWING ACTIVITIES PRIOR TO PROVIDING RECORD DRAWINGS AND A CROSSING ASSURANCE STATEMENT:
     - LAYOUT OF RIPRAP/ABUTMENT LOCATION PRIOR TO INITIAL EXCAVATION
     - FOUNDATION SOILS FOLLOWING EXCAVATION
     - RIPRAP AND ABUTMENT CONSTRUCTION
     - BACKFILL MATERIAL AND TECHNIQUE
     - OTHER SITE INSPECTIONS AT THE DISCRETION OF THE PROFESSIONAL
9. **INSTALLATION NOTES:**
   - 9.1. RIPRAP SOURCE HAS NOT BEEN IDENTIFIED.
   - 9.2. NOTE THAT WHERE EXCAVATION SPECIFICATIONS ON THESE DRAWINGS CONFLICT WITH WORKSAFEBC REGULATIONS, WORKSAFEBC REGULATIONS ARE TO GOVERN.
   - 9.3. PLAN TO DEWATER FOOTING AREAS.



TYPICAL STREAM PROFILE VIEW

2:1



BCL-625 DESIGN TRUCK LOADING DIAGRAM

V = VARIABLE SPACING - 6.6m TO 18m INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES THE MAXIMUM STRESSES.

CAUTION:
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C	ISSUED FOR REVIEW	APR 13, 2021	JL	MF
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PRINCE GEORGE, BC V2N 1A3
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
TYPICAL CROSSING DESIGN SHEET 1 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-5
DRAWING NO. 012
SHEET: 12 OF 14
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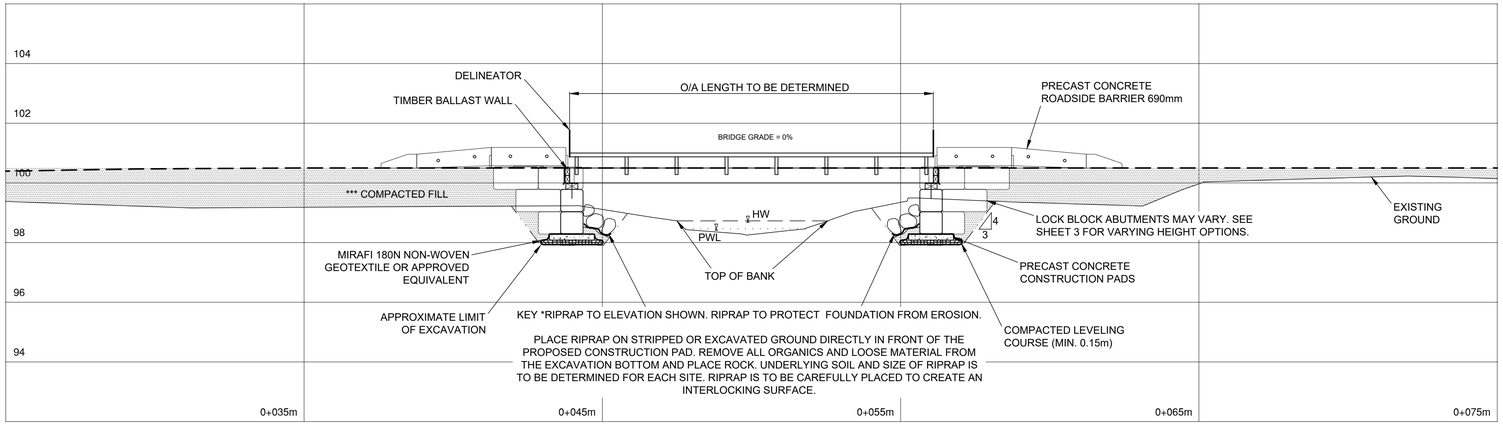
A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.



TYPICAL ELEVATION VIEW

10:1

PARTIAL MATERIALS LIST

QTY	ITEM DESCRIPTION
TBD	ROLLS NON-WOVEN GEOTEXTILE: MIRAFI 180N OR EQUIVALENT
TBD	ROLLS OF GEOGRID: MIRAFI 7XT OR EQUIVALENT
Xm³	LEVELING COURSE (SANDY GRAVEL OR 19mm CLEAR CRUSH) - CRUSH RECOMMENDED WHERE WATER EXPECTED IN FOOTING AREA
4	PRECAST CONCRETE CONSTRUCTION PADS: 0.2m X 1.5m X 4.6m [15']
TBD	STD CONCRETE BLOCKS (INTERLOCKING): 0.75m X 0.75m X 1.5m (TYP.)
TBD	FLAT TOP CONCRETE BLOCKS (INTERLOCKING): 0.75m X 0.75m X 1.5m (TYP.)
2	TREATED TIMBER SILLS: 0.2m X 0.4m X 4.9m [16']
6	STEEL PINS: 25mmØ [1"] TO ATTACH SILL TO LOCK BLOCKS
8	LAG BOLTS: 19mmØ [¾"] X 200mm TO ATTACH STEEL GIRDERS TO SILL
TBD	TIMBER BALLAST WALL: 0.15m X 0.3m X 6.0m [20'] LONG TIMBERS
4	GUIDE LOGS: 0.6m Ø X 6m LENGTH (TYP.)
4	W-054 SERIES DELINEATORS (2 LEFT, 2 RIGHT)
2	W-051 SERIES NARROW STRUCTURE SIGNS
2	POSTS FOR NARROW STRUCTURE SIGNS: 0.2m X 4.0m LENGTH LOG POSTS OR 0.1m X 0.1m X 3.0m LENGTH TREATED TIMBERS
1	BAG ROADSIDE GRASS SEED MIX
	RIPRAP: SEE SPECIFICATIONS ON THIS SHEET

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 50kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 5(155)
50% 50(330)
85% 150(475)
NOMINAL THICKNESS OF RIPRAP
550mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 100kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 10(195)
50% 100(415)
85% 300(600)
NOMINAL THICKNESS OF RIPRAP
700mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 250kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 25(260)
50% 250(565)
85% 750(815)
NOMINAL THICKNESS OF RIPRAP
1000mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

LEGEND	
DESIGNED ROAD GRADE	— — —
APPROXIMATE LIMIT OF EXCAVATION	— · · —
HIGH WATER LEVEL	— — — —
PRESENT WATER LEVEL	· · · · · · · ·
MIRAFI 180N GEOTEXTILE (OR APPROVED EQUIVALENT)	— — — —

CAUTION:
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**SOIL DENSITY	
VERY LOOSE	EASILY EXCAVATED WITH A SPADE
LOOSE	SOME RESISTANCE TO SPADE
COMPACT	CONSIDERABLE RESISTANCE TO SPADE
DENSE	REQUIRES PICK FOR EXCAVATION
VERY DENSE	HIGH RESISTANCE TO PICK

***COMPACTED FILL
GRANULAR FILL TO BE COMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY.

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LOWER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
TYPICAL CROSSING DESIGN SHEET 2 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-5
DRAWING NO. 013
SHEET: 13 OF 14
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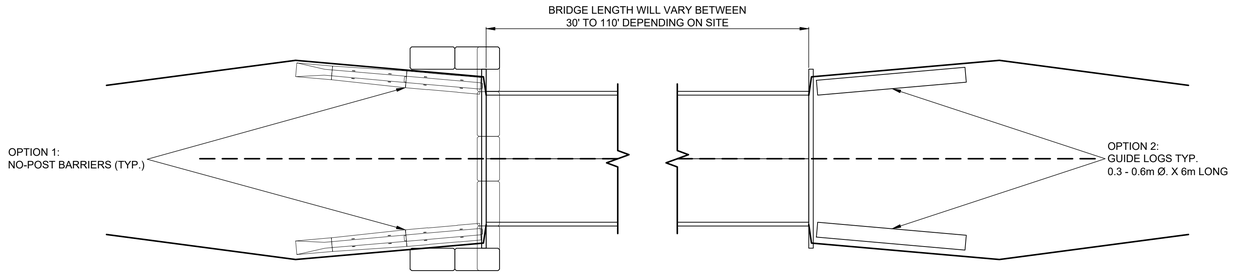
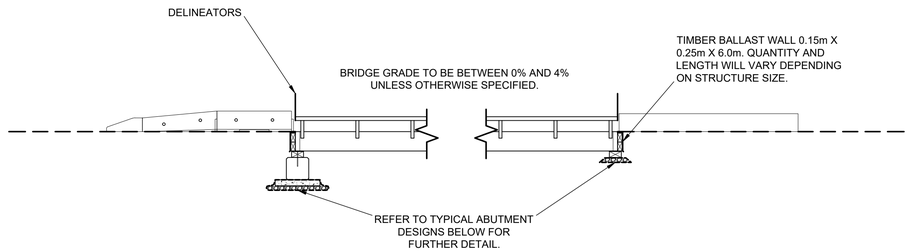




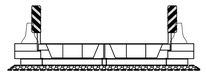
A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.

LEGEND	
DESIGNED ROAD EDGES	———
DESIGNED ROAD GRADE	— — —
MIRAFI 7XT GEOGRID (OR APPROVED EQUIVALENT)	— — —
MIRAFI 180N GEOTEXTILE (OR APPROVED EQUIVALENT)	- - - - -

SPECIFICATIONS FOR CONCRETE BLOCKS (INTERLOCKING):

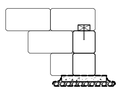
- CONCRETE MUST HAVE A 28 DAY STRENGTH OF 20MPa MINIMUM UNLESS OTHERWISE SPECIFIED.
- BLOCKS SHALL BE CAST MONOLITHICALLY (I.E., NO COLD JOINTS ALLOWED).
- THE FINISH SHALL MEET CLASS 1.
- CLASS 1 - CLASS 1 FINISH IS THE BASIC FINISH TO BE PRODUCED ON ALL FORMED SURFACES NOT EXPOSED TO VIEW UNLESS A BETTER FINISH IS SPECIFIED OR REQUIRED BY THE DRAWINGS OR SPECIAL PROVISIONS.
  - IN ORDER TO PRODUCE A CLASS 1 FINISH, THE FORMWORK SHALL BE MORTAR TIGHT. PANEL MARKS AND TEXTURE ARE OF NO IMPORTANCE.
  - ALL TIES, BOLTS, NAILS AND OTHER METAL SPECIFICALLY REQUIRED FOR CONSTRUCTION PURPOSES SHALL BE REMOVED OR CUT BACK TO A DEPTH OF 50mm FROM THE SURFACES OF THE CONCRETE AND THE RESULTING HOLES FILLED.
  - NO DRY TIES SHALL BE PERMITTED; FORM TIE RODS SHALL REMAIN EMBEDDED AND TERMINATE NOT LESS THAN 50mm FROM THE FORMED FACE OF THE CONCRETE. REMOVABLE EMBEDDED FASTENERS ON THE ENDS OF THE RODS SHALL BE SUCH AS TO LEAVE HOLES OF A REGULAR SHAPE FOR REAMING AND FILLING.
  - HONEYCOMBS AND VOIDS OVER 500mm^2 IN AREA SHALL BE FILLED.
- BLOCK SIZE MUST BE 1500x750x750mm.
- DIMENSIONAL TOLERANCE MUST BE ± 20mm FOR LENGTH, WIDTH AND HEIGHT AND THE BLOCKS SHALL BE REASONABLY SQUARE, WITH THE DIAGONALS WITHIN A TOLERANCE OF ± 15mm OF EACH OTHER.
- TOP AND BOTTOM SURFACES MUST BE FLAT TO A TOLERANCE OF ± 3mm UNDER A 600mm STRAIGHT EDGE.
- CONCRETE SHALL BE AIR ENTRAINED 4-7% TO PROTECT THE SURFACE FROM FREEZE THAW DEGRADATION.
- EACH BLOCK MUST CONTAIN A SATISFACTORY EMBEDDED LIFTING DEVICE.
- EDGES SHALL BE CHAMFERED.

TYPICAL ABUTMENT ELEVATION VIEW -
TIMBER SILL

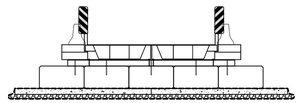


TYPICAL ABUTMENT CROSS SECTION VIEW -
TIMBER SILL

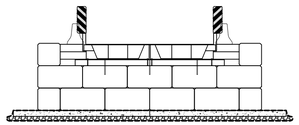
TYPICAL ABUTMENT ELEVATION VIEW -
1 LOCK BLOCK HIGH



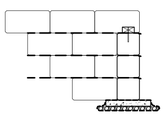
TYPICAL ABUTMENT ELEVATION VIEW -
2 LOCK BLOCK HIGH



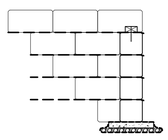
TYPICAL ABUTMENT CROSS SECTION VIEW -
1 LOCK BLOCK HIGH



TYPICAL ABUTMENT CROSS SECTION VIEW -
2 LOCK BLOCK HIGH

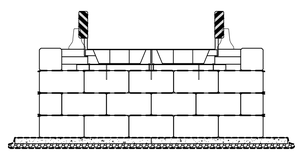


TYPICAL ABUTMENT ELEVATION VIEW -
3 LOCK BLOCK HIGH

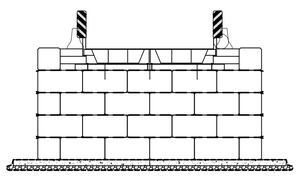


TYPICAL ABUTMENT ELEVATION VIEW -
4 LOCK BLOCK HIGH

GEOGRID TIEBACKS NEEDED ON 3 OR 4 LOCK BLOCK HIGH ABUTMENTS



TYPICAL ABUTMENT CROSS SECTION VIEW -
3 LOCK BLOCK HIGH



TYPICAL ABUTMENT CROSS SECTION VIEW -
4 LOCK BLOCK HIGH

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LOWER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
TYPICAL CROSSING DESIGN SHEET 3 OF 3

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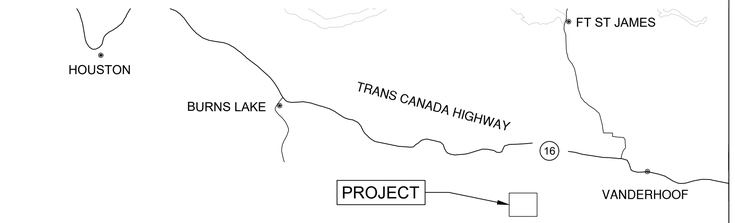
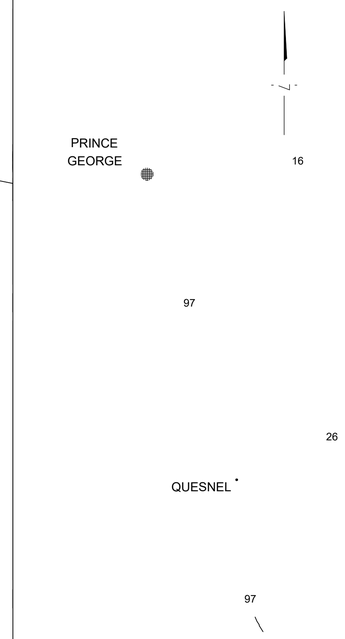
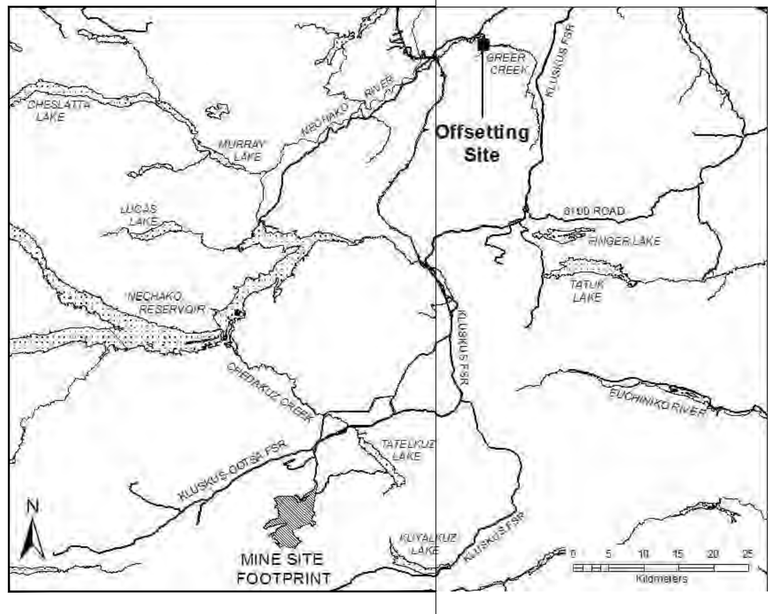


KEY PLAN
NTS



DRAWING INDEX	
SHEET No.	SHEET TITLE
1824-4-6-001	TITLE PAGE
1824-4-6-002	GENERAL NOTES
1824-4-6-003	OVERALL PLAN SHEET 1 OF 3
1824-4-6-004	OVERALL PLAN SHEET 2 OF 3
1824-4-6-005	OVERALL PLAN SHEET 3 OF 3
1824-4-6-006	STANDARD DETAILS SHEET 1 OF 1
1824-4-6-007	STANDARD DETAILS SHEET 2 OF 2 & PLANTING NOTES FOR CHANNEL WORKS
1824-4-6-008	ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS
1824-4-6-009	SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR CHANNEL WORKS
1824-4-6-010	WORK AREA ISOLATION MEASURES & PLANTING NOTES FOR CHANNEL WORKS
1824-4-6-011	TYPICAL CROSSING DESIGN SHEET 1 OF 3
1824-4-6-012	TYPICAL CROSSING DESIGN SHEET 2 OF 3
1824-4-6-013	TYPICAL CROSSING DESIGN SHEET 3 OF 3



LOCATION PLAN
NTS

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INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
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LAYDOWNS & ACCESS ROADS

- ALL LAYDOWNS AND ACCESS ROADS ARE TEMPORARY IN NATURE AND ARE ONLY REQUIRED FOR THE DURATION OF CHANNEL WORKS. GRASS AND PATHS DISTURBED DURING CONSTRUCTION ARE TO BE RESTORED TO THEIR ORIGINAL CONDITION PRE-CONSTRUCTION TO THE BEST OF THE CHOSEN CONTRACTOR'S ABILITIES AFTER ALL WORKS ARE COMPLETED.
- FINAL LOCATION, SIZE, AND SPECIFICATIONS OF THE PROPOSED LAYDOWN AREA AND ACCESS ROADS ARE TO BE REFINED BY THE SELECTED CONTRACTOR AS REQUIRED. DEPENDING ON CONDITIONS AT THE TIME OF CONSTRUCTION ACCESS MAY BE A VARIETY OF RIG MATS, FROZEN GROUND, OR BUILT UP GRAVEL ACCESS ROADS WITH GEOGRID.
- AVOID DISTURBANCE TO ANY EXISTING HERITAGE FEATURES
- AVOID DISTURBANCE TO ADJACENT PRIVATE PROPERTY

GENERAL STREAM NOTES

- BASED ON THE ONLINE TOOL (https://OWT.BCWATERTOOL.CA) THE WINTERTIME LOW FLOW IS ESTIMATED TO BE 0.5m3/sec WITH A MEAN ANNUAL DISCHARGE OF ~1.7m3/sec
- WATER SURFACE ELEVATIONS IN THE CHANNEL WERE ESTIMATED BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND UNMANNED AERIAL VEHICLE (I.E. DRONE) SURVEY, CONDUCTED BY DWB CONSULTING SERVICES LTD
- NOTE THAT THERE IS BEAVER ACTIVITY ALONG GREER CREEK. AS SUCH, WATER DEPTHS MAY BE LOCALLY HIGHER THAN EXPECTED BASED SOLELY ON LOCAL FLOW CONDITIONS.
- NOTE THAT THE GROUNDWATER TABLE IS RELATIVELY HIGH ACROSS THE FLAT VALLEY BOTTOM OF GREER CREEK, CONTROLLED IN THE ALLUVIUM COMPRISING THE FLOODPLAIN BY THE WATER SURFACE ELEVATION ALONG THE CHANNEL (WHICH MAY BE LOCALLY AFFECTED BY BEAVER ACTIVITY).

FLOODPLAIN SOILS

- NO DRILLING OR TEST PITTING HAS BEEN COMPLETED TO INVESTIGATE SOILS WITHIN THE VALLEY BOTTOM FLOODPLAIN SEDIMENTS WHERE CHANNEL WORKS ARE PROPOSED.
- OPPORTUNISTIC EXAMINATION OF FLOODPLAIN SOILS IN ERODED CREEK BANKS AND HAND AUGER HOLES (<1.2m DEEP) INDICATES ALLUVIAL SEDIMENTS TYPICAL OF RECURRENT FLOODPLAIN DEPOSITION: FINE SAND AND SILT WITH LOCALIZED GRAVELS AND ORGANICS.

SURVEY NOTES

DATUM: NAD 83 (CSRS) 2002.0

UTM ZONE: 10

THE SURVEY DATA USED TO CREATE THE TIN SURFACE FOR THIS DESIGN WAS PROVIDED TO ONSITE ENGINEERING LTD. BY PALMER. ALL SURVEY DATA WAS COLLECTED BY DWB CONSULTING SERVICES LTD. OCTOBER 24-27, 2016.

DESIGN TEAM

ENGINEERING - ONSITE ENGINEERING LTD. MICHAEL FOSTER, P.ENG.

GEOMORPHOLOGY/ENVIRONMENTAL/SEDIMENT AND EROSION CONTROL - PALMER ROBIN MCKILLOP, MSc, P.GEO. AND DAN MCPARLAND, MSc, P.GEO.

OVERVIEW

U:\Projects\1824\4\9\6- Mid Greer OS Design\AutoCAD\1824-4-6-Mid Greer Creek.dwg
DATE: 16/02/2021 2:27 PM BY: - Jesse Lutz

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 19, 2021	JL	MF
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
MID GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
GENERAL NOTES

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-6
DRAWING NO. 002
SHEET: 2 OF 13
REV E

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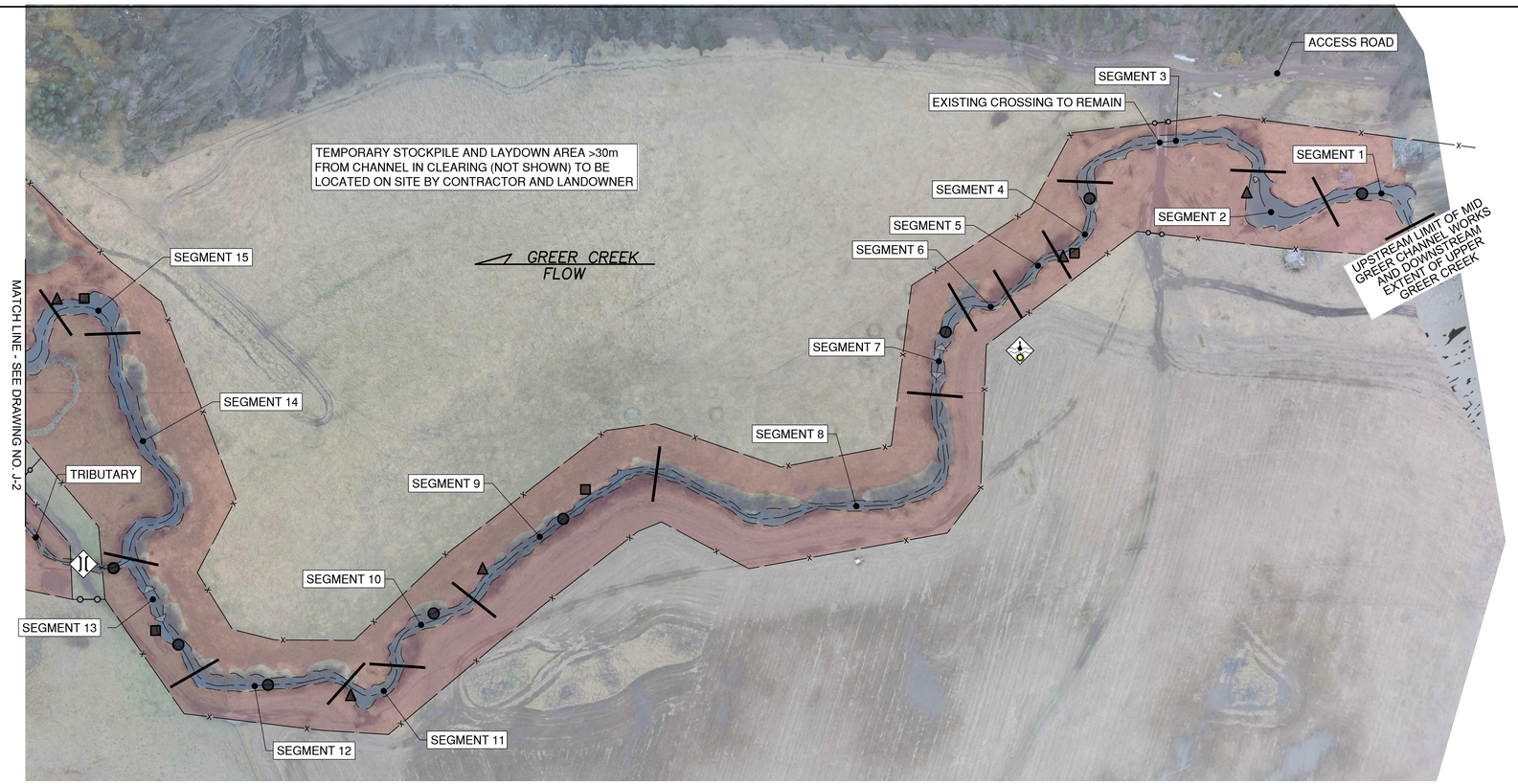

ISSUED FOR PERMIT APPROVAL

LEGEND

- APPROXIMATE WATERLINE
- APPROXIMATE CHANNEL CENTRE LINE
- PROPOSED CATTLE FENCING - BARB
- PROPOSED CATTLE FENCING - GATE
- EXISTING FENCE
- EXISTING ROAD
- CHANNEL SEGMENT BREAK LINES
- PROPOSED CROSSING
- PROPOSED CATTLE SUMMER WATERING - SOLAR
- PROPOSED STATIONARY CATTLE WINTER WATERING - SOLAR
- EXISTING BUILDING
- PROPOSED RIPARIAN PLANTING AREA

ABBREVIATIONS
(TREATMENT DETAILS SHOWN ON SHEET 006)

ISSUES
CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

CHANNEL MORPHOLOGY (Viewing Downstream):
RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

TREATMENTS

REGRADING:
BankR - Bank Regrading: Detail 1A

WOODY DEBRIS:
WDhabitat Enhancement:
» ▲ - ROOTWAD: Detail 2D
» ■ - LOG: Detail 2C

BANK TREATMENTS:
BL - Brush Layers: Detail 3B

BED MATERIALS:
BC - Boulder Cluster: Detail 4A
» ●
GP - Gravel Placement: Detail 4B
» ◁ - Downstream Limit
» ▷ - Upstream Limit

GREER CREEK: MID - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT EASTING	UPSTREAM LIMIT NORTHING	DOWNSTREAM LIMIT EASTING	DOWNSTREAM LIMIT NORTHING	SEGMENT LENGTH (m)	CHANNEL MORPHOLOGY & ISSUES	PROPOSED TREATMENTS	SPECIFICATIONS	NOTES
1	404027.306	5963897.282	403988.620	5963894.774	46.21	RBK: CT & UV LBK: UV BED: CT	RBK: BankR & BL BED: BC		
2	403988.620	5963894.774	403957.074	5963897.957	45.12	RBK: UV LBK: CT & UV	LBK: BankR, BL & WDhabitat		
3	403957.074	5963897.957	403887.393	5963867.907	91.16	RBK: UV LBK: UV			Existing bridge to remain
4	403887.393	5963867.907	403886.548	5963833.189	39.23	RBK: UV LBK: CT & UV	LBK: BankR, BL & WDhabitat BED: BC		
5	403886.548	5963833.189	403872.328	5963809.625	28.25	RBK: UV LBK: UV			
6	403872.328	5963809.625	403855.532	5963797.470	21.85	RBK: UV LBK: CT & UV	LBK: BankR & BL		
7	403855.532	5963797.470	403857.178	5963757.965	41.29	RBK: CT & UV LBK: UV BED: CT	RBK: BankR & BL BED: BC & GP	Gravel Placement Length = 10m	
8	403857.178	5963757.965	403753.448	5963684.229	171.18	RBK: UV LBK: UV			
9	403753.448	5963684.229	403696.995	5963604.801	100.32	RBK: CT & UV LBK: UV BED: CT	RBK: BankR, BL & WDhabitat BED: BC		
10	403696.995	5963604.801	403675.319	5963566.096	49.41	RBK: CT, UV LBK: UV	RBK: BankR & BL BED: BC		
11	403675.319	5963566.096	403657.516	5963551.187	31.06	RBK: UV LBK: CT & UV	LBK: BankR, BL & WDhabitat		
12	403657.516	5963551.187	403593.541	5963533.271	69.04	RBK: UV LBK: UV	BED: BC		
13	403593.541	5963533.271	403550.271	5963570.837	57.60	RBK: CT & UV LBK: CT & UV BED: CT	LBK: BankR, BL & WDhabitat BED: BC & GP	Gravel Placement Length = 12m	
14	403550.271	5963570.837	403509.042	5963660.840	118.12	RBK: UV LBK: UV			
15	403509.042	5963660.840	403482.360	5963661.129	31.80	RBK: CT & UV LBK: UV	RBK: BankR, BL & WDhabitat		

NOTES:
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9. SUMMER AND WINTER OFF-CHANNEL WATERING DETAILS ARE PROVIDED ON DRAWING 007.

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
MID GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL PLAN SHEET 1 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-6
DRAWING NO. 003
SHEET: 3 OF 13
REV E

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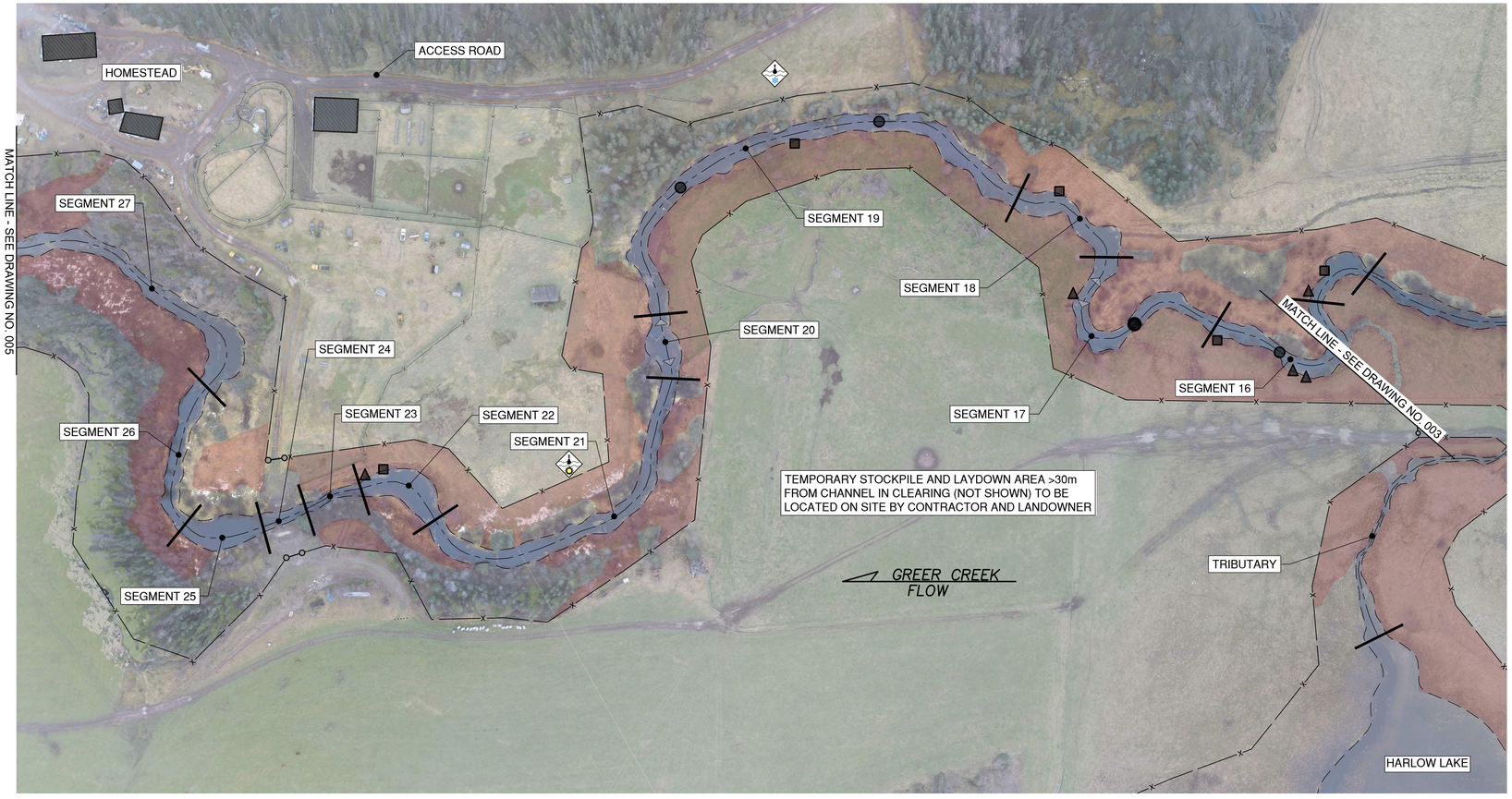

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GREER CREEK: MID - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT EASTING	UPSTREAM LIMIT NORTHING	DOWNSTREAM EASTING	DOWNSTREAM NORTHING	SEGMENT LENGTH (m)	CHANNEL MORPHOLOGY & ISSUES	PROPOSED TREATMENTS	SPECIFICATIONS	NOTES
TRIBUTARY	**403550.271**	**5963570.837**	**403432.094**	**5963515.041**	**159.45**	**RBK: CT & UV LBK: CT & UV BED: CT**	**RBK: BankR LBK: BankR BED: BC**		**Proposed crossing in segment**
16	**403482.360**	**5963661.129**	**403437.494**	**5963674.570**	**87.12**	**RBK: CT & UV LBK: CT & UV BED: CT**	**RBK: BankR & BL LBK: BankR, BL & WDhabitat BED: BC**		
17	**403437.494**	**5963674.570**	**403409.053**	**5963725.501**	**105.47**	**RBK: UV LBK: CT & UV BED: CT**	**LBK: BankR, BL & WDhabitat BED: BC & GP**	**Gravel Placement Length = 10m**	
18	**403409.053**	**5963725.501**	**403386.880**	**5963769.036**	**53.76**	**RBK: CT & UV LBK: CT & UV BED: CT**	**RBK: NW, BL & WDhabitat LBK: NW & BL**	**Bankfull Width = 9m**	
19	**403386.880**	**5963769.036**	**403219.683**	**5963802.200**	**237.38**	**RBK: UV LBK: CT & UV BED: CT**	**LBK: BankR, BL & WDhabitat BED: BC**		
20	**403219.683**	**5963802.200**	**403210.372**	**5963774.090**	**29.67**	**RBK: CT & UV LBK: CT & UV BED: CT**	**RBK: NW, BL & WDhabitat LBK: NW & BL BED: GP**	**Bankfull width = 10m Gravel placement length = 16m**	
21	**403210.372**	**5963774.090**	**403085.210**	**5963771.004**	**161.22**	**RBK: UV LBK: UV**			
22	**403085.210**	**5963771.004**	**403062.805**	**5963799.868**	**42.15**	**RBK: CT & UV LBK: CT & UV**	**RBK: BankR, BL & WDhabitat LBK: WDnarrow**		
23	**403062.805**	**5963799.868**	**403036.653**	**5963803.934**	**26.76**	**RBK: CT & UV LBK: UV BED: CT**	**RBK: BankR & BL**		
24	**403036.653**	**5963803.934**	**402985.258**	**5963806.485**	**21.22**	**RBK: UV LBK: UV**			**Existing crossing to remain. New bridge deck has been installed since imagery was collected (2016)**
25	**403015.605**	**5963806.485**	**403024.307**	**5963824.659**	**37.97**	**RBK: CT & UV**	**RBK: WDnarrow**		
26	**402985.258**	**5963824.659**	**402893.363**	**5963874.066**	**67.44**	**RBK: UV**			
27	**403024.307**	**5963874.066**	**403015.605**	**5964069.780**	**270.53**				

ABBREVIATIONS
(TREATMENT DETAILS SHOWN ON SHEET 006)

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OVERALL PLAN SHEET 2 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-6
DRAWING NO. 004
SHEET: 4 OF 13
REV E

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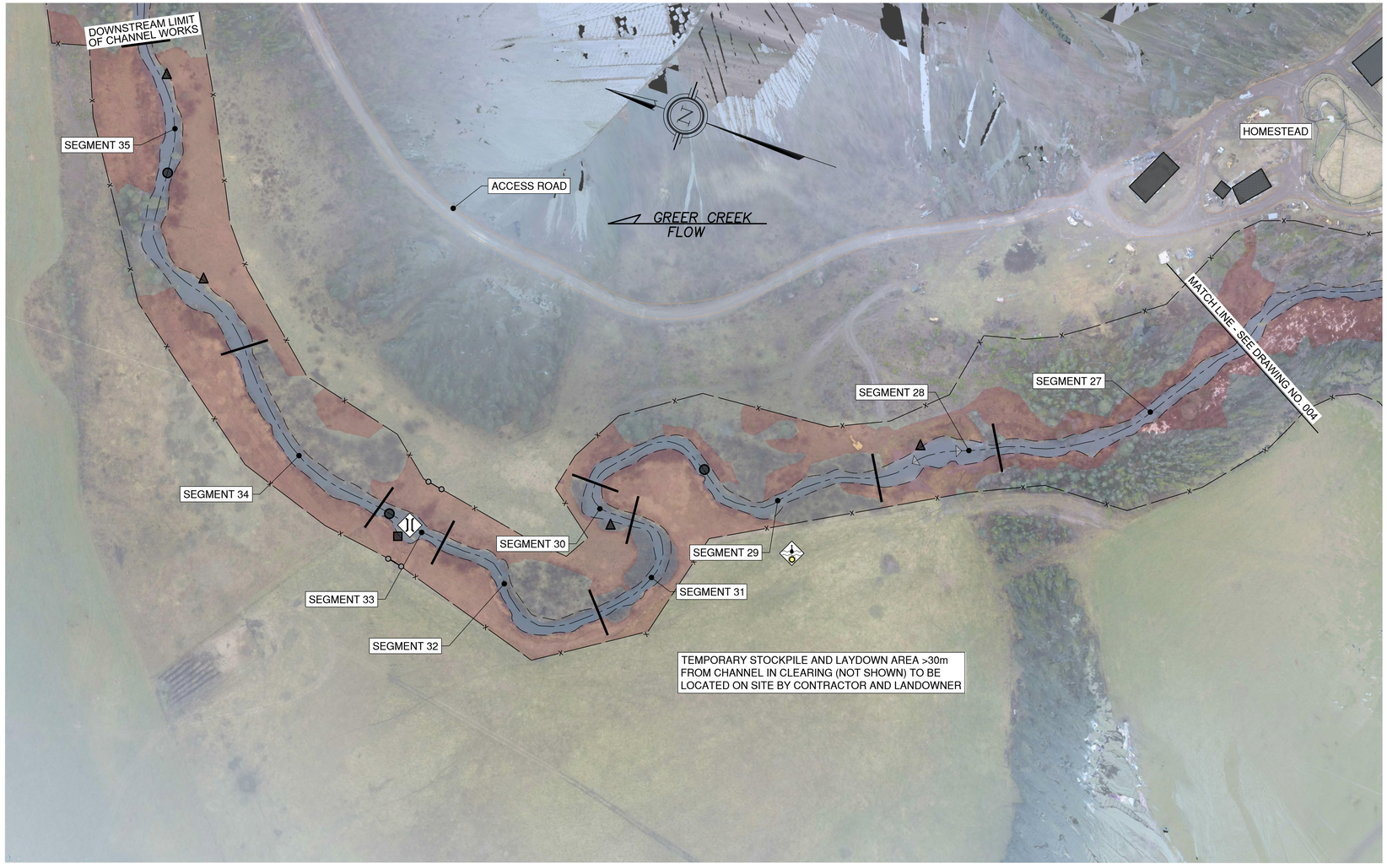

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27	403024.307	5963874.066	402893.363	5964069.780	270.53				
28	402893.363	5964069.780	402859.805	5964121.550	62.76	RBK: CT & UV LBK: CT & UV BED: CT & VC	RBK: NW, BL & WDhabitat LBK: NW & BL BED: GP	Bankfull width = 10m Gravel placement length = 14m	
29	402859.805	5964121.550	402812.132	5964253.012	163.63	RBK: UV LBK: UV	BED: BC		
30	402812.132	5964253.012	402800.812	5964229.840	30.69	RBK: CT & UV LBK: UV	RBK: BankR, BL & WDhabitat		
31	402800.812	5964229.840	402752.251	5964230.492	70.65	RBK: UV LBK: UV			
32	402752.251	5964230.492	402759.943	5964315.286	98.07	RBK: UV LBK: CT & UV	LBK: BankR & BL		
33	402759.943	5964315.286	402766.197	5964350.923	36.19	RBK: CT & UV LBK: CT & UV BED: CT	RBK: NW & BL LBK: NW, WDhabitat & BL BED: BC	Bankfull width = 11m	Proposed crossing in segment
34	402766.197	5964350.923	402819.881	5964439.807	108.39	RBK: UV LBK: UV			
35	402819.881	5964439.807	402947.241	5964535.075	173.18	RBK: CT & UV LBK: UV BED: CT	RBK: BankR, BL & WDhabitat BED: BC		

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OVERALL PLAN SHEET 3 OF 3

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-6
DRAWING NO.	005
SHEET:	5 OF 13
REV	E

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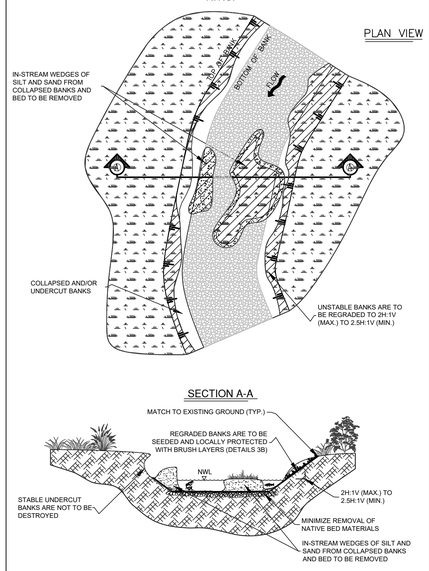
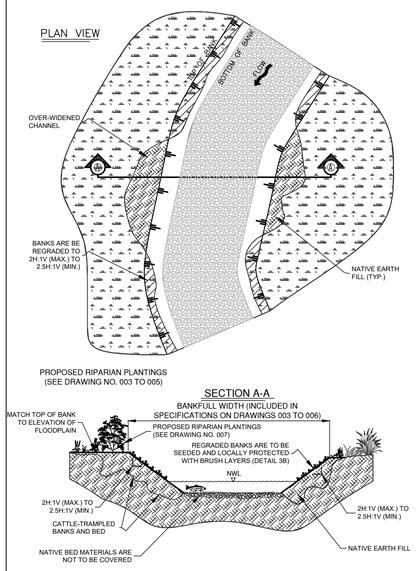
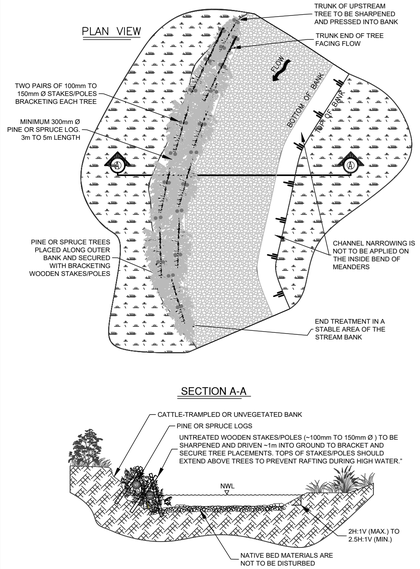
DETAIL 1A
RECONSTRUCTION OF CHANNEL BED AND/OR BANK REGRADING (BankR)
N.T.S.



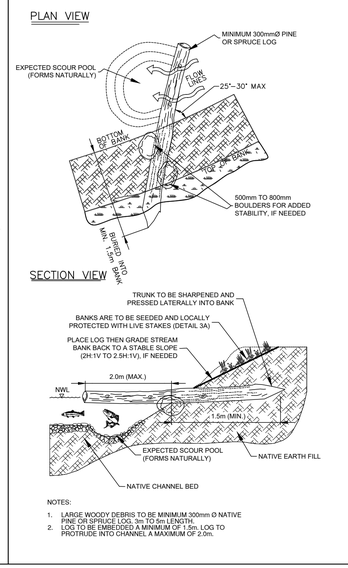
DETAIL 1B
RESTORATION OF NATURAL CHANNEL WIDTH (NW)
N.T.S.



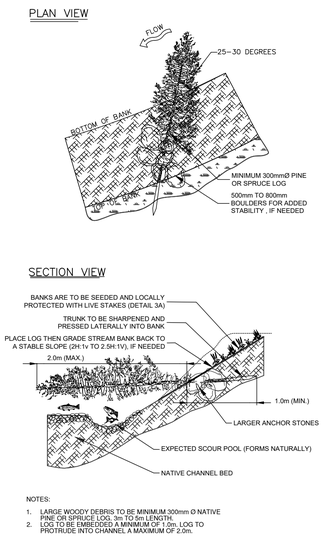
DETAIL 2A
WOODY DEBRIS CHANNEL NARROWING (WDnarrow)
N.T.S.



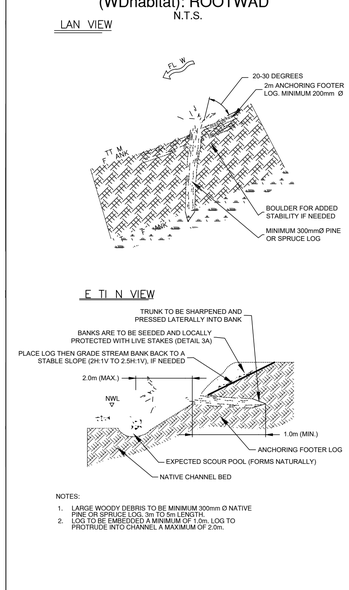
DETAIL 2B
WOODY DEBRIS CHANNEL DEFLECTION (WDdeflect)
N.T.S.



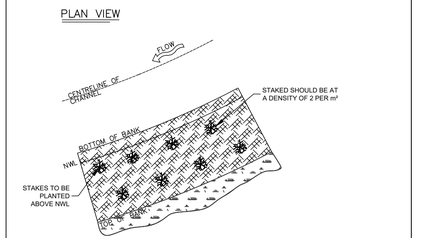
DETAIL 2C
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): LOG
N.T.S.



DETAIL 2D
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): ROOTWAD
N.T.S.

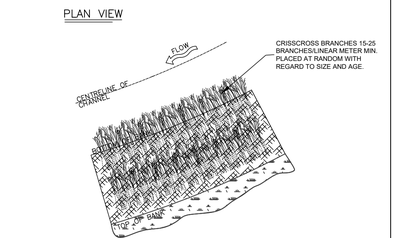


DETAIL 3A
BANK TREATMENT: LIVE STAKES (LS)
N.T.S.



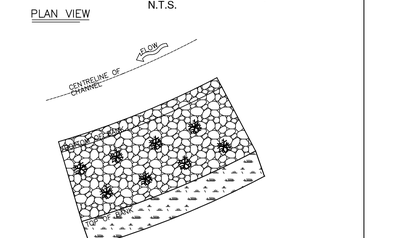
NOTES:
1. LIVE STAKINGS TO BE: -DORMANT LIVE STAKE CUTTING, (LIVE DOGWOOD AND WILLOW) -35-50mm DIA., WITH ANGLE CUT BASE, AND BLUNT CUT TOP. STAKE LENGTH TO BE 600-800mm.
2. TAMP ANGLE CUT BASE INTO SOIL AT RIGHT ANGLE TO SLOPE. ENSURE 75-80% OF LENGTH OF CUTTING IS EMBEDDED INTO SOIL. -TAMP TOPSOIL FIRMLY AROUND BASE.
3. SOAK LIVE STAKES FOR MINIMUM OF 24 HOURS PRIOR TO INSTALLATION.

DETAIL 3B
BANK TREATMENT: BRUSH LAYERS (BL)
N.T.S.



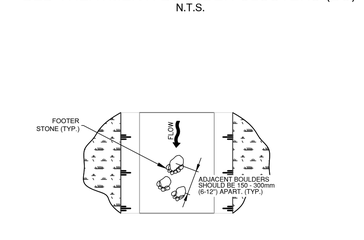
NOTES:
1. COVER BRUSHLAYER IMMEDIATELY WITH 0.15m (6") OF FILL SOIL, WATER AND COMPACT USING A VIBRATORY TAMPER.
2. BRUSH LAYERS WILL BE NATIVE WILLOW AND DOGWOOD SPECIES.
3. THE NUMBER OF LAYERS (I.E. LIFTS) WILL BE CONFIRMED BY THE INSPECTOR IN THE FIELD. IN GENERAL, BANKS <1m HIGH REQUIRE ONE LAYER, BANKS 1m TO 2m HIGH REQUIRE TWO LAYERS, AND BANKS >2m REQUIRE THREE LAYERS.

DETAIL 3C
BANK TREATMENT: VEGETATED BOULDER REVETMENT (VBR)
N.T.S.



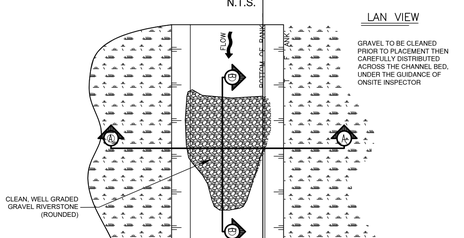
NOTES:
1. BOULDERS SHOULD BE ROUNDED TO SUB-ANGULAR.
2. GRADATION SHOULD BE WELL GRADED AND ANDERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE CLASS 25kg (MEDIAN GRAIN SIZE OF 260mm, MAXIMUM GRAIN SIZE OF 450mm).
3. INSTALLATION SHOULD ADHERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE GUIDANCE " RIPRAP INSTALLATION GUIDE"
4. BOULDERS ARE TO BE INDIVIDUALLY PLACED (I.E. NO DUMPING) TO MAXIMIZE INTERLOCKING. VOIDS ARE TO BE FILLED WITH SMALLER GRAVELS AND NATIVE MATERIALS.
5. THE BOULDER REVETMENT CAN BE FORMED IN LIFTS OR LIVE STAKE CAN BE INSERTED IF CARE IS TAKEN TO LEAVE SUFFICIENT VOIDS.
6. FILTER FABRIC SHOULD NOT BE USED.

DETAIL 4A
BED TREATMENT: BOULDER CLUSTERS (BC)
N.T.S.



NOTES:
1. BOULDER SHOULD BE 0.5-0.8m STONE.
2. BOULDERS ARE NOT TO BE PLACED IN DEPOSITIONAL ZONES.
3. BOULDERS SHOULD OCCUPY LESS THAN 1/5 OF THE CHANNEL WIDTH AFTER PARTIAL EMBEDMENT.
4. BOULDERS SHOULD BE A MINIMUM OF TWO STONE SIZES AWAY FROM THE CHANNEL'S BANKS.

DETAIL 4B
BED TREATMENT: GRAVEL PLACEMENT (GP)
N.T.S.



NOTES:
1. ONSITE INSPECTOR WILL NEED TO ENSURE NO FISH OR EGGS ARE PRESENT PRIOR TO PLACEMENT.
2. GRAVEL PLACEMENT SHOULD BE COMPLETED AT LOW FLOWS.

REMOVAL OR REGRADING
NATIVE VEGETATION
NWL NORMAL WATER LEVEL
NATIVE BED MATERIAL
NATIVE EARTH
SILT AND SAND

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B	ISSUED FOR REVIEW	MAR 26, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 14, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 18, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUN 8, 2022	JL	MF

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VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
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PH.: 250-833-5643 FAX: 866-235-6943
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STANDARD DETAILS SHEET 1 OF 1

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-6
DRAWING NO.	006
SHEET:	6 OF 13
REV	E

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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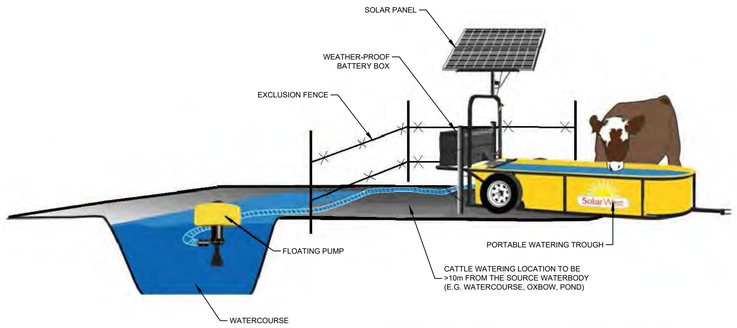
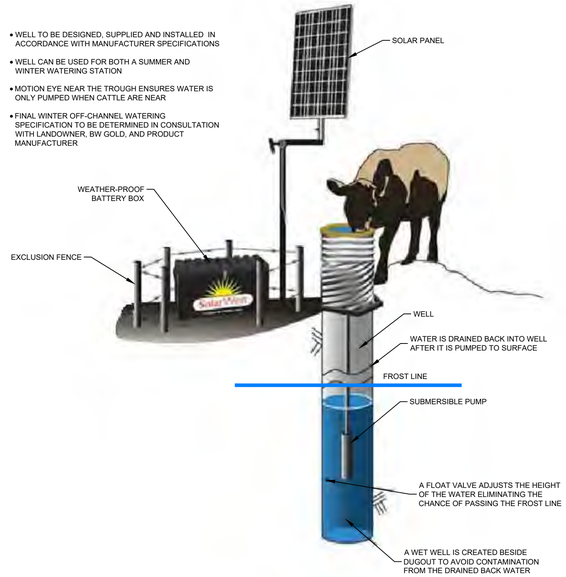
DETAIL 5A - SUMMER (MAY THROUGH OCTOBER) OFF-CHANNEL CATTLE WATERING
N.T.S



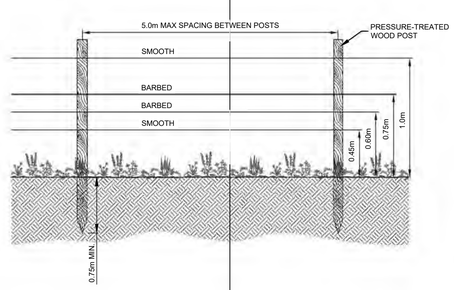
- PORTABLE WATERING STATION CAN EXTRACT WATER FROM WATERCOURSE, OXBOW AND/ OR ESTABLISHED WELL
- PORTABLE WATERING STATION CAN BE USED FOR BOTH SUMMER AND WINTER SEASON (IF GEOTHERMAL)
- PORTABLE WATERING STATION TO BE DESIGNED, SUPPLIED, AND INSTALLED BASED ON MANUFACTURER SPECIFICATIONS
- FLOAT SWITCH IN TROUGH MAINTAINS WATER LEVEL
- FINAL SUMMER OFF-CHANNEL WATERING SPECIFICATIONS TO BE DETERMINED IN CONSULTATION WITH LANDOWNER, BW GOLD, AND PRODUCT MANUFACTURER

DETAIL 5B - WINTER (NOVEMBER THROUGH APRIL) OFF-CHANNEL CATTLE WATERING
N.T.S

- WELL TO BE DESIGNED, SUPPLIED AND INSTALLED IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS
- WELL CAN BE USED FOR BOTH A SUMMER AND WINTER WATERING STATION
- MOTION EYE NEAR THE TROUGH ENSURES WATER IS ONLY PUMPED WHEN CATTLE ARE NEAR
- FINAL WINTER OFF-CHANNEL WATERING SPECIFICATION TO BE DETERMINED IN CONSULTATION WITH LANDOWNER, BW GOLD, AND PRODUCT MANUFACTURER

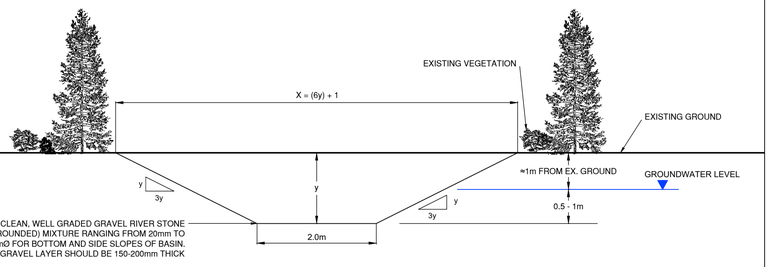


DETAIL 5C - CATTLE EXCLUSION FENCING - BARBED WIRE
N.T.S



- POSTS ARE TO BE 0.1m TO 0.15m IN DIAMETER AND 2m IN HEIGHT (MINIMUM)
- WIRE TO BE 12.5 GALVANIZED (CLASS 1 GALVANIZING MINIMUM), 4-POINT BARBS
- WIRE TO HAVE MINIMUM 950-LB BREAKING STRENGTH
- SMOOTH TOP AND BOTTOM WIRE TO FACILITATE WILDLIFE PASSAGE
- WIRE EXCLUSION FENCE DESIGN REFERENCES THE FENCING FACTSHEET 307.260-1 REVISED DECEMBER 15, 2015, BC MINISTRY OF AGRICULTURE, LIVESTOCK CONTROL - NON-ELECTRIC FENCE DESIGNS. FENCE TO BE SUPPLIED AND INSTALLED ACCORDING TO SPECIFICATIONS WITHIN THE FACTSHEET. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/farm-management/structures-and-mechanization/300-series/307260-1_livestock_contol_-_non-electric_fence.pdf

DETAIL 5D - GROUNDWATER INTERCEPTOR BASIN SECTION VIEW
N.T.S.



PROVISIONAL PLANTING NOTES

SITE PREPARATION:

- EXISTING WOODY VEGETATION TO BE RETAINED AND PROTECTED TO THE GREATEST EXTENT FEASIBLE.
- EXISTING HERBACEOUS VEGETATION IS TO BE MOWED OR SCYTHED TO 15cm IN HEIGHT BEFORE PLANTING AND / OR SEEDING.
- UNVEGETATED SOIL ON FORMER AGRICULTURAL FIELDS IS TO BE SCARIFIED WITH A SHALLOW VERTICAL TILL PLOW WHERE SEEDING IS PROPOSED. SCARIFICATION SHOULD BE PARALLEL TO THE STREAM TO MINIMIZE SURFACE RUNOFF.

PLANT MATERIAL:

- PLANT MATERIAL MUST BE LOCALLY SOURCED AND SPECIES MUST BE NATIVE TO THE REGION.
- PLANT STOCK MUST BE INSPECTED UPON DELIVERY TO ENSURE THAT THE MATERIAL CONSISTS OF APPROPRIATE NATIVE SPECIES IN GOOD CONDITION
- TREES TO BE CONTAINER GROWN OR BAREROOT STOCK RANGING FROM 1.0m TO 1.5m IN HEIGHT.
- SHRUBS TO BE CONTAINER GROWN OR BARE ROOT AND RANGING FROM 0.4m TO 1.0m IN HEIGHT.
- SEEDS OF THE SUGGESTED MIXTURE OR SIMILAR BLEND TO BE MIXED BEFORE THE APPLICATION.
- LIVE STAKES TO BE 35 TO 50mm IN DIAMETER AND 1 TO 1.5m IN LENGTH. SOAKED FOR A MINIMUM OF 24 HOURS BEFORE INSTALLATION. TIPS OF LIVE STAKES CAN BE SEALED TO MINIMIZE RISK OF DISEASE.
- GRASSES AND SHRUBS TO BE PLANTED IN RIPARIAN AREA ABOVE HIGH WATER MARK (ABOVE STREAM BANK) IF CURRENTLY BARREN. PLANT GRASSES ONLY IF SHRUBS ARE PRESENT. BRUSH LAYERING CUTTINGS TO BE A MINIMUM OF 10mm IN DIAMETER AND 1.5 TO 2.0m IN LENGTH.

PLANTING DENSITY:

- TREES TO BE PLANTED 1 TREE PER 36m² (APPROXIMATELY 6m ON CENTER).
- SHRUBS TO BE PLANTED 1 SHRUB PER m² IN CLUSTERS OF 6 INDIVIDUAL SHRUBS. EACH SHRUB CLUSTER SHOULD COMPRISE A MINIMUM OF 2 SPECIES. SHRUB CLUSTERS ARE TO BE SCATTERED APPROXIMATELY 12m APART.
- SEED MIX IS TO BE APPLIED AT A RATE OF 20 kg/ha.
- LIVE STAKES TO BE PLANTED 2 LIVE STAKES PER m².
- BRUSH LAYER CUTTINGS TO BE DENSELY PACKED, SIDE-BY-SIDE, TO FORM A CONTINUOUS LAYER ACROSS THE FULL LENGTH OF THE LIFT. EACH LIFT WILL BE COMPOSED OF 15-25 BRANCHES PER LINEAR METER.

TIMING:

- PLANTING OF WOODY MATERIAL SHOULD BE COMPLETED IN THE SPRING (APRIL TO MAY) OR FALL (SEPTEMBER TO OCTOBER).
- SEEDING SHOULD BE COMPLETED IMMEDIATELY AFTER THE PLANTING OF WOODY VEGETATION.

TENDING:

- ALL PLANTINGS SHOULD BE WATERED IMMEDIATELY AFTER INSTALLATION.
- ALL PLANTINGS SHOULD BE WATERED DURING PERIODS OF NATURAL DROUGHT CONDITIONS (ESPECIALLY FROM LATE SPRING TO THE END OF SUMMER) FOR THE FIRST GROWING SEASON.

PROVISIONAL PLANTING LIST AND QUANTITIES

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
Seed Mix 1 – Dry/Moist	Bluejoint Reedgrass	Calamagrostic canadensis	Dry seed mixed by weight to 45 kg for Shrub Cluster 1 areas
	Blue Wildrye	Elymus glaucus	
	Showy Aster	Eurybia conspicua	
	American Vetch	Vicia americana	
	Fireweed	Chamerion angustifolium	
	Palmate Coltsfoot	Petasites frigidus var. palmatus	
	Lindley's aster	Symphyotrichum ciliolatum	
	Rough-leaved Rice Grass	Oryzopsis asperifolia	
Seed Mix 2 – Moist/Wet	Purple Peavine	Lathyrus nevadensis	Dry seed mixed by weight to 24 kg for Shrub Cluster 2 areas.
	Heart-leaved Arnica	Arnica cordifolia	
	Beaked Sedge	Carex utriculata	
	Slender Sedge	Carex lasiocarpa	
Shrub Cluster 1 – Dry/Moist [Plant with Seed Mix 1]	Saskatoon	Amelanchier alnifolia	100
	Soopolallie	Shepherdia canadensis	100
	Prickly Rose	Rosa acicularis	100
	Red Raspberry	Rubus ideaus	117
Shrub Cluster 2 – Moist/Wet [Plant with Seed Mix 2]	Highbush-cranberry	Viburnum edule	74
	Black Twinberry	Lonicera involucrata	74
	Dwarf Birch	Betula glandulosa	74
Tree Cluster 1 – Dry/Moist	White Spruce	Picea glauca	400
	Lodgepole Pine	Pinus contorta	376
	Trembling Aspen	Populus tremuloides	376
Tree Cluster 2 – Moist/Wet	Black Cottonwood	Populus trichocarpa	142
	Trembling Aspen	Populus tremuloides	142
Live Stakes (LS)	Red-Osier Dogwood	Cornus stolonifera	66
	Scouler's Willow	Salix scouleriana	66
	Coyote Willow	Salix exigua	66
	Geyer's Willow	Salix geyeriana	66
Brush Layer Cuttings (BL)	Red-osier Dogwood	Cornus stolonifera	17 595
	Pacific Willow	Salix lasiandra	17 595
	Hooker's Willow	Salix hookeriana	17 595
	Coyote Willow	Salix exigua	17 595

A DETAILED PLANTING PLAN TO INCORPORATE UPDATED SITE INFORMATION AND FIRST NATION COMMENTS WILL BE DEVELOPED FOLLOWING THE COMPLETION OF VEGETATION SURVEYS DURING THE SUMMER OF 2022. PLEASE REFER TO THE VEGETATION WORK PLAN PRESENTED IN THE FISHERIES ACT AUTHORIZATION APPLICATION FOR ADDITIONAL DETAILS.

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A	ISSUED FOR REVIEW	FEB 19, 2021	JL	MF
B	ISSUED FOR REVIEW	MAR 26, 2021	JL	MF
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STANDARD DETAILS SHEET 2 OF 2
& PLANTING NOTES FOR CHANNEL WORKS

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CHANNEL WORKS - EROSION & SEDIMENT CONTROL AND WORK AREA ISOLATION - NOTES:

INTRODUCTORY STATEMENT

- THE EROSION & SEDIMENT CONTROL PLAN HAS BEEN DEVELOPED TO ENSURE ESTABLISHMENT AND MAINTENANCE OF ALL NECESSARY ENVIRONMENTAL PROTECTION MEASURES BEFORE, DURING AND AFTER CHANNEL RESTORATION AND ENHANCEMENT WORKS. IT ALSO ALLOWS THE CONTRACTOR, OVERSEEN BY AN ENVIRONMENTAL INSPECTOR, THE FLEXIBILITY TO OPTIMIZE THE MEASURES FOR THE MOST EFFECTIVE SEQUENCE AND APPROACH FOR IMPLEMENTATION. RATHER THAN PRESCRIBING EXACTLY WHERE AND WHEN DIFFERENT MEASURES ARE TO BE USED, TYPICAL LAYOUTS FOR ENVIRONMENTAL PROTECTION AND WORK-AREA SITE ISOLATION ARE PROVIDED TO MAKE CLEAR WHAT OPTIONS ARE AVAILABLE TO THE CONTRACTOR. AN ENVIRONMENTAL INSPECTOR FAMILIAR WITH THE EROSION & SEDIMENT CONTROL PLAN WILL BE AVAILABLE ON SITE TO ANSWER QUESTIONS AND PROVIDE GUIDANCE TO THE CONTRACTOR.

SECTION 1: SITE MANAGEMENT

1. EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING THE CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER, ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED AND / OR REPLACED WITHIN 48 HOURS OF INSPECTION.
2. DISTURBED AREAS WILL BE MINIMIZED TO THE EXTENT POSSIBLE, AND TEMPORARILY OR PERMANENTLY STABILIZED OR RESTORED AS THE WORK PROGRESSES.
3. ALL IN-WATER AND NEAR WATER EARTHWORKS WILL BE CONDUCTED IN THE DRY AND / OR WITHIN AN ISOLATED WORK AREA WITH APPROPRIATE EROSION AND SEDIMENT CONTROLS. SPECIFIED PLACEMENTS OF BOULDERS, GRAVEL, AND LARGE WOOD MAY BE MADE IN / NEAR WATER WITHOUT COMPLETE ISOLATION IF NOT ASSOCIATED WITH EARTHWORK.
4. THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED / AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREAS. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF DELETERIOUS SUBSTANCE, INCLUDING SEDIMENT, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY.
5. AN ENVIRONMENTAL MONITOR WILL ATTEND THE SITE TO INSPECT ALL NEW CONTROLS, AS WELL AS ON A REGULAR BASIS, OR FOLLOWING RAIN / SNOW MELT EVENTS, TO MONITOR ALL WORKS, AND IN PARTICULAR WORKS RELATED TO EROSION AND SEDIMENT CONTROLS, DE-WATERING, RESTORATION, AND IN / NEAR-WATER WORKS. SHOULD CONCERNS ARISE ON SITE, THE ENVIRONMENTAL MONITOR WILL CONTACT THE APPROPRIATE REGULATORY OFFICER AS WELL AS THE PROPONENT.
6. ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT THE ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE, OR OTHER DELETERIOUS SUBSTANCES INTO THE WATER. VEHICULAR REFUELING AND MAINTENANCE WILL BE CONDUCTED A MINIMUM OF 30 METERS FROM THE WATER.
7. THE PROPONENT / CONTRACTOR SHALL MONITOR THE WEATHER FOR THE DURATION OF CONSTRUCTION TO ENSURE THAT THE WORKS WILL BE CONDUCTED DURING FAVORABLE WEATHER CONDITIONS. SHOULD AN UNEXPECTED STORM OR SNOWMELT ARISE, THE CONTRACTOR WILL REMOVE ALL UNFIXED ITEMS FROM THE CHANNEL AND FLOOD PLAIN THAT WOULD HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW, E.G., FUEL TANKS, PORTA-POTTIES, MACHINERY, EQUIPMENT, CONSTRUCTION MATERIALS, ETC.
8. ALL DE-WATERING SHALL BE TREATED AND RELEASED TO THE ENVIRONMENT AT LEAST 15 METERS FROM A WATERCOURSE OR POND AND ALLOWED TO DRAIN THROUGH A FILTER BAG AND WELL-VEGETATED AREA. NO DE-WATERING EFFLUENT SHALL BE SENT DIRECTLY TO ANY WATERCOURSE, POND, FOREST, OR ALLOWED TO DRAIN ONTO DISTURBED SOILS WITHIN THE WORK AREA. THESE CONTROL MEASURES SHALL BE MONITORED FOR EFFECTIVENESS AND MAINTAINED OR REVISED TO MEET THE OBJECTIVE OF PREVENTING THE RELEASE OF SEDIMENT-LADEN WATER.
9. ESC MEASURES ARE TO REMAIN IN PLACE AND IN WORKING ORDER UNTIL ALL ON-SITE CONSTRUCTION IS COMPLETED.
10. AREAS WHICH REMAIN DISTURBED FOR MORE THAN 30 DAYS SHALL BE STABILIZED USING SEED, APPROVED EROSION CONTROL BLANKETS, OR SIMILAR APPROVED EQUIVALENT. IF CONDITIONS AREN'T SUITABLE FOR SEED APPLICATION, AN EROSION CONTROL BLANKET WILL BE USED IN ITS PLACE. SEE EROSION CONTROL BLANKET TYPICAL DETAIL ON SHEET 009.
11. NO EROSION AND SEDIMENT CONTROL MEASURE SHALL CONTAIN ANY PLASTIC, EVEN IF IT IS BIODEGRADABLE.
12. THE CONTRACTOR MUST HAVE SUITABLE PUMPING CAPABILITIES ON SITE AT ALL TIMES TO FACILITATE CONSTRUCTION ACTIVITIES IN THE DRY.
13. WORKS SHOULD BE COMPLETED IN STAGES TO REDUCE THE DURATION OF DISTURBED AREAS.
14. CONTRACTOR IS NOT TO DISPOSE OF ANY OF THE MATERIAL USED IN THE PEA GRAVEL METER BAGS INTO THE CHANNEL OR SURROUNDING AREA. ALL PEA GRAVEL BAGS ARE TO BE REMOVED OFF OF SITE.
15. TEMPORARY STAGING AREAS ARE TO BE SITUATED MORE THAN 15 METERS FROM THE WATERCOURSE. ALL MAJOR OVERNIGHT STAGING / STOCKPILING AREAS WILL BE A MINIMUM OF 30 METERS AWAY FROM THE WATERCOURSE. CONTRACTOR TO MONITOR WEATHER FORECASTS TO ENSURE MACHINES AND MATERIALS ARE REMOVED WHEN THE INCLEMENT WEATHER IS ANTICIPATED. STOCKPILE HEIGHTS WILL BE KEPT BELOW 1.5 METERS IN HEIGHT.

SECTION 2: CONSTRUCTION TIMING

16. TO PROTECT LOCAL FISH POPULATIONS DURING THEIR SPAWNING, NURSERY AND MIGRATORY PERIODS, IN-WATER ACTIVITIES SHOULD OCCUR DURING THE TIME PERIOD OF JULY 15 TO SEPTEMBER 15, IN ACCORDANCE WITH THE OMINECA REGION LEAST-RISK TIMING WINDOW FOR RAINBOW TROUT AND CHINOOK SALMON. THIS TIMING WINDOW IS SUBJECT TO CONFIRMATION FROM PROVINCIAL REGULATORS. CHANNEL WORKS ARE BEST COMPLETED IN LATE SUMMER, WHEN FLOWS ARE LOW AND THERE IS NO ICE.

SECTION 3: FISH RELOCATION

17. FISH STRANDED WITHIN THE WORK AREA SHALL BE CAPTURED AND RELEASED LIVE IN SUITABLE HABITAT DOWNSTREAM OF THE WORK AREA UNDER THE SUPERVISION OF A QUALIFIED AQUATIC BIOLOGIST. A PERMIT FROM MOFLNRORD IS REQUIRED.

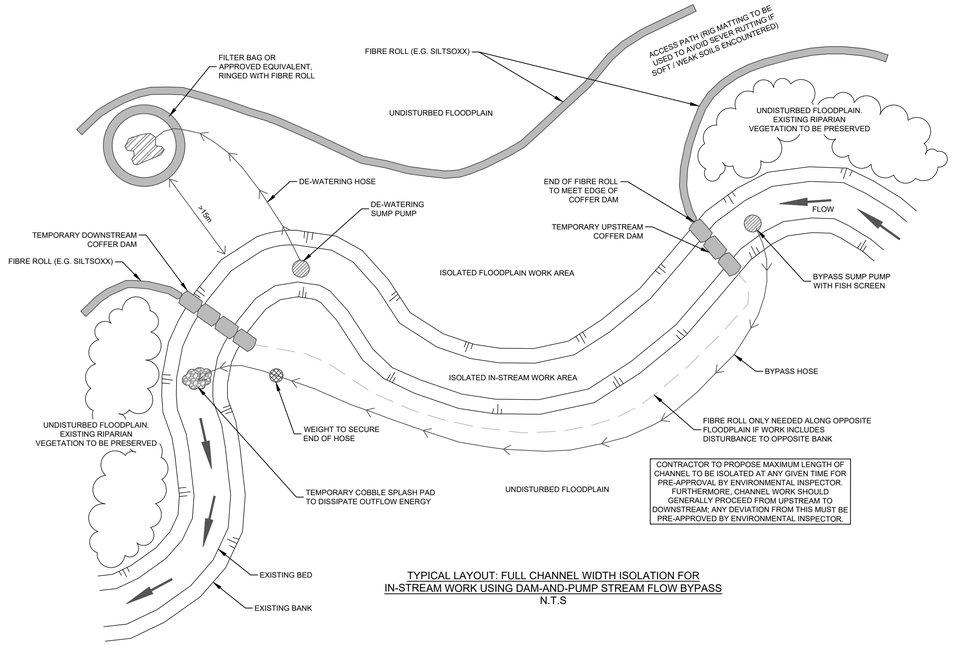
GENERAL STAGING PLAN FOR IN-CHANNEL WORK:

1. INSTALL FIBRE ROLLS ALONG ACCESS ROAD WHEN IT IS WITHIN 15m OF THE WATERCOURSE. ENSURE ENDS OF FIBRE ROLLS ARE POSITIONED TO TIE-IN WITH EDGES OF COFFER DAMS.
2. LAY DOWN RIG MATS ALONG ANY PORTIONS OF THE FLOODPLAIN ACCESS ROUTE WHERE THE SOILS ARE OBSERVED OR EXPECTED TO BE SOFT / WEAK, PRIOR TO EQUIPMENT ACCESS.
3. INSTALL UPSTREAM AND DOWNSTREAM COFFER DAMS IN A CONTROLLED MANNER TO REDUCE DISTURBANCE OF CHANNEL BED / BANKS AND RELEASE OF SEDIMENTS INTO CHANNEL.
4. INSTALL BYPASS PUMP AND HOSE TO BYPASS STREAM FLOW AROUND ISOLATED WORK AREA.
5. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
6. INSTALL DE-WATERING PUMP, HOSE, AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
7. PERFORM REQUIRED CHANNEL / BANK RESTORATION AND ENHANCEMENT WORKS, AS PER DESIGN SPECIFICATIONS.
8. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO REINTRODUCE FLOW GRADUALLY BACK INTO THE RESTORED CHANNEL.
9. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING DOWNSTREAM TO THE NEXT IN-CHANNEL WORK AREA.
10. REPEAT FROM STEP 1, AS NECESSARY, AS CHANNEL WORKS ARE COMPLETED FROM UPSTREAM TO DOWNSTREAM.

***NOTE: TEMPORARY EROSION & SEDIMENT CONTROL MEASURES TO BE REMOVED ONCE AREA STABILIZED. ALL DISTURBED RIPARIAN/FLOODPLAIN AREAS, INCLUDING BUT NOT LIMITED TO ACCESS ROADS AND LAYDOWN AREAS, TO BE SEEDED/RESTORED AS NEEDED TO PRE-EXISTING CONDITIONS OR BETTER.

WORK AREA ISOLATION NOTES

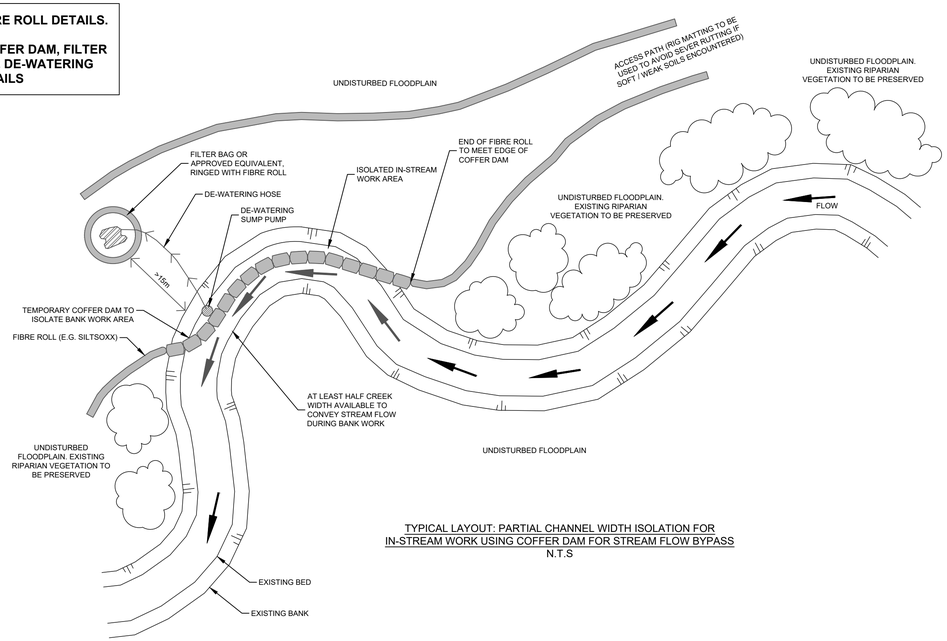
- INSTALL IN-STREAM PUMP OR INTAKE LINE OF REMOTE PUMP IN POOL LOCATED UPSTREAM OF WORK AREA. PROVIDE SCREENING TO PREVENT FISH FROM ENTERING INTO PUMP INTAKE . GO TO https://www.dfo-mpo.gc.ca/pnw-ppa/codes/screen-ecran-eng.html FOR APPROPRIATE SIZING OF FISH SCREEN. DIG TEMPORARY SUMP UPSTREAM IF NO NATURAL POOL EXISTS. DISCHARGE WATER THROUGH OR INTO AN ENERGY DISSIPATER INTO THE WATERCOURSE SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- INSTALL UPSTREAM COFFER DAM WITH IMPERVIOUS LINER ACROSS WATERCOURSE AND MATCH WITH EXISTING CREEK BANKS. CENTER OF COFFER DAM TO BE DEPRESSED 0.150m
- WATER COLLECTED WITHIN THE ISOLATED WORK AREA TO BE PUMPED AROUND THE CONSTRUCTION SITE, DISCHARGED THROUGH A FILTER BAG LOCATED WITHIN THE FLOODPLAIN AS REMOTE FROM THE WATERCOURSE AS POSSIBLE AND SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- AT THE END OF THE DAY THE STREAM MUST BE STABILIZED AND FREE FLOWING OR PUMPING MUST BE SUPERVISED.
- IN GENERAL ALL IN-STREAM CONSTRUCTION TO BE COMPLETED IN THE DRY. FISH EVACUATION PLAN MUST BE SUBMITTED AND APPROVED BY MOFLNRORD PRIOR TO COMMENCEMENT OF THE PROJECT. FISH RESCUE SHALL BE CONDUCTED FROM ISOLATED WORK AREAS BY A QUALIFIED INDIVIDUAL WITH A VALID PERMIT IN ACCORDANCE WITH THE BRITISH COLUMBIA STANDARDS AND BEST PRACTICES FOR IN-STREAM WORKS.
- INSTALL UPSTREAM COFFER DAM CONSISTING OF DOUBLE LINE WALL OF PEA GRAVEL BAGS COMPLETE WITH A LAYER OF IMPERMEABLE LINER SECURED BETWEEN THEM ACROSS WATERCOURSE AND MATCH EXISTING BANKS. DOWNSTREAM PEA GRAVEL BAGS SHALL BE INSTALLED TO PREVENT MIGRATION OF SILT AND SEDIMENT INTO THE ACTIVE STREAM FLOW. ENSURE COFFER DAM INSTALLATION IS EFFECTIVELY ISOLATING THE WORK AREA.
- IN-STREAM WORK IS TO START AT THE UPSTREAM LIMIT OF CONSTRUCTION AND BE COMPLETED SIMULTANEOUSLY WITH EXCAVATION SUCH THAT UNPROTECTED EXPOSURE IS MINIMIZED.
- DISTURBANCE CAUSED BY CONSTRUCTION EQUIPMENT ALONG THE BANK OR EDGE OF CREEK SHALL BE MINIMIZED BY THE USE OF RUBBER TRACKED EQUIPMENT, WOODEN MATS, OR OTHER APPROVED PROTECTIVE MEASURES.



TYPICAL LAYOUT: FULL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING DAM-AND-PUMP STREAM FLOW BYPASS
N.T.S

REFER TO SHEET 009 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 010 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS



TYPICAL LAYOUT: PARTIAL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING COFFER DAM FOR STREAM FLOW BYPASS
N.T.S

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REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 19, 2021	JL	MF
B	ISSUED FOR REVIEW	MAR 26, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 14, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 18, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUN 8, 2022	JL	MF

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PH.: 604-629-9075

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INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN

MID GREER CREEK HABITAT RESTORATION AND ENHANCEMENT

ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501

OEL PROJECT NO. 1824-4-6

DRAWING NO. 008

SHEET: 8 OF 13

REV E

U:\Projects\1824\09\6- Mid Greer OS Design\AutoCAD\1824-4-6- ESC Plans - STREAM WORK ONLY.dwg
DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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SEDIMENT CONTROL BARRIERS

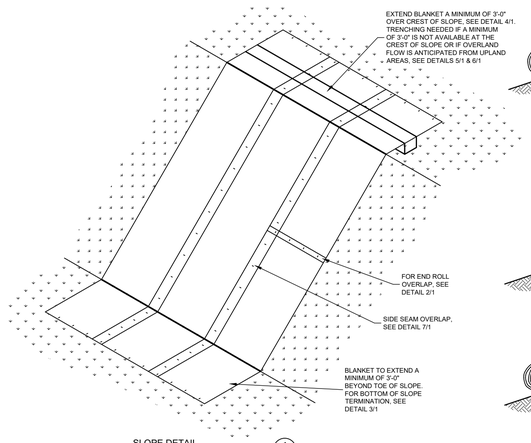
OPTION 1 - FIBRE ROLL

- FIBRE ROLL (E.G FILTREXX SILTSOXX OR APPROVED EQUIVALENT), FILLED WITH WOOD CHIPS, ARE THE PREFERRED TYPE OF SEDIMENT CONTROL BARRIER.
- MIN. DIAMETER = 300mm
- FIBRE ROLLS TO BE REGULARLY INSPECTED FOR TEARS OR HOLES, AND REPAIRED / REPLACED AS NEEDED TO MAINTAIN FUNCTION.
- FIBRE ROLLS MAY BE RE-USED IN A DIFFERENT LOCATION, ONLY IF THEY REMAIN FREE OF TEARS / HOLES, HAVE NOT LOST ANY OF THEIR CONTENTS, AND STILL MAINTAIN THE MINIMUM DIAMETER.
- REMOVE ALL SURFACE OBSTRUCTIONS GREATER THAN 50mm FROM THE GROUND PRIOR TO PLACING FIBRE ROLLS.
- TYPICAL FIBRE ROLL INSTALLATION DETAILS ARE SHOWN ON THIS SHEET FOR A FILTREXX SILTSOXX FIBRE ROLL. THE CONTRACTOR MAY USE THIS BRAND OF FIBRE ROLL OR AN APPROVED EQUIVALENT.

OPTION 2 - SEDIMENT CONTROL FENCE

- SEDIMENT CONTROL FENCE SUPPLIES SHOULD BE AVAILABLE ON SITE FOR USE IN CASES WHERE SURFACE PONDING OCCURS AND ADDITIONAL SILTATION CONTROL IS WARRANTED BEYOND WHAT THE FIBRE ROLLS CAN PROVIDE.
- GEOTEXTILE TO BE NON-WOVEN WITH A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
- NON-WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1 METER AT JOINTS.
- TYPICAL SEDIMENT CONTROL FENCE INSTALLATION DETAILS ARE SHOWN ON THIS SHEET. THESE DETAILS REPRESENT IDEAL SCENARIOS. ACTUAL SITE CONDITIONS MAY VARY AND SEDIMENT CONTROL FENCE INSTALLATION SHOULD BE TAILORED FOR EACH SITE.

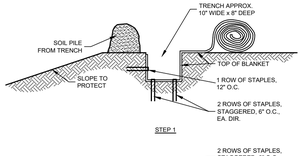
EROSION CONTROL BLANKET - TYPICAL DETAILS

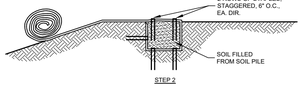


SLOPE DETAIL
NO SCALE
1/1

OVER SLOPE
CREST METHOD
NO SCALE
4/1

DO NOT NEED TO TRENCH BLANKET IN IF IT CAN BE EXTENDED A MINIMUM OF 3'-0" OVER THE CREST OF THE SLOPE.





SLOPE TRENCHING
METHOD "A"
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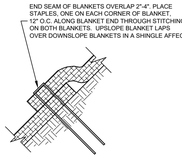
5/1



END ROLL OVERLAP
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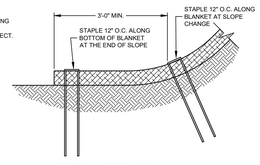
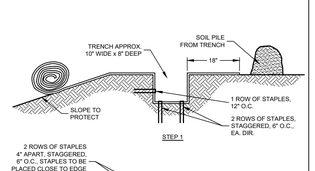
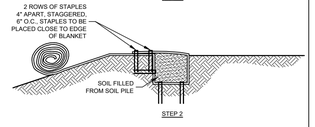
2/1

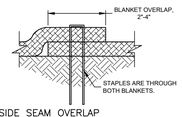


BOTTOM OF SLOPE
TERMINATION
NO SCALE
3/1





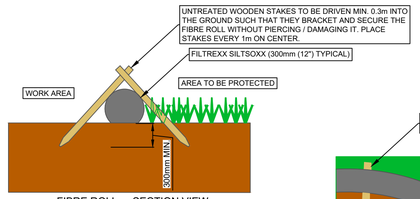
SLOPE TRENCHING
METHOD "B"
NO SCALE
6/1



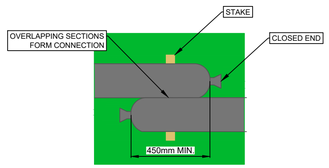
SIDE SEAM OVERLAP
STAPLE DETAIL
NO SCALE
7/1

EROSION CONTROL BLANKETS

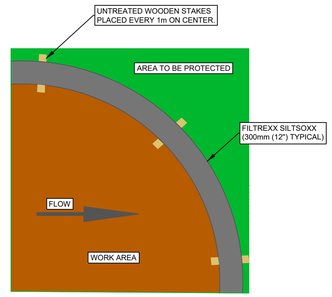
- BIODEGRADABLE EROSION CONTROL BLANKETS (E.G WOVEN JUTE, COIR MESH, GREAT LAKES ASPEN, ETC) TO BE AVAILABLE ON SITE IN CASE THEY ARE NEEDED TO HELP MITIGATE EROSION OF TEMPORARILY EXPOSED SOILS ON THE FLOODPLAIN
- DRAWINGS SHOWN ON THIS SHEET ILLUSTRATE TYPICAL INSTALLATION DETAILS FOR AN AMERICAN EXCELSIOR CURLEX NETFREE SLOPE PROTECTION EROSION CONTROL BLANKET. THE CONTRACTOR MAY USE THIS BRAND OF EROSION CONTROL BLANKET OR AN APPROVED EQUIVALENT.



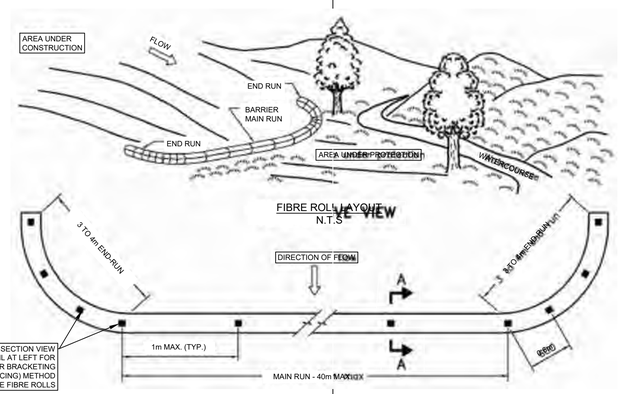
FIBRE ROLL - SECTION VIEW
N.T.S



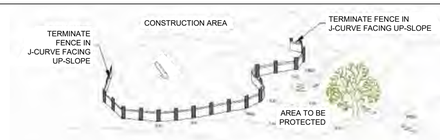
FIBRE ROLL - END CONNECTION DETAIL
N.T.S



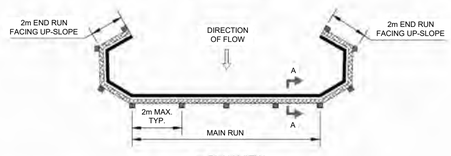
FIBRE ROLL - PLAN VIEW
N.T.S



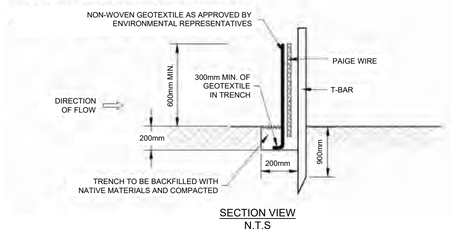
FIBRE ROLL LAYOUT - PLAN VIEW
N.T.S



PERSPECTIVE VIEW
N.T.S

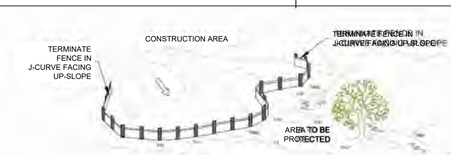


PLAN VIEW
N.T.S



SECTION VIEW
N.T.S

SEDIMENT CONTROL FENCE - UNFROZEN CONDITIONS



PERSPECTIVE VIEW
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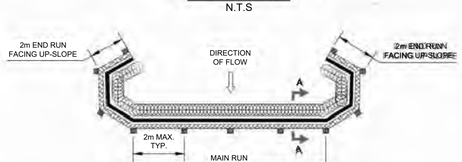

PLAN VIEW
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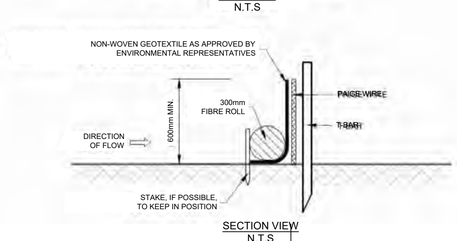

SECTION VIEW
N.T.S

SEDIMENT CONTROL FENCE - FROZEN CONDITIONS

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B	ISSUED FOR REVIEW	MAR 26, 2021	JL	MF
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
MID GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
SEDIMENT CONTROL BARRIERS & EROSION CONTROL
BLANKET DETAILS FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-6
DRAWING NO. 009
SHEET: 9 OF 13
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WORK AREA ISOLATION MEASURES

METRE BAG COFFER DAM

- FOR ISOLATION OF THE FULL CHANNEL WIDTH (DAM-AND-PUMP STREAM-FLOW BYPASS) OR ONLY A PORTION OF THE CHANNEL WIDTH (PASSIVE STREAM-FLOW BYPASS FOR SINGLE-BANK WORK) FOR IN-CHANNEL WORK.
- 1-2 TIER, SINGLE-STACK METRE BAG COFFER DAM PREFERRED GIVEN MINIMAL DISTURBANCE; PYRAMID-STACK METRE BAG COFFER DAM MAY BE NECESSARY IN DEEPER-WATER SCENARIOS.
- METRE BAGS SHOULD BE FILLED WITH PEA GRAVEL AND SHOULD NOT BE OVER-FILLED.
- A WATERPROOF MEMBRANE IS REQUIRED OVER THE PEA-GRAVEL METRE BAGS. THE WATERPROOF MEMBRANE MUST BE KEYED IN UNDER THE BARRIER TO MINIMIZE LEAKAGE.
- COFFER DAM MAY BE CONSTRUCTED OF SMALLER PEA-GRAVEL SANDBAGS OR OTHER SUITABLE EQUIVALENT. SEE BELOW FOR DETAILS.

PEA GRAVEL COFFER DAM

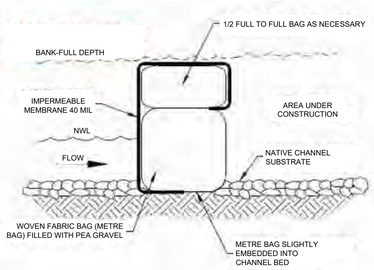
- CAN BE USED AT THE DISCRETION OF THE ENVIRONMENTAL REPRESENTATIVE FOR ISOLATION OF CHANNELS IN LOW-FLOW, SHALLOW WATER CONDITIONS WHEN LOCAL WORKS CAN BE COMPLETED WITHIN A FAVORABLE WEATHER WINDOW AND / OR THE CHANNEL IS LOCALLY TOO NARROW OR AWKWARD FOR THE USE OF METRE BAGS.

DE-WATERING SUMP PUMP

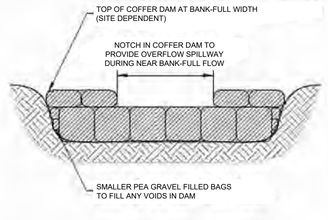
- FOR TEMPORARY MAINTENANCE OF DRY OR SHALLOWER CONDITIONS WITHIN AN ISOLATED IN-CHANNEL WORK AREA.
- A PUMP WITH A MINIMUM RECOMMENDED PUMPING CAPACITY OF 2000GPM MUST BE USED.
- DURING ELEVATED FLOWS APPROACHING BANK-FULL DEPTH, ALL PUMPING WILL BE STOPPED AND COFFER DAMS WILL BE TEMPORARILY REMOVED TO ALLOW FLOWS TO PASS UNOBSTRUCTED.

DE-WATERING FILTER BAG RINGED WITH FILTREXX SILTSOXX (OR APPROVED EQUIVALENT)

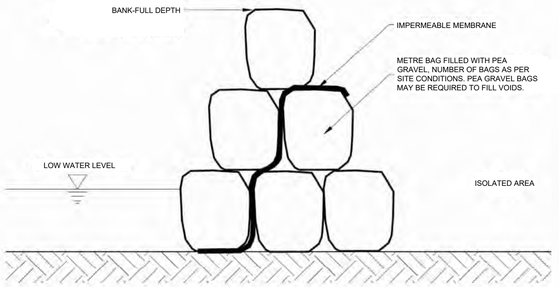
- FOR CONTROLLED DEPOSITION OF FINE SEDIMENT PUMPED OUT OF AN ISOLATED IN-CHANNEL WORK AREA, AWAY FROM THE WATERCOURSE.
- PLACE FILTER BAG (3.5m X 5.0m TERRAFIX ENVIROBAG OR APPROVED EQUIVALENT) ON A LEVEL, STABILIZED AREA OF THE FLOODPLAIN, ON VEGETATED GROUND > 15m AWAY FROM THE CHANNEL. FILTREXX SILTSOXX (300mm (12") DIAMETER) OR APPROVED EQUIVALENT TO BE PLACED AROUND THE FILTER BAG.
- ISOLATED SECTION OF CHANNEL TO BE PUMPED AND DE-WATERED INTO FILTER BAG.
- REPLACE UNIT WHEN HALF FULL OF SEDIMENT OR WHEN SEDIMENT HAS SIGNIFICANTLY REDUCED THE FLOW RATE OF PUMP DISCHARGE.
- ALLOW SEDIMENT BAG TO DRY IN DESIGNATED SEDIMENT DRYING AREA AND THEN RE-USE THE SEDIMENT AS PART OF BANK RESTORATION OR DISPOSE OF IT OFF SITE UNDER DIRECTION OF THE ON-SITE ENVIRONMENTAL REPRESENTATIVE.



METRE BAG COFFER DAM - SECTION
N.T.S



METRE BAG COFFER DAM - PROFILE
N.T.S



METRE BAG WATERPROOF ISOLATION BARRIER - SECTION
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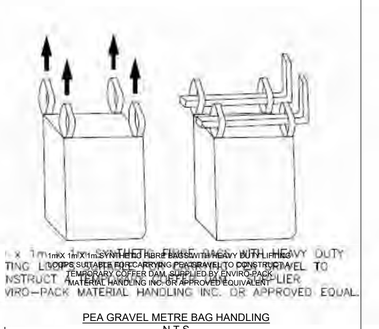

PEA GRAVEL METRE BAG HANDLING
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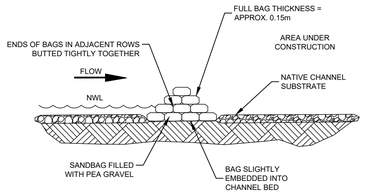

PEA GRAVEL BAG COFFER DAM - SECTION
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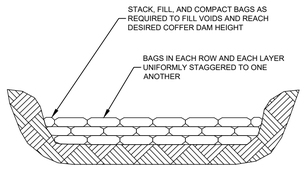

PEA GRAVEL BAG COFFER DAM - PROFILE
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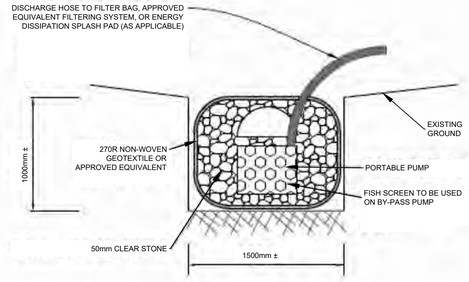

DE-WATERING SUMP PUMP DETAIL
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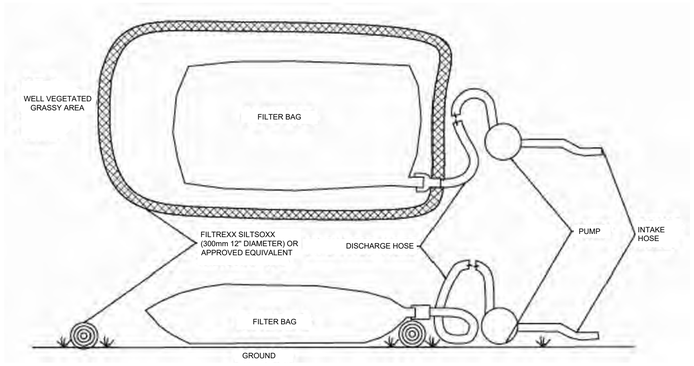

DE-WATERING FILTER BAG WITH FILTREXX SILTSOXX - PLAN & PROFILE
N.T.S

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	FEB 19, 2021	JL	MF
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C	ISSUED FOR REVIEW	APR 14, 2021	JL	MF
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PO BOX 2012, SALMON ARM, BC, V1E 4R1
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
MID GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
WORK AREA ISOLATION MEASURES & PLANTING NOTES FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-6
DRAWING NO. 010
SHEET: 10 OF 13
REV E

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DATE: 2021\12\2020 5:12 PM BY: Jesse Lutz

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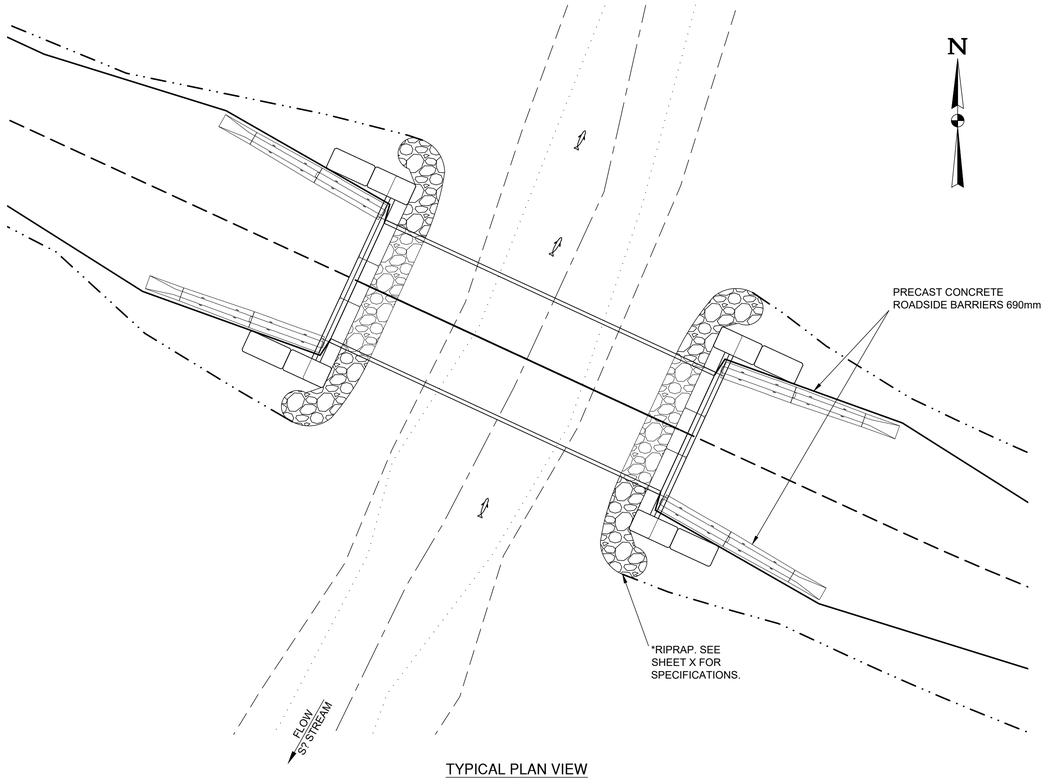


TYPICAL PLAN VIEW

10:1

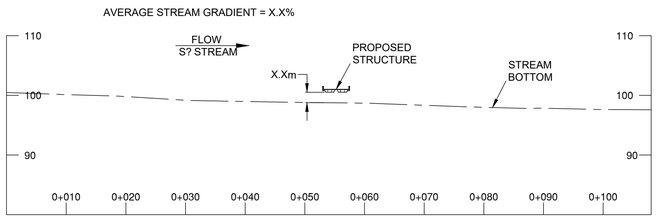
OBJECTIVE:
CROSSINGS ARE PROPOSED AT STRATEGIC LOCATIONS TO ALLOW FOR THE SAFE PASSAGE OF MACHINERY AND LIVESTOCK ACROSS THE CHANNEL AND TO AVOID EXCESS DISTURBANCE TO THE CREEK (E.G. CATTLE TRAMPLING, MACHINERY FORDS). CLEAR SPAN BRIDGES WERE CHOSEN TO ENSURE FISH AND WILDLIFE PASSAGE AND TO ACCOMMODATE NATURAL CREEK PROCESSES. THE PROPOSED CROSSING LOCATIONS WERE CHOSEN BASED ON GEOMORPHIC, ECOLOGICAL, AND AGRICULTURAL CONSIDERATIONS. CROSSINGS ARE NOT POSITIONED NEAR SHARP MEANDER BENDS.

A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.

LEGEND	
DESIGNED ROAD EDGES	
DESIGNED ROAD CENTRELINE	
APPROXIMATE EXTENT OF CUT/FILL SLOPE	
HIGH WATER LEVEL	
STREAM THALWEG	
PRESENT WATER LEVEL	

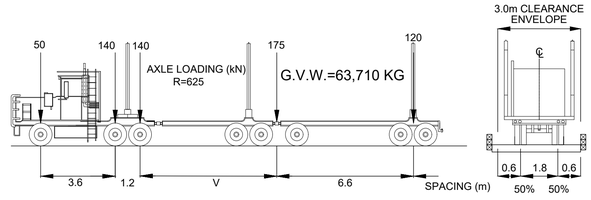
NOTES:

1. **DURATION:**
   - 1.1. FOR THE PURPOSE OF THIS DESIGN THE TERM PERMANENT AS IT REFERS TO DURATION OF THE INSTALL MEANS FORTY-FIVE (45) YEARS OR LESS. AS TREATED SILL AND BALLAST WALL TIMBERS ARE TO BE USED, REPLACEMENT OF TIMBER COMPONENTS IS EXPECTED AFTER TWENTY FIVE (25) YEARS. ROUTINE BRIDGE INSPECTIONS ARE TO BE COMPLETED TO DETERMINE THE ACTUAL LIFE OF TIMBER COMPONENTS AND WHEN THEY ARE TO BE REPLACED.
2. **DESIGN LIVE LOAD:**
   - 2.1. DESIGN VEHICLE: BCL-625 AS PER MOFLNRORD (STD-EC-000-001 TO 002).
3. **STRUCTURE:**
   - 3.1. SUPERSTRUCTURE TO BE PROVIDED BY OTHERS. SUPERSTRUCTURE DESIGN TO BE IN ACCORDANCE WITH CAN/CSA-S6 (MODIFIED AS PER MOFLNRORD INTERIM BRIDGE DESIGN GUIDELINES JULY 23-2010) AND IS TO TAKE INTO ACCOUNT LOGGING TRUCKS WITH UNBALANCED LOADS AND OFF-CENTER DRIVING.
   - 3.2. EXCEPT AS NOTED, SPECIFICATIONS TO BE AS PER MOFLNRORD STANDARD DRAWINGS FOR ALL STEEL PORTABLE BRIDGES (STD-E-090-01 TO 02), LOCK BLOCK ABUTMENT (STD-EC-050-01 AND STD-EC-050-012), CONSTRUCTION PAD (STD-EC-050-15), AND NO POST BARRIERS/GUIDE LOGS (STD-E-010-05).
   - 3.3. IF SUPERSTRUCTURE HAS BEEN USED PREVIOUSLY AT ANOTHER LOCATION IT MUST BE INSPECTED BY A PROFESSIONAL ENGINEER PRIOR TO USE AT THIS SITE. IF A NEW STRUCTURE IS PLANNED, OEL IS TO REVIEW FABRICATION DRAWINGS PRIOR TO FABRICATION OF SUPERSTRUCTURE FOR COMPLIANCE WITH THIS DESIGN.
   - 3.4. CHECK REQUIRED BEARING TO BEARING DISTANCE AND DEPTH OF ACTUAL STRUCTURE PRIOR TO CONSTRUCTION OF THE ABUTMENTS. BOTTOM OF GIRDER ELEVATIONS TO GOVERN.
   - 3.5. GENERAL ARRANGEMENT DRAWING. SOME SUPERSTRUCTURE COMPONENTS NOT SHOWN. REFER TO FABRICATION DRAWINGS.
4. **DESIGN OF ROAD APPROACHES AND DECK WIDTH:**
   - 4.1. HORIZONTAL ALIGNMENT AND ROAD WIDTHS TO PERMIT W-19 TRUCKS WITH 0.5m CLEARANCE INSIDE CURBS.
5. **CREEK NOTES:**
   - 5.1. STREAM RIPARIAN CLASS IS TO BE DETERMINED FOR EACH SITE BASED ON STREAM WIDTH AND FISH PRESENCE/ACCESS.
   - 5.2. STREAM BED MATERIAL IS TO BE DETERMINED FOR EACH SITE.
   - 5.3. THE DESIGN FLOOD IS EXPECTED TO BE: ■ CLEARWATER FLOOD ☐ DEBRIS FLOOD ☐ DEBRIS FLOW
   - 5.4. DESIGN FLOOD: TO BE DETERMINED FOR EACH SITE. THE PEAK FLOW FOR DESIGN PURPOSES WILL BE DETERMINED BASED ON REVIEW OF CHANNEL CHARACTERISTICS, PREVIOUS HIGH FLOW EVIDENCE, AND REVIEW OF THE RESULTS OF PEAK FLOW EMPIRICAL MODELS SUCH AS THE RATIONAL METHOD AND A REGIONAL ANALYSIS. WATERSHED CHARACTERISTICS, AND OTHER RELEVANT INFORMATION ARE ALSO USED TO ESTIMATE PEAK FLOW.
   - 5.5. LOW LIKELIHOOD OF WOODY DEBRIS MOVEMENT.
   - 5.6. CLIMATE CHANGE: CLIMATE CHANGE WILL BE CONSIDERED IN THE DESIGN FLOOD ASSESSMENT.
6. **GEOTECHNICAL:**
   - 6.1. FOUNDATION DESIGN REFERENCES THE CANADIAN FOUNDATION ENGINEERING MANUAL. SUBSURFACE INFORMATION WILL BE INFERRED FROM SITE OBSERVATIONS OF SOIL EXPOSURES IN ROAD CUTS AND ALONG STREAMBANKS AND FROM SHALLOW HAND DUG TEST PITS AND PROBES (TO BE DETERMINED FOR EACH SITE). NO DETAILED SUBSURFACE FIELD INVESTIGATION WAS CONDUCTED (LARGE TEST PITS OR BORE HOLES). FIELD CONDITIONS MAY VARY FROM THOSE INFERRED. IF, UPON EXCAVATION, FIELD CONDITIONS VARY FROM THOSE INFERRED, THEN CHANGES TO THE FOUNDATION DESIGN OR INSTALLATION MAY BE REQUIRED.
   - 6.2. FOOTING DESIGN BASED ON ASSUMED SOIL BEARING CAPACITY OF 200kPa.
7. **FIELD REVIEWS:**
   - 7.1. A PROFESSIONAL ENGINEER OR THEIR DESIGNATE IS REQUIRED TO INSPECT THE FOLLOWING ACTIVITIES PRIOR TO PROVIDING RECORD DRAWINGS AND A CROSSING ASSURANCE STATEMENT:
     - LAYOUT OF RIPRAP/ABUTMENT LOCATION PRIOR TO INITIAL EXCAVATION
     - FOUNDATION SOILS FOLLOWING EXCAVATION
     - RIPRAP AND ABUTMENT CONSTRUCTION
     - BACKFILL MATERIAL AND TECHNIQUE
     - OTHER SITE INSPECTIONS AT THE DISCRETION OF THE PROFESSIONAL
9. **INSTALLATION NOTES:**
   - 9.1. RIPRAP SOURCE HAS NOT BEEN IDENTIFIED.
   - 9.2. NOTE THAT WHERE EXCAVATION SPECIFICATIONS ON THESE DRAWINGS CONFLICT WITH WORKSAFEBC REGULATIONS, WORKSAFEBC REGULATIONS ARE TO GOVERN.
   - 9.3. PLAN TO DEWATER FOOTING AREAS.



TYPICAL STREAM PROFILE VIEW

2:1



BCL-625 DESIGN TRUCK LOADING DIAGRAM

V = VARIABLE SPACING - 6.6m TO 18m INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES THE MAXIMUM STRESSES.

CAUTION:
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
MID GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
TYPICAL CROSSING DESIGN SHEET 1 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-6
DRAWING NO. 011
SHEET: 11 OF 13
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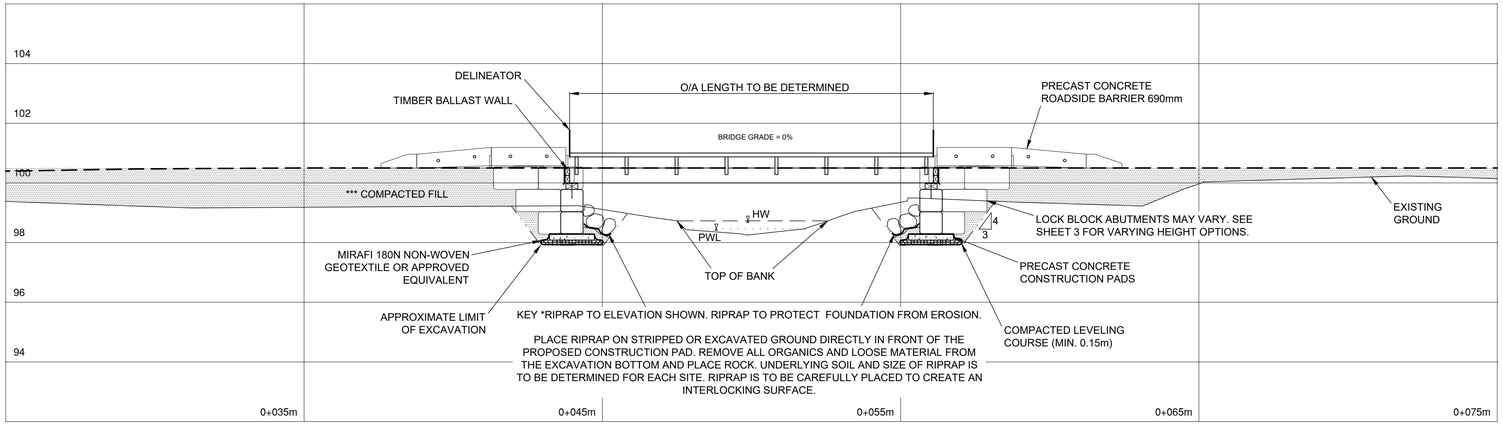
A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.



TYPICAL ELEVATION VIEW

10:1

PARTIAL MATERIALS LIST

QTY	ITEM DESCRIPTION
TBD	ROLLS NON-WOVEN GEOTEXTILE: MIRAFI 180N OR EQUIVALENT
TBD	ROLLS OF GEOGRID: MIRAFI 7XT OR EQUIVALENT
Xm³	LEVELING COURSE (SANDY GRAVEL OR 19mm CLEAR CRUSH) - CRUSH RECOMMENDED WHERE WATER EXPECTED IN FOOTING AREA
4	PRECAST CONCRETE CONSTRUCTION PADS: 0.2m X 1.5m X 4.6m [15']
TBD	STD CONCRETE BLOCKS (INTERLOCKING): 0.75m X 0.75m X 1.5m (TYP.)
TBD	FLAT TOP CONCRETE BLOCKS (INTERLOCKING): 0.75m X 0.75m X 1.5m (TYP.)
2	TREATED TIMBER SILLS: 0.2m X 0.4m X 4.9m [16']
6	STEEL PINS: 25mmØ [1"] TO ATTACH SILL TO LOCK BLOCKS
8	LAG BOLTS: 19mmØ [¾"] X 200mm TO ATTACH STEEL GIRDERS TO SILL
TBD	TIMBER BALLAST WALL: 0.15m X 0.3m X 6.0m [20'] LONG TIMBERS
4	GUIDE LOGS: 0.6m Ø X 6m LENGTH (TYP.)
4	W-054 SERIES DELINEATORS (2 LEFT, 2 RIGHT)
2	W-051 SERIES NARROW STRUCTURE SIGNS
2	POSTS FOR NARROW STRUCTURE SIGNS: 0.2m X 4.0m LENGTH LOG POSTS OR 0.1m X 0.1m X 3.0m LENGTH TREATED TIMBERS
1	BAG ROADSIDE GRASS SEED MIX
	RIPRAP: SEE SPECIFICATIONS ON THIS SHEET

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 50kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 5(155)
50% 50(330)
85% 150(475)
NOMINAL THICKNESS OF RIPRAP
550mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 100kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 10(195)
50% 100(415)
85% 300(600)
NOMINAL THICKNESS OF RIPRAP
700mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 250kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 25(260)
50% 250(565)
85% 750(815)
NOMINAL THICKNESS OF RIPRAP
1000mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

LEGEND

DESIGNED ROAD GRADE	— — —
APPROXIMATE LIMIT OF EXCAVATION	— · · —
HIGH WATER LEVEL	— — —
PRESENT WATER LEVEL	· · · · ·
MIRAFI 180N GEOTEXTILE (OR APPROVED EQUIVALENT)	— — —

CAUTION:
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**SOIL DENSITY	
VERY LOOSE	EASILY EXCAVATED WITH A SPADE
LOOSE	SOME RESISTANCE TO SPADE
COMPACT	CONSIDERABLE RESISTANCE TO SPADE
DENSE	REQUIRES PICK FOR EXCAVATION
VERY DENSE	HIGH RESISTANCE TO PICK

***COMPACTED FILL
GRANULAR FILL TO BE COMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY.

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MID GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
TYPICAL CROSSING DESIGN SHEET 2 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-6
DRAWING NO. 012
SHEET: 12 OF 13
REV E

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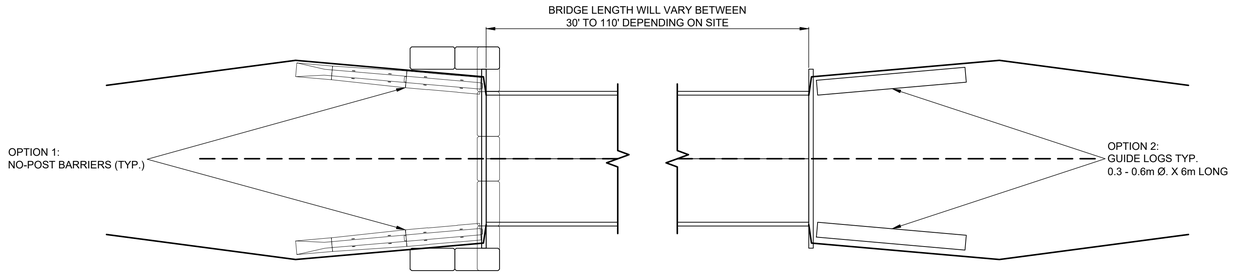
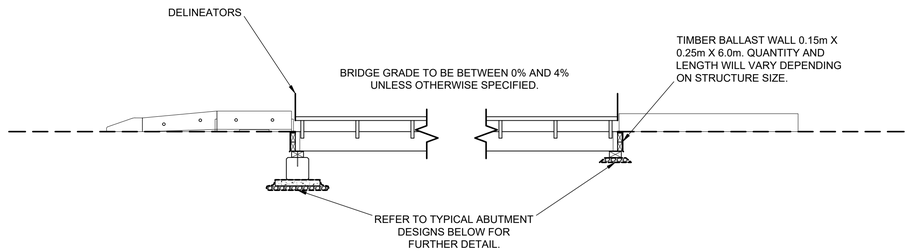




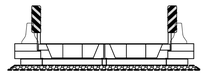
A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.

LEGEND	
DESIGNED ROAD EDGES	———
DESIGNED ROAD GRADE	— — —
MIRAFI 7XT GEOGRID (OR APPROVED EQUIVALENT)	— — —
MIRAFI 180N GEOTEXTILE (OR APPROVED EQUIVALENT)	- - - - -

SPECIFICATIONS FOR CONCRETE BLOCKS (INTERLOCKING):

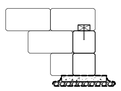
- CONCRETE MUST HAVE A 28 DAY STRENGTH OF 20MPa MINIMUM UNLESS OTHERWISE SPECIFIED.
- BLOCKS SHALL BE CAST MONOLITHICALLY (I.E., NO COLD JOINTS ALLOWED).
- THE FINISH SHALL MEET CLASS 1.
- CLASS 1 - CLASS 1 FINISH IS THE BASIC FINISH TO BE PRODUCED ON ALL FORMED SURFACES NOT EXPOSED TO VIEW UNLESS A BETTER FINISH IS SPECIFIED OR REQUIRED BY THE DRAWINGS OR SPECIAL PROVISIONS.
  - IN ORDER TO PRODUCE A CLASS 1 FINISH, THE FORMWORK SHALL BE MORTAR TIGHT. PANEL MARKS AND TEXTURE ARE OF NO IMPORTANCE.
  - ALL TIES, BOLTS, NAILS AND OTHER METAL SPECIFICALLY REQUIRED FOR CONSTRUCTION PURPOSES SHALL BE REMOVED OR CUT BACK TO A DEPTH OF 50mm FROM THE SURFACES OF THE CONCRETE AND THE RESULTING HOLES FILLED.
  - NO DRY TIES SHALL BE PERMITTED; FORM TIE RODS SHALL REMAIN EMBEDDED AND TERMINATE NOT LESS THAN 50mm FROM THE FORMED FACE OF THE CONCRETE. REMOVABLE EMBEDDED FASTENERS ON THE ENDS OF THE RODS SHALL BE SUCH AS TO LEAVE HOLES OF A REGULAR SHAPE FOR REAMING AND FILLING.
  - HONEYCOMBS AND VOIDS OVER 500mm^2 IN AREA SHALL BE FILLED.
- BLOCK SIZE MUST BE 1500x750x750mm.
- DIMENSIONAL TOLERANCE MUST BE ± 20mm FOR LENGTH, WIDTH AND HEIGHT AND THE BLOCKS SHALL BE REASONABLY SQUARE, WITH THE DIAGONALS WITHIN A TOLERANCE OF ± 15mm OF EACH OTHER.
- TOP AND BOTTOM SURFACES MUST BE FLAT TO A TOLERANCE OF ± 3mm UNDER A 600mm STRAIGHT EDGE.
- CONCRETE SHALL BE AIR ENTRAINED 4-7% TO PROTECT THE SURFACE FROM FREEZE THAW DEGRADATION.
- EACH BLOCK MUST CONTAIN A SATISFACTORY EMBEDDED LIFTING DEVICE.
- EDGES SHALL BE CHAMFERED.

TYPICAL ABUTMENT ELEVATION VIEW -
TIMBER SILL

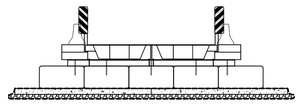


TYPICAL ABUTMENT CROSS SECTION VIEW -
TIMBER SILL

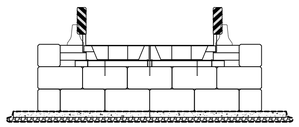
TYPICAL ABUTMENT ELEVATION VIEW -
1 LOCK BLOCK HIGH



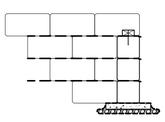
TYPICAL ABUTMENT ELEVATION VIEW -
2 LOCK BLOCK HIGH



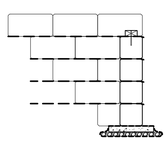
TYPICAL ABUTMENT CROSS SECTION VIEW -
1 LOCK BLOCK HIGH



TYPICAL ABUTMENT CROSS SECTION VIEW -
2 LOCK BLOCK HIGH

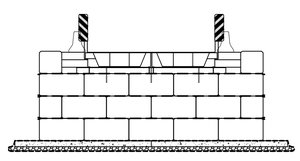


TYPICAL ABUTMENT ELEVATION VIEW -
3 LOCK BLOCK HIGH

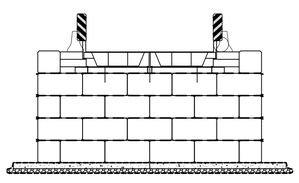


TYPICAL ABUTMENT ELEVATION VIEW -
4 LOCK BLOCK HIGH

GEOGRID TIEBACKS NEEDED ON 3 OR 4 LOCK BLOCK HIGH ABUTMENTS



TYPICAL ABUTMENT CROSS SECTION VIEW -
3 LOCK BLOCK HIGH



TYPICAL ABUTMENT CROSS SECTION VIEW -
4 LOCK BLOCK HIGH

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
INTENDED TO BE PRINTED ON 22" X 34" PAPER.

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C	ISSUED FOR REVIEW	APR 14, 2021	JL	MF
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
MID GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
TYPICAL CROSSING DESIGN SHEET 3 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-6
DRAWING NO. 013
SHEET: 13 OF 13
REV E

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BLACKWATER PROJECT -
SCHEDULE 35 FISHERIES OFFSETTING PLAN
UPPER GREER CREEK HABITAT
RESTORATION AND ENHANCEMENT

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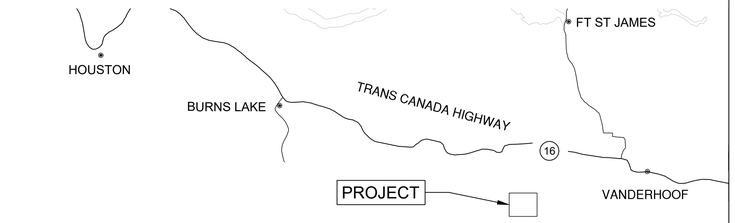
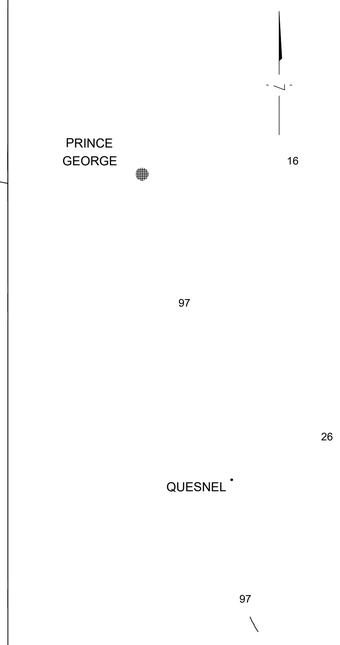
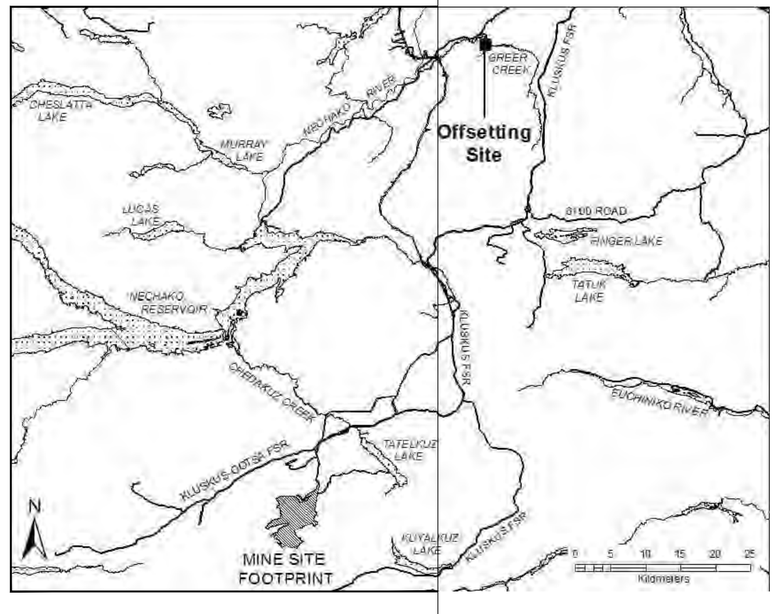


KEY PLAN
NTS



DRAWING INDEX	
SHEET No.	SHEET TITLE
1824-4-7-001	TITLE PAGE
1824-4-7-002	GENERAL NOTES
1824-4-7-003	OVERALL PLAN SHEET 1 OF 8
1824-4-7-004	OVERALL PLAN SHEET 2 OF 8
1824-4-7-005	OVERALL PLAN SHEET 3 OF 8
1824-4-7-006	OVERALL PLAN SHEET 4 OF 8
1824-4-7-007	OVERALL PLAN SHEET 5 OF 8
1824-4-7-008	OVERALL PLAN SHEET 6 OF 8
1824-4-7-009	OVERALL PLAN SHEET 7 OF 8
1824-4-7-010	OVERALL PLAN SHEET 8 OF 8
1824-4-7-011	STANDARD DETAILS SHEET 1 OF 2
1824-4-7-012	STANDARD DETAILS SHEET 2 OF 2
1824-4-7-013	ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS
1824-4-7-014	SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR CHANNEL WORKS
1824-4-7-015	WORK AREA ISOLATION MEASURES & PLANTING NOTES FOR CHANNEL WORKS
1824-4-7-016	TYPICAL CROSSING DESIGN SHEET 1 OF 3
1824-4-7-017	TYPICAL CROSSING DESIGN SHEET 2 OF 3
1824-4-7-018	TYPICAL CROSSING DESIGN SHEET 3 OF 3



LOCATION PLAN
NTS

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LAYDOWNS & ACCESS ROADS

- ALL LAYDOWNS AND ACCESS ROADS ARE TEMPORARY IN NATURE AND ARE ONLY REQUIRED FOR THE DURATION OF CHANNEL WORKS. GRASS AND PATHS DISTURBED DURING CONSTRUCTION ARE TO BE RESTORED TO THEIR ORIGINAL CONDITION PRE-CONSTRUCTION TO THE BEST OF THE CHOSEN CONTRACTOR'S ABILITIES AFTER ALL WORKS ARE COMPLETED.
- FINAL LOCATION, SIZE, AND SPECIFICATIONS OF THE PROPOSED LAYDOWN AREA AND ACCESS ROADS ARE TO BE REFINED BY THE SELECTED CONTRACTOR AS REQUIRED. DEPENDING ON CONDITIONS AT THE TIME OF CONSTRUCTION ACCESS MAY BE A VARIETY OF RIG MATS, FROZEN GROUND, OR BUILT UP GRAVEL ACCESS ROADS WITH GEOGRID.
- AVOID DISTURBANCE TO ANY EXISTING HERITAGE FEATURES
- AVOID DISTURBANCE TO ADJACENT PRIVATE PROPERTY

GENERAL STREAM NOTES

- BASED ON THE ONLINE TOOL (https://OWT.BCWATERTOOL.CA) THE WINTERTIME LOW FLOW IS ESTIMATED TO BE 0.5 m3/sec WITH A MEAN ANNUAL DISCHARGE OF ~1.5 m3/sec
- NOTE THAT THERE IS BEAVER ACTIVITY, ALONG GREER CREEK. AS SUCH, WATER DEPTHS MAY BE LOCALLY HIGHER THAN EXPECTED BASED SOLELY ON LOCAL FLOW CONDITIONS.
- NOTE THAT THE GROUNDWATER TABLE IS RELATIVELY HIGH ACROSS THE FLAT VALLEY BOTTOM OF GREER CREEK, CONTROLLED IN THE ALLUVIUM COMPRISING THE FLOODPLAIN BY THE WATER SURFACE ELEVATION ALONG THE CHANNEL (WHICH MAY BE LOCALLY AFFECTED BY BEAVER ACTIVITY).

FLOODPLAIN SOILS

- NO DRILLING OR TEST PITTING HAS BEEN COMPLETED TO INVESTIGATE SOILS WITHIN THE VALLEY BOTTOM FLOODPLAIN SEDIMENTS WHERE CHANNEL WORKS ARE PROPOSED.
- OPPORTUNISTIC EXAMINATION OF FLOODPLAIN SOILS IN ERODED CREEK BANKS AND HAND AUGER HOLES (<1.2m DEEP) INDICATES ALLUVIAL SEDIMENTS TYPICAL OF RECURRENT FLOODPLAIN DEPOSITION: FINE SAND AND SILT WITH LOCALIZED GRAVELS AND ORGANICS.

BASE MAPPING NOTES

DATUM: NAD 83 (CSRS) 2002.0

UTM ZONE: 10

UNMANNED AERIAL VEHICLE, HIGH-RESOLUTION IMAGERY (0.06m) WAS COLLECTED BY PALMER ON OCTOBER 23, 2020 TO INFORM CHANNEL RESTORATION AND ENHANCEMENT DESIGN.

DESIGN TEAM

ENGINEERING - ONSITE ENGINEERING LTD. MICHAEL FOSTER, P.ENG.

GEOMORPHOLOGY/ENVIRONMENTAL/SEDIMENT AND EROSION CONTROL - PALMER ROBIN MCKILLOP, MSc, P.GEO. AND DAN MCPARLAND, MSc, P.GEO. AND MICHAEL BRIERLEY, MSc

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UPPER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
GENERAL NOTES

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DRAWING NO.	002
SHEET:	2 OF 18
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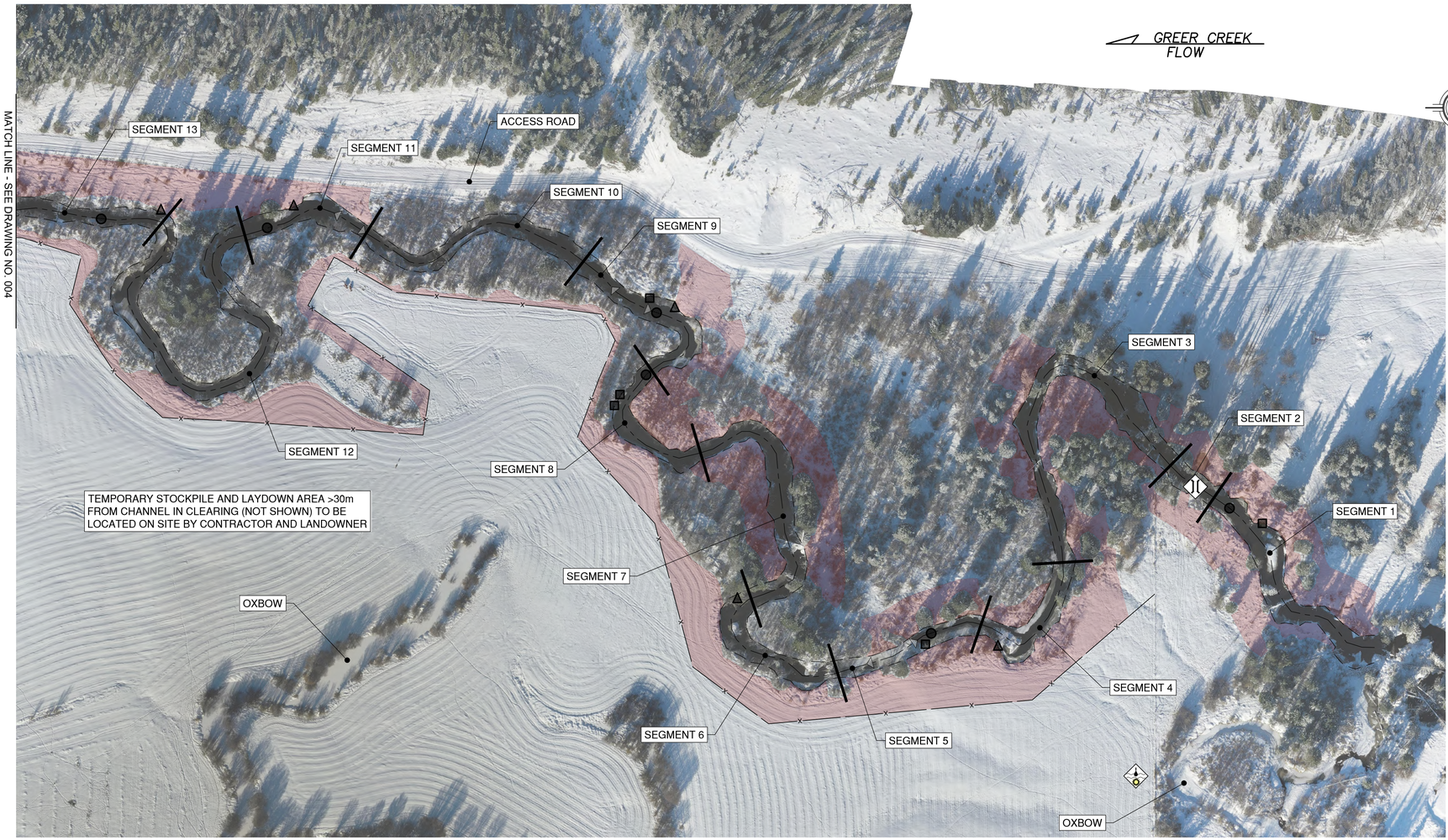

LEGEND

- APPROXIMATE WATERLINE
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- PROPOSED CATTLE FENCING - BARB
- PROPOSED CATTLE FENCING - GATE
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- PROPOSED STATIONARY CATTLE WINTER WATERING - SOLAR
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ABBREVIATIONS
(TREATMENT DETAILS SHOWN ON SHEET 011)

ISSUES
CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

CHANNEL MORPHOLOGY (Viewing Downstream):
RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

TREATMENTS
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BankR - Bank Regrading: Detail 1A
WOODY DEBRIS:
WDhabitat Enhancement:
» ▲ - ROOTWAD: Detail 2D
» ■ - LOG: Detail 2C

BANK TREATMENTS:
BL - Brush Layers: Detail 3B
BED MATERIALS:
BC - Boulder Cluster: Detail 4A
» ●
GP - Gravel Placement: Detail 4B
» ◁ - Downstream Limit
» ▷ - Upstream Limit

NOTES:
1. SITE PLAN PREPARED BY PALMER BASED ON DRONE HIGH RESOLUTION IMAGERY COLLECTED ON OCTOBER 23, 2020. COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE INTERPRETED FROM PHOTOGRAMMETRY.
3. DESIGN BY PALMER. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD.
4. BANKFULL CHANNEL DIMENSIONS ARE TO BE CONFIRMED BY ENVIRONMENTAL INSPECTOR FOR BankR AND NW TREATMENTS
5. LOCAL CHANNEL GRADIENTS ARE TO BE MAINTAINED THROUGHOUT STUDY AREA REGARDLESS OF PROPOSED BANK AND BED TREATMENTS
6. REFER TO RIPARIAN RESTORATION AND ENHANCEMENT DETAILS (DRAWING 012) FOR SEGMENTS WHERE UNVEGETATED (UV) HAS BEEN IDENTIFIED AS AN ISSUE
7. REFER TO DRAWING 013, 014 AND 015 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS
8. REFER TO DRAWING 012 FOR FENCING DETAILS. REFER TO DRAWING 016, 017 AND 018 FOR CHANNEL CROSSING DETAILS
9. SUMMER AND WINTER OFF-CHANNEL WATERING DETAILS ARE PROVIDED ON DRAWING 012.

GREER CREEK: UPPER - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT		DOWNSTREAM LIMIT		SEGMENT LENGTH	CHANNEL MORPHOLOGY AND ISSUES	PROPOSED TREATMENTS	SPECIFICATIONS	NOTES
	EASTING	NORTHING	EASTING	NORTHING					
1	407077	5963743	407013	5963803	95	RBK: CT & UV LBK: UV BED: CT	RBK: BankR, BL & WDhabitat BED: BC		BL to be constructed at channel bends only
2	407013	5963803	406995	5963815	22	RBK: CT & VC LBK: CT & VC	RBK: BankR LBK: BankR		Proposed crossing in segment
3	406995	5963815	406952	5963777	147				
4	406952	5963777	406920	5963752	57	LBK: CT	LBK: BankR, BL & WDhabitat		
5	406920	5963752	406863	5963733	62	LBK: UV	LBK: WDhabitat BED: GP & BC	Gravel Placement length = 18m	
6	406863	5963733	406828	5963762	65	LBK: CT & UV	LBK: BankR, BL & WDhabitat		
7	406828	5963762	406808	5963820	106				
8	406808	5963820	406788	5963853	61	LBK: CT & UV BED: CT	LBK: BankR, BL & WDhabitat BED: BC		
9	406788	5963853	406761	5963897	76	RBK: CT & UV BED: CT	RBK: BankR, BL & WDhabitat BED: GP & BC	Gravel Placement length = 14m	
10	406761	5963897	406675	5963908	99				
11	406675	5963908	406626	5963907	53	RBK: CT & UV BED: CT	RBK: BankR, BL & WDhabitat BED: GP & BC	Gravel Placement length = 10m	
12	406626	5963907	406593	5963912	183	LBK: UV			Channel cut-off is probable over the coming decade
13	406593	5963912	406504	5963829	287	RBK: UV	RBK: WDhabitat BED: GP & BC	Gravel Placement length = 10m (Two sites)	

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
UPPER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL PLAN SHEET 1 OF 8

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-7
DRAWING NO. 003
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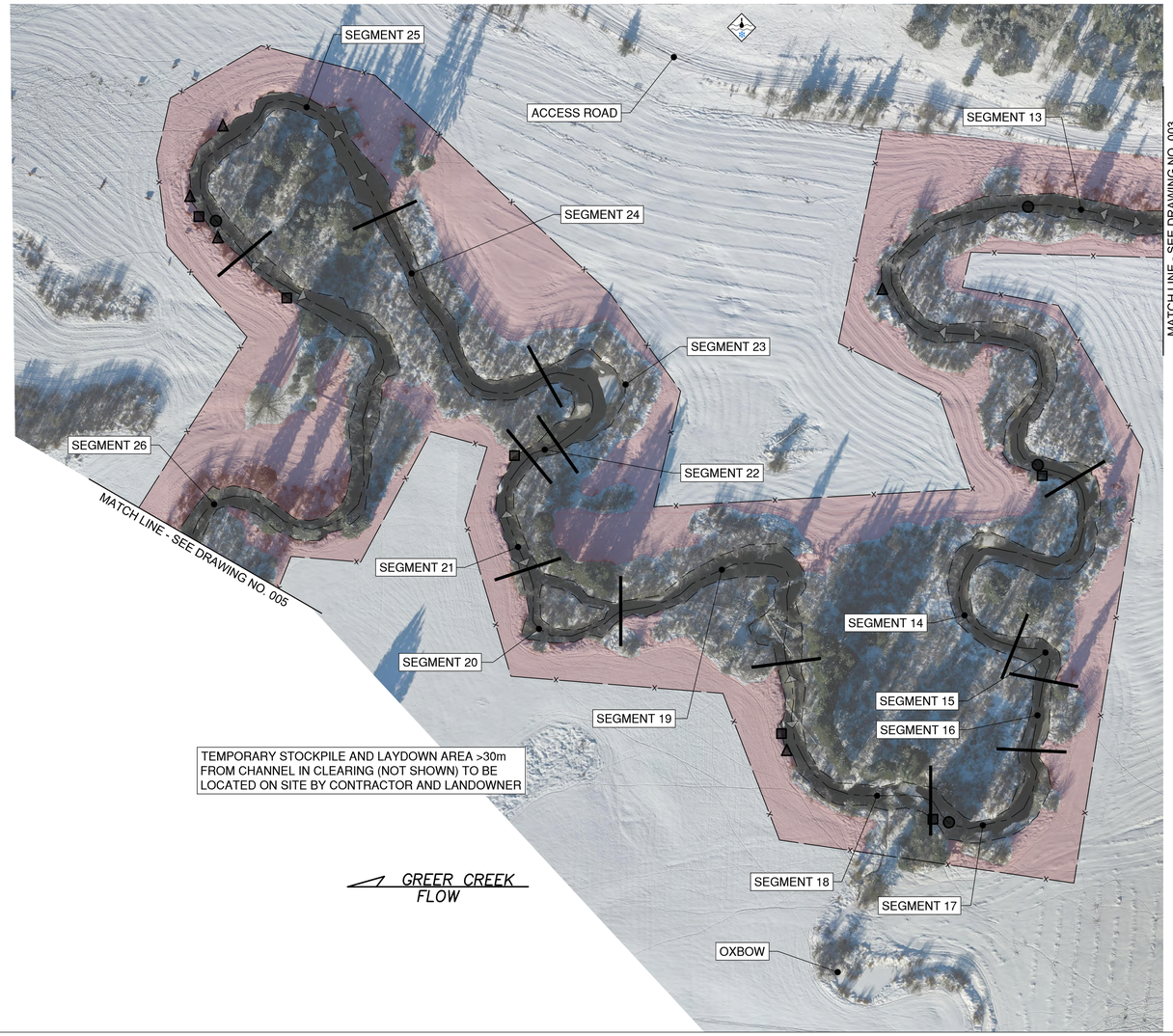

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WOODY DEBRIS:
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13	406593	5963912	406504	5963829	287	RBK: UV	RBK: WDhabitat BED: GP & BC	Gravel Placement length = 10m (Two sites)	
14	406504	5963829	406483	5963771	110				
15	406483	5963771	406493	5963760	22	LBK: UV	LBK: WDnarrow		
16	406493	5963760	406489	5963735	25	LBK: UV			
17	406489	5963735	406454	5963718	60	LBK: UV	LBK: BankR, BL & WDhabitat BED: BC		
18	406454	5963718	406404	5963766	84	LBK: UV	LBK: WDhabitat BED: GP	Gravel Placement length = 14m	
19	406404	5963766	406346	5963784	95	LBK: UV			
20	406346	5963784	406314	5963798	53	LBK: UV			
21	406314	5963798	406315	5963837	43	LBK: UV	LBK: BankR, BL & WDhabitat BED: GP	Gravel Placement length = 16m	
22	406315	5963837	406324	5963841	11	LBK: UV			
23	406324	5963841	406320	5963865	43				
24	406320	5963865	406264	5963921	94				
25	406264	5963921	406216	5963908	129	RBK: CT & UV BED: CT	RBK: BankR, BL & WDhabitat BED: GP & BC	Gravel Placement length = 16m	
26	406216	5963908	406248	5963712	375	LBK: UV	RBK: WDhabitat BED: GP	Gravel Placement length = 18m	
27	406248	5963712	406216	5963669	61	LBK: UV			
28	406216	5963669	406183	5963663	36	LBK: UV	LBK: WDnarrow BED: BC		

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OVERALL PLAN SHEET 2 OF 8

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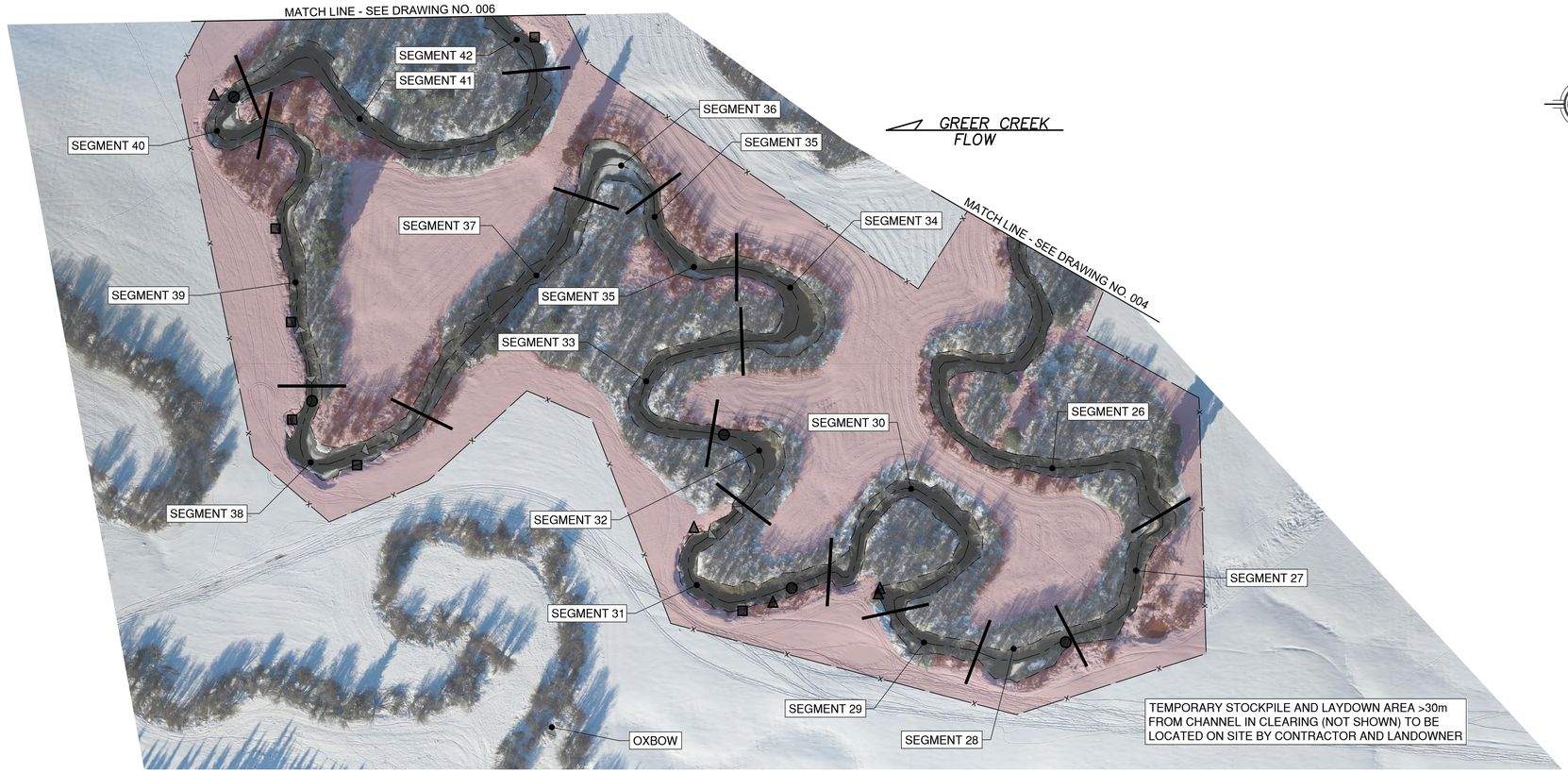

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BC - Boulder Cluster: Detail 4A
» ●
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» ◁ - Downstream Limit
» ▷ - Upstream Limit

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9. SUMMER AND WINTER OFF-CHANNEL WATERING DETAILS ARE PROVIDED ON DRAWING 012.

GREER CREEK: UPPER - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT		DOWNSTREAM LIMIT		SEGMENT LENGTH	CHANNEL MORPHOLOGY AND ISSUES	PROPOSED TREATMENTS	SPECIFICATIONS	NOTES
	EASTING	NORTHING	EASTING	NORTHING					
26	406216	5963908	406248	5963712	375	LBK: UV	RBK: WDhabitat BED: GP	Gravel Placement length = 18m	
27	406248	5963712	406216	5963669	61	LBK: UV			
28	406216	5963669	406183	5963663	36	LBK: UV	LBK: WDnarrow BED: BC		
29	406183	5963663	406153	5963677	35	LBK: UV			
30	406153	5963677	406130	5963691	118	RBK: UV	LBK: WDhabitat		Channel cut-off is probable over the coming decade
31	406130	5963691	406099	5963715	89	LBK: UV	LBK: BankR, BL & WDhabitat BED: BC & GP	Gravel Placement length = 12m	
32	406099	5963715	406088	5963741	40	RBK: UV	RBK: WDnarrow		
33	406088	5963741	406099	5963773	84				
34	406099	5963773	406097	5963800	57				
35	406097	5963800	406067	5963826	47				
36	406067	5963826	406043	5963824	35				
37	406043	5963824	405985	5963747	98				
38	405985	5963747	405946	5963757	74	LBK: CT & UV BED: CT	LBK: BankR, BL & WDhabitat BED: GP & BC	Gravel Placement length = 10m	
39	405946	5963757	405929	5963850	104	LBK: UV	LBK: WDhabitat BED: GP	Gravel Placement length = 16m	
40	405929	5963850	405923	5963864	41	LBK: UV	LBK: BankR, BL & WDhabitat BED: BC		
41	405923	5963864	406026	5963869	135				
42	406026	5963869	405982	5963906	60	RBK: CT & UV BED:CT	RBK: BankR, BL & WDhabitat BED: GP	Gravel Placement length = 16m	

NOTES:

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
UPPER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL PLAN SHEET 3 OF 8

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-7
DRAWING NO.	005
SHEET:	5 OF 18
REV	D

BC 1C 1-800-474-6886

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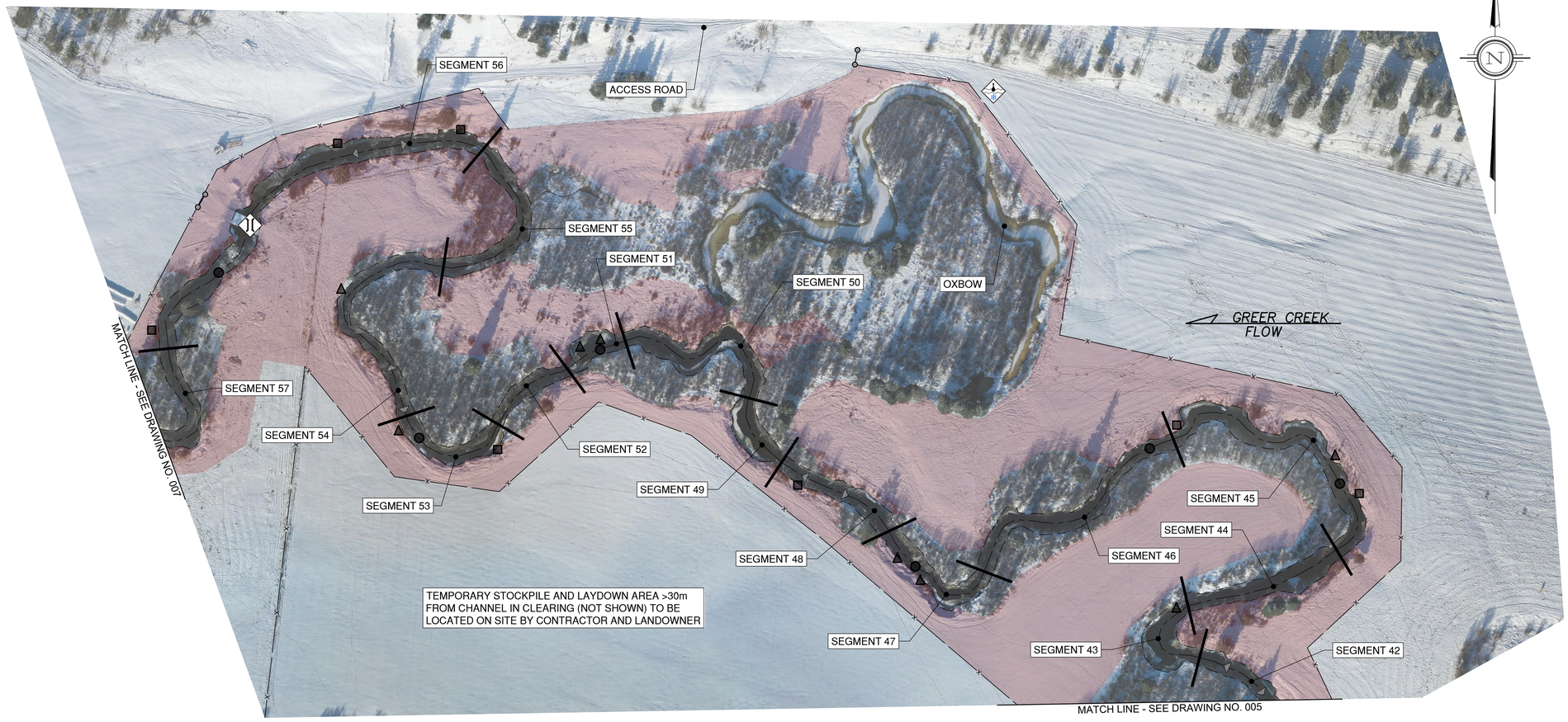

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FO - Flow Obstruction

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	EASTING	NORTHING	EASTING	NORTHING					
42	406026	5963869	405982	5963906	60	RBK: CT & UV BED:CT	RBK: BankR, BL & WDhabitat BED: GP	Gravel Placement length = 16m	
43	405982	5963906	405978	5963927	39	LBK: UV	LBK: NW, BL & WDhabitat	Bankfull width: 9.0 m	Narrow from left bank only
44	405978	5963927	406038	5963950	65	RBK: UV			
45	406038	5963950	405972	5963995	121	RBK: CT & UV BED:CT	RBK: BankR, BL & WDhabitat BED: BC		
46	405972	5963995	405895	5963941	104	RBK: UV	BED: BC		
47	405895	5963941	405856	5963958	56	LBK: UV	LBK: BankR, BL & WDhabitat		
48	405856	5963958	405813	5963986	53	RBK: UV LBK: UV	LBK: WDhabitat BED: GP	Gravel Placement length = 16m	
49	405813	5963986	405799	5964012	32	LBK: UV	LBK: BankR, BL		
50	405799	5964012	405749	5964035	76				
51	405749	5964035	405726	5964023	26	RBK: CT & UV BED: CT	RBK: NW, BL & WDhabitat BED: BC	Bankfull width: 8.0 m	Narrow from right bank only
52	405726	5964023	405697	5964001	38	LBK: UV			
53	405697	5964001	405660	5964004	51	LBK: UV	LBK: BankR, BL & WDhabitat BED: BC		
54	405660	5964004	405675	5964065	102	LBK: UV	LBK: WDhabitat BED: GP	Gravel Placement length = 16m	
55	405675	5964065	405691	5964112	75	RBK: UV			
56	405691	5964112	405564	5964032	173	RBK: UV & CT LBK: UV BED: CT	RBK: BankR, BL & WDhabitat BED: GP & BC	Gravel Placement length = 18m	
57	405564	5964032	405528	5964034	106	LBK: UV			

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OVERALL PLAN SHEET 4 OF 8

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-7
DRAWING NO. 006
SHEET: 6 OF 18
REV D

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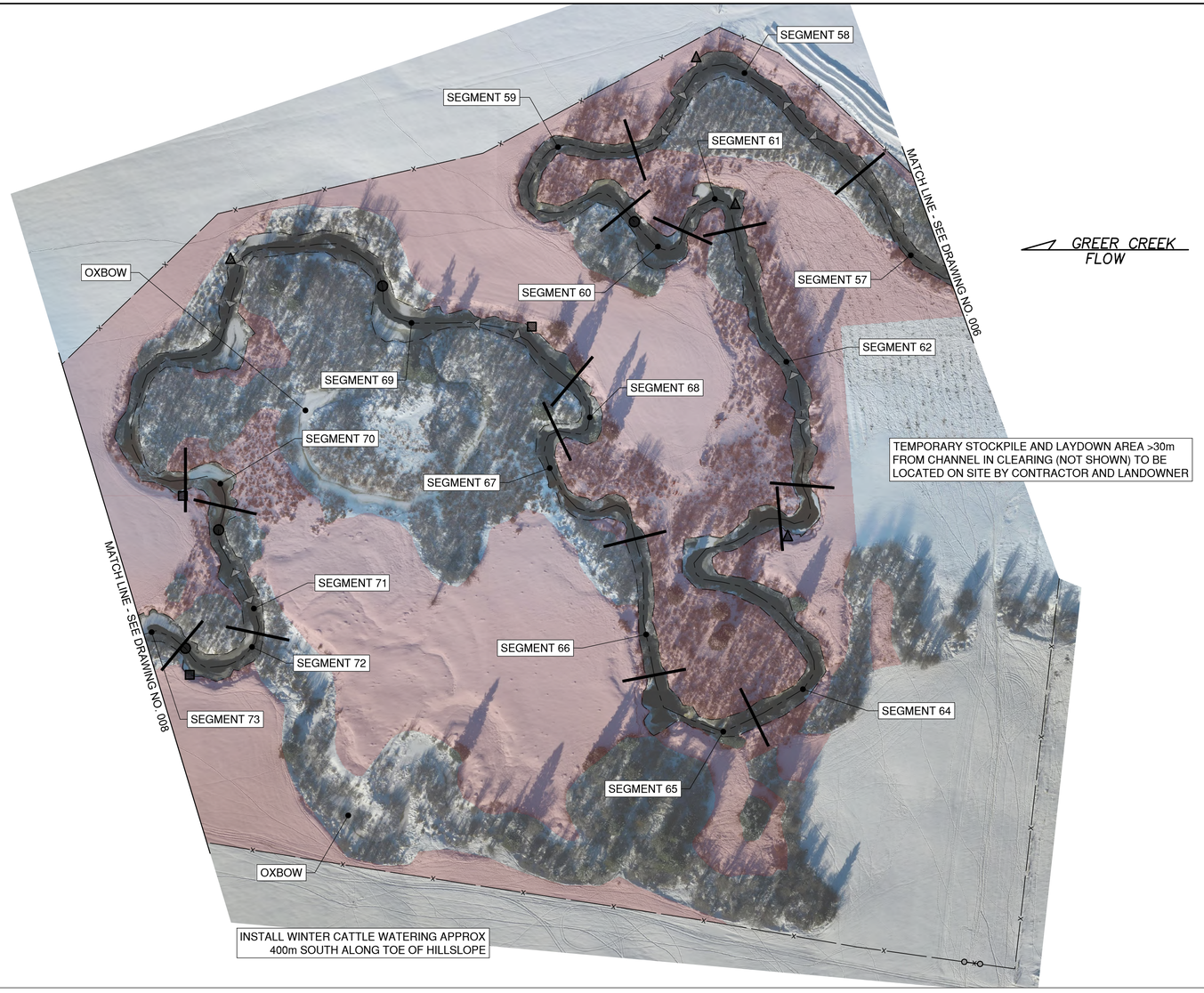

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57	405564	5964032	405528	5964034	106	LBK: UV			
58	405528	5964034	405443	5964043	116	RBK: UV	RBK: WDhabitat BED: GP	Gravel Placement length = 14m (Two Sites)	
59	405443	5964043	405439	5964020	97	RBK: UV			
60	405439	5964020	405461	5964013	33	RBK: UV	RBK: WDnarrow BED: BC		
61	405461	5964013	405480	5964013	33	LBK: UV	LBK: NW, BL & WDhabitat	Bankfull width: 8.5 m	Narrow from left bank only
62	405480	5964013	405506	5963917	103		BED: GP	Gravel Placement length = 16m	
63	405506	5963917	405497	5963904	25	LBK: UV	LBK: BankR, BL & WDhabitat		
64	405497	5963904	405488	5963829	134				
65	405488	5963829	405450	5963845	50	LBK: UV	LBK: BankR & BL		
66	405450	5963845	405443	5963897	52				
67	405443	5963897	405413	5963937	66				
68	405413	5963937	405419	5963956	32	RBK: UV	RBK: BankR & BL		
69	405419	5963956	405274	5963919	268	RBK: UV	RBK: WDhabitat BED: GP & BC	Gravel Placement length = 14m (Two Sites)	
70	405274	5963919	405274	5963919	23	RBK: UV	LBK: WDnarrow		
71	405274	5963919	405301	5963861	52	LBK: UV	BED: GP & BC	Gravel Placement length = 10m	
72	405301	5963861	405272	5963856	38	LBK: UV	LBK: BankR & BL BED: BC		
73	405272	5963856	405239	5963837	49	RBK: UV	RBK: NW, BL & WDhabitat	Bankfull width: 9.0 m	Narrow from right bank only

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OVERALL PLAN SHEET 5 OF 8

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-7
DRAWING NO. 007
SHEET: 7 OF 18
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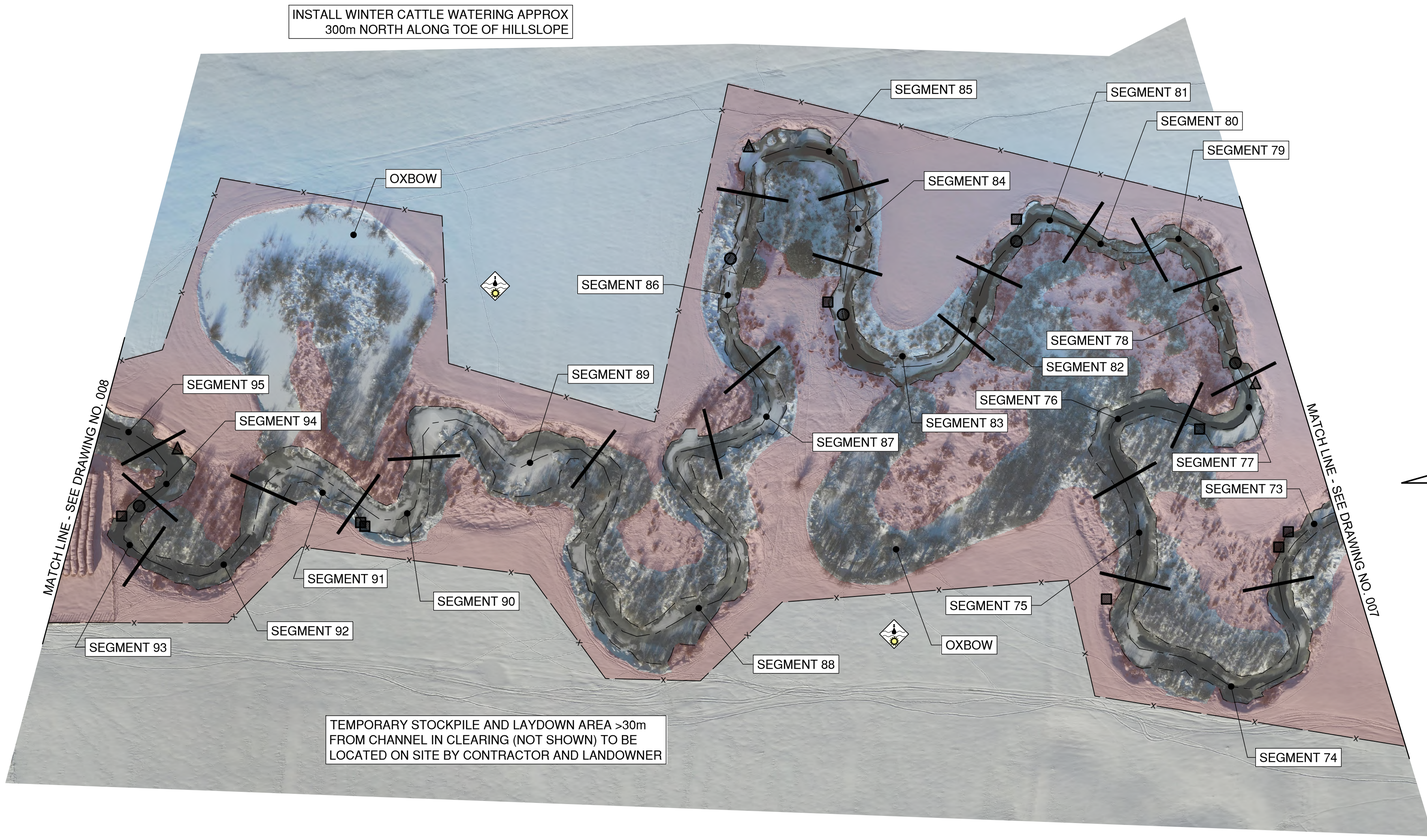

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	EASTING	NORTHING	EASTING	NORTHING					
73	405272	5963856	405239	5963837	49	RBK: UV	RBK: NW, BL & WDhabitat	Bankfull width: 9.0 m	Narrow from right bank only
74	405239	5963837	405191	5963838	111	LBK: UV	LBK: BankR, BL & WDhabitat		
75	405191	5963838	405187	5963871	35	RBK: UV LBK: UV			
76	405187	5963871	405208	5963893	47				
77	405208	5963893	405227	5963905	36	RBK: UV	RBK: NW, BL & WDhabitat	Bankfull width: 9.0 m	Narrow from right bank only
78	405227	5963905	405215	5963939	36	RBK: UV	BED: GP & BC	Gravel Placement length = 18m	
79	405215	5963939	405196	5963949	28	RBK: UV	RBK: WDnarrow		
80	405196	5963949	405173	5963955	24	RBK: UV			
81	405173	5963955	405142	5963941	40	RBK: UV	RBK: BankR, BL & WDhabitat BED: BC		
82	405142	5963941	405134	5963919	23	RBK: UV			
83	405134	5963919	405094	5963944	72	RBK: UV LBK: CT & UV	LBK: BankR, BL & WDhabitat		
84	405094	5963944	405096	5963969	26	RBK: UV	BED: GP	Gravel Placement length = 12m	
85	405096	5963969	405063	5963967	53	RBK: UV LBK: UV	RBK: NW, BL & WDhabitat	Bankfull width: 9.5 m	Narrow from right bank only
86	405063	5963967	405062	5963908	62	RBK: UV	BED: GP & BC	Gravel Placement length = 12m	
87	405062	5963908	405049	5963884	39	RBK: UV	LBK: WDnarrow		
88	405049	5963884	405009	5963879	172	RBK: UV LBK: UV			Channel cut-off is probable over the coming decade
89	405009	5963879	404952	5963879	76	RBK: UV BED: FO	RBK: WDnarrow		
90	404952	5963879	404930	5963863	39	LBK: UV BED: FO	RBK: BankR, BL & WDhabitat		
91	404930	5963863	404899	5963868	39	RBK: UV LBK: UV BED: FO			REMOVE FLOW OBSTRUCTION
92	404899	5963868	404859	5963846	59	LBK: UV			
93	404859	5963846	404861	5963866	26	LBK: UV	LBK: BankR, BL & WDhabitat BED: BC		
94	404861	5963866	404862	5963882	21	RBK: UV	RBK: NW, BL & WDhabitat	Bankfull width: 9.0 m	Narrow from right bank only
95	404862	5963882	404829	5963891	36	RBK: UV	RBK: NW & BL	Bankfull width: 9.0 m	Narrow from right bank only

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OVERALL PLAN SHEET 6 OF 8

CLIENT PROJECT NO.	2006501
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DRAWING NO.	008
SHEET:	8 OF 18
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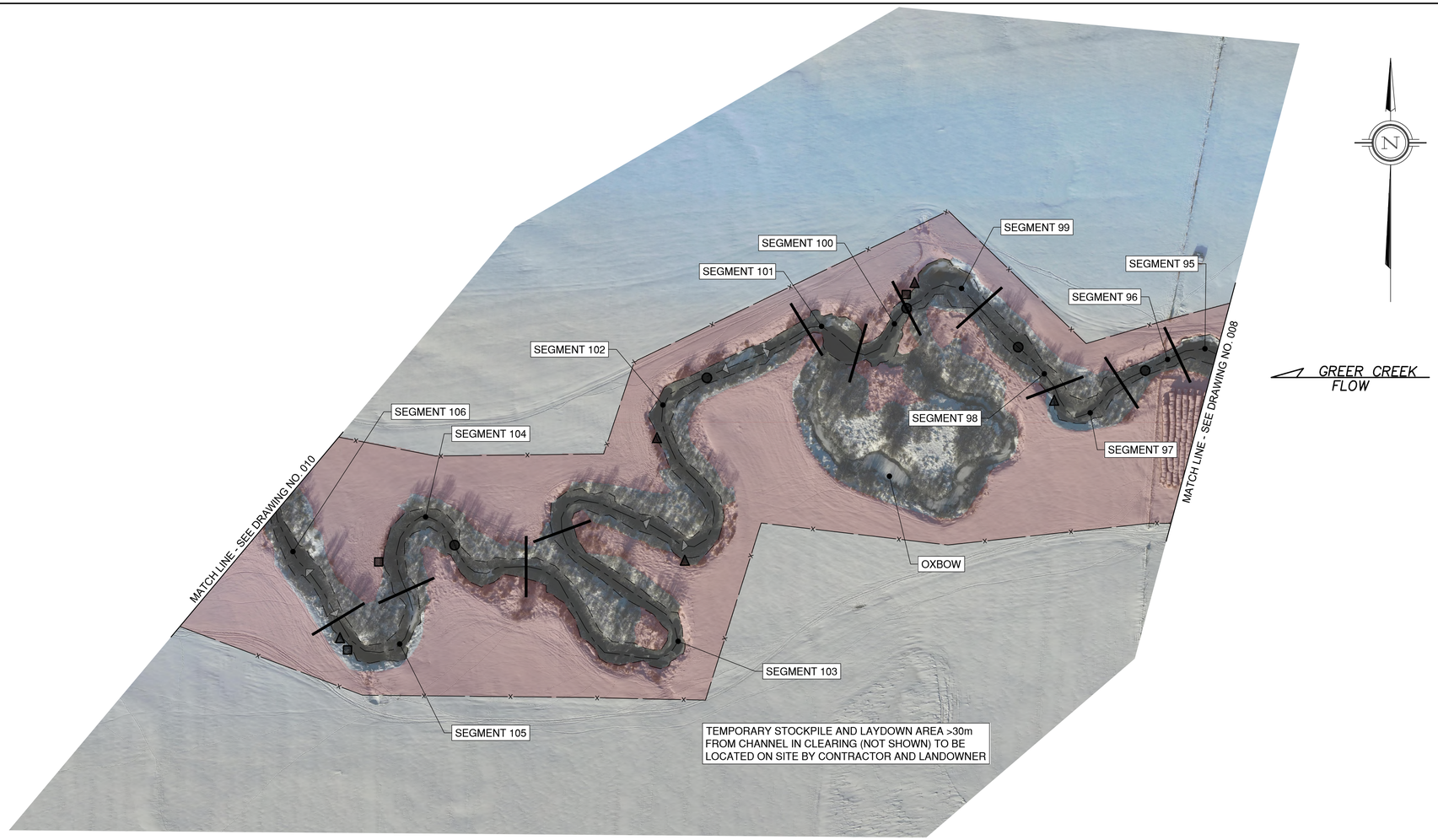

ISSUED FOR PERMIT APPROVAL

LEGEND

- APPROXIMATE WATERLINE
- APPROXIMATE CHANNEL CENTRE LINE
- PROPOSED CATTLE FENCING - BARB
- PROPOSED CATTLE FENCING - GATE
- CHANNEL SEGMENT BREAK LINES
- PROPOSED CROSSING
- PROPOSED CATTLE SUMMER WATERING - SOLAR
- PROPOSED STATIONARY CATTLE WINTER WATERING - SOLAR
- PROPOSED RIPARIAN PLANTING AREA

ABBREVIATIONS
(TREATMENT DETAILS SHOWN ON SHEET 011)

ISSUES
CT - Cattle Trampled
UV - Unvegetated
VC - Vehicle Crossing
FO - Flow Obstruction

CHANNEL MORPHOLOGY (Viewing Downstream):
RBK - Right Bank
LBK - Left Bank
BED - Channel Bed

TREATMENTS

REGRADING:
BankR - Bank Regrading: Detail 1A

WOODY DEBRIS:
WDhabitat Enhancement:
» ▲ - ROOTWAD: Detail 2D
» ■ - LOG: Detail 2C

BANK TREATMENTS:
BL - Brush Layers: Detail 3B
BED MATERIALS:
BC - Boulder Cluster: Detail 4A
» ●
GP - Gravel Placement: Detail 4B
» ◁ - Downstream Limit
» ▷ - Upstream Limit

NOTES:
1. SITE PLAN PREPARED BY PALMER BASED ON DRONE HIGH RESOLUTION IMAGERY COLLECTED ON OCTOBER 23, 2020. COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE INTERPRETED FROM PHOTOGRAMMETRY.
3. DESIGN BY PALMER. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD.
4. BANKFULL CHANNEL DIMENSIONS ARE TO BE CONFIRMED BY ENVIRONMENTAL INSPECTOR FOR BankR AND NW TREATMENTS
5. LOCAL CHANNEL GRADIENTS ARE TO BE MAINTAINED THROUGHOUT STUDY AREA REGARDLESS OF PROPOSED BANK AND BED TREATMENTS
6. REFER TO RIPARIAN RESTORATION AND ENHANCEMENT DETAILS (DRAWING 012) FOR SEGMENTS WHERE UNVEGETATED (UV) HAS BEEN IDENTIFIED AS AN ISSUE
7. REFER TO DRAWING 013, 014 AND 015 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS
8. REFER TO DRAWING 012 FOR FENCING DETAILS. REFER TO DRAWING 016, 017 AND 018 FOR CHANNEL CROSSING DETAILS
9. SUMMER AND WINTER OFF-CHANNEL WATERING DETAILS ARE PROVIDED ON DRAWING 012.

GREER CREEK: UPPER - CHANNEL SEGMENTS

SEGMENT NUMBER	UPSTREAM LIMIT		DOWNSTREAM LIMIT		SEGMENT LENGTH	CHANNEL MORPHOLOGY AND ISSUES	PROPOSED TREATMENTS	SPECIFICATIONS	NOTES
	EASTING	NORTHING	EASTING	NORTHING					
95	404862	5963882	404829	5963891	36	RBK: UV	RBK: NW & BL	Bankfull width: 9.0 m	Narrow from right bank only
96	404829	5963891	404807	5963880	25	RBK: UV LBK: UV	BED: BC		
97	404807	5963880	404780	5963878	39	LBK: UV	LBK: BankR, BL & WDhabitat		
98	404780	5963878	404750	5963909	44	RBK: UV LBK: UV	BED: BC		
99	404750	5963909	404721	5963909	36	RBK: CT & UV LBK: UV BED: CT	RBK: NW, BL & WDhabitat BED: BC	Bankfull width: 9.5 m	Narrow from right bank only
100	404721	5963909	404702	5963891	29				
101	404702	5963891	404682	5963901	24	RBK: UV	RBK: BankR & BL		
102	404682	5963901	404584	5963821	198	RBK: UV LBK: UV	RBK: WDhabitat LBK: WDhabitat BED: GP & BC	Gravel Placement length = 16m (Two sites)	
103	404584	5963821	404570	5963807	147	RBK: UV LBK: UV			Channel cut-off is probable over the coming decade
104	404570	5963807	404522	5963797	88	RBK: UV LBK: UV	RBK: WDhabitat BED: BC		
105	404522	5963797	404495	5963786	55	RBK: UV LBK: UV	LBK: BankR, BL & WDhabitat		
106	404495	5963786	404442	5963818	117	RBK: UV LBK: UV	BED: GP & BC	Gravel Placement length = 18m	

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	MAR 23, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 15, 2021	JL	MF
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D	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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DRAWN: JL
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SURVEYED: -
DATE: JUNE 2022

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UPPER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
OVERALL PLAN SHEET 7 OF 8

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-7
DRAWING NO. 009
SHEET: 9 OF 18
REV D

BC 1C 1-800-474-6886

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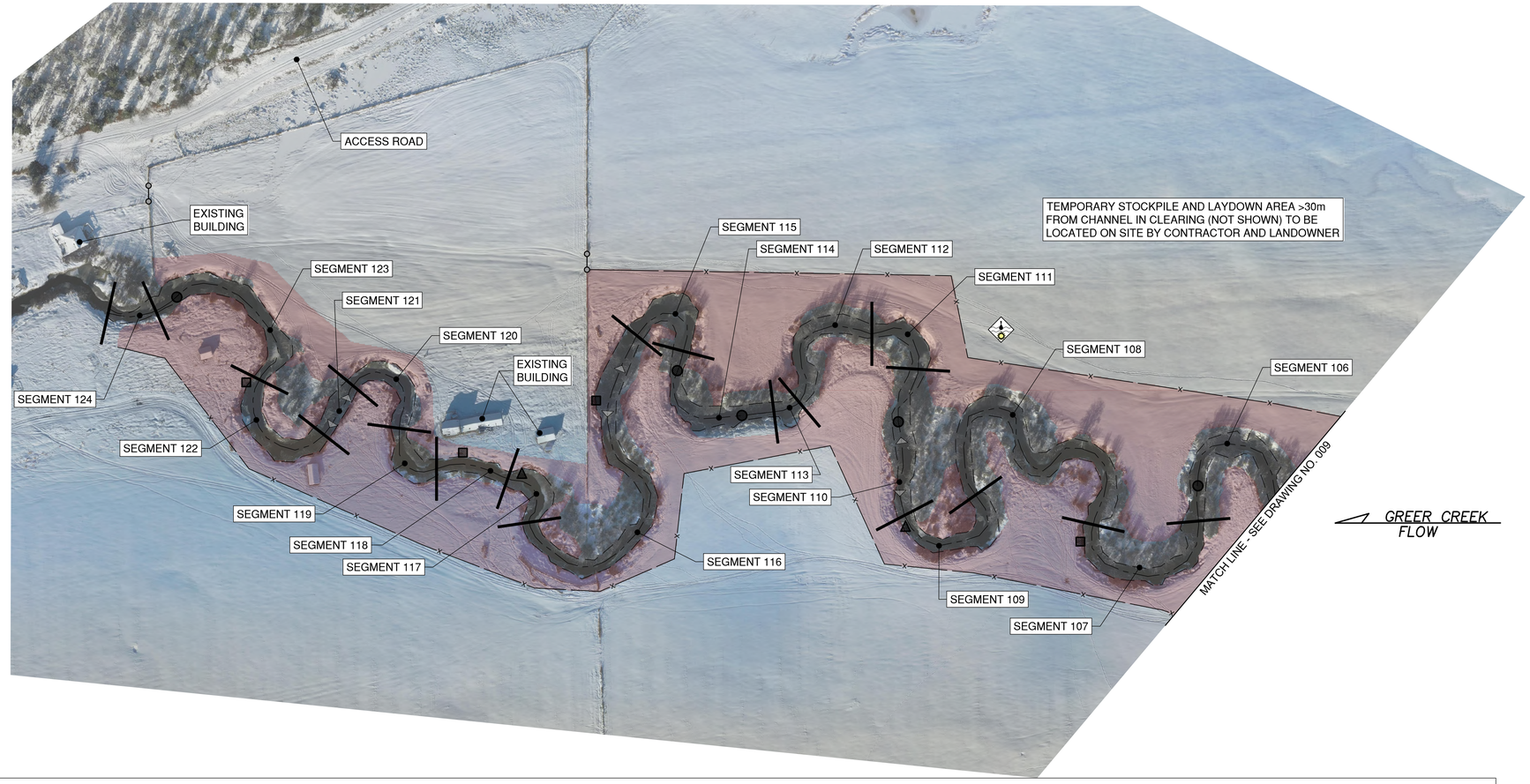

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106	404495	5963786	404442	5963818	117	RBK: UV LBK: UV	BED: GP & BC	Gravel Placement length = 18m	
107	404442	5963818	404402	5963817	66	RBK: UV LBK: UV	LBK: BankR, BL & WDhabitat		
108	404402	5963817	404357	5963828	128	RBK: UV LBK: UV			
109	404357	5963828	404330	5963820	52	RBK: UV LBK: UV	LBK: BankR, BL & WDhabitat		
110	404330	5963820	404335	5963876	58	LBK: UV	BED: GP & BC	Gravel Placement length = 18m	
111	404335	5963876	404317	5963889	29	RBK: UV LBK: UV	RBK: BankR & BL		
112	404317	5963889	404290	5963863	53	RBK: UV LBK: UV			
113	404290	5963863	404280	5963860	10	RBK: UV LBK: UV	LBK: BankR & BL		
114	404280	5963860	404246	5963883	60	RBK: UV LBK: UV	BED: BC		
115	404246	5963883	404228	5963889	34	RBK: UV LBK: UV	RBK: BankR & BL		
116	404228	5963889	404187	5963818	138	RBK: UV LBK: UV	RBK: WDhabitat BED: GP	Gravel Placement length = 16m	
117	404187	5963818	404179	5963834	25	RBK: UV LBK: UV	RBK: NW, BL & WDhabitat	Bankfull width: 8.0 m	Narrow from right bank only
118	404179	5963834	404152	5963838	28	RBK: UV LBK: UV	RBK: WDhabitat		
119	404152	5963838	404138	5963854	27	RBK: UV LBK: UV	LBK: BankR & BL		
120	404138	5963854	404120	5963870	39	RBK: UV LBK: UV	RBK: WDnarrow		
121	404120	5963870	404109	5963851	22	RBK: UV LBK: UV	BED: GP	Gravel Placement length = 10m	
122	404109	5963851	404085	5963872	48	RBK: UV LBK: UV	LBK: BankR, BL & WDhabitat		
123	404085	5963872	404045	5963898	76	RBK: UV LBK: UV	RBK: WDnarrow		
124	404045	5963898	404027	5963897	19	RBK: UV LBK: UV			

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DATE: 16/02/2021 2:27 PM BY: - Jesse Lutz

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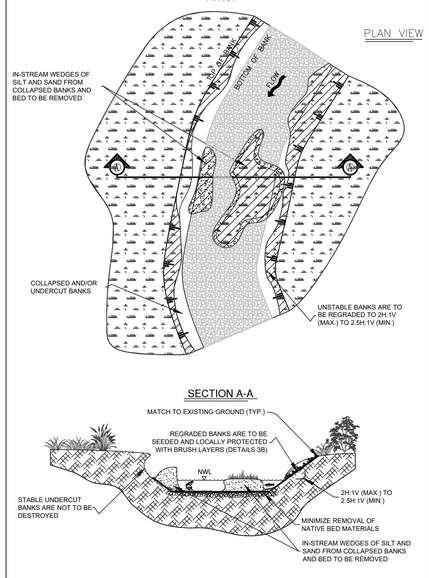
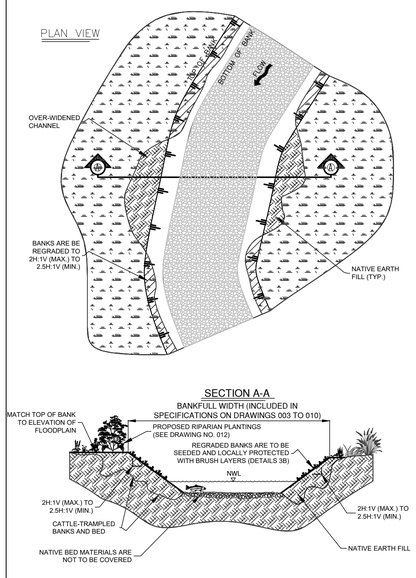
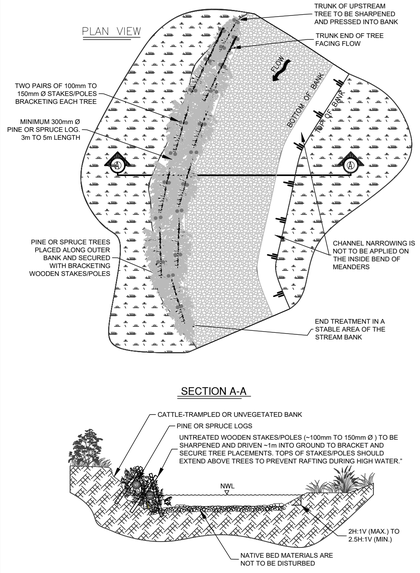
DETAIL 1A
RECONSTRUCTION OF CHANNEL BED AND/OR BANK REGRADING (BankR)
N.T.S.



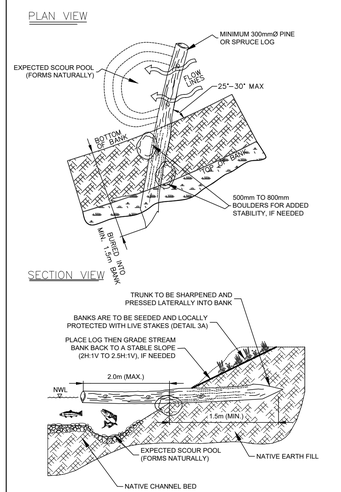
DETAIL 1B
RESTORATION OF NATURAL CHANNEL WIDTH (NW)
N.T.S.



DETAIL 2A
WOODY DEBRIS CHANNEL NARROWING (WDnarrow)
N.T.S.

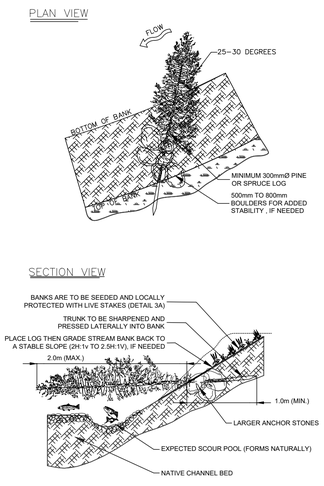


DETAIL 2B
WOODY DEBRIS CHANNEL DEFLECTION (WDdeflect)
N.T.S.



NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.5m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 2C
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): LOG
N.T.S.



NOTES:
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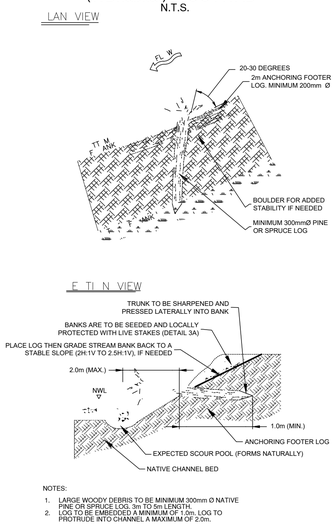
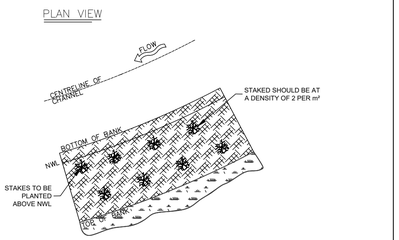
2. LOG TO BE EMBEDDED A MINIMUM OF 1.0m. LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 2D
WOODY DEBRIS HABITAT ENHANCEMENT (WDhabitat): ROOTWAD
N.T.S.



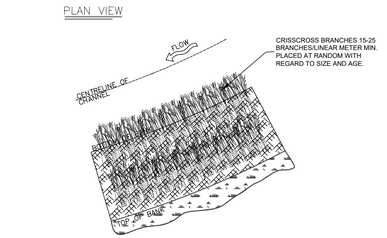
NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 300mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.0m, LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 2.0m.

DETAIL 3A
BANK TREATMENT: LIVE STAKES (LS)
N.T.S.



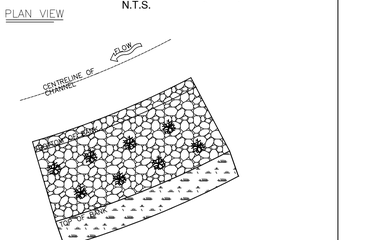
NOTES:
1. LIVE STAKINGS TO BE: -DORMANT LIVE STAKE CUTTING, (LIVE DOGWOOD AND WILLOW) -35-50mm DIA., WITH ANGLE CUT BASE, AND BLUNT CUT TOP. STAKE LENGTH TO BE 600-800mm.
2. TAMP ANGLE CUT BASE INTO SOIL AT RIGHT ANGLE TO SLOPE. ENSURE 75-80% OF LENGTH OF CUTTING IS EMBEDDED INTO SOIL. -TAMP TOPSOIL FIRMLY AROUND BASE.
3. SOAK LIVE STAKES FOR MINIMUM OF 24 HOURS PRIOR TO INSTALLATION.

DETAIL 3B
BANK TREATMENT: BRUSH LAYERS (BL)
N.T.S.



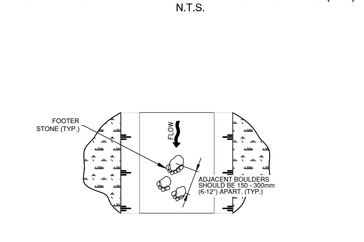
NOTES:
1. COVER BRUSHLAYER IMMEDIATELY WITH 0.15m (6") OF FILL SOIL, WATER AND COMPACT USING A VIBRATORY TAMPER.
2. BRUSH LAYERS WILL BE NATIVE WILLOW AND DOGWOOD SPECIES.
3. THE NUMBER OF LAYERS (I.E. LIFTS) WILL BE CONFIRMED BY THE INSPECTOR IN THE FIELD. IN GENERAL, BANKS <1m HIGH REQUIRE ONE LAYER, BANKS 1m TO 2m HIGH REQUIRE TWO LAYERS, AND BANKS >2m REQUIRE THREE LAYERS.

DETAIL 3C
BANK TREATMENT: VEGETATED BOULDER REVETMENT (VBR)
N.T.S.



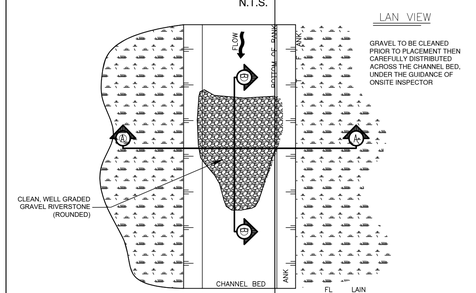
NOTES:
1. BOULDERS SHOULD BE ROUNDED TO SUB-ANGULAR.
2. GRADATION SHOULD BE WELL GRADED AND ANDERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE CLASS 25kg (MEDIAN GRAIN SIZE OF 260mm, MAXIMUM GRAIN SIZE OF 450mm).
3. INSTALLATION SHOULD ADHERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE GUIDANCE " RIPRAP INSTALLATION GUIDE"
4. BOULDERS ARE TO BE INDIVIDUALLY PLACED (I.E. NO DUMPING) TO MAXIMIZE INTERLOCKING. VOIDS ARE TO BE FILLED WITH SMALLER GRAVELS AND NATIVE MATERIALS.
5. THE BOULDER REVETMENT CAN BE FORMED IN LIFTS OR LIVE STAKE CAN BE INSERTED IF CARE IS TAKEN TO LEAVE SUFFICIENT VOIDS.
6. FILTER FABRIC SHOULD NOT BE USED.

DETAIL 4A
BED TREATMENT: BOULDER CLUSTERS (BC)
N.T.S.



NOTES:
1. BOULDER SHOULD BE 0.5-0.8m STONE.
2. BOULDERS ARE NOT TO BE PLACED IN DEPOSITIONAL ZONES.
3. BOULDERS SHOULD OCCUPY LESS THAN 1/3 OF THE CHANNEL WIDTH AFTER PARTIAL EMBEDMENT.
4. BOULDERS SHOULD BE A MINIMUM OF TWO STONE SIZES AWAY FROM THE CHANNEL'S BANKS.

DETAIL 4B
BED TREATMENT: GRAVEL PLACEMENT (GP)
N.T.S.



NOTES:
1. ONSITE INSPECTOR WILL NEED TO ENSURE NO FISH OR EGGS ARE PRESENT PRIOR TO PLACEMENT.
2. GRAVEL PLACEMENT SHOULD BE COMPLETED AT LOW FLOWS.

REMOVAL OR REGRADING
NATIVE VEGETATION
NWL NORMAL WATER LEVEL
NATIVE BED MATERIAL
NATIVE EARTH
SILT AND SAND

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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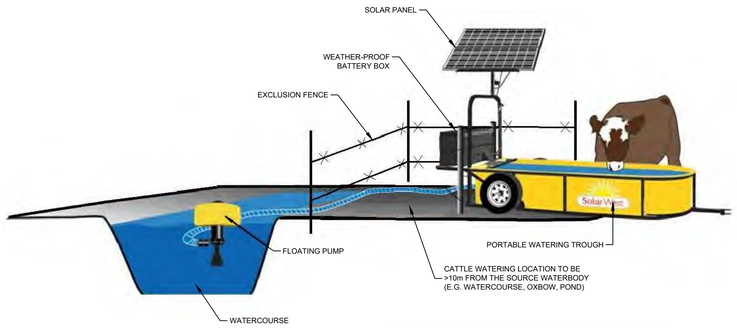
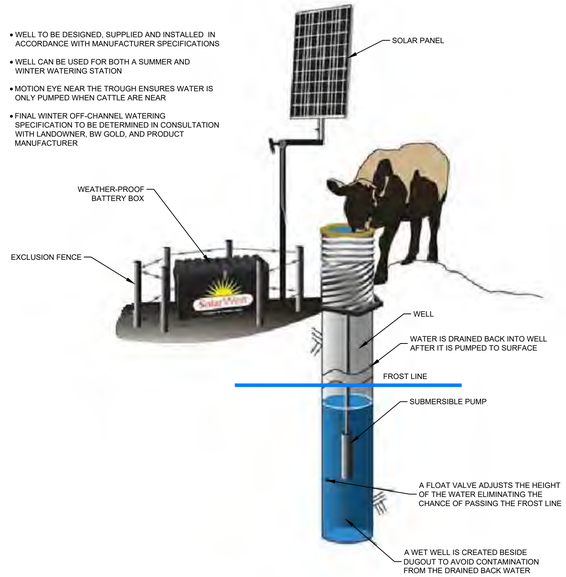
DETAIL 5A - SUMMER (MAY THROUGH OCTOBER) OFF-CHANNEL CATTLE WATERING
N.T.S



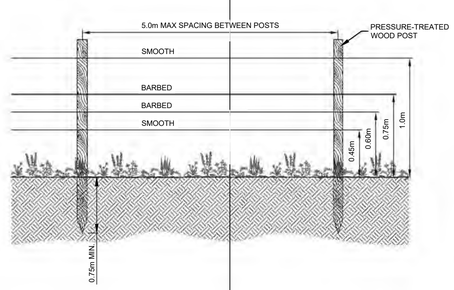
- PORTABLE WATERING STATION CAN EXTRACT WATER FROM WATERCOURSE, OXBOW AND/ OR ESTABLISHED WELL
- PORTABLE WATERING STATION CAN BE USED FOR BOTH SUMMER AND WINTER SEASON (IF GEOTHERMAL)
- PORTABLE WATERING STATION TO BE DESIGNED, SUPPLIED, AND INSTALLED BASED ON MANUFACTURER SPECIFICATIONS
- FLOAT SWITCH IN TROUGH MAINTAINS WATER LEVEL
- FINAL SUMMER OFF-CHANNEL WATERING SPECIFICATIONS TO BE DETERMINED IN CONSULTATION WITH LANDOWNER, BW GOLD, AND PRODUCT MANUFACTURER

DETAIL 5B - WINTER (NOVEMBER THROUGH APRIL) OFF-CHANNEL CATTLE WATERING
N.T.S

- WELL TO BE DESIGNED, SUPPLIED AND INSTALLED IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS
- WELL CAN BE USED FOR BOTH A SUMMER AND WINTER WATERING STATION
- MOTION EYE NEAR THE TROUGH ENSURES WATER IS ONLY PUMPED WHEN CATTLE ARE NEAR
- FINAL WINTER OFF-CHANNEL WATERING SPECIFICATION TO BE DETERMINED IN CONSULTATION WITH LANDOWNER, BW GOLD, AND PRODUCT MANUFACTURER

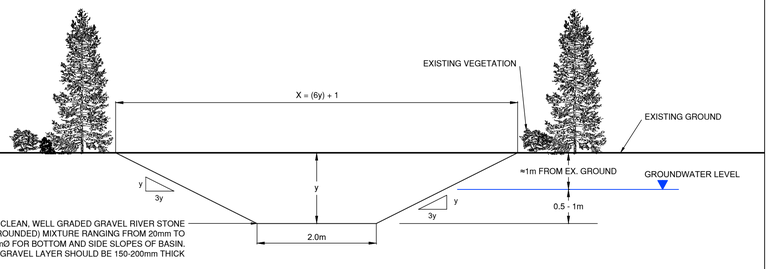


DETAIL 5C - CATTLE EXCLUSION FENCING - BARBED WIRE
N.T.S



- POSTS ARE TO BE 0.1m TO 0.15m IN DIAMETER AND 2m IN HEIGHT (MINIMUM)
- WIRE TO BE 12.5 GALVANIZED (CLASS 1 GALVANIZING MINIMUM), 4-POINT BARBS
- WIRE TO HAVE MINIMUM 950-LB BREAKING STRENGTH
- SMOOTH TOP AND BOTTOM WIRE TO FACILITATE WILDLIFE PASSAGE
- WIRE EXCLUSION FENCE DESIGN REFERENCES THE FENCING FACTSHEET 307.260-1 REVISED DECEMBER 15, 2015, BC MINISTRY OF AGRICULTURE, LIVESTOCK CONTROL - NON-ELECTRIC FENCE DESIGNS. FENCE TO BE SUPPLIED AND INSTALLED ACCORDING TO SPECIFICATIONS WITHIN THE FACTSHEET. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/farm-management/structures-and-mechanization/300-series/307260-1_livestock_contol_-_non-electric_fence.pdf

DETAIL 5D - GROUNDWATER INTERCEPTOR BASIN SECTION VIEW
N.T.S.



PROVISIONAL PLANTING NOTES

SITE PREPARATION:

- EXISTING WOODY VEGETATION TO BE RETAINED AND PROTECTED TO THE GREATEST EXTENT FEASIBLE.
- EXISTING HERBACEOUS VEGETATION IS TO BE MOWED OR SCYTHED TO 15cm IN HEIGHT BEFORE PLANTING AND / OR SEEDING.
- UNVEGETATED SOIL ON FORMER AGRICULTURAL FIELDS IS TO BE SCARIFIED WITH A SHALLOW VERTICAL TILL PLOW WHERE SEEDING IS PROPOSED. SCARIFICATION SHOULD BE PARALLEL TO THE STREAM TO MINIMIZE SURFACE RUNOFF.

PLANT MATERIAL:

- PLANT MATERIAL MUST BE LOCALLY SOURCED AND SPECIES MUST BE NATIVE TO THE REGION.
- PLANT STOCK MUST BE INSPECTED UPON DELIVERY TO ENSURE THAT THE MATERIAL CONSISTS OF APPROPRIATE NATIVE SPECIES IN GOOD CONDITION
- TREES TO BE CONTAINER GROWN OR BAREROOT STOCK RANGING FROM 1 TO 1.5 M IN HEIGHT.
- SHRUBS TO BE CONTAINER GROWN OR BARE ROOT AND RANGING FROM 0.4m TO 1.0m IN HEIGHT.
- SEEDS OF THE SUGGESTED MIXTURE OR SIMILAR BLEND TO BE MIXED BEFORE THE APPLICATION.
- LIVE STAKES TO BE 35 TO 50mm IN DIAMETER AND 1 TO 1.5m IN LENGTH. SOAKED FOR A MINIMUM OF 24 HOURS BEFORE INSTALLATION. TIPS OF LIVE STAKES CAN BE SEALED TO MINIMIZE RISK OF DISEASE.
- BRUSH LAYERING CUTTINGS TO BE A MINIMUM OF 10mm IN DIAMETER AND 1.5 TO 2.0m IN LENGTH.
- GRASSES AND SHRUBS TO BE PLANTED IN RIPARIAN AREA ABOVE HIGH WATER MARK (ABOVE STREAM BANK) IF CURRENTLY BARREN. PLANT GRASSES ONLY IF SHRUBS ARE PRESENT

PLANTING DENSITY:

- TREES TO BE PLANTED 1 TREE PER 36 m² (APPROXIMATELY 6m ON CENTER).
- SHRUBS TO BE PLANTED 1 SHRUB PER m² IN CLUSTERS OF 6 INDIVIDUAL SHRUBS. EACH SHRUB CLUSTER SHOULD COMPRISE A MINIMUM OF 2 SPECIES. SHRUB CLUSTERS ARE TO BE SCATTERED APPROXIMATELY 12m APART.
- SEED MIX IS TO BE APPLIED AT A RATE OF 20 kg/ha.
- LIVE STAKES TO BE PLANTED 2 LIVE STAKES PER m².
- BRUSH LAYER CUTTINGS TO BE DENSELY PACKED, SIDE-BY-SIDE, TO FORM A CONTINUOUS LAYER ACROSS THE FULL LENGTH OF THE LIFT. EACH LIFT WILL BE COMPOSED OF 15-25 BRANCHES PER LINEAR METER.

TIMING:

- PLANTING OF WOODY MATERIAL SHOULD BE COMPLETED IN THE SPRING (APRIL TO MAY) OR FALL (SEPTEMBER TO OCTOBER).
- SEEDING SHOULD BE COMPLETED IMMEDIATELY AFTER THE PLANTING OF WOODY VEGETATION.

TENDING:

- ALL PLANTINGS SHOULD BE WATERED IMMEDIATELY AFTER INSTALLATION.
- ALL PLANTINGS SHOULD BE WATERED DURING PERIODS OF NATURAL DROUGHT CONDITIONS (ESPECIALLY FROM LATE SPRING TO THE END OF SUMMER) FOR THE FIRST GROWING SEASON.

PROVISIONAL PLANTING LIST AND QUANTITIES

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
Seed Mix – Dry/Moist	Bluejoint Reedgrass	Calamagrostic canadensis	Dry seed mixed by weight to 297 kg for Shrub Cluster 1 areas.
	Blue Wildrye	Elymus glaucus	
	Showy Aster	Eurybia conspicua	
	American Vetch	Vicia americana	
	Fireweed	Chamerion angustifolium	
	Palmate Coltsfoot	Petasites frigidus var. palmatus	
	Lindley's aster	Symphyotrichum ciliolatum	
	Rough-leaved Rice Grass	Oryzopsis asperifolia	
Shrub Cluster – Dry/Moist [Plant with Seed Mix 1]	Saskatoon	Amelanchier alnifolia	700
	Soopolallie	Shepherdia canadensis	677
	Prickly Rose	Rosa acicularis	677
	Red Raspberry	Rubus ideaus	700
Tree Cluster – Dry/Moist	White Spruce	Picea glauca	800
	Lodgepole Pine	Pinus contorta	610
	Trembling Aspen	Populus tremuloides	610
Live Stakes (LS)	Red-Osier Dogwood	Cornus stolonifera	306
	Scouler's Willow	Salix scouleriana	306
	Coyote Willow	Salix exigua	306
	Geyer's Willow	Salix geyeriana	306
Brush Layer Cuttings (BL)	Red-osier Dogwood	Cornus stolonifera	25,070
	Pacific Willow	Salix lasiandra	25,070
	Hooker's Willow	Salix hookeriana	25,070
	Coyote Willow	Salix exigua	25,070

A DETAILED PLANTING PLAN TO INCORPORATE UPDATED SITE INFORMATION AND FIRST NATION COMMENTS WILL BE DEVELOPED FOLLOWING THE COMPLETION OF VEGETATION SURVEYS DURING THE SUMMER OF 2022.PLEASE REFER TO THE VEGETATION WORK PLAN PRESENTED IN THE FISHERIES ACT AUTHORIZATION APPLICATION FOR ADDITIONAL DETAILS.

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	MAR 23, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 15, 2021	JL	MF
C	ISSUED FOR PERMIT APPROVAL	MAY 18, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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DATE:	JUNE 2022

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470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
www.onsite-engineering.ca

BC 1C
1-800-474-6886

BW GOLD LTD

BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
UPPER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
STANDARD DETAILS SHEET 2 OF 2
& PLANTING NOTES FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-7
DRAWING NO. 012
SHEET: 12 OF 18
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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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CHANNEL WORKS - EROSION & SEDIMENT CONTROL AND WORK AREA ISOLATION - NOTES:

INTRODUCTORY STATEMENT

- THE EROSION & SEDIMENT CONTROL PLAN HAS BEEN DEVELOPED TO ENSURE ESTABLISHMENT AND MAINTENANCE OF ALL NECESSARY ENVIRONMENTAL PROTECTION MEASURES BEFORE, DURING AND AFTER CHANNEL RESTORATION AND ENHANCEMENT WORKS. IT ALSO ALLOWS THE CONTRACTOR, OVERSEEN BY AN ENVIRONMENTAL INSPECTOR, THE FLEXIBILITY TO OPTIMIZE THE MEASURES FOR THE MOST EFFECTIVE SEQUENCE AND APPROACH FOR IMPLEMENTATION. RATHER THAN PRESCRIBING EXACTLY WHERE AND WHEN DIFFERENT MEASURES ARE TO BE USED, TYPICAL LAYOUTS FOR ENVIRONMENTAL PROTECTION AND WORK-AREA SITE ISOLATION ARE PROVIDED TO MAKE CLEAR WHAT OPTIONS ARE AVAILABLE TO THE CONTRACTOR. AN ENVIRONMENTAL INSPECTOR FAMILIAR WITH THE EROSION & SEDIMENT CONTROL PLAN WILL BE AVAILABLE ON SITE TO ANSWER QUESTIONS AND PROVIDE GUIDANCE TO THE CONTRACTOR.

SECTION 1: SITE MANAGEMENT

1. EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING THE CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER, ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED AND / OR REPLACED WITHIN 48 HOURS OF INSPECTION.
2. DISTURBED AREAS WILL BE MINIMIZED TO THE EXTENT POSSIBLE, AND TEMPORARILY OR PERMANENTLY STABILIZED OR RESTORED AS THE WORK PROGRESSES.
3. ALL IN-WATER AND NEAR WATER EARTHWORKS WILL BE CONDUCTED IN THE DRY AND / OR WITHIN AN ISOLATED WORK AREA WITH APPROPRIATE EROSION AND SEDIMENT CONTROLS. SPECIFIED PLACEMENTS OF BOULDERS, GRAVEL, AND LARGE WOOD MAY BE MADE IN / NEAR WATER WITHOUT COMPLETE ISOLATION IF NOT ASSOCIATED WITH EARTHWORK.
4. THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED / AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREAS. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF DELETERIOUS SUBSTANCE, INCLUDING SEDIMENT, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY.
5. AN ENVIRONMENTAL MONITOR WILL ATTEND THE SITE TO INSPECT ALL NEW CONTROLS, AS WELL AS ON A REGULAR BASIS, OR FOLLOWING RAIN / SNOW MELT EVENTS, TO MONITOR ALL WORKS, AND IN PARTICULAR WORKS RELATED TO EROSION AND SEDIMENT CONTROLS, DE-WATERING, RESTORATION, AND IN / NEAR-WATER WORKS. SHOULD CONCERNS ARISE ON SITE, THE ENVIRONMENTAL MONITOR WILL CONTACT THE APPROPRIATE REGULATORY OFFICER AS WELL AS THE PROPONENT.
6. ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT THE ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE, OR OTHER DELETERIOUS SUBSTANCES INTO THE WATER. VEHICULAR REFUELING AND MAINTENANCE WILL BE CONDUCTED A MINIMUM OF 30 METERS FROM THE WATER.
7. THE PROPONENT / CONTRACTOR SHALL MONITOR THE WEATHER FOR THE DURATION OF CONSTRUCTION TO ENSURE THAT THE WORKS WILL BE CONDUCTED DURING FAVORABLE WEATHER CONDITIONS. SHOULD AN UNEXPECTED STORM OR SNOWMELT ARISE, THE CONTRACTOR WILL REMOVE ALL UNFIXED ITEMS FROM THE CHANNEL AND FLOOD PLAIN THAT WOULD HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW, E.G., FUEL TANKS, PORTA-POTTIES, MACHINERY, EQUIPMENT, CONSTRUCTION MATERIALS, ETC.
8. ALL DE-WATERING SHALL BE TREATED AND RELEASED TO THE ENVIRONMENT AT LEAST 15 METERS FROM A WATERCOURSE OR POND AND ALLOWED TO DRAIN THROUGH A FILTER BAG AND WELL-VEGETATED AREA. NO DE-WATERING EFFLUENT SHALL BE SENT DIRECTLY TO ANY WATERCOURSE, POND, FOREST, OR ALLOWED TO DRAIN ONTO DISTURBED SOILS WITHIN THE WORK AREA. THESE CONTROL MEASURES SHALL BE MONITORED FOR EFFECTIVENESS AND MAINTAINED OR REVISED TO MEET THE OBJECTIVE OF PREVENTING THE RELEASE OF SEDIMENT-LADEN WATER.
9. ESC MEASURES ARE TO REMAIN IN PLACE AND IN WORKING ORDER UNTIL ALL ON-SITE CONSTRUCTION IS COMPLETED.
10. AREAS WHICH REMAIN DISTURBED FOR MORE THAN 30 DAYS SHALL BE STABILIZED USING SEED, APPROVED EROSION CONTROL BLANKETS, OR SIMILAR APPROVED EQUIVALENT. IF CONDITIONS AREN'T SUITABLE FOR SEED APPLICATION, AN EROSION CONTROL BLANKET WILL BE USED IN ITS PLACE. SEE EROSION CONTROL BLANKET TYPICAL DETAIL ON SHEET 014.
11. NO EROSION AND SEDIMENT CONTROL MEASURE SHALL CONTAIN ANY PLASTIC, EVEN IF IT IS BIODEGRADABLE.
12. THE CONTRACTOR MUST HAVE SUITABLE PUMPING CAPABILITIES ON SITE AT ALL TIMES TO FACILITATE CONSTRUCTION ACTIVITIES IN THE DRY.
13. WORKS SHOULD BE COMPLETED IN STAGES TO REDUCE THE DURATION OF DISTURBED AREAS.
14. CONTRACTOR IS NOT TO DISPOSE OF ANY OF THE MATERIAL USED IN THE PEA GRAVEL METER BAGS INTO THE CHANNEL OR SURROUNDING AREA. ALL PEA GRAVEL BAGS ARE TO BE REMOVED OFF OF SITE.
15. TEMPORARY STAGING AREAS ARE TO BE SITUATED MORE THAN 15 METERS FROM THE WATERCOURSE. ALL MAJOR OVERNIGHT STAGING / STOCKPILING AREAS WILL BE A MINIMUM OF 30 METERS AWAY FROM THE WATERCOURSE. CONTRACTOR TO MONITOR WEATHER FORECASTS TO ENSURE MACHINES AND MATERIALS ARE REMOVED WHEN THE INCLEMENT WEATHER IS ANTICIPATED. STOCKPILE HEIGHTS WILL BE KEPT BELOW 1.5 METERS IN HEIGHT.

SECTION 2: CONSTRUCTION TIMING

16. TO PROTECT LOCAL FISH POPULATIONS DURING THEIR SPAWNING, NURSERY AND MIGRATORY PERIODS, IN-WATER ACTIVITIES SHOULD OCCUR DURING THE TIME PERIOD OF JULY 15 TO SEPTEMBER 15, IN ACCORDANCE WITH THE OMINECA REGION LEAST-RISK TIMING WINDOW FOR RAINBOW TROUT AND CHINOOK SALMON. THIS TIMING WINDOW IS SUBJECT TO CONFIRMATION FROM PROVINCIAL REGULATORS. CHANNEL WORKS ARE BEST COMPLETED IN LATE SUMMER, WHEN FLOWS ARE LOW AND THERE IS NO ICE.

SECTION 3: FISH RELOCATION

17. FISH STRANDED WITHIN THE WORK AREA SHALL BE CAPTURED AND RELEASED LIVE IN SUITABLE HABITAT DOWNSTREAM OF THE WORK AREA UNDER THE SUPERVISION OF A QUALIFIED AQUATIC BIOLOGIST. A PERMIT FROM MOFLNRORD IS REQUIRED.

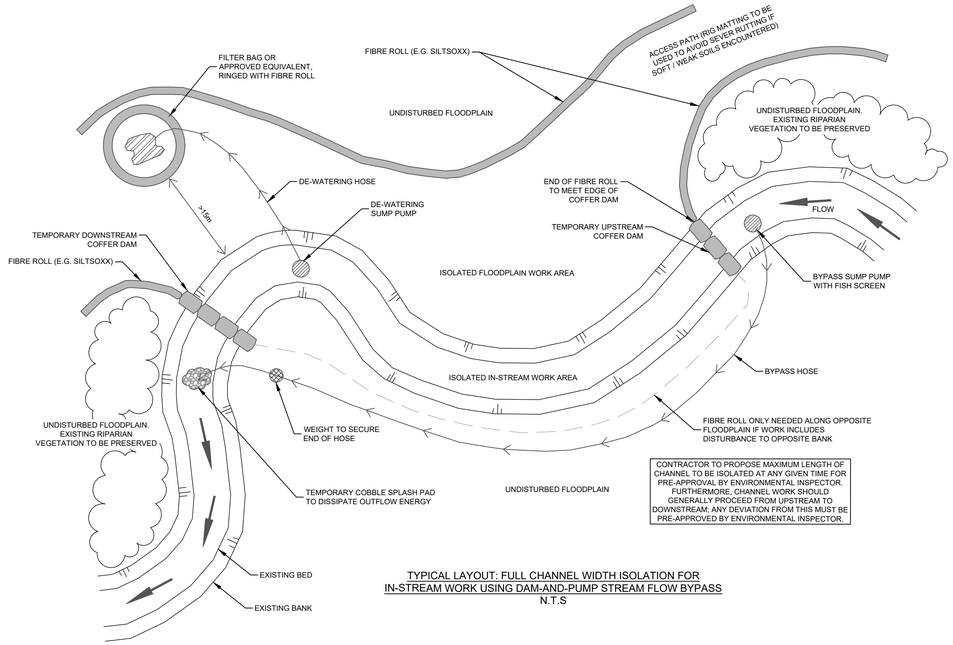
GENERAL STAGING PLAN FOR IN-CHANNEL WORK:

1. INSTALL FIBRE ROLLS ALONG ACCESS ROAD WHEN IT IS WITHIN 15m OF THE WATERCOURSE. ENSURE ENDS OF FIBRE ROLLS ARE POSITIONED TO TIE-IN WITH EDGES OF COFFER DAMS.
2. LAY DOWN RIG MATS ALONG ANY PORTIONS OF THE FLOODPLAIN ACCESS ROUTE WHERE THE SOILS ARE OBSERVED OR EXPECTED TO BE SOFT / WEAK, PRIOR TO EQUIPMENT ACCESS.
3. INSTALL UPSTREAM AND DOWNSTREAM COFFER DAMS IN A CONTROLLED MANNER TO REDUCE DISTURBANCE OF CHANNEL BED / BANKS AND RELEASE OF SEDIMENTS INTO CHANNEL.
4. INSTALL BYPASS PUMP AND HOSE TO BYPASS STREAM FLOW AROUND ISOLATED WORK AREA.
5. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
6. INSTALL DE-WATERING PUMP, HOSE, AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
7. PERFORM REQUIRED CHANNEL / BANK RESTORATION AND ENHANCEMENT WORKS, AS PER DESIGN SPECIFICATIONS.
8. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO REINTRODUCE FLOW GRADUALLY BACK INTO THE RESTORED CHANNEL.
9. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING DOWNSTREAM TO THE NEXT IN-CHANNEL WORK AREA.
10. REPEAT FROM STEP 1, AS NECESSARY, AS CHANNEL WORKS ARE COMPLETED FROM UPSTREAM TO DOWNSTREAM.

***NOTE: TEMPORARY EROSION & SEDIMENT CONTROL MEASURES TO BE REMOVED ONCE AREA STABILIZED. ALL DISTURBED RIPARIAN/FLOODPLAIN AREAS, INCLUDING BUT NOT LIMITED TO ACCESS ROADS AND LAYDOWN AREAS, TO BE SEEDED/RESTORED AS NEEDED TO PRE-EXISTING CONDITIONS OR BETTER.

WORK AREA ISOLATION NOTES

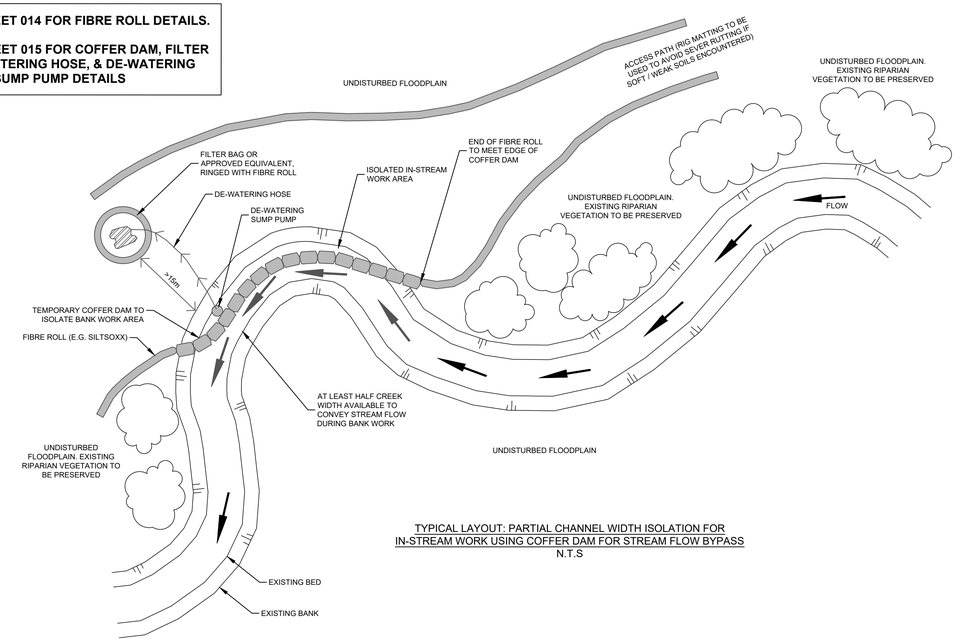
- INSTALL IN-STREAM PUMP OR INTAKE LINE OF REMOTE PUMP IN POOL LOCATED UPSTREAM OF WORK AREA. PROVIDE SCREENING TO PREVENT FISH FROM ENTERING INTO PUMP INTAKE . GO TO https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html FOR APPROPRIATE SIZING OF FISH SCREEN. DIG TEMPORARY SUMP UPSTREAM IF NO NATURAL POOL EXISTS. DISCHARGE WATER THROUGH OR INTO AN ENERGY DISSIPATER INTO THE WATERCOURSE SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- INSTALL UPSTREAM COFFER DAM WITH IMPERVIOUS LINER ACROSS WATERCOURSE AND MATCH WITH EXISTING CREEK BANKS. CENTER OF COFFER DAM TO BE DEPRESSED 0.150m
- WATER COLLECTED WITHIN THE ISOLATED WORK AREA TO BE PUMPED AROUND THE CONSTRUCTION SITE, DISCHARGED THROUGH A FILTER BAG LOCATED WITHIN THE FLOODPLAIN AS REMOTE FROM THE WATERCOURSE AS POSSIBLE AND SUFFICIENTLY DOWNSTREAM TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- AT THE END OF THE DAY THE STREAM MUST BE STABILIZED AND FREE FLOWING OR PUMPING MUST BE SUPERVISED.
- IN GENERAL ALL IN-STREAM CONSTRUCTION TO BE COMPLETED IN THE DRY. FISH EVACUATION PLAN MUST BE SUBMITTED AND APPROVED BY MOFLNRORD PRIOR TO COMMENCEMENT OF THE PROJECT. FISH RESCUE SHALL BE CONDUCTED FROM ISOLATED WORK AREAS BY A QUALIFIED INDIVIDUAL WITH A VALID PERMIT IN ACCORDANCE WITH THE BRITISH COLUMBIA STANDARDS AND BEST PRACTICES FOR IN-STREAM WORKS.
- INSTALL UPSTREAM COFFER DAM CONSISTING OF DOUBLE LINE WALL OF PEA GRAVEL BAGS COMPLETE WITH A LAYER OF IMPERMEABLE LINER SECURED BETWEEN THEM ACROSS WATERCOURSE AND MATCH EXISTING BANKS. DOWNSTREAM PEA GRAVEL BAGS SHALL BE INSTALLED TO PREVENT MIGRATION OF SILT AND SEDIMENT INTO THE ACTIVE STREAM FLOW. ENSURE COFFER DAM INSTALLATION IS EFFECTIVELY ISOLATING THE WORK AREA.
- IN-STREAM WORK IS TO START AT THE UPSTREAM LIMIT OF CONSTRUCTION AND BE COMPLETED SIMULTANEOUSLY WITH EXCAVATION SUCH THAT UNPROTECTED EXPOSURE IS MINIMIZED.
- DISTURBANCE CAUSED BY CONSTRUCTION EQUIPMENT ALONG THE BANK OR EDGE OF CREEK SHALL BE MINIMIZED BY THE USE OF RUBBER TRACKED EQUIPMENT, WOODEN MATS, OR OTHER APPROVED PROTECTIVE MEASURES.



TYPICAL LAYOUT: FULL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING DAM-AND-PUMP STREAM FLOW BYPASS
N.T.S

REFER TO SHEET 014 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 015 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS



TYPICAL LAYOUT: PARTIAL CHANNEL WIDTH ISOLATION FOR IN-STREAM WORK USING COFFER DAM FOR STREAM FLOW BYPASS
N.T.S

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REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	MAR 23, 2021	AB	MF
B	ISSUED FOR REVIEW	APR 15, 2021	JL	MF
C	ISSUED FOR PERMIT APPROVAL	MAY 18, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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470 GRANVILLE STREET, SUITE 630
VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
www.onsite-engineering.ca

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN

UPPER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT

ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501

OEL PROJECT NO. 1824-4-7

DRAWING NO. 013

SHEET: 13 OF 18

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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SEDIMENT CONTROL BARRIERS

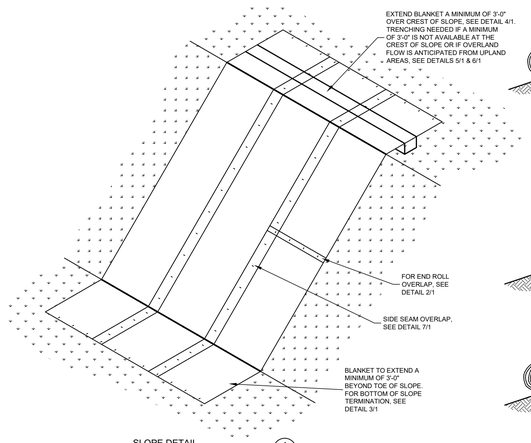
OPTION 1 - FIBRE ROLL

- FIBRE ROLL (E.G FILTREXX SILTSOXX OR APPROVED EQUIVALENT), FILLED WITH WOOD CHIPS, ARE THE PREFERRED TYPE OF SEDIMENT CONTROL BARRIER.
- MIN. DIAMETER = 300mm
- FIBRE ROLLS TO BE REGULARLY INSPECTED FOR TEARS OR HOLES, AND REPAIRED / REPLACED AS NEEDED TO MAINTAIN FUNCTION.
- FIBRE ROLLS MAY BE RE-USED IN A DIFFERENT LOCATION, ONLY IF THEY REMAIN FREE OF TEARS / HOLES, HAVE NOT LOST ANY OF THEIR CONTENTS, AND STILL MAINTAIN THE MINIMUM DIAMETER.
- REMOVE ALL SURFACE OBSTRUCTIONS GREATER THAN 50mm FROM THE GROUND PRIOR TO PLACING FIBRE ROLLS.
- TYPICAL FIBRE ROLL INSTALLATION DETAILS ARE SHOWN ON THIS SHEET FOR A FILTREXX SILTSOXX FIBRE ROLL. THE CONTRACTOR MAY USE THIS BRAND OF FIBRE ROLL OR AN APPROVED EQUIVALENT.

OPTION 2 - SEDIMENT CONTROL FENCE

- SEDIMENT CONTROL FENCE SUPPLIES SHOULD BE AVAILABLE ON SITE FOR USE IN CASES WHERE SURFACE PONDING OCCURS AND ADDITIONAL SILTATION CONTROL IS WARRANTED BEYOND WHAT THE FIBRE ROLLS CAN PROVIDE.
- GEOTEXTILE TO BE NON-WOVEN WITH A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
- NON-WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1 METER AT JOINTS.
- TYPICAL SEDIMENT CONTROL FENCE INSTALLATION DETAILS ARE SHOWN ON THIS SHEET. THESE DETAILS REPRESENT IDEAL SCENARIOS. ACTUAL SITE CONDITIONS MAY VARY AND SEDIMENT CONTROL FENCE INSTALLATION SHOULD BE TAILORED FOR EACH SITE.

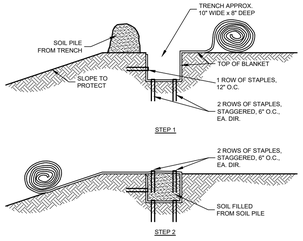
EROSION CONTROL BLANKET - TYPICAL DETAILS



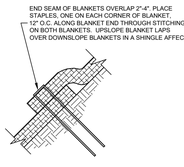
SLOPE DETAIL
NO SCALE
1/1

OVER SLOPE
CREST METHOD
NO SCALE
4/1

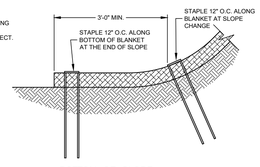
DO NOT NEED TO TRENCH BLANKET IN IF IT CAN BE EXTENDED A MINIMUM OF 3'-0" OVER THE CREST OF THE SLOPE.



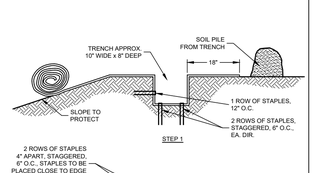
SLOPE TRENCHING
METHOD "A"
NO SCALE
5/1



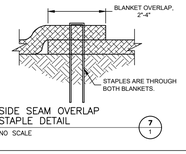
END ROLL OVERLAP
NO SCALE
2/1



BOTTOM OF SLOPE
TERMINATION
NO SCALE
3/1



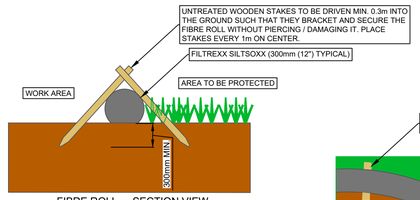
SLOPE TRENCHING
METHOD "B"
NO SCALE
6/1



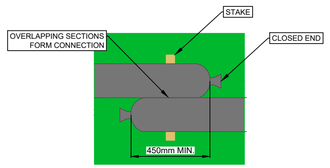
SIDE SEAM OVERLAP
STAPLE DETAIL
NO SCALE
7/1

EROSION CONTROL BLANKETS

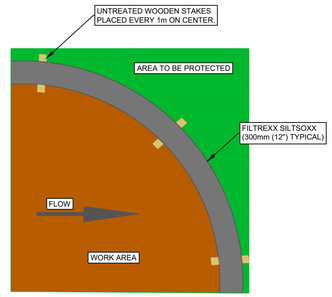
- BIODEGRADABLE EROSION CONTROL BLANKETS (E.G WOVEN JUTE, COIR MESH, GREAT LAKES ASPEN, ETC) TO BE AVAILABLE ON SITE IN CASE THEY ARE NEEDED TO HELP MITIGATE EROSION OF TEMPORARILY EXPOSED SOILS ON THE FLOODPLAIN
- DRAWINGS SHOWN ON THIS SHEET ILLUSTRATE TYPICAL INSTALLATION DETAILS FOR AN AMERICAN EXCELSIOR CURLEX NETFREE SLOPE PROTECTION EROSION CONTROL BLANKET. THE CONTRACTOR MAY USE THIS BRAND OF EROSION CONTROL BLANKET OR AN APPROVED EQUIVALENT.



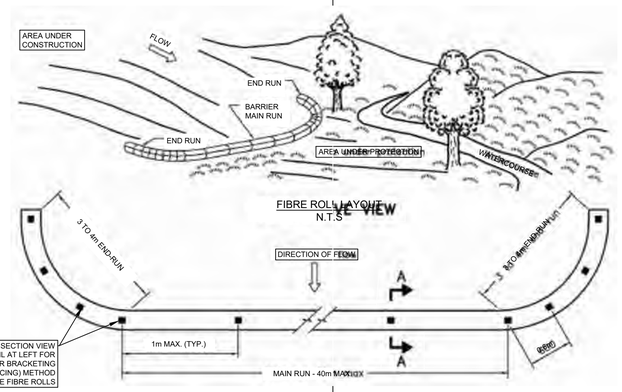
FIBRE ROLL - SECTION VIEW
N.T.S



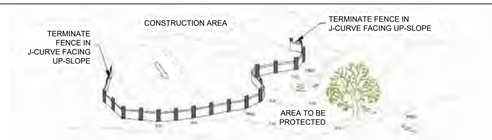
FIBRE ROLL - END CONNECTION DETAIL
N.T.S



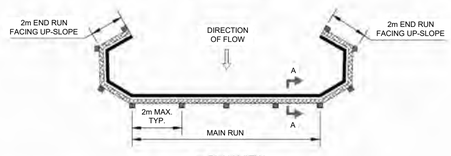
FIBRE ROLL - PLAN VIEW
N.T.S



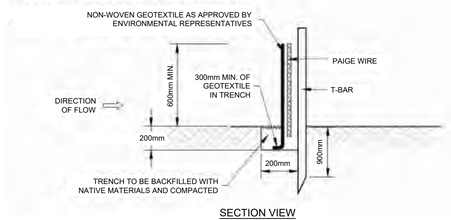
FIBRE ROLL LAYOUT - PLAN VIEW
N.T.S



PERSPECTIVE VIEW
N.T.S

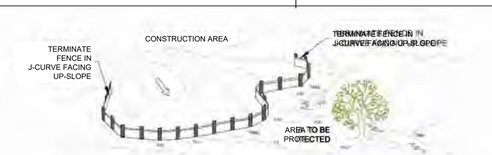


PLAN VIEW
N.T.S

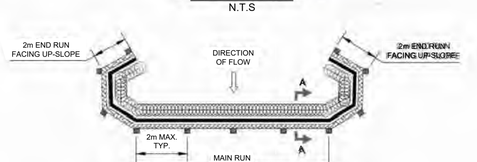


SECTION VIEW
N.T.S

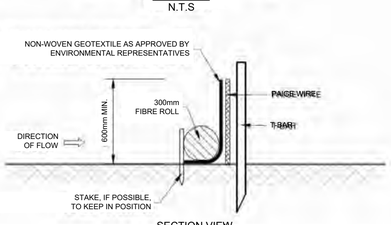
SEDIMENT CONTROL FENCE - UNFROZEN CONDITIONS



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
N.T.S



SECTION VIEW
N.T.S

SEDIMENT CONTROL FENCE - FROZEN CONDITIONS

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A	ISSUED FOR REVIEW	MAR 23, 2021	AB	MF
B	ISSUED FOR REVIEW	APR 15, 2021	JL	MF
C	ISSUED FOR PERMIT APPROVAL	MAY 18, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

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INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN

UPPER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT

SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-7
DRAWING NO. 014
SHEET: 14 OF 18
REV D

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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WORK AREA ISOLATION MEASURES

METRE BAG COFFER DAM

- FOR ISOLATION OF THE FULL CHANNEL WIDTH (DAM-AND-PUMP STREAM-FLOW BYPASS) OR ONLY A PORTION OF THE CHANNEL WIDTH (PASSIVE STREAM-FLOW BYPASS FOR SINGLE-BANK WORK) FOR IN-CHANNEL WORK.
- 1-2 TIER, SINGLE-STACK METRE BAG COFFER DAM PREFERRED GIVEN MINIMAL DISTURBANCE; PYRAMID-STACK METRE BAG COFFER DAM MAY BE NECESSARY IN DEEPER-WATER SCENARIOS.
- METRE BAGS SHOULD BE FILLED WITH PEA GRAVEL AND SHOULD NOT BE OVER-FILLED.
- A WATERPROOF MEMBRANE IS REQUIRED OVER THE PEA-GRAVEL METRE BAGS. THE WATERPROOF MEMBRANE MUST BE KEYED IN UNDER THE BARRIER TO MINIMIZE LEAKAGE.
- COFFER DAM MAY BE CONSTRUCTED OF SMALLER PEA-GRAVEL SANDBAGS OR OTHER SUITABLE EQUIVALENT. SEE BELOW FOR DETAILS.

PEA GRAVEL COFFER DAM

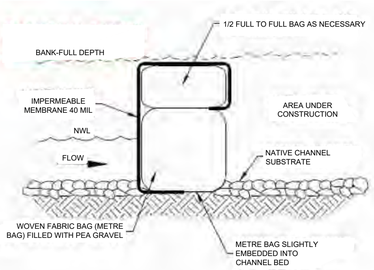
- CAN BE USED AT THE DISCRETION OF THE ENVIRONMENTAL REPRESENTATIVE FOR ISOLATION OF CHANNELS IN LOW-FLOW, SHALLOW WATER CONDITIONS WHEN LOCAL WORKS CAN BE COMPLETED WITHIN A FAVORABLE WEATHER WINDOW AND / OR THE CHANNEL IS LOCALLY TOO NARROW OR AWKWARD FOR THE USE OF METRE BAGS.

DE-WATERING SUMP PUMP

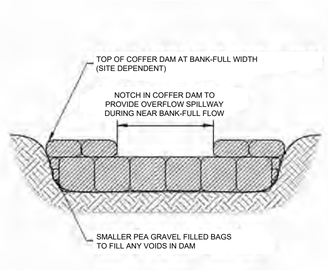
- FOR TEMPORARY MAINTENANCE OF DRY OR SHALLOWER CONDITIONS WITHIN AN ISOLATED IN-CHANNEL WORK AREA.
- A PUMP WITH A MINIMUM RECOMMENDED PUMPING CAPACITY OF 2000GPM MUST BE USED.
- DURING ELEVATED FLOWS APPROACHING BANK-FULL DEPTH, ALL PUMPING WILL BE STOPPED AND COFFER DAMS WILL BE TEMPORARILY REMOVED TO ALLOW FLOWS TO PASS UNOBSTRUCTED.

DE-WATERING FILTER BAG RINGED WITH FILTREXX SILTSOXX (OR APPROVED EQUIVALENT)

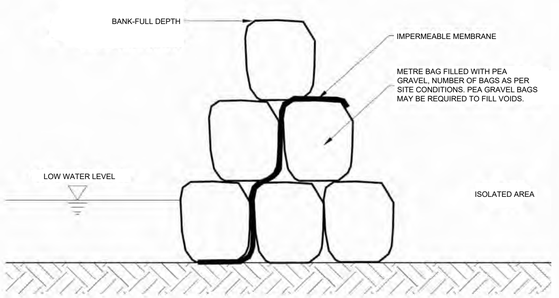
- FOR CONTROLLED DEPOSITION OF FINE SEDIMENT PUMPED OUT OF AN ISOLATED IN-CHANNEL WORK AREA, AWAY FROM THE WATERCOURSE.
- PLACE FILTER BAG (3.5m X 5.0m TERRAFIX ENVIROBAG OR APPROVED EQUIVALENT) ON A LEVEL, STABILIZED AREA OF THE FLOODPLAIN, ON VEGETATED GROUND > 15m AWAY FROM THE CHANNEL. FILTREXX SILTSOXX (300mm (12") DIAMETER) OR APPROVED EQUIVALENT TO BE PLACED AROUND THE FILTER BAG.
- ISOLATED SECTION OF CHANNEL TO BE PUMPED AND DE-WATERED INTO FILTER BAG.
- REPLACE UNIT WHEN HALF FULL OF SEDIMENT OR WHEN SEDIMENT HAS SIGNIFICANTLY REDUCED THE FLOW RATE OF PUMP DISCHARGE.
- ALLOW SEDIMENT BAG TO DRY IN DESIGNATED SEDIMENT DRYING AREA AND THEN RE-USE THE SEDIMENT AS PART OF BANK RESTORATION OR DISPOSE OF IT OFF SITE UNDER DIRECTION OF THE ON-SITE ENVIRONMENTAL REPRESENTATIVE.



METRE BAG COFFER DAM - SECTION
N.T.S



METRE BAG COFFER DAM - PROFILE
N.T.S



METRE BAG WATERPROOF ISOLATION BARRIER - SECTION
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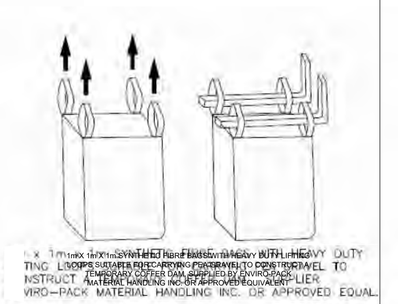
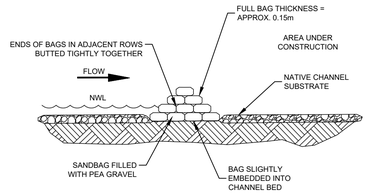


PEA GRAVEL METRE BAG HANDLING
N.T.S



PEA GRAVEL BAG COFFER DAM - SECTION
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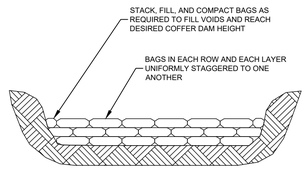

PEA GRAVEL BAG COFFER DAM - PROFILE
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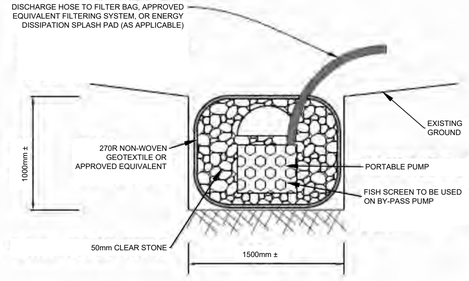

DE-WATERING SUMP PUMP DETAIL
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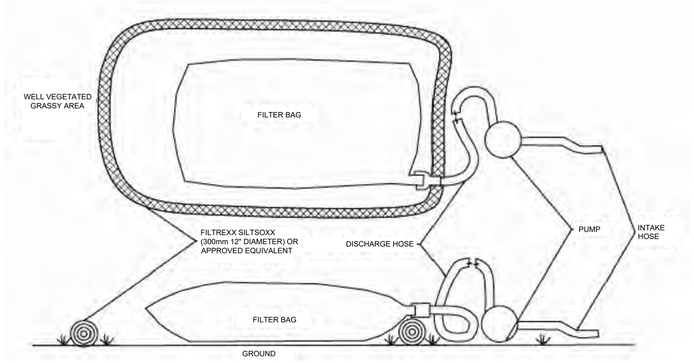

DE-WATERING FILTER BAG WITH FILTREXX SILTSOXX - PLAN & PROFILE
N.T.S

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DATE: 2021.05.12 PM BY: Jesse Lutz

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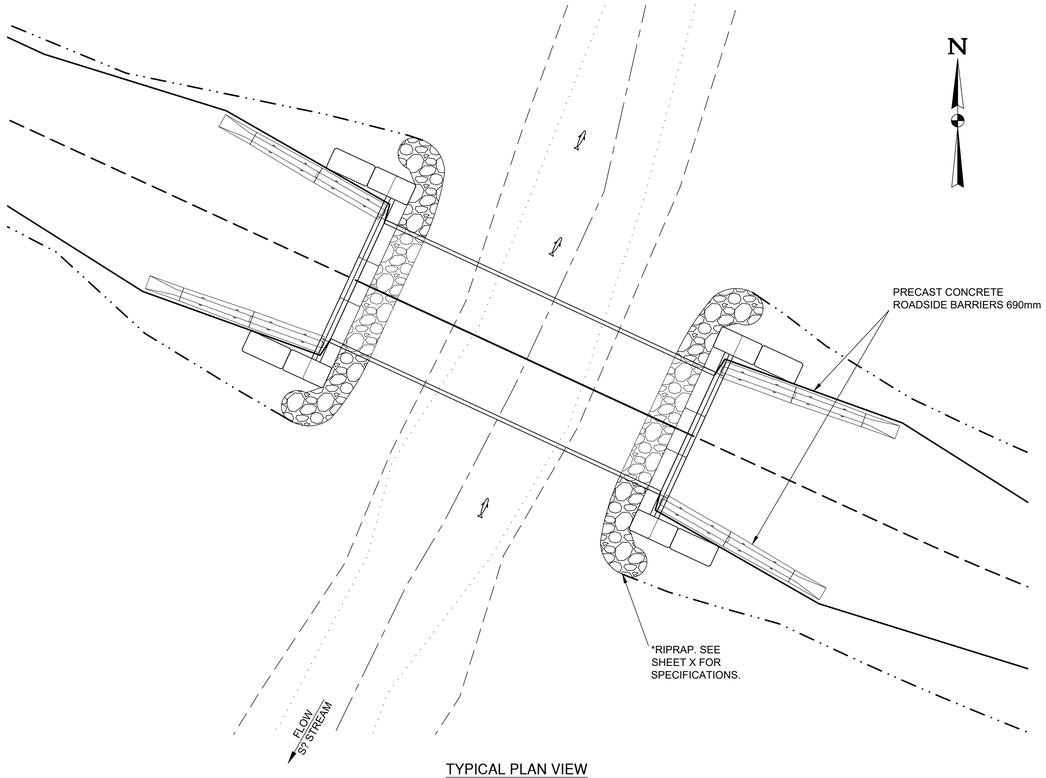


TYPICAL PLAN VIEW

10:1

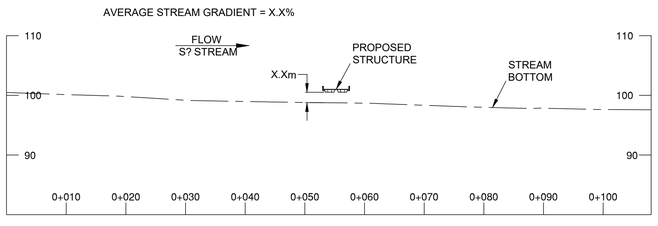
OBJECTIVE:
CROSSINGS ARE PROPOSED AT STRATEGIC LOCATIONS TO ALLOW FOR THE SAFE PASSAGE OF MACHINERY AND LIVESTOCK ACROSS THE CHANNEL AND TO AVOID EXCESS DISTURBANCE TO THE CREEK (E.G. CATTLE TRAMPLING, MACHINERY FORDS). CLEAR SPAN BRIDGES WERE CHOSEN TO ENSURE FISH AND WILDLIFE PASSAGE AND TO ACCOMMODATE NATURAL CREEK PROCESSES. THE PROPOSED CROSSING LOCATIONS WERE CHOSEN BASED ON GEOMORPHIC, ECOLOGICAL, AND AGRICULTURAL CONSIDERATIONS. CROSSINGS ARE NOT POSITIONED NEAR SHARP MEANDER BENDS.

A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.

LEGEND	
DESIGNED ROAD EDGES	
DESIGNED ROAD CENTRELINE	
APPROXIMATE EXTENT OF CUT/FILL SLOPE	
HIGH WATER LEVEL	
STREAM THALWEG	
PRESENT WATER LEVEL	

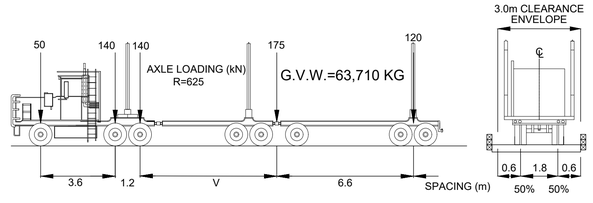
NOTES:

1. **DURATION:**
   - 1.1. FOR THE PURPOSE OF THIS DESIGN THE TERM PERMANENT AS IT REFERS TO DURATION OF THE INSTALL MEANS FORTY-FIVE (45) YEARS OR LESS. AS TREATED SILL AND BALLAST WALL TIMBERS ARE TO BE USED, REPLACEMENT OF TIMBER COMPONENTS IS EXPECTED AFTER TWENTY FIVE (25) YEARS. ROUTINE BRIDGE INSPECTIONS ARE TO BE COMPLETED TO DETERMINE THE ACTUAL LIFE OF TIMBER COMPONENTS AND WHEN THEY ARE TO BE REPLACED.
2. **DESIGN LIVE LOAD:**
   - 2.1. DESIGN VEHICLE: BCL-625 AS PER MOFLNRORD (STD-EC-000-001 TO 002).
3. **STRUCTURE:**
   - 3.1. SUPERSTRUCTURE TO BE PROVIDED BY OTHERS. SUPERSTRUCTURE DESIGN TO BE IN ACCORDANCE WITH CAN/CSA-S6 (MODIFIED AS PER MOFLNRORD INTERIM BRIDGE DESIGN GUIDELINES JULY 23-2010) AND IS TO TAKE INTO ACCOUNT LOGGING TRUCKS WITH UNBALANCED LOADS AND OFF-CENTER DRIVING.
   - 3.2. EXCEPT AS NOTED, SPECIFICATIONS TO BE AS PER MOFLNRORD STANDARD DRAWINGS FOR ALL STEEL PORTABLE BRIDGES (STD-E-090-01 TO 02), LOCK BLOCK ABUTMENT (STD-EC-050-01 AND STD-EC-050-012), CONSTRUCTION PAD (STD-EC-050-15), AND NO POST BARRIERS/GUIDE LOGS (STD-E-010-05).
   - 3.3. IF SUPERSTRUCTURE HAS BEEN USED PREVIOUSLY AT ANOTHER LOCATION IT MUST BE INSPECTED BY A PROFESSIONAL ENGINEER PRIOR TO USE AT THIS SITE. IF A NEW STRUCTURE IS PLANNED, OEL IS TO REVIEW FABRICATION DRAWINGS PRIOR TO FABRICATION OF SUPERSTRUCTURE FOR COMPLIANCE WITH THIS DESIGN.
   - 3.4. CHECK REQUIRED BEARING TO BEARING DISTANCE AND DEPTH OF ACTUAL STRUCTURE PRIOR TO CONSTRUCTION OF THE ABUTMENTS. BOTTOM OF GIRDER ELEVATIONS TO GOVERN.
   - 3.5. GENERAL ARRANGEMENT DRAWING. SOME SUPERSTRUCTURE COMPONENTS NOT SHOWN. REFER TO FABRICATION DRAWINGS.
4. **DESIGN OF ROAD APPROACHES AND DECK WIDTH:**
   - 4.1. HORIZONTAL ALIGNMENT AND ROAD WIDTHS TO PERMIT W-19 TRUCKS WITH 0.5m CLEARANCE INSIDE CURBS.
5. **CREEK NOTES:**
   - 5.1. STREAM RIPARIAN CLASS IS TO BE DETERMINED FOR EACH SITE BASED ON STREAM WIDTH AND FISH PRESENCE/ACCESS.
   - 5.2. STREAM BED MATERIAL IS TO BE DETERMINED FOR EACH SITE.
   - 5.3. THE DESIGN FLOOD IS EXPECTED TO BE: ■ CLEARWATER FLOOD ☐ DEBRIS FLOOD ☐ DEBRIS FLOW
   - 5.4. DESIGN FLOOD: TO BE DETERMINED FOR EACH SITE. THE PEAK FLOW FOR DESIGN PURPOSES WILL BE DETERMINED BASED ON REVIEW OF CHANNEL CHARACTERISTICS, PREVIOUS HIGH FLOW EVIDENCE, AND REVIEW OF THE RESULTS OF PEAK FLOW EMPIRICAL MODELS SUCH AS THE RATIONAL METHOD AND A REGIONAL ANALYSIS. WATERSHED CHARACTERISTICS, AND OTHER RELEVANT INFORMATION ARE ALSO USED TO ESTIMATE PEAK FLOW.
   - 5.5. LOW LIKELIHOOD OF WOODY DEBRIS MOVEMENT.
   - 5.6. CLIMATE CHANGE: CLIMATE CHANGE WILL BE CONSIDERED IN THE DESIGN FLOOD ASSESSMENT.
6. **GEOTECHNICAL:**
   - 6.1. FOUNDATION DESIGN REFERENCES THE CANADIAN FOUNDATION ENGINEERING MANUAL. SUBSURFACE INFORMATION WILL BE INFERRED FROM SITE OBSERVATIONS OF SOIL EXPOSURES IN ROAD CUTS AND ALONG STREAMBANKS AND FROM SHALLOW HAND DUG TEST PITS AND PROBES (TO BE DETERMINED FOR EACH SITE). NO DETAILED SUBSURFACE FIELD INVESTIGATION WAS CONDUCTED (LARGE TEST PITS OR BORE HOLES). FIELD CONDITIONS MAY VARY FROM THOSE INFERRED. IF, UPON EXCAVATION, FIELD CONDITIONS VARY FROM THOSE INFERRED, THEN CHANGES TO THE FOUNDATION DESIGN OR INSTALLATION MAY BE REQUIRED.
   - 6.2. FOOTING DESIGN BASED ON ASSUMED SOIL BEARING CAPACITY OF 200kPa.
7. **FIELD REVIEWS:**
   - 7.1. A PROFESSIONAL ENGINEER OR THEIR DESIGNATE IS REQUIRED TO INSPECT THE FOLLOWING ACTIVITIES PRIOR TO PROVIDING RECORD DRAWINGS AND A CROSSING ASSURANCE STATEMENT:
     - LAYOUT OF RIPRAP/ABUTMENT LOCATION PRIOR TO INITIAL EXCAVATION
     - FOUNDATION SOILS FOLLOWING EXCAVATION
     - RIPRAP AND ABUTMENT CONSTRUCTION
     - BACKFILL MATERIAL AND TECHNIQUE
     - OTHER SITE INSPECTIONS AT THE DISCRETION OF THE PROFESSIONAL
9. **INSTALLATION NOTES:**
   - 9.1. RIPRAP SOURCE HAS NOT BEEN IDENTIFIED.
   - 9.2. NOTE THAT WHERE EXCAVATION SPECIFICATIONS ON THESE DRAWINGS CONFLICT WITH WORKSAFEBC REGULATIONS, WORKSAFEBC REGULATIONS ARE TO GOVERN.
   - 9.3. PLAN TO DEWATER FOOTING AREAS.



TYPICAL STREAM PROFILE VIEW

2:1



BCL-625 DESIGN TRUCK LOADING DIAGRAM

V = VARIABLE SPACING - 6.6m TO 18m INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES THE MAXIMUM STRESSES.

CAUTION:
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
UPPER GREER CREEK HABITAT RESTORATION AND ENHANCEMENT
TYPICAL CROSSING DESIGN SHEET 1 OF 3

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-7
DRAWING NO. 016
SHEET: 16 OF 18
REV D

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DATE: 05/04/2021 5:00 PM BY: Jesse Lutz

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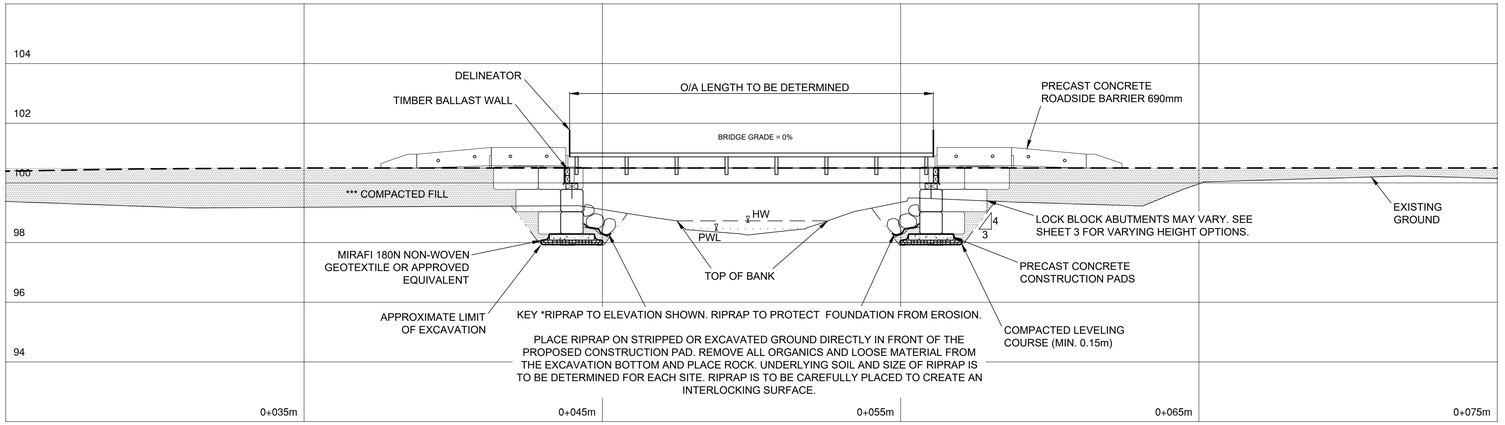
A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.



TYPICAL ELEVATION VIEW

10:1

PARTIAL MATERIALS LIST	
QTY	ITEM DESCRIPTION
TBD	ROLLS NON-WOVEN GEOTEXTILE: MIRAFI 180N OR EQUIVALENT
TBD	ROLLS OF GEOGRID: MIRAFI 7XT OR EQUIVALENT
Xm³	LEVELING COURSE (SANDY GRAVEL OR 19mm CLEAR CRUSH) - CRUSH RECOMMENDED WHERE WATER EXPECTED IN FOOTING AREA
4	PRECAST CONCRETE CONSTRUCTION PADS: 0.2m X 1.5m X 4.6m [15']
TBD	STD CONCRETE BLOCKS (INTERLOCKING): 0.75m X 0.75m X 1.5m (TYP.)
TBD	FLAT TOP CONCRETE BLOCKS (INTERLOCKING): 0.75m X 0.75m X 1.5m (TYP.)
2	TREATED TIMBER SILLS: 0.2m X 0.4m X 4.9m [16']
6	STEEL PINS: 25mmØ [1"] TO ATTACH SILL TO LOCK BLOCKS
8	LAG BOLTS: 19mmØ [¾"] X 200mm TO ATTACH STEEL GIRDERS TO SILL
TBD	TIMBER BALLAST WALL: 0.15m X 0.3m X 6.0m [20'] LONG TIMBERS
4	GUIDE LOGS: 0.6m Ø X 6m LENGTH (TYP.)
4	W-054 SERIES DELINEATORS (2 LEFT, 2 RIGHT)
2	W-051 SERIES NARROW STRUCTURE SIGNS
2	POSTS FOR NARROW STRUCTURE SIGNS: 0.2m X 4.0m LENGTH LOG POSTS OR 0.1m X 0.1m X 3.0m LENGTH TREATED TIMBERS
1	BAG ROADSIDE GRASS SEED MIX
	RIPRAP: SEE SPECIFICATIONS ON THIS SHEET

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 50kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 5(155)
50% 50(330)
85% 150(475)
NOMINAL THICKNESS OF RIPRAP
550mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 100kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 10(195)
50% 100(415)
85% 300(600)
NOMINAL THICKNESS OF RIPRAP
700mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

*RIPRAP: CLEAN ANGULAR ROCK

CLASS 250kg RIPRAP
ROCK GRADATION
PERCENT SMALLER THAN GIVEN
ROCK MASS kg(mm)
15% 25(260)
50% 250(565)
85% 750(815)
NOMINAL THICKNESS OF RIPRAP
1000mm

ALL ROCK TO BE PLACED TO MAXIMIZE INTERLOCKING BETWEEN PIECES. ALL ROCK TO BE UNDERLAIN WITH MIRAFI 180N OR APPROVED EQUIVALENT NON-WOVEN GEOTEXTILE.

LEGEND	
DESIGNED ROAD GRADE	— — —
APPROXIMATE LIMIT OF EXCAVATION	— · · —
HIGH WATER LEVEL	— — —
PRESENT WATER LEVEL	· · · · · · · ·
MIRAFI 180N GEOTEXTILE (OR APPROVED EQUIVALENT)	— — —

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**SOIL DENSITY	
VERY LOOSE	EASILY EXCAVATED WITH A SPADE
LOOSE	SOME RESISTANCE TO SPADE
COMPACT	CONSIDERABLE RESISTANCE TO SPADE
DENSE	REQUIRES PICK FOR EXCAVATION
VERY DENSE	HIGH RESISTANCE TO PICK

***COMPACTED FILL
GRANULAR FILL TO BE COMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY.

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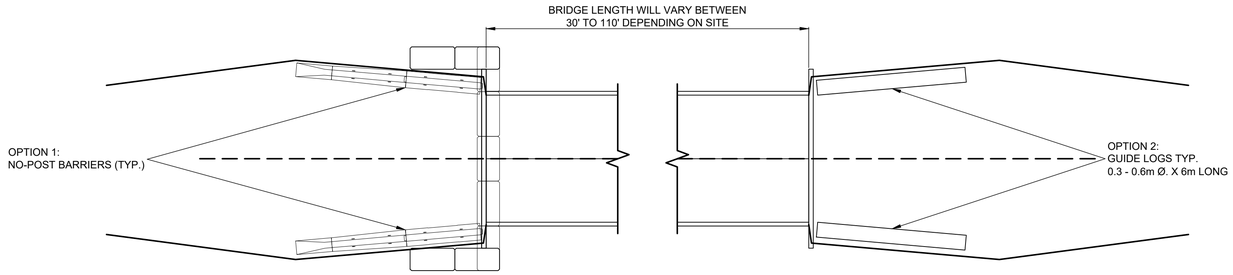
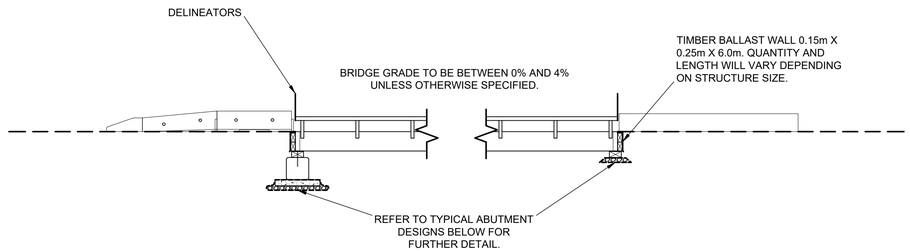




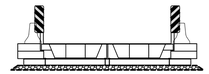
A TOPOGRAPHIC SURVEY IS TO BE COMPLETED FOR EACH SITE TO DETERMINE STRUCTURE LENGTH AND APPROPRIATE ABUTMENTS.

LEGEND	
DESIGNED ROAD EDGES	———
DESIGNED ROAD GRADE	— — —
MIRAFI 7XT GEOGRID (OR APPROVED EQUIVALENT)	— — —
MIRAFI 180N GEOTEXTILE (OR APPROVED EQUIVALENT)	- - - - -

SPECIFICATIONS FOR CONCRETE BLOCKS (INTERLOCKING):

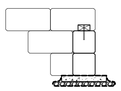
- CONCRETE MUST HAVE A 28 DAY STRENGTH OF 20MPa MINIMUM UNLESS OTHERWISE SPECIFIED.
- BLOCKS SHALL BE CAST MONOLITHICALLY (I.E., NO COLD JOINTS ALLOWED).
- THE FINISH SHALL MEET CLASS 1.
- CLASS 1 - CLASS 1 FINISH IS THE BASIC FINISH TO BE PRODUCED ON ALL FORMED SURFACES NOT EXPOSED TO VIEW UNLESS A BETTER FINISH IS SPECIFIED OR REQUIRED BY THE DRAWINGS OR SPECIAL PROVISIONS.
  - IN ORDER TO PRODUCE A CLASS 1 FINISH, THE FORMWORK SHALL BE MORTAR TIGHT. PANEL MARKS AND TEXTURE ARE OF NO IMPORTANCE.
  - ALL TIES, BOLTS, NAILS AND OTHER METAL SPECIFICALLY REQUIRED FOR CONSTRUCTION PURPOSES SHALL BE REMOVED OR CUT BACK TO A DEPTH OF 50mm FROM THE SURFACES OF THE CONCRETE AND THE RESULTING HOLES FILLED.
  - NO DRY TIES SHALL BE PERMITTED; FORM TIE RODS SHALL REMAIN EMBEDDED AND TERMINATE NOT LESS THAN 50mm FROM THE FORMED FACE OF THE CONCRETE. REMOVABLE EMBEDDED FASTENERS ON THE ENDS OF THE RODS SHALL BE SUCH AS TO LEAVE HOLES OF A REGULAR SHAPE FOR REAMING AND FILLING.
  - HONEYCOMBS AND VOIDS OVER 500mm^2 IN AREA SHALL BE FILLED.
- BLOCK SIZE MUST BE 1500x750x750mm.
- DIMENSIONAL TOLERANCE MUST BE ± 20mm FOR LENGTH, WIDTH AND HEIGHT AND THE BLOCKS SHALL BE REASONABLY SQUARE, WITH THE DIAGONALS WITHIN A TOLERANCE OF ± 15mm OF EACH OTHER.
- TOP AND BOTTOM SURFACES MUST BE FLAT TO A TOLERANCE OF ± 3mm UNDER A 600mm STRAIGHT EDGE.
- CONCRETE SHALL BE AIR ENTRAINED 4-7% TO PROTECT THE SURFACE FROM FREEZE THAW DEGRADATION.
- EACH BLOCK MUST CONTAIN A SATISFACTORY EMBEDDED LIFTING DEVICE.
- EDGES SHALL BE CHAMFERED.

TYPICAL ABUTMENT ELEVATION VIEW -
TIMBER SILL

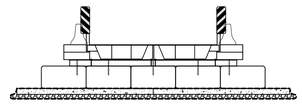


TYPICAL ABUTMENT CROSS SECTION VIEW -
TIMBER SILL

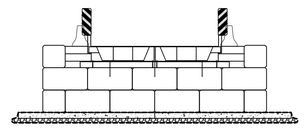
TYPICAL ABUTMENT ELEVATION VIEW -
1 LOCK BLOCK HIGH



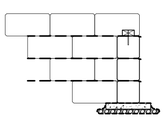
TYPICAL ABUTMENT ELEVATION VIEW -
2 LOCK BLOCK HIGH



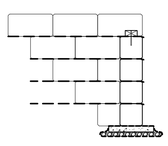
TYPICAL ABUTMENT CROSS SECTION VIEW -
1 LOCK BLOCK HIGH



TYPICAL ABUTMENT CROSS SECTION VIEW -
2 LOCK BLOCK HIGH

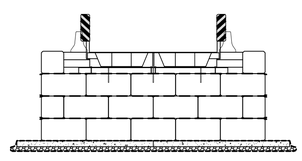


TYPICAL ABUTMENT ELEVATION VIEW -
3 LOCK BLOCK HIGH

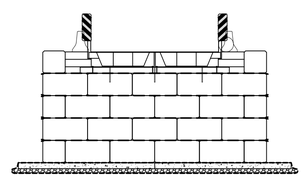


TYPICAL ABUTMENT ELEVATION VIEW -
4 LOCK BLOCK HIGH

GEOGRID TIEBACKS NEEDED ON 3 OR 4 LOCK BLOCK HIGH ABUTMENTS



TYPICAL ABUTMENT CROSS SECTION VIEW -
3 LOCK BLOCK HIGH



TYPICAL ABUTMENT CROSS SECTION VIEW -
4 LOCK BLOCK HIGH

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TYPICAL CROSSING DESIGN SHEET 3 OF 3

CLIENT PROJECT NO.	2006501
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SHEET:	18 OF 18
REV	D

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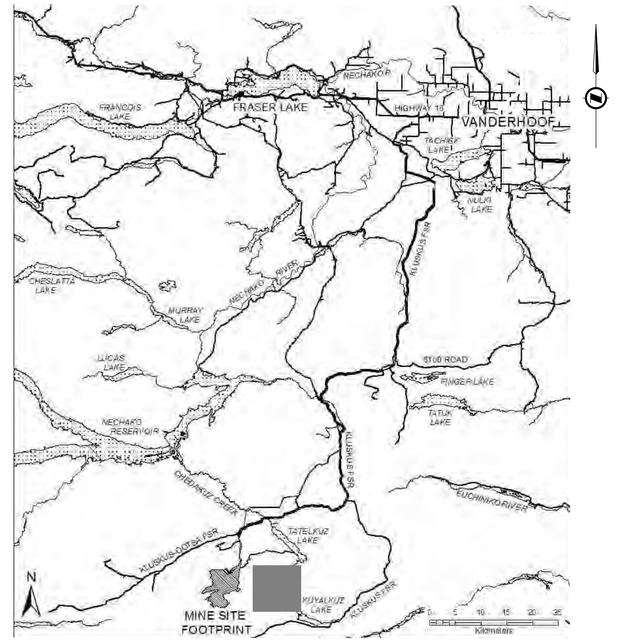
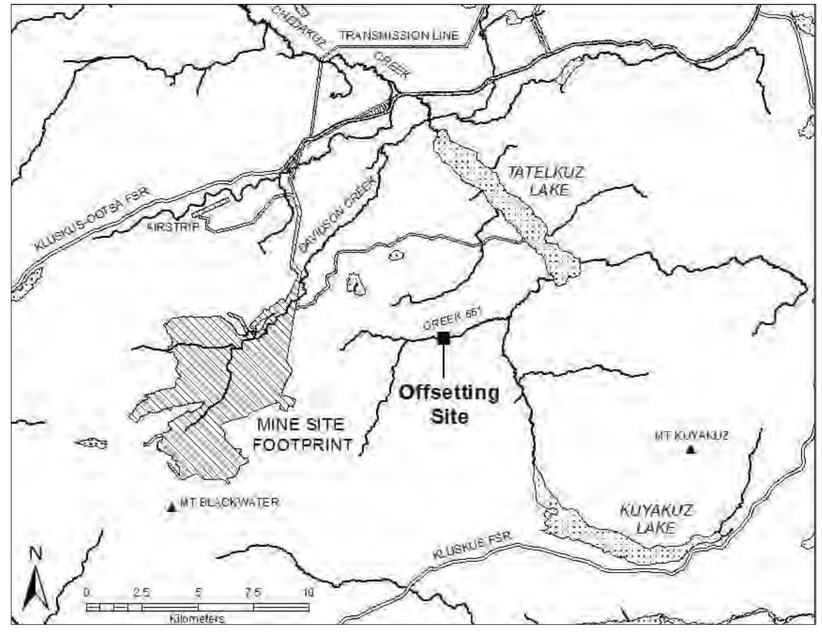
BLACKWATER PROJECT -
SCHEDULE 35 FISHERIES OFFSETTING PLAN
CREEK 661 OVERWINTERING POND

ISSUED FOR PERMIT APPROVAL

	DRAWING INDEX
SHEET No.	SHEET TITLE
1824-4-4-001	TITLE PAGE
1824-4-4-002	GENERAL NOTES
1824-4-4-003	OVERWINTERING POND PLAN
1824-4-4-004	OVERWINTERING POND SECTIONS
1824-4-4-005	OVERWINTERING POND TYPICAL DETAILS
1824-4-4-006	ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR OVERWINTERING POND
1824-4-4-007	SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR OVERWINTERING POND
1824-4-4-008	WORK AREA ISOLATION MEASURES & PLANTING NOTES FOR OVERWINTERING POND



KEY PLAN
NTS



LOCATION PLAN
NTS

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PH.: 604-629-9075

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INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
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www.onsite-engineering.ca

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LAYDOWNS & ACCESS ROADS

- ALL LAYDOWNS AND ACCESS ROADS ARE TEMPORARY IN NATURE AND ARE ONLY REQUIRED FOR THE DURATION OF CHANNEL/POND WORKS. GRASS AND PATHS DISTURBED DURING CONSTRUCTION ARE TO BE RESTORED TO THEIR ORIGINAL CONDITION PRE-CONSTRUCTION TO THE BEST OF THE CHOSEN CONTRACTOR'S ABILITIES AFTER ALL WORKS ARE COMPLETED.
- FINAL LOCATION, SIZE, AND SPECIFICATIONS OF THE PROPOSED LAYDOWN AREA AND ACCESS ROADS ARE TO BE REFINED BY THE SELECTED CONTRACTOR AS REQUIRED. DEPENDING ON CONDITIONS AT THE TIME OF CONSTRUCTION ACCESS MAY BE A VARIETY OF RIG MATS, FROZEN GROUND, OR BUILT UP GRAVEL ACCESS ROADS WITH GEOGRID.
- AVOID DISTURBANCE TO ANY EXISTING HERITAGE FEATURES
- AVOID DISTURBANCE TO ADJACENT PRIVATE PROPERTY

GENERAL STREAM NOTES

- BASED ON THE ONLINE TOOL (https://OWT.BCWATERTOOL.CA) THE WINTERTIME LOW FLOW IS ESTIMATED TO BE 0.1m3/sec WITH A MEAN ANNUAL DISCHARGE OF ~0.3m3/sec
- WATER SURFACE ELEVATIONS IN THE CHANNEL/PONDS WERE ESTIMATED BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND UNMANNED AERIAL VEHICLE (I.E. DRONE) SURVEY, CONDUCTED BY DWB CONSULTING SERVICES LTD
- NOTE THAT THERE IS BEAVER ACTIVITY ALONG CREEK 661. AS SUCH, WATER DEPTHS MAY BE LOCALLY HIGHER THAN EXPECTED BASED SOLETELY ON LOCAL FLOW CONDITIONS.
- NOTE THAT THE GROUNDWATER TABLE IS RELATIVELY HIGH ACROSS THE FLAT VALLEY BOTTOM OF CREEK 661, CONTROLLED IN THE ALLUVIUM COMPRISING THE FLOODPLAIN BY THE WATER SURFACE ELEVATION ALONG THE CHANNEL (WHICH MAY BE LOCALLY AFFECTED BY BEAVER ACTIVITY).

FLOODPLAIN SOILS

- NO DRILLING OR TEST PITTING HAS BEEN COMPLETED TO INVESTIGATE SOILS WITHIN THE VALLEY BOTTOM FLOODPLAIN SEDIMENTS WHERE CHANNEL/POND WORKS ARE PROPOSED.
- OPPORTUNISTIC EXAMINATION OF FLOODPLAIN SOILS IN ERODED CREEK BANKS AND HAND AUGER HOLES (<1.2m DEEP) INDICATES ALLUVIAL SEDIMENTS TYPICAL OF RECURRENT FLOODPLAIN DEPOSITION: FINE SAND AND SILT WITH LOCALIZED GRAVELS AND ORGANICS.

SURVEY NOTES

DATUM: NAD 83 (CSRS) 2002.0

UTM ZONE: 10

SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON BLENDING RESULTS OF LOCAL RTK GPS SURVEY, CONDUCTED ON SEPTEMBER 8, 2016 WITH BROADER, HIGH-RESOLUTION, LIDAR-DERIVED ELEVATION DATA ACQUIRED BY EAGLE MAPPING LTD. ON AUGUST 8-9, 2011. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.

DESIGN TEAM

ENGINEERING - ONSITE ENGINEERING LTD. MICHAEL FOSTER, P.ENG.

GEOMORPHOLOGY/ENVIRONMENTAL/SEDIMENT AND EROSION CONTROL - PALMER ROBIN MCKILLOP, MSc, P.GEO. AND DAN MCPARLAND, MSc, P.GEO.

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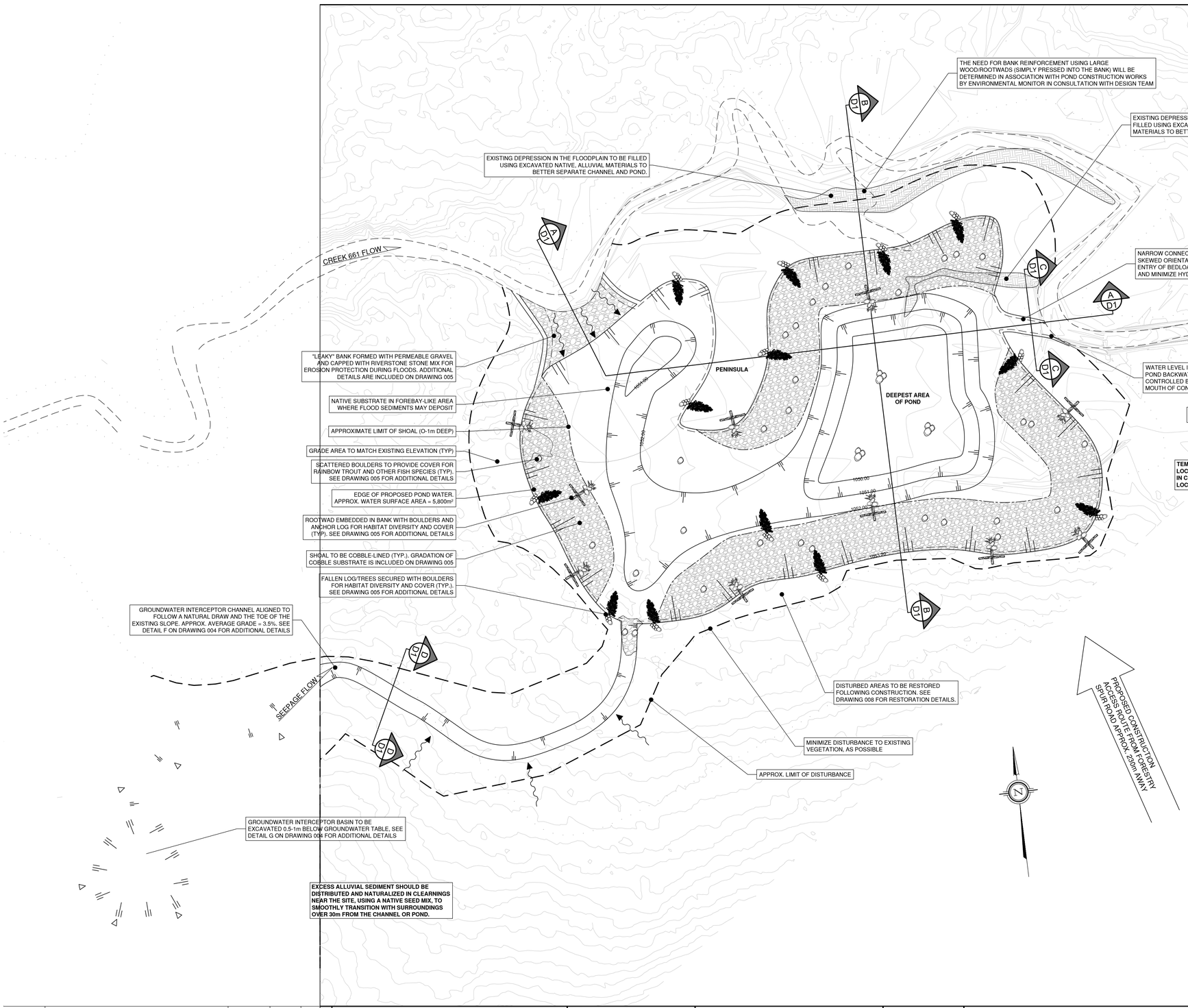

LEGEND

- APPROXIMATE WATERLINE
- EXISTING EDGE OF EXTENSIVE TREES AND SHRUBS
- APPROXIMATE LIMIT OF DISTURBANCE
- APPROXIMATE LIMIT OF PROPOSED SHOAL
- PROPOSED COBBLE
- PROPOSED CONIFEROUS TREE
- PROPOSED ROOTWAD
- PROPOSED BOULDER

DESIGN OBJECTIVES & PURPOSE

OVERWINTERING HABITAT IS A KEY LIMITING FACTOR IN FISHERIES PRODUCTIVITY IN THE WATERSHED. THE PROPOSED OVERWINTERING POND IS SITUATED AT A LOCATION WITH NATURALLY HIGH GROUNDWATER TABLE AND THROUGH-FLOW TO MINIMIZE WINTER ICE COVER THICKNESS AND MAXIMIZE DISSOLVED OXYGEN. DEEP WATER (>2m), COBBLE/BOULDER SUBSTRATES AND OVERHEAD COVER ARE INCORPORATED INTO THE POND DESIGN TO MAXIMIZE THE HABITAT QUALITY. A PROPOSED GROUNDWATER INTERCEPTOR CHANNEL FOLLOWS A NATURAL DRAW IN THE VALLEY SIDE, WHERE GROUNDWATER IS CLOSEST TO THE SURFACE. THE INTERCEPTOR CHANNEL WILL BE EXCAVATED BELOW THE GROUNDWATER TABLE WITH THE AIM OF CONCENTRATING GROUNDWATER DISCHARGE INTO THE POND THROUGHOUT THE YEAR, PARTICULARLY DURING WINTER MONTHS.

NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON BLENDING RESULTS OF LOCAL RTK GPS SURVEY, CONDUCTED ON SEPTEMBER 8, 2016 WITH BROADER, HIGH-RESOLUTION, LIDAR-DERIVED ELEVATION DATA ACQUIRED BY EAGLE MAPPING LTD. ON AUGUST 8-9, 2011. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM PHOTOGRAMMETRY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER.
4. REFER TO DRAWING 004 FOR TYPICAL DETAILS FOR CONNECTOR CHANNEL AND INTERCEPTOR CHANNEL.
5. REFER TO DRAWING 005 FOR TYPICAL DETAILS FOR PROPOSED SALVAGED CONIFEROUS TREE, ROOTWAD, BOULDER, COBBLE GRADATION AND LEAKY BANK.
6. REFER TO DRAWING 006 TO 008 FOR EROSION SEDIMENT CONTROL AND SITE ISOLATION DETAILS.
7. REFER TO DRAWING 008 FOR RIPARIAN RESTORATION AND ENHANCEMENT DETAILS.

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REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	MAR 15, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 1, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 16, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 26, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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SCALE: 1:400 (0, 8, 24m)

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CHECKED:	MF
SURVEYED:	-
DATE:	JUNE 2022

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VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

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INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
PH.: 250-833-5643 FAX: 866-235-6943
www.onsite-engineering.ca

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
CREEK 661 OVERWINTERING POND
OVERWINTERING POND PLAN

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-4
DRAWING NO. 003
SHEET: 3 OF 10
REV E

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DATE: 10/03/2021 9:51 PM BY: Jesse Lutz

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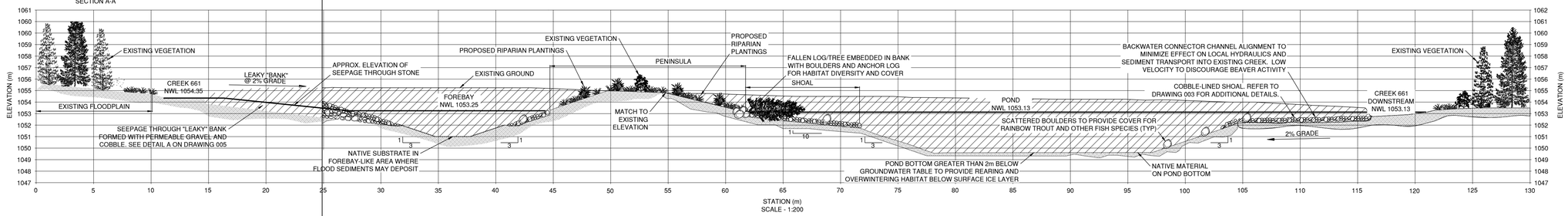
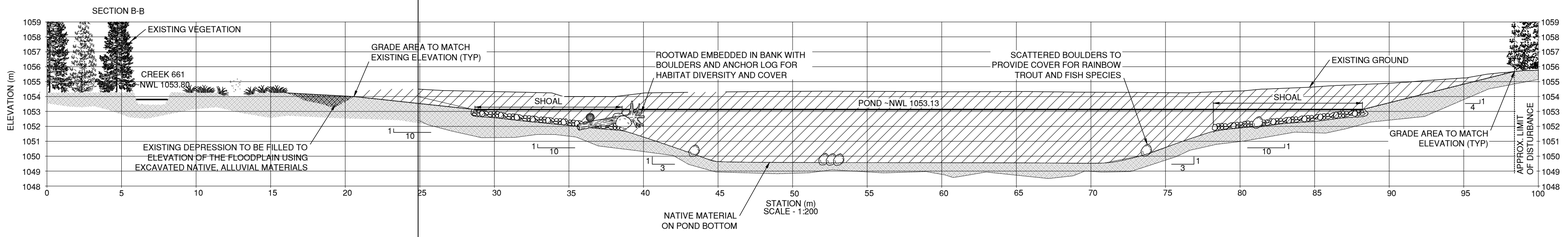
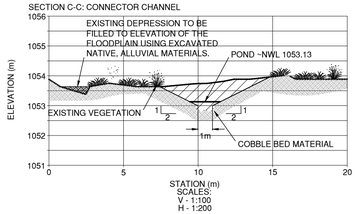
SECTION A-A



SECTION B-B

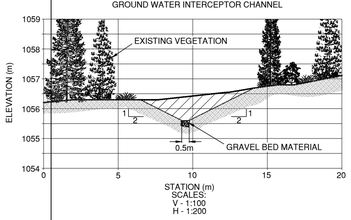


SECTION C-C: CONNECTOR CHANNEL

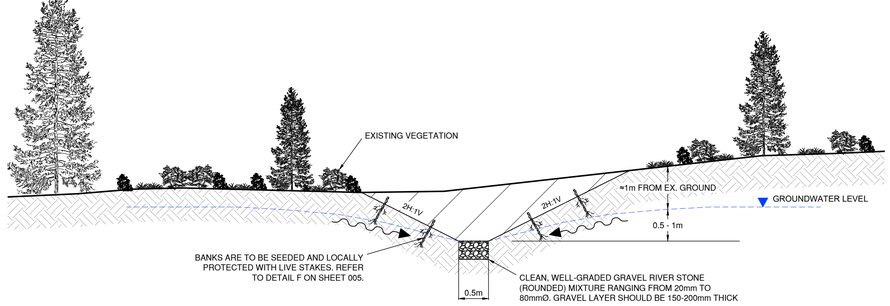


REFER TO DRAWING 005 FOR ADDITIONAL CONNECTOR CHANNEL DETAILS.

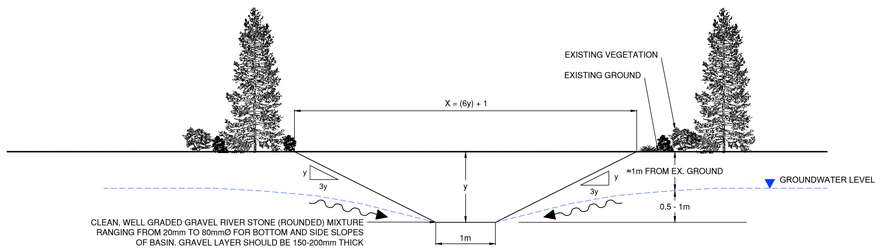
SECTION D-D:
GROUND WATER INTERCEPTOR CHANNEL



REFER TO DETAILS 1 AND 2 ON THIS SHEET FOR ADDITIONAL GROUNDWATER INTERCEPTOR AND CHANNEL DETAILS.



DETAIL 1 - GROUNDWATER INTERCEPTOR CHANNEL
SECTION VIEW
NO SCALE



DETAIL 2 - GROUNDWATER INTERCEPTOR BASIN
SECTION VIEW
NO SCALE

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DATE: JUNE 2022

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
CREEK 661 OVERWINTERING POND
OVERWINTERING POND SECTIONS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-4
DRAWING NO. 004
SHEET: 4 OF 10
REV E

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DATE: 10/03/2021 9:51 PM BY: Jesse Lutz

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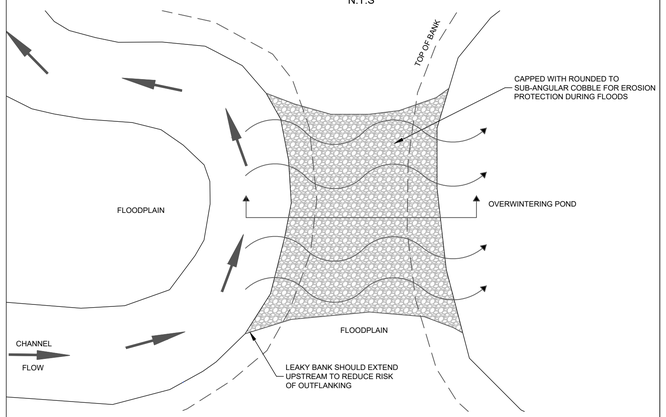
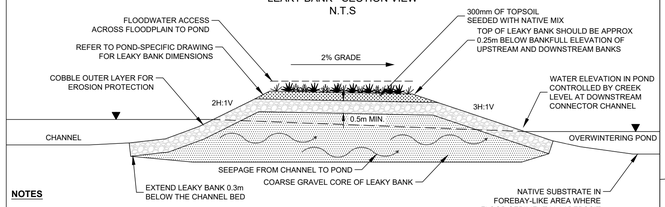
DETAIL A
LEAKY BANK - PLAN VIEW
N.T.S



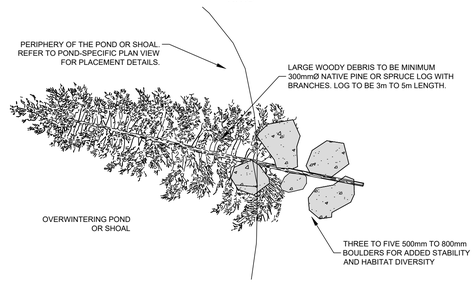
LEAKY BANK - SECTION VIEW
N.T.S



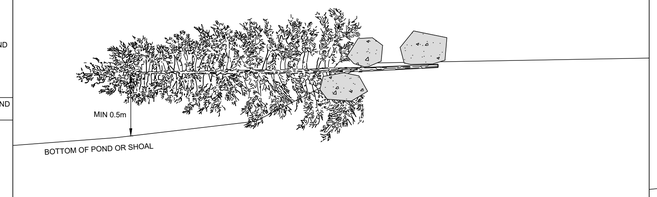
NOTES

1. COBBLE OUTER LAYER - GRADATION SHOULD BE WELL-GRADED AND ADHERE TO BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE CLASS 25kg (MEDIAN GRAIN SIZE OF 260mm, MAXIMUM GRAIN SIZE OF 450mm). THE LAYER SHOULD BE 0.5m THICK, AT MINIMUM.
2. GRAVEL CORE - WELL-GRADED MIXTURE RANGING FROM 20mm TO 80mm.

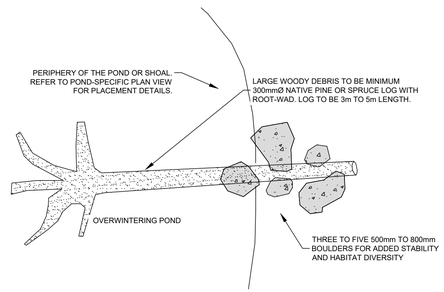
DETAIL B
CONIFEROUS TREE PLACEMENT - PLAN VIEW
N.T.S



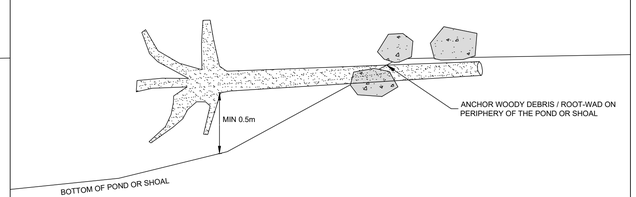
CONIFEROUS TREE PLACEMENT - SECTION VIEW
N.T.S



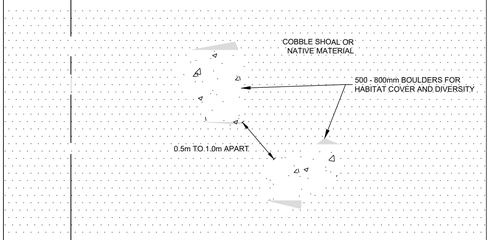
DETAIL C
ROOT-WAD PLACEMENT - PLAN VIEW
N.T.S



ROOT-WAD PLACEMENT - SECTION VIEW
N.T.S

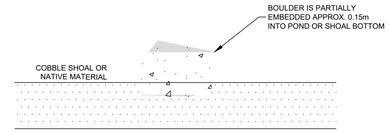


DETAIL D
BOULDER PLACEMENT - PLAN VIEW
N.T.S

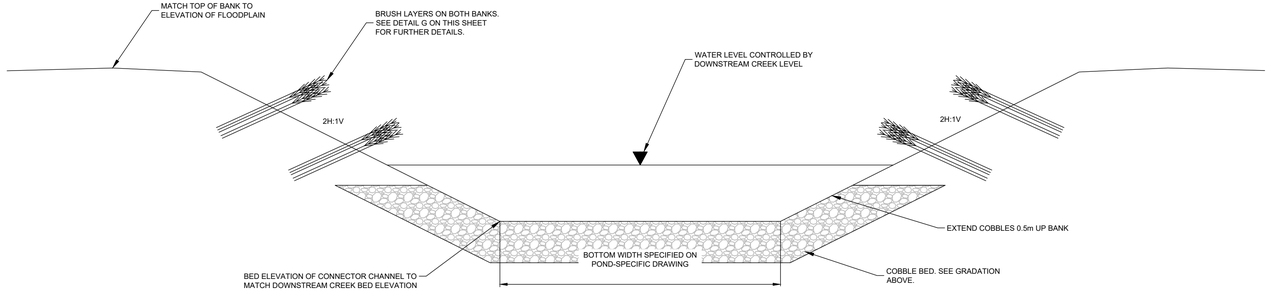


REFER TO POND-SPECIFIC PLAN VIEW DRAWING FOR NUMBER OF BOULDERS TO BE PLACED AT A GIVEN LOCATION

BOULDER PLACEMENT - SECTION VIEW
N.T.S



DETAIL E
CONNECTOR CHANNEL - SECTION VIEW
N.T.S



OVERWINTERING POND - GRADATION FOR SHOAL AND CONNECTOR CHANNEL

%PASSING BY NOMINAL DIAMETER
20% 200-250mm
30% 100-200mm
30% 50-100mm
20% 10-50mm

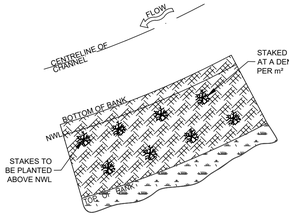
THICKNESS: 250mm

MATERIALS SHOULD BE ROUNDED TO SUB-ANGULAR.

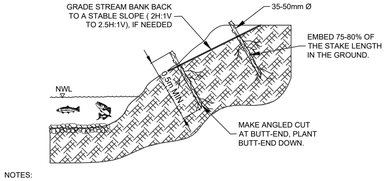
GRAVEL TO BE CLEANED PRIOR TO PLACEMENT, THEN CAREFULLY DISTRIBUTED ACROSS CHANNEL BED, UNDER THE GUIDANCE OF ON-SITE INSPECTOR.

DETAIL F
BANK TREATMENT: LIVE STAKES (LS)
N.T.S.

PLAN VIEW



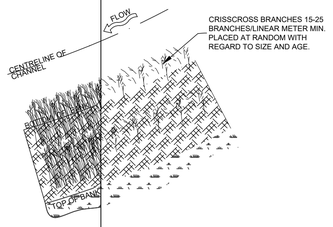
SECTION VIEW



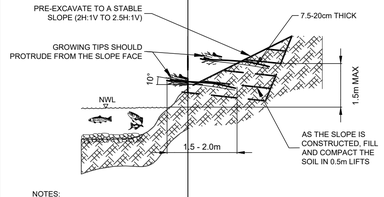
NOTES:
1. LIVE STAKINGS TO BE: -DORMANT LIVE STAKE CUTTING, (LIVE DOGWOOD AND WILLOW) -35-50mm DIA., WITH ANGLE CUT BASE, AND BLUNT CUT TOP. STAKE LENGTH TO BE 600-800mm.
2. TAMP ANGLE CUT BASE INTO SOIL AT RIGHT ANGLE TO SLOPE. ENSURE 75-80% OF LENGTH OF CUTTING IS EMBEDDED INTO SOIL. -TAMP TOPSOIL FIRMLY AROUND BASE.
3. SOAK LIVE STAKES FOR MINIMUM OF 24 HOURS PRIOR TO INSTALLATION.

DETAIL G
BANK TREATMENT: BRUSH LAYERS (BL)
N.T.S.

PLAN VIEW



SECTION VIEW



NOTES:
1. COVER BRUSHLAYER IMMEDIATELY WITH 0.15m (6") OF FILL SOIL, WATER AND COMPACT USING A VIBRATORY TAMPER.
2. BRUSH LAYERS WILL BE NATIVE WILLOW AND DOGWOOD SPECIES.
3. THE NUMBER OF LAYERS (I.E. LIFTS) WILL BE CONFIRMED BY THE INSPECTOR IN THE FIELD. IN GENERAL, BANKS <1m HIGH REQUIRE ONE LAYER, BANKS 1m TO 2m HIGH REQUIRE TWO LAYERS, AND BANKS >2m REQUIRE THREE LAYERS.

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SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN

CREEK 661 OVERWINTERING POND

OVERWINTERING POND TYPICAL DETAILS

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-4
DRAWING NO.	005
SHEET:	5 OF 8
REV	E

U:\Projects\1824\4\04- Creek 661 OWP\AutoCAD\1824-4-4- ESC Plans - POND WORK ONLY.dwg
DATE: 2021/12/2020 5:12 PM BY: Jesse Lutz

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OVERWINTERING PONDS - EROSION & SEDIMENT CONTROL AND WORK AREA ISOLATION - NOTES:

INTRODUCTORY STATEMENT

- THE EROSION & SEDIMENT CONTROL PLAN HAS BEEN DEVELOPED TO ENSURE ESTABLISHMENT AND MAINTENANCE OF ALL NECESSARY ENVIRONMENTAL PROTECTION MEASURES BEFORE, DURING AND AFTER EXCAVATION AND NATURALIZATION OF THE OVERWINTERING PONDS. IT ALSO ALLOWS THE CONTRACTOR, OVERSEEN BY AN ENVIRONMENTAL INSPECTOR, THE FLEXIBILITY TO OPTIMIZE THE MEASURES FOR THE MOST EFFECTIVE SEQUENCE AND APPROACH FOR IMPLEMENTATION, RATHER THAN PRESCRIBING EXACTLY WHERE AND WHEN DIFFERENT MEASURES ARE TO BE USED. TYPICAL LAYOUTS FOR ENVIRONMENTAL PROTECTION AND WORK-AREA SITE ISOLATION ARE PROVIDED TO MAKE CLEAR WHAT OPTIONS ARE AVAILABLE TO THE CONTRACTOR. THE PONDS WILL BE EXCAVATED AND NATURALIZED IN COMPLETE ISOLATION FROM THE ADJACENT CHANNEL AND ONLY CONNECTED AT THE VERY END, IN A GRADUAL AND CONTROLLED MANNER, TO MINIMIZE POTENTIAL FOR SUSPENSION AND OUTFLOW OF SETTLED SEDIMENT. AN ENVIRONMENTAL INSPECTOR FAMILIAR WITH THE EROSION & SEDIMENT CONTROL PLAN WILL BE AVAILABLE ON SITE TO ANSWER QUESTIONS AND PROVIDE GUIDANCE TO THE CONTRACTOR.
- EXCAVATION AND NATURALIZATION OF OVERWINTERING PONDS TO BE COMPLETED IN WINTER, WHEN GROUNDWATER LEVELS ARE RELATIVELY LOW AND ALLUVIAL FLOODPLAIN SOILS ARE FROZEN AND AT LEAST PARTLY SNOW-COVERED AT SURFACE, TO OPTIMIZE EARTHWORKS AND SEDIMENT MANAGEMENT.

SECTION 1: SITE MANAGEMENT

1. EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING THE CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER. ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED AND / OR REPLACED WITHIN 48 HOURS OF INSPECTION.
2. DISTURBED AREAS WILL BE MINIMIZED TO THE EXTENT POSSIBLE, AND TEMPORARILY OR PERMANENTLY STABILIZED OR RESTORED AS THE WORK PROGRESSES.
3. ALL IN-WATER AND NEAR WATER EARTHWORKS WILL BE CONDUCTED IN THE DRY AND / OR WITHIN AN ISOLATED WORK AREA WITH APPROPRIATE EROSION AND SEDIMENT CONTROLS. SPECIFIED PLACEMENTS OF BOULDERS, GRAVEL, AND LARGE WOOD MAY BE IN / NEAR WATER WITHOUT COMPLETE ISOLATION IF NOT ASSOCIATED WITH EARTHWORK.
4. THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED / AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREAS. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF DELETERIOUS SUBSTANCE, INCLUDING SEDIMENT, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY.
5. AN ENVIRONMENTAL MONITOR WILL ATTEND THE SITE TO INSPECT ALL NEW CONTROLS, AS WELL AS ON A REGULAR BASIS, OR FOLLOWING RAIN / SNOW MELT EVENTS, TO MONITOR ALL WORKS, AND IN PARTICULAR WORKS RELATED TO EROSION AND SEDIMENT CONTROLS, DE-WATERING, RESTORATION, AND IN / NEAR-WATER WORKS. SHOULD CONCERNS ARISE ON SITE, THE ENVIRONMENTAL MONITOR WILL CONTACT THE APPROPRIATE REGULATORY OFFICER AS WELL AS THE PROPONENT.
6. ALL ACTIVITIES, INCLUDING MAINTENANCE PROCEDURES, WILL BE CONTROLLED TO PREVENT THE ENTRY OF PETROLEUM PRODUCTS, DEBRIS, RUBBLE, CONCRETE, OR OTHER DELETERIOUS SUBSTANCES INTO THE WATER. VEHICULAR REFUELING AND MAINTENANCE WILL BE CONDUCTED A MINIMUM OF 30 METERS FROM THE WATER.
7. THE PROPONENT / CONTRACTOR SHALL MONITOR THE WEATHER FOR THE DURATION OF CONSTRUCTION TO ENSURE THAT THE WORKS WILL BE CONDUCTED DURING FAVORABLE WEATHER CONDITIONS. SHOULD AN UNEXPECTED STORM OR SNOWMELT ARISE, THE CONTRACTOR WILL REMOVE ALL UNFIXED ITEMS FROM THE CHANNEL, POND, AND FLOOD PLAIN THAT WOULD HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW, E.G., FUEL TANKS, PORTA-POTTIES, MACHINERY, EQUIPMENT, CONSTRUCTION MATERIALS, ETC.
8. ALL DE-WATERING SHALL BE TREATED AND RELEASED TO THE ENVIRONMENT AT LEAST 15 METERS FROM A WATERCOURSE OR POND AND ALLOWED TO DRAIN THROUGH A FILTER BAG AND WELL-VEGETATED AREA. NO DE-WATERING EFFLUENT SHALL BE SENT DIRECTLY TO ANY WATERCOURSE, POND, FOREST, OR ALLOWED TO DRAIN ONTO DISTURBED SOILS WITHIN THE WORK AREA. THESE CONTROL MEASURES SHALL BE MONITORED FOR EFFECTIVENESS AND MAINTAINED OR REVISED TO MEET THE OBJECTIVE OF PREVENTING THE RELEASE OF SEDIMENT-LADEN WATER.
9. ALL ACCESS TO THE POND WORK AREA SHALL BE FROM THE EAST END OF THE VALLEY. NO EQUIPMENT OR VEHICLES ARE PERMITTED TO CROSS THROUGH THE WATERCOURSE.
10. THE CONTRACTOR SHALL INSTALL FIBRE ROLLS AND / OR SEDIMENT CONTROL FENCING AS REQUIRED TO CONTROL THE DISCHARGE OF EXPOSED SOIL OR TEMPORARY PILE(S) OF EXCAVATED SOILS OR, SOILS AND GRANULAR MATERIAL TO BE USED DURING CONSTRUCTION.
11. ESC MEASURES ARE TO REMAIN IN PLACE AND IN WORKING ORDER UNTIL ALL ON-SITE CONSTRUCTION IS COMPLETED.
12. AREAS WHICH REMAIN DISTURBED FOR MORE THAN 30 DAYS SHALL BE STABILIZED USING SEED, APPROVED EROSION CONTROL BLANKETS, OR SIMILAR APPROVED EQUIVALENT. IF CONDITIONS ARENT SUITABLE FOR SEED APPLICATION, AN EROSION CONTROL BLANKET WILL BE USED IN ITS PLACE. SEE EROSION CONTROL BLANKET TYPICAL DETAIL ON SHEET 007.
13. NO EROSION AND SEDIMENT CONTROL MEASURE SHALL CONTAIN ANY PLASTIC, EVEN IF IT IS BIODEGRADABLE.
14. THE CONTRACTOR MUST HAVE SUITABLE PUMPING CAPABILITIES ON SITE AT ALL TIMES TO FACILITATE CONSTRUCTION ACTIVITIES IN THE DRY.
15. WORKS SHOULD BE COMPLETED IN STAGES TO REDUCE THE DURATION OF DISTURBED AREAS.
16. CONTRACTOR IS NOT TO DISPOSE OF ANY OF THE MATERIAL USED IN THE PEA GRAVEL METER BAGS INTO THE CHANNEL, POND, OR SURROUNDING AREA. ALL PEA GRAVEL BAGS ARE TO BE REMOVED OFF OF SITE.
17. TEMPORARY STAGING AREAS ARE TO BE SITUATED MORE THAN 15 METERS FROM THE WATERCOURSE OR POND. ALL MAJOR OVERNIGHT STAGING / STOCKPILING AREAS WILL BE A MINIMUM OF 15 METERS AWAY FROM THE WATERCOURSE OR POND. CONTRACTOR TO MONITOR WEATHER FORECASTS TO ENSURE MACHINES AND MATERIALS ARE REMOVED WHEN THE INCLEMENT WEATHER IS ANTICIPATED. STOCKPILE HEIGHTS WILL BE KEPT BELOW 1.5 METERS IN HEIGHT.
18. TEMPORARY STOCKPILES OF EXCAVATED ALLUVIAL SEDIMENT ARE TO BE KEPT AS SMALL AS POSSIBLE (<1.5 METER HEIGHT) BY ENSURING REDISTRIBUTION OF MATERIAL AROUND FORMER HOMESTEAD, OR OFFSITE HAULAGE. KEEPS PACE WITH EXCAVATION.
19. ALLUVIAL SEDIMENTS EXCAVATED FROM POND LIMITS TO BE STORED OUTSIDE OF THE 15m RIPARIAN BUFFER AND/OR INCORPORATED INTO THE HABITAT ENHANCEMENT (E.G., GRAVELS AND COBBLES, IF PRESENT, WILL BE USED ALONG SHOAL HABITAT).

SECTION 2: CONSTRUCTION TIMING

20. EXCAVATION AND NATURALIZATION OF OVERWINTERING PONDS TO BE COMPLETED IN WINTER, WHEN GROUNDWATER LEVELS ARE RELATIVELY LOW AND ALLUVIAL FLOODPLAIN SOILS ARE FROZEN AND AT LEAST PARTLY SNOW-COVERED AT SURFACE, TO OPTIMIZE EARTHWORKS AND SEDIMENT MANAGEMENT.
21. TO PROTECT LOCAL FISH POPULATIONS DURING THEIR SPAWNING, NURSERY AND MIGRATORY PERIODS, IN-WATER ACTIVITIES SHOULD OCCUR DURING THE TIME PERIOD OF JULY 15 TO AUGUST 31, IN ACCORDANCE WITH THE OMINECA REGION LEAST-RISK TIMING WINDOW FOR RAINBOW TROUT AND KOKANEE. THIS TIMING WINDOW IS SUBJECT TO CONFIRMATION FROM PROVINCIAL REGULATORS. CHANNEL WORKS ARE BEST COMPLETED IN LATE SUMMER, WHEN FLOWS ARE LOW AND THERE IS NO ICE. EXCAVATION AND NATURALIZATION OF OVERWINTERING PONDS IS BEST COMPLETED IN WINTER WHEN THE GROUND SURFACE IS FROZEN AND THE GROUNDWATER LEVEL IN THE ALLUVIAL FLOODPLAIN SOILS IS LOW.

SECTION 3: FISH RELOCATION

22. FISH STRANDED WITHIN THE WORK AREA SHALL BE CAPTURED AND RELEASED LIVE IN SUITABLE HABITAT DOWNSTREAM OF THE WORK AREA UNDER THE SUPERVISION OF A QUALIFIED AQUATIC BIOLOGIST. A PERMIT FROM MOFLNRORD IS REQUIRED.

GENERAL STAGING PLAN FOR OVERWINTERING POND CONSTRUCTION (INCLUDING GROUNDWATER INTERCEPTOR CHANNEL/BASIN) AND CONNECTION TO ADJACENT CREEK:

EXCAVATION AND NATURALIZATION OF POND (INCLUDING GROUNDWATER CONNECTOR CHANNEL/BASIN)

1. INSTALL FIBRE ROLLS ALONG ACCESS ROAD WHEN IT IS WITHIN 15m OF THE WATERCOURSE. ENSURE ENDS OF FIBRE ROLLS ARE POSITIONED TO TIE-IN WITH EDGES OF COFFER DAMS.
2. LAY DOWN RIG MATS ALONG ANY PORTIONS OF THE FLOODPLAIN ACCESS ROUTE WHERE THE SOILS ARE OBSERVED OR EXPECTED TO BE SOFT / WEAK, PRIOR TO EQUIPMENT ACCESS.
3. INSTALL FIBRE ROLLS AROUND PERIMETER OF TEMPORARY STOCKPILE AREA TO FULLY ISOLATE IT FROM SURROUNDINGS.
4. INSTALL FIBRE ROLLS AROUND PERIMETER OF OVERWINTERING POND EXCAVATION LIMITS TO FULLY ISOLATE EXCAVATION AND NATURALIZATION AREA FROM SURROUNDINGS.
5. STRIP AND SALVAGE TOPSOIL WITHIN LIMITS OF EXCAVATION AREA FOR LATER USE IN ASSOCIATION WITH RESTORATION/SEEDING OF DISTURBED AREAS.
6. BEGIN EXCAVATION FROM SECTION OF POND SHORELINE FARTHEST FROM ACCESS ROUTE, ACCORDING TO TYPICAL LAYOUT DETAILS ON THIS SHEET, WITH EQUIPMENT FULLY INSIDE THE POND LIMITS AND AT NO TIME POSITIONED OUTSIDE THE POND LIMITS.
7. INSTALL DE-WATERING PUMP, HOSE AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DRAW DOWN WATER WITHIN CURRENT WORK AREA TO THE EXTENT NECESSARY. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
8. PROCEED WITH EXCAVATION IN A DELIBERATE AND SYSTEMATIC MANNER, PROGRESSIVELY DEEPER AND TOWARD ACCESS, SUCH THAT LITTLE TO NO MOVEMENT OF EQUIPMENT IS REQUIRED ON CUT BENCHES/SLOPES AND ALL MATERIAL HANDLING IS CONCENTRATED IN ONE AREA AROUND ACCESS ROUTE. DE-WATERING SYSTEM TO BE MOVED, AS NEEDED, DURING PROGRESSIVE EXCAVATION.
9. INSTALL WOOD AND BOULDER HABITAT FEATURES, ACCORDING TO TYPICAL DETAILS ON SHEETS, 005, AND DESIGN DETAILS ON SHEETS 003 AND 004, PREFERABLY AS EXCAVATION PROCEEDS AS OPPOSED TO AFTER FULL COMPLETION OF EXCAVATION.
10. REMOVE ANY RIG MATS THAT WERE USED WITHIN THE POND LIMITS AND RE-USE ELSEWHERE OR TRANSPORT OFF-SITE.

CONSTRUCTION OF "LEAKY BANK":

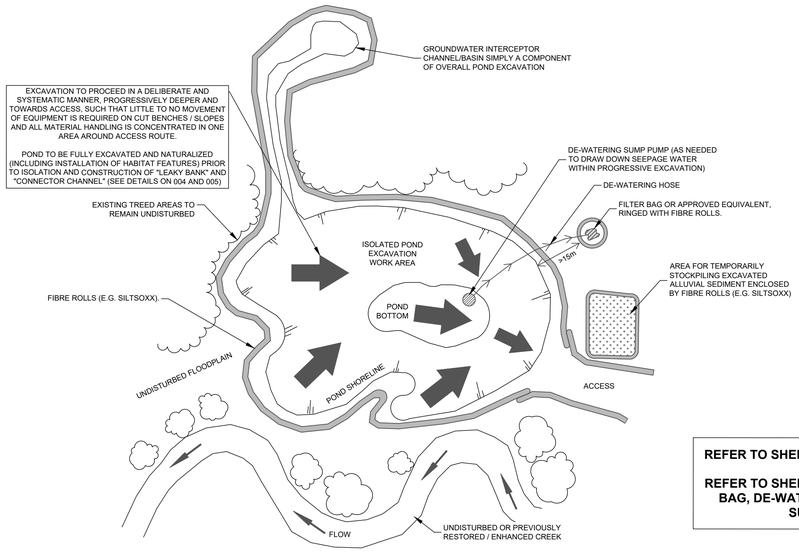
1. INSTALL COFFER DAMS AT EDGES OF CHANNEL AND POND IN A CONTROLLED MANNER TO REDUCE DISTURBANCE TO BED/BANKS AND RELEASE OF SEDIMENTS INTO WATER. ENSURE ENDS OF FIBRE ROLLS ON FLOODPLAIN MEET EDGES OF COFFER DAM AT BANK.
2. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
3. INSTALL DE-WATERING PUMP, HOSE AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE OR POND, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
4. PROGRESSIVELY EXCAVATE THE FLOODPLAIN TO THE SPECIFIED WIDTH AND DEPTH SLIGHTLY BELOW THE CHANNEL BED, BEGINNING AT THE POND SHORELINE AND MOVING TOWARD THE CHANNEL. CAREFULLY PLACE THE GRAVEL-COBBLE MIXTURE TO FORM THE CORE OF THE 'LEAKY BANK'. SEE THIS SHEET AND SHEET 005 FOR DETAILS.
5. COVER THE 'LEAKY BANK' WITH COBBLE GRADATION SPECIFIED ON SHEET 005, ENSURING THE CORRECT CREST ELEVATION.
6. CAP THE 'LEAKY BANK' WITH 300mm OF TOPSOIL AND NATIVE SEED MIX AS PER DETAILS ON SHEET 005.
7. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO INTRODUCE FLOW GRADUALLY BACK INTO THE BANK AREA. SEEPAGE WILL BEGIN TO MOVE THROUGH THE 'LEAKY BANK' INTO THE ISOLATED POND.
8. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING TO THE NEXT WORK AREA.

CONSTRUCTION OF "CONNECTOR CHANNEL":

1. INSTALL COFFER DAMS AT EDGES OF CHANNEL AND POND IN A CONTROLLED MANNER TO REDUCE DISTURBANCE TO BED/BANKS AND RELEASE OF SEDIMENTS INTO WATER. ENSURE ENDS OF FIBRE ROLLS ON FLOODPLAIN MEET EDGES OF COFFER DAM AT BANK.
2. ALLOW A QUALIFIED PROFESSIONAL TO CONDUCT FISH RESCUE AND SALVAGE, AS PER PERMIT CONDITIONS, AND LIVE RELEASE ANY FISH FROM THE ISOLATED AREA INTO THE DOWNSTREAM CHANNEL.
3. INSTALL DE-WATERING PUMP, HOSE AND DOWNSTREAM FIBRE ROLL-RINGED FILTER BAG TO DE-WATER CURRENT WORK AREA. THE FILTER BAG MUST BE MORE THAN 15m FROM THE WATERCOURSE OR POND, ON VEGETATED GROUND, AND SHOULD MINIMIZE DISTURBANCE, RILLING AND EROSION.
4. PROGRESSIVELY EXCAVATE THE FLOODPLAIN TO THE SPECIFIED WIDTH AND DEPTH, BEGINNING AT THE POND SHORELINE AND MOVING TOWARD THE CHANNEL.
5. INSTALL THE BRUSH LAYERS IN LIFTS, AS PER DESIGN DETAILS ON SHEET 005. CAREFULLY PLACE THE GRAVEL SUBSTRATE ALONG THE BOTTOM OF THE CONNECTOR CHANNEL. SEE SHEETS 004 FOR DETAILS.
6. REMOVE THE DE-WATERING PUMP AND ASSOCIATED EQUIPMENT, THEN SLOWLY REMOVE THE TEMPORARY COFFER DAMS TO GRADUALLY CONNECT MAIN CREEK TO POND AND ALLOW THROUGH-FLOW.
7. RECONFIGURE THE POSITIONS AND EXTENTS OF THE FIBRE ROLLS AND RIG MATS, AS NECESSARY, TO RE-ESTABLISH ENVIRONMENTAL PROTECTION MEASURES PRIOR TO MOVING TO THE NEXT WORK AREA.

WORK AREA ISOLATION NOTES

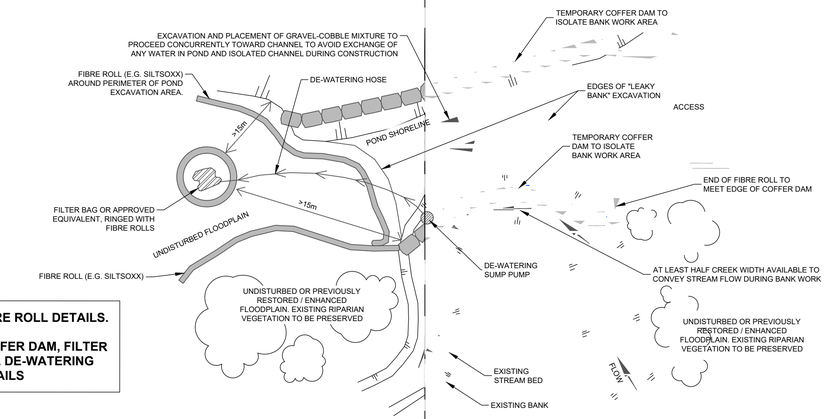
- INSTALL COFFER DAM WITH IMPERVIOUS LINER AGAINST BANKS AND ALONG CHANNEL BED, IN APPROXIMATE CRESCENT SHAPE, TO FULLY ISOLATE BANK WORK AREA.
- WATER COLLECTED WITHIN THE ISOLATED WORK AREA TO BE PUMPED OUTSIDE THE IMMEDIATE WORK AREA, DISCHARGED THROUGH A FILTER BAG LOCATED WITHIN A VEGETATED PORTION OF THE FLOODPLAIN AS REMOTE FROM THE WATERCOURSE AND POND AS POSSIBLE (MIN. >15m) TO PREVENT WATER FROM FLOWING BACK INTO THE WORK AREA.
- AT THE END OF THE DAY THE WATERCOURSE MUST BE STABILIZED AND FREE FLOWING OR PUMPING MUST BE SUPERVISED.
- IN GENERAL, ALL IN-STREAM CONSTRUCTION TO BE COMPLETED IN THE DRY, OR AT LEAST FOLLOWING FULL ISOLATION OF THE WORK AREA. FISH EVACUATION PLAN MUST BE SUBMITTED AND APPROVED BY MOFLNRORD PRIOR TO COMMENCEMENT OF THE PROJECT. FISH RESCUE SHALL BE CONDUCTED FROM ISOLATED WORK AREAS BY A QUALIFIED INDIVIDUAL WITH A VALID PERMIT IN ACCORDANCE WITH THE BRITISH COLUMBIA STANDARDS AND BEST PRACTICES FOR IN-STREAM WORKS.



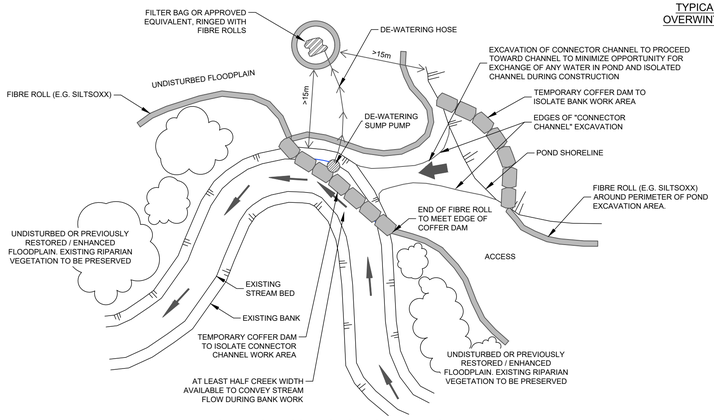
TYPICAL LAYOUT: ISOLATION AND PROGRESSIVE EXCAVATION OF OVERWINTERING POND
N.T.S

REFER TO SHEET 007 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 008 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS



TYPICAL LAYOUT: ISOLATION OF WORK AREA FOR OVERWINTERING POND "LEAKY BANK" CONSTRUCTION
N.T.S



TYPICAL LAYOUT: ISOLATION OF WORK AREA FOR OVERWINTERING POND "CONNECTOR CHANNEL" CONSTRUCTION
N.T.S

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REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	MAR 15, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 1, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 16, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 26, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

ONSITE Engineering Ltd.
INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN

CREEK 661 OVERWINTERING POND

ESC GENERAL NOTES & WORK AREA ISOLATION LAYOUT FOR OVERWINTERING POND

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-4
DRAWING NO. 006
SHEET: 6 OF 8
REV E

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DATE: 25/11/2020 5:12 PM BY: Jesse Luz

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SEDIMENT CONTROL BARRIERS

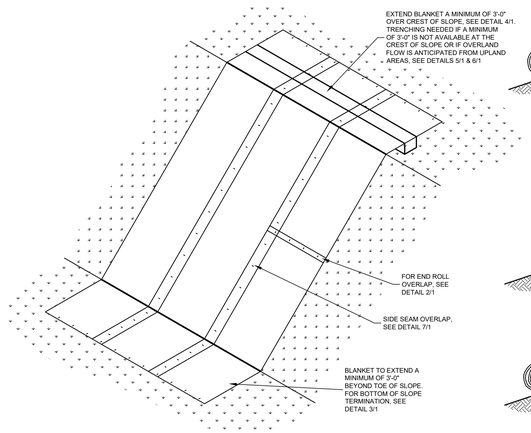
OPTION 1 - FIBRE ROLL

- FIBRE ROLL (E.G FILTREXX SILTSOXX OR APPROVED EQUIVALENT), FILLED WITH WOOD CHIPS, ARE THE PREFERRED TYPE OF SEDIMENT CONTROL BARRIER.
- MIN. DIAMETER = 300mm
- FIBRE ROLLS TO BE REGULARLY INSPECTED FOR TEARS OR HOLES, AND REPAIRED / REPLACED AS NEEDED TO MAINTAIN FUNCTION.
- FIBRE ROLLS MAY BE RE-USED IN A DIFFERENT LOCATION, ONLY IF THEY REMAIN FREE OF TEARS / HOLES, HAVE NOT LOST ANY OF THEIR CONTENTS, AND STILL MAINTAIN THE MINIMUM DIAMETER.
- REMOVE ALL SURFACE OBSTRUCTIONS GREATER THAN 50mm FROM THE GROUND PRIOR TO PLACING FIBRE ROLLS.
- TYPICAL FIBRE ROLL INSTALLATION DETAILS ARE SHOWN ON THIS SHEET FOR A FILTREXX SILTSOXX FIBRE ROLL. THE CONTRACTOR MAY USE THIS BRAND OF FIBRE ROLL OR AN APPROVED EQUIVALENT.

OPTION 2 - SEDIMENT CONTROL FENCE

- SEDIMENT CONTROL FENCE SUPPLIES SHOULD BE AVAILABLE ON SITE FOR USE IN CASES WHERE SURFACE PONDING OCCURS AND ADDITIONAL SILTATION CONTROL IS WARRANTED BEYOND WHAT THE FIBRE ROLLS CAN PROVIDE.
- GEOTEXTILE TO BE NON-WOVEN WITH A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
- NON-WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1 METER AT JOINTS.
- TYPICAL SEDIMENT CONTROL FENCE INSTALLATION DETAILS ARE SHOWN ON THIS SHEET. THESE DETAILS REPRESENT IDEAL SCENARIOS. ACTUAL SITE CONDITIONS MAY VARY AND SEDIMENT CONTROL FENCE INSTALLATION SHOULD BE TAILORED FOR EACH SITE.

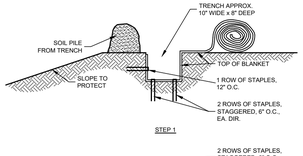
EROSION CONTROL BLANKET - TYPICAL DETAILS



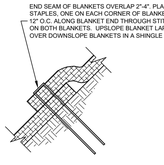
SLOPE DETAIL
NO SCALE — 1/1

OVER SLOPE CREST METHOD
NO SCALE — 4/1

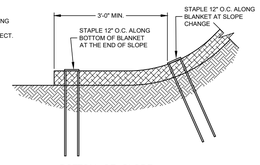
DO NOT NEED TO TRENCH BLANKET IN IF IT CAN BE EXTENDED A MINIMUM OF 3'-0" OVER THE CREST OF THE SLOPE.



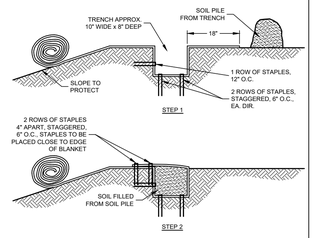
SLOPE TRENCHING METHOD "A"
NO SCALE — 5/1



END ROLL OVERLAP
NO SCALE — 2/1



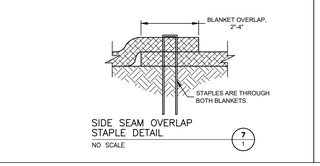
BOTTOM OF SLOPE TERMINATION
NO SCALE — 3/1



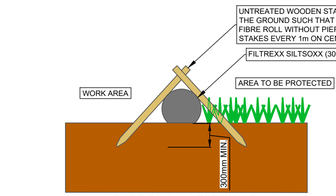
SLOPE TRENCHING METHOD "B"
NO SCALE — 6/1

EROSION CONTROL BLANKETS

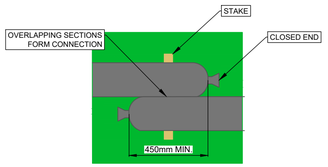
- BIODEGRADABLE EROSION CONTROL BLANKETS (E.G WOVEN JUTE, COIR MESH, GREAT LAKES ASPEN, ETC) TO BE AVAILABLE ON SITE IN CASE THEY ARE NEEDED TO HELP MITIGATE EROSION OF TEMPORARILY EXPOSED SOILS ON THE FLOODPLAIN AND / OR ALONG THE POND SHORELINE
- DRAWINGS SHOWN ON THIS SHEET ILLUSTRATE TYPICAL INSTALLATION DETAILS FOR AN AMERICAN EXCELSIOR CURLEX NETFREE SLOPE PROTECTION EROSION CONTROL BLANKET. THE CONTRACTOR MAY USE THIS BRAND OF EROSION CONTROL BLANKET OR AN APPROVED EQUIVALENT.



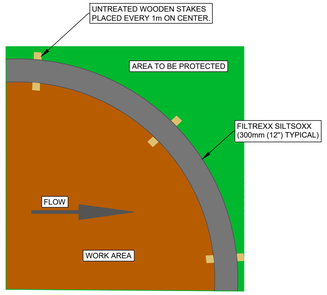
SIDE SEAM OVERLAP STAPLE DETAIL
NO SCALE — 7/1



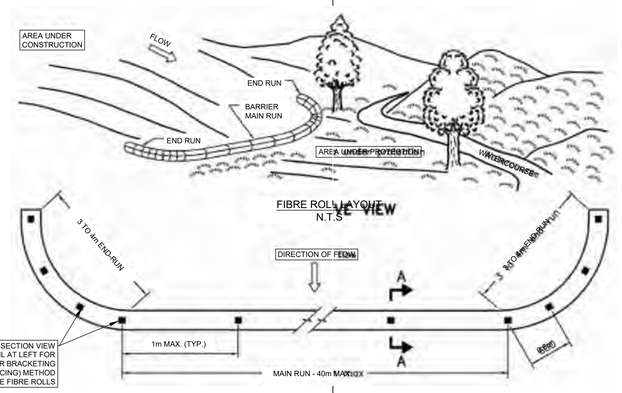
FIBRE ROLL - SECTION VIEW
N.T.S



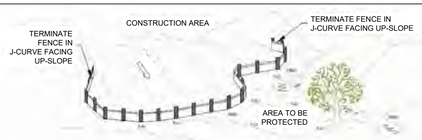
FIBRE ROLL - END CONNECTION DETAIL
N.T.S



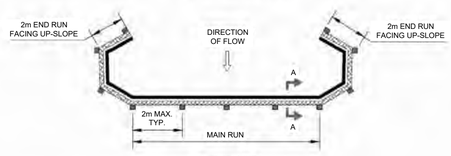
FIBRE ROLL - PLAN VIEW
N.T.S



FIBRE ROLL LAYOUT - PLAN VIEW
N.T.S



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
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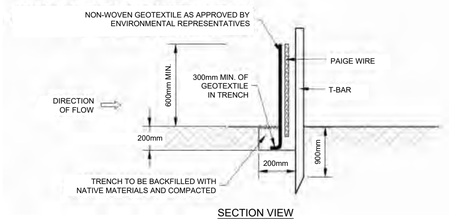
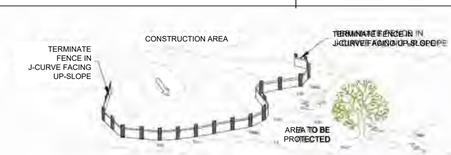
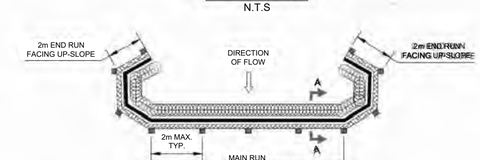


SECTION VIEW
N.T.S

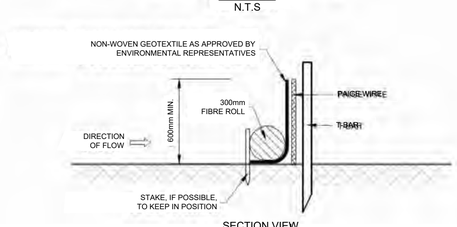
SEDIMENT CONTROL FENCE - UNFROZEN CONDITIONS



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
N.T.S



SECTION VIEW
N.T.S

SEDIMENT CONTROL FENCE - FROZEN CONDITIONS

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A	ISSUED FOR REVIEW	MAR 15, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 1, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 16, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 26, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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CREEK 661 OVERWINTERING POND
SEDIMENT CONTROL BARRIERS &
EROSION CONTROL BLANKET DETAILS FOR OVERWINTERING POND

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-4
DRAWING NO. 007
SHEET: 7 OF 8
REV E

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WORK AREA ISOLATION MEASURES

METRE BAG COFFER DAM

- FOR ISOLATION OF THE FULL CHANNEL WIDTH (DAM-AND-PUMP STREAM-FLOW BYPASS) OR ONLY A PORTION OF THE CHANNEL WIDTH (PASSIVE STREAM-FLOW BYPASS FOR SINGLE-BANK WORK) FOR IN-CHANNEL WORK, OR SECTION OF POND SHORELINE FOR CONNECTION TO CHANNEL.
- 1-2 TIER, SINGLE-STACK METRE BAG COFFER DAM PREFERRED GIVEN MINIMAL DISTURBANCE; PYRAMID-STACK METRE BAG COFFER DAM MAY BE NECESSARY IN DEEPER-WATER SCENARIOS.
- METRE BAGS SHOULD BE FILLED WITH PEA GRAVEL AND SHOULD NOT BE OVER-FILLED.
- A WATERPROOF MEMBRANE IS REQUIRED OVER THE PEA-GRAVEL METRE BAGS. THE WATERPROOF MEMBRANE MUST BE KEYED IN UNDER THE BARRIER TO MINIMIZE LEAKAGE.
- COFFER DAM MAY BE CONSTRUCTED OF SMALLER PEA-GRAVEL SANDBAGS OR OTHER SUITABLE EQUIVALENT. SEE BELOW FOR DETAILS.

PEA GRAVEL COFFER DAM

- CAN BE USED AT THE DISCRETION OF THE ENVIRONMENTAL REPRESENTATIVE FOR ISOLATION OF CHANNELS IN LOW-FLOW, SHALLOW WATER CONDITIONS WHEN LOCAL WORKS CAN BE COMPLETED WITHIN A FAVORABLE WEATHER WINDOW AND / OR THE CHANNEL IS LOCALLY TOO NARROW OR AWKWARD FOR THE USE OF METRE BAGS.

DE-WATERING SUMP PUMP

- FOR TEMPORARY MAINTENANCE OF DRY OR SHALLOWER CONDITIONS WITHIN AN ISOLATED IN-CHANNEL / POND WORK AREA.
- A PUMP WITH A MINIMUM RECOMMENDED PUMPING CAPACITY OF 2000GPM MUST BE USED.
- DURING ELEVATED FLOWS APPROACHING BANK-FULL DEPTH, ALL PUMPING WILL BE STOPPED AND COFFER DAMS WILL BE TEMPORARILY REMOVED TO ALLOW FLOWS TO PASS UNOBSTRUCTED.

DE-WATERING FILTER BAG RINGED WITH FILTREXX SILTSOXX (OR APPROVED EQUIVALENT)

- FOR CONTROLLED DEPOSITION OF FINE SEDIMENT PUMPED OUT OF AN ISOLATED IN-CHANNEL / POND WORK AREA, AWAY FROM THE WATERCOURSE OR POND
- PLACE FILTER BAG (3.5m X 5.0m TERRAFIX ENVIROBAG OR APPROVED EQUIVALENT) ON A LEVEL, STABILIZED AREA OF THE FLOODPLAIN, ON VEGETATED GROUND > 15m AWAY FROM THE CHANNEL. FILTREXX SILTSOXX (300mm (12") DIAMETER) OR APPROVED EQUIVALENT TO BE PLACED AROUND THE FILTER BAG.
- ISOLATED SECTION OF CHANNEL TO BE PUMPED AND DE-WATERED INTO FILTER BAG
- REPLACE UNIT WHEN HALF FULL OF SEDIMENT OR WHEN SEDIMENT HAS SIGNIFICANTLY REDUCED THE FLOW RATE OF PUMP DISCHARGE
- ALLOW FILLED FILTER BAG TO DRY IN DESIGNATED SEDIMENT DRYING AREA AND THEN RE-USE THE SEDIMENT AS PART OF BANK RESTORATION OR DISPOSE OF IT OFF SITE UNDER DIRECTION OF THE ON-SITE ENVIRONMENTAL REPRESENTATIVE

PROVISIONAL PLANTING NOTES

SITE PREPARATION:

- APPLY 10cm OF TOPSOIL AND/OR LOOSE GROWTH MEDIUM WILL BE SOURCED FROM WITHIN THE FOOTPRINT OF THE DISTURBANCE AREA ALONG THE PERIPHERY OF THE POND, INCLUDING THE TOP OF THE 'LEAKY BANKS(S)". ANY MATERIAL WILL BE GRADED ON SITE AND RESTORE WITH SEED AND/OR PLANTINGS..

PLANT MATERIAL:

- PLANT MATERIAL MUST BE LOCALLY SOURCED AND SPECIES MUST BE NATIVE TO THE REGION.
- PLANT MATERIAL TO BE INSPECTED UPON DELIVERY TO ENSURE THAT THE MATERIAL CONSISTS OF APPROPRIATE NATIVE SPECIES IN GOOD CONDITION
- TREES TO BE CONTAINER GROWN OR BARE ROOT AND RANGING BETWEEN 1 to 1.5m IN HEIGHT.
- SHRUBS TO BE CONTAINER GROWN OR BARE ROOT AND RANGING FROM 0.4m TO 1.0m IN HEIGHT.
- DRY SEEDS OF THE SUGGESTED MIXTURE OR SIMILAR BLEND TO BE MIXED BEFORE THE APPLICATION
- LIVE STAKES TO BE 35 TO 50mm IN DIAMETER AND 1 TO 1.5m IN LENGTH. SOAKED FOR A MINIMUM OF 24 HOURS BEFORE INSTALLATION. TIPS OF LIVE STAKED CAN BE SEALED TO MINIMIZE RISK OF DISEASE.
- BRUSH LAYER CUTTINGS TO BE A MINIMUM OF 10mm IN DIAMETER AND 1.5 TO 2m IN LENGTH.
- GRASSES AND SHRUBS TO BE PLANTED IN RIPARIAN AREA ABOVE HIGH WATER MARK (ABOVE STREAM BANK) IF CURREBTLY BARREN. PLANT GRASSES ONLY IF SHRUBS ARE PRESENT.

PLANTING LOCATIONS:

- TREES, SHRUBS AND SEED MIX TO BE PLANTED WITHIN THE "AREA OF DISTURBANCE" AROUND THE PERIPHERY OF THE POND
- THE TOP OF THE "LEAKY BANK" IS TO BE PLANTED WITH SEED MIX ONLY (NO SHRUBS).
- LIVE STAKES AND BRUSH LAYER CUTTINGS SHOULD BE INSTALLED WHERE INDICATED ON THE DRAWINGS.

PLANTING DENSITY:

- TREES TO BE SCATTERED IN BETWEEN SHRUBS CLUSTERS AND PLANTED A MINIMUM OF 3m APART
- SHRUBS TO BE PLANTED 1 SHRUB PER m² IN CLUSTERS OF 4 INDIVIDUAL SHRUBS. EACH SHRUB CLUSTER SHOULD COMPRISE A MINIMUM OF 2 SPECIES. SHRUB CLUSTERS ARE TO BE SCATTERED APPROXIMATELY 4m APART.
- SEED MIX IS TO BE APPLIED AT A RATE OF 20 kg/ha.
- LIVE STAKES TO BE PLANTED 2 LIVE STAKES PER m²
- BRUSH LAYER CUTTINGS TO BE DENSELY PACKED, SIDE-BY-SIDE, TO FORM A CONTINUOUS LAYER ACROSS THE FULL LENGTH OF THE LIFT. EACH LIFT WILL BE COMPRISED OF 15-25 BRANCHES PER LINEAR METER.

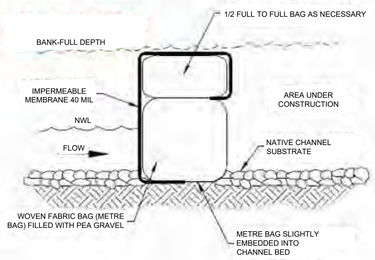
TIMING:

- PLANTING OF WOODY MATERIAL SHOULD BE COMPLETED IN THE SPRING (APRIL TO MAY) OR FALL (SEPTEMBER TO OCTOBER).
- SEEDING SHOULD BE COMPLETED IMMEDIATELY AFTER THE PLANTING OF WOODY VEGETATION.

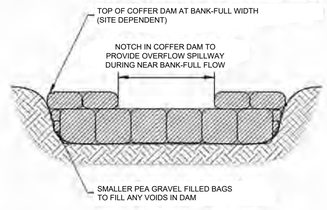
PROVISIONAL PLANTING LIST AND QUANTITIES

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
Seed Mix (SM)	Northern beaked Sedge	Carex utriculata	Dry seed mixed by weight to 10.2 kg
	Water Sedge	Carex aquatilis	
	Fringed Brome	Bromus ciliatus	
	Thickspike Wildrye	Elymus lanceolatus	
	Fowl Bluegrass	Poa palustris	
	Purple-leaved Willowherb	Epilobium ciliatum	
	Bluejoint Reedgrass	Calamagrostic canadensis	
Shrubs – Dry/Moist [Plant with Seed Mix 1]	Scouler's Willow	Salix scouleriana	330
	Hooker's Willow	Salix hookeriana	330
	Dwarf Birch	Betula glandulosa	305
	Sitka Alder	Alnus viridis ssp. sinuata	305
Trees – Dry/Moist	White Spruce	Picea glauca	100
	Trembling Aspen	Populus tremuloides	100
Live Stakes (LS)	Red-Osier Dogwood	Cornus stolonifera	300
	Scouler's Willow	Salix scouleriana	300
	Coyote Willow	Salix exigua	300
	Geyer's Willow	Salix geyeriana	300
Brush Layer Cuttings (BL)	Red-osier Dogwood	Cornus stolonifera	300
	Pacific Willow	Salix lasiandra	300
	Hooker's Willow	Salix hookeriana	300
	Coyote Willow	Salix exigua	300

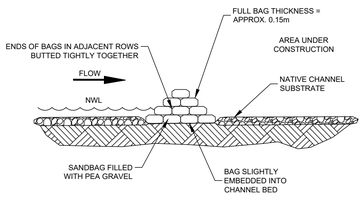
A DETAILED PLANTING PLAN TO INCORPORATE UPDATED SITE INFORMATION AND FIRST NATION COMMENTS WILL BE DEVELOPED FOLLOWING THE COMPLETION OF VEGETATION SURVEYS DURING THE SUMMER OF 2022. PLEASE REFER TO THE VEGETATION WORK PLAN PRESENTED IN THE FISHERIES ACT AUTHORIZATION APPLICATION FOR ADDITIONAL DETAILS.



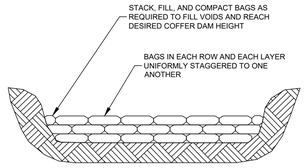
METRE BAG COFFER DAM - SECTION
N.T.S



METRE BAG COFFER DAM - PROFILE
N.T.S



PEA GRAVEL BAG COFFER DAM - SECTION
N.T.S



PEA GRAVEL BAG COFFER DAM - PROFILE
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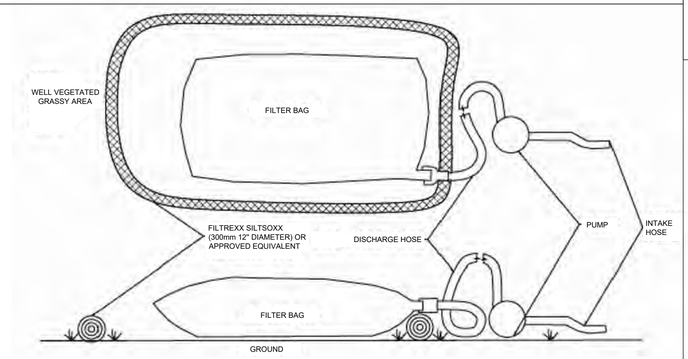
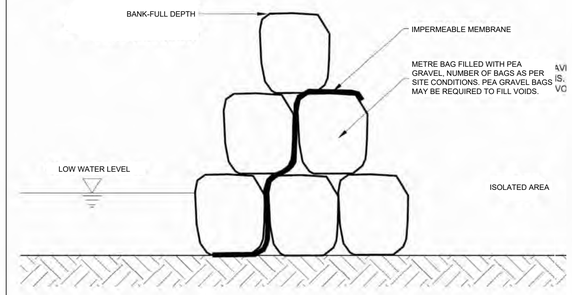
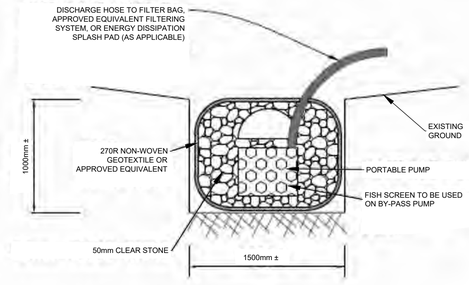


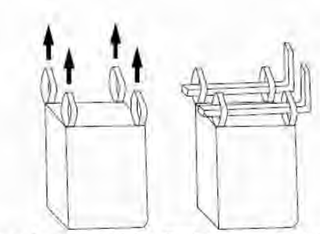
DE-WATERING FILTER BAG WITH FILTREXX SILTSOXX - PLAN & PROFILE
N.T.S



METRE BAG WATERPROOF ISOLATION BARRIER - SECTION
N.T.S



DE-WATERING SUMP PUMP DETAIL
N.T.S



PEA GRAVEL METRE BAG HANDLING
N.T.S

BC — 1C
1-800-474-6886

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	MAR 15, 2021	JL	MF
B	ISSUED FOR REVIEW	APR 1, 2021	JL	MF
C	ISSUED FOR REVIEW	APR 16, 2021	JL	MF
D	ISSUED FOR PERMIT APPROVAL	MAY 26, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JUNE 8, 2022	JL	MF

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SCALE:

CAUTION:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASUREMENTS IN m UNLESS OTHERWISE NOTED.

DESIGNED:	RM & DM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JUNE 2022

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN

CREEK 661 OVERWINTERING POND

WORK AREA ISOLATION MEASURES
& PLANTING NOTES FOR OVERWINTERING POND

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-4
DRAWING NO. 008
SHEET: 8 OF 8
REV E

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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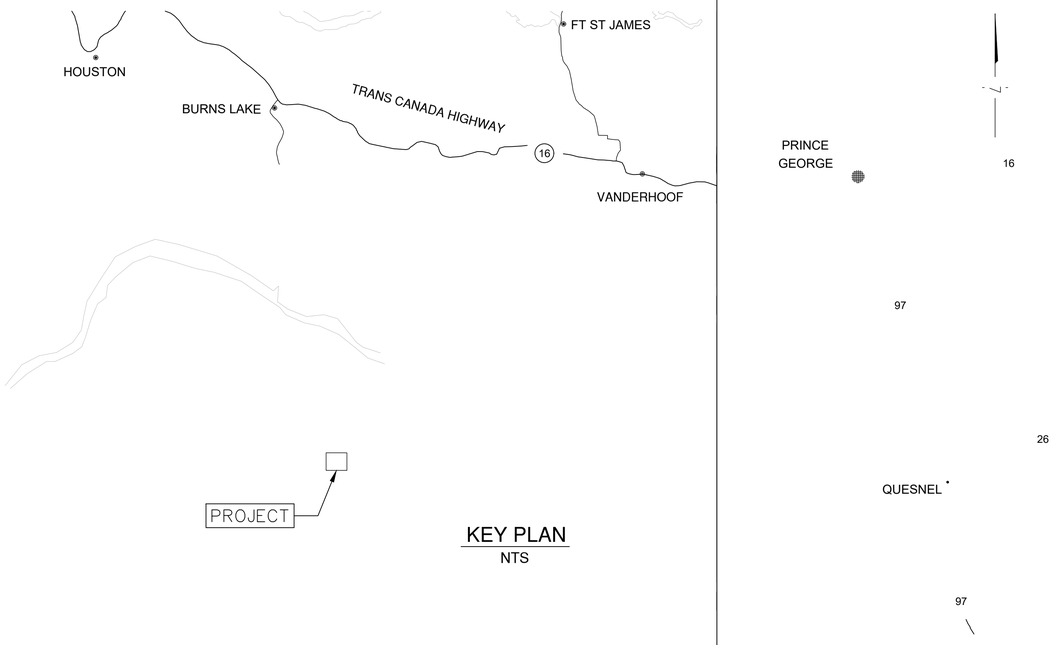
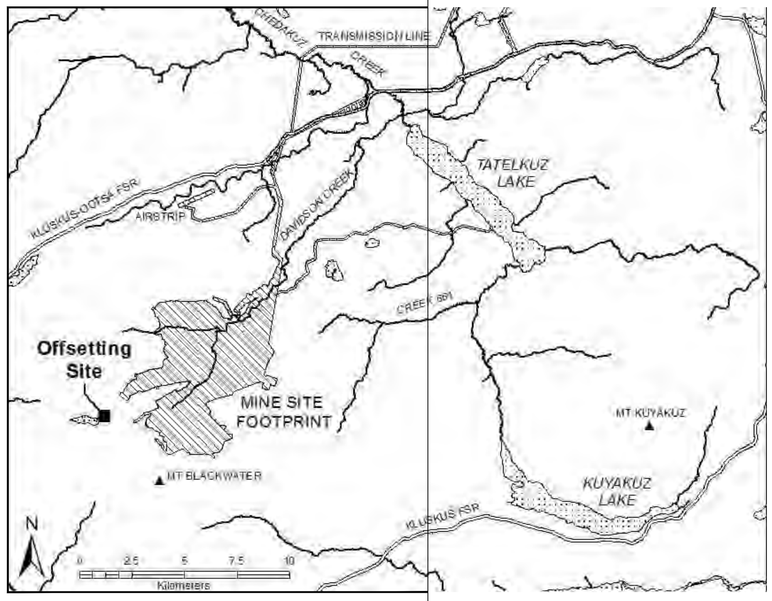
BLACKWATER PROJECT -
SCHEDULE 35 FISHERIES OFFSETTING PLAN
LAKE 15 & 16 CONNECTOR ARM/CHANNEL

ISSUED FOR CONSTRUCTION



KEY PLAN
NTS

DRAWING INDEX	
SHEET No.	SHEET TITLE
1824-4-10-001	TITLE PAGE
1824-4-10-002	GENERAL NOTES
1824-4-10-003	OVERALL PLAN AND PROFILE
1824-4-10-004	SECTIONS
1824-4-10-005	STANDARD DETAILS SHEET 1 OF 1 & PLANTING NOTES FOR CHANNEL WORKS
1824-4-10-006	CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN - STAGE 1
1824-4-10-007	CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN - STAGE 2
1824-4-10-008	CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN - STAGE 3
1824-4-10-009	CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN - STAGE 4
1824-4-10-010	CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN - STAGE 5
1824-4-10-011	SEDIMENT CONTROL BARRIERS & EROSION CONTROL BLANKET DETAILS FOR CHANNEL WORKS
1824-4-10-012	WORK AREA ISOLATION MEASURES



LOCATION PLAN
NTS

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DATE: 2022-04-04 9:45 PM BY: Jesse Lutz

NOT FOR CONSTRUCTION

LAYDOWNS & ACCESS ROADS

- ALL LAYDOWNS AND ACCESS ROADS ARE TEMPORARY IN NATURE AND ARE ONLY REQUIRED FOR THE DURATION OF CHANNEL WORKS. GRASS AND PATHS DISTURBED DURING CONSTRUCTION ARE TO BE RESTORED TO THEIR ORIGINAL CONDITION PRE-CONSTRUCTION TO THE BEST OF THE CHOSEN CONTRACTOR'S ABILITIES AFTER ALL WORKS ARE COMPLETED.
- FINAL LOCATION, SIZE, AND SPECIFICATIONS OF THE PROPOSED LAYDOWN AREA AND ACCESS ROADS ARE TO BE REFINED BY THE SELECTED CONTRACTOR AS REQUIRED. DEPENDING ON CONDITIONS AT THE TIME OF CONSTRUCTION ACCESS MAY BE A VARIETY OF RIG MATS, FROZEN GROUND, OR BUILT UP GRAVEL ACCESS ROADS WITH GEOGRID.
- AVOID DISTURBANCE TO ANY EXISTING HERITAGE FEATURES

GENERAL WATER LEVEL NOTES

- WATER SURFACE ELEVATIONS IN THE LAKES WERE ESTIMATED BASED ON RESULTS OF LOCAL RTK GPS SURVEY, CONDUCTED BY DWB CONSULTING SERVICES LTD ON SEPTEMBER 6, 2016.
- NOTE THAT THERE IS BEAVER ACTIVITY, ALONG THE EXISTING LAKE IS OUTLET CHANNEL (DAVIDSON CREEK). AS SUCH, WATER DEPTHS WITHIN LAKE 16 MAY BE LOCALLY HIGHER THAN EXPECTED BASED SOLELY ON LOCAL FLOW CONDITIONS.
- NOTE THAT THE GROUNDWATER TABLE IS RELATIVELY HIGH ACROSS THE FLAT VALLEY BOTTOM OF LAKE 15 AND 16 CONNECTOR CHANNEL, CONTROLLED IN THE GLACIOFLUVIAL SAND/GRAVEL COMPRISING THE AREA BY THE WATER LEVELS IN LAKE 15 AND LAKE 16. LOCALIZED GROUNDWATER MEASUREMENTS FROM TEST PITS BETWEEN LAKE 15 AND LAKE 16 PROVIDED BY KNIGHT PIESOLD RANGED FROM 1344m TO 1346m ON JUNE 30, 2013.
- LAKE LEVELS MEASURED BY DWB CONSULTING SERVICES LTD. ARE ASSUMED TO REPRESENT THE LOW WATER LEVEL CONDITION. MEASUREMENTS OF LAKE 16 STAGE PROVIDED BY KNIGHT PIESOLD FLUCTUATED BY 0.3m DURING THE MONITORING PERIOD (FROM MAY 10, 2012 TO OCTOBER 29, 2014).

VALLEY BOTTOM SOILS

- NO DRILLING OR TEST PITTING HAS BEEN COMPLETED TO INVESTIGATE SOILS WITHIN THE VALLEY BOTTOM SEDIMENTS WHERE CHANNEL WORKS ARE PROPOSED.
- OPPORTUNISTIC EXAMINATION OF SUBSURFACE SOILS VIA TEST PITS (3.5m TO 5m DEEP) IN THE GENERAL AREA INDICATES GLACIOFLUVIAL SEDIMENTS: COARSE TO MEDIUM SAND AND GRAVEL, WITH NUMEROUS COBBLES AND BOULDERS.

SURVEY NOTES

DATUM: NAD 83 (CSRS) 2002.0

UTM ZONE: 10

THE SURVEY DATA USED TO CREATE THE TIN SURFACE FOR THIS DESIGN WAS PROVIDED TO ONSITE ENGINEERING LTD. BY PALMER. ALL SURVEY DATA WERE COLLECTED BY DWB CONSULTING SERVICES LTD. OCTOBER 22-23, 2016 AND JUNE 19-22, 2017. HIGH RESOLUTION LIDAR-DERIVED ELEVATION DATA WAS ACQUIRED BY EAGLE MAPPING LTD. ON AUGUST 8-9, 2011. LIDAR WAS BLENDED WITH LOCAL RTK GPS SURVEY BY DWB CONSULTING SERVICES LTD., CONDUCTED ON SEPTEMBER 6, 2016 AT LAKE 16 OUTLET (PROPOSED) AND LAKE 15 INLET (PROPOSED).

DESIGN TEAM

ENGINEERING - ONSITE ENGINEERING LTD. MICHAEL FOSTER, P.ENG.

GEOMORPHOLOGY/ENVIRONMENTAL/SEDIMENT AND EROSION CONTROL - PALMER ROBIN MCKILLOP, M.Sc, P.GEO. AND MICHAEL BRIERLEY, M.Sc

OVERVIEW

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	APR 23, 2021	JL	MF
B	ISSUED FOR REVIEW	MAY 21, 2021	JL	MF
C	ISSUED FOR REVIEW	JUNE 2, 2021	JL	MF
D	ISSUED FOR REVIEW	JUNE 9, 2021	JL	MF
E	ISSUED FOR CONSTRUCTION	JULY 7, 2021	JL	MF
F	ISSUED FOR CONSTRUCTION	JUNE 9, 2022	JL	MF

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LAKE 15 & 16 CONNECTOR ARM/CHANNEL
GENERAL NOTES

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-10
DRAWING NO.	002
SHEET:	2 OF 12
REV	F

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DATE: 11/05/2021 4:17 PM BY: Jesse Lutz

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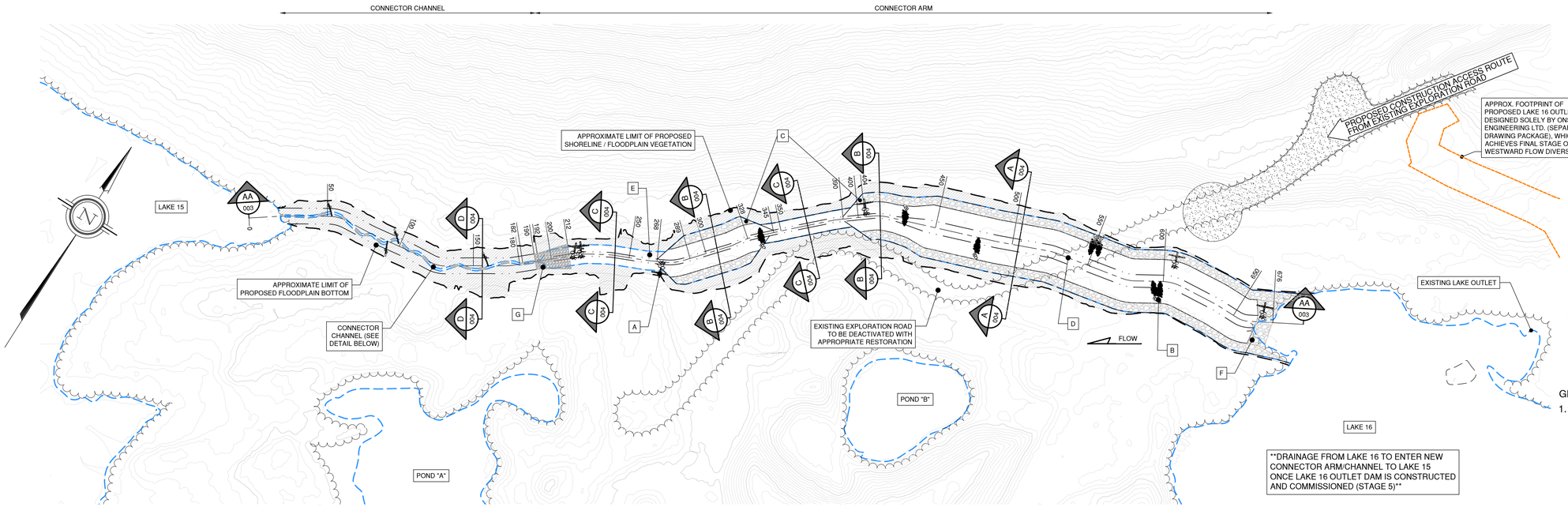


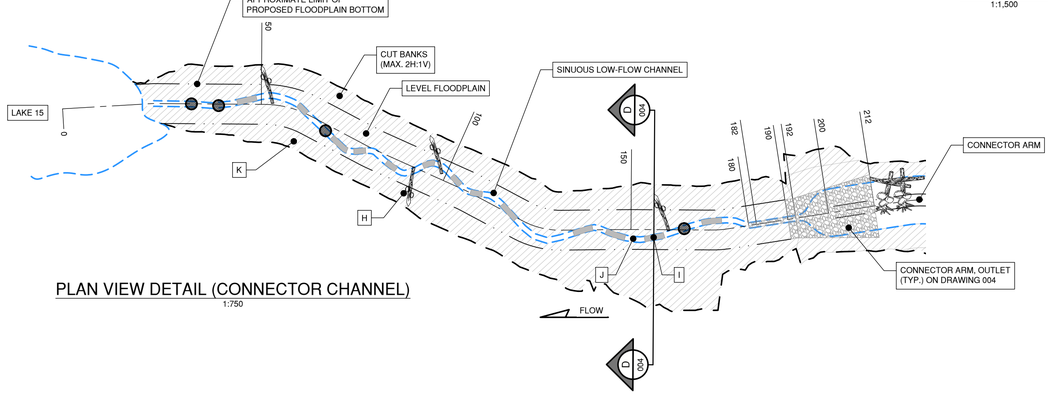
PLAN VIEW
1:1,500

DESIGN OBJECTIVES AND PURPOSE

A SMALL DAM (SITE C WEST DAM) WILL BE CONSTRUCTED TO ISOLATE DAVIDSON CREEK AND PREVENT EXCESS WATER FROM FLOWING THROUGH THE MINE SITE. THE PROPOSED LAKE CONNECTOR ARM/CHANNEL WILL CONNECT LAKE 15 AND 16 TO ALLOW FISH PASSAGE (BOTH DIRECTIONS) AND CREATE PRODUCTIVE HABITAT FOR RAINBOW TROUT. THE CONNECTOR ARM WILL HAVE AN IRREGULAR WIDTH WITH DEEP HABITAT (>1.5 M), SHALLOW COBBLE SHOALS, AND WOODY DEBRIS STRUCTURES INCORPORATED INTO THE DESIGN TO MAXIMIZE HABITAT DIVERSITY. THE CONNECTOR ARM/CHANNEL IS SITUATED AT A LOCATION WITH NATURALLY HIGH GROUNDWATER TABLE THAT WILL MAXIMIZE DISSOLVED OXYGEN AND PROMOTE FLOW WITHIN THE LOW FLOW CHANNEL OUTSIDE OF THE SPRING FRESHET. THE OUTLET CHANNEL WILL HAVE A SINUOUS PLANFORM WITH GRAVELS PLACED ALONG THE BED TO MIMIC CONDITIONS OBSERVED ALONG A NEARBY TRIBUTARY.

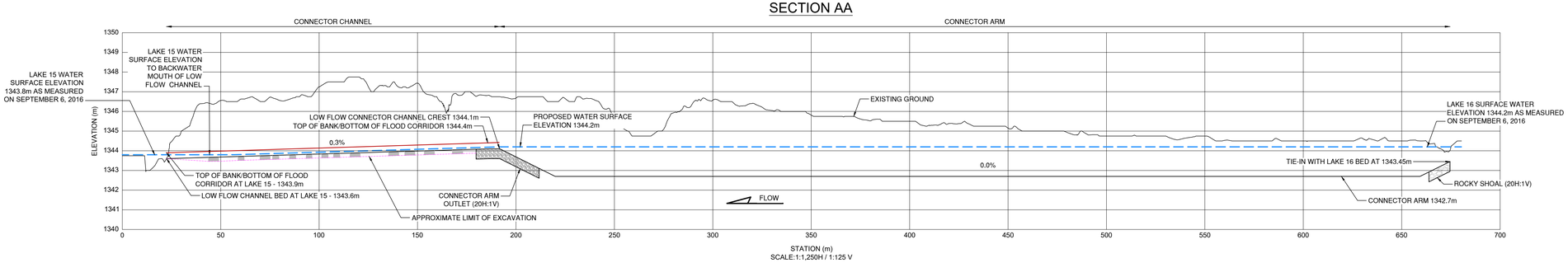
DESIGN TARGETS

- CONNECT LAKE 15 AND 16 TO ALLOW FISH PASSAGE
- MIN. CONNECTOR ARM DEPTH OF 1.5m
- FLOW WITHIN CONNECTOR CHANNEL DURING ADULT RAINBOW TROUT MIGRATORY WINDOW
- WOODY DEBRIS AND COBBLE FISH HABITAT FEATURES



PLAN VIEW DETAIL (CONNECTOR CHANNEL)
1:750

SECTION AA



LEGEND

- APPROXIMATE WATERLINE
- EXISTING EDGE OF TREES AND SHRUBS
- APPROXIMATE LIMIT OF DISTURBANCE
- APPROXIMATE LIMIT OF PROPOSED SHOAL
- APPROXIMATE LIMIT OF PROPOSED SHORELINE
- APPROXIMATE LIMIT OF PROPOSED FLOODPLAIN BOTTOM
- SHORELINE / FLOODPLAIN VEGETATION
- CONNECTOR ARM OUTLET - COBBLE
- ROCKY SHOAL HABITAT
- PROPOSED CONIFEROUS TREE
- PROPOSED ROOTWAD
- CC - COBBLE CLUSTER
- GP - GRAVEL PLACEMENT
- WOODY DEBRIS DEFLECTOR

GENERAL NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON BLENDING RESULTS OF LOCAL RTK GPS SURVEY, CONDUCTED ON SEPTEMBER 6, 2016 WITH BROADER, HIGH-RESOLUTION, LIDAR-DERIVED ELEVATION DATA ACQUIRED BY EAGLE MAPPING LTD. ON AUGUST 8-9, 2011. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. WATERLINE AND TREELINE INTERPRETED FROM AERIAL IMAGERY AND RTK GPS POINTS.
3. DESIGN REVIEW AND DRAFTING BY ONSITE ENGINEERING LTD. DESIGN BY PALMER.
4. REFER TO DRAWING 006 TO 012 FOR CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN

CONNECTOR ARM NOTES

- A ROOTWAD EMBEDDED IN BANK WITH BOULDERS AND ANCHOR LOG FOR HABITAT DIVERSITY AND COVER (TYP). SEE DETAIL 5C ON DRAWING 005 FOR ADDITIONAL DETAILS
- B FALLEN LOG/TREES SECURED WITH BOULDERS FOR HABITAT DIVERSITY AND COVER (TYP.). SEE DRAWING DETAIL 5B ON DRAWING 005 FOR ADDITIONAL DETAILS
- C SHOAL TO BE COBBLE-LINED (TYP.). GRADATION OF COBBLE SUBSTRATE IS INCLUDED ON DRAWING 004
- D NATIVE SUBSTRATE ALONG BOTTOM OF CONNECTOR ARM (MOSTLY GRAVELLY MATERIAL BASED ON LANDFORMS AND TEST PITS IN THE AREA)
- E VEGETATED SHORELINE AND LIMIT OF DISTURBANCE TO BE PLANTED WITH NATIVE VEGETATION. PLANTINGS AND SEED MIXES PROVIDED ON DRAWING 005.
- F CONNECTOR ARM INLET TO BE COBBLE LINED (TYP.). GRADATION OF COBBLE SUBSTRATE IS INCLUDED ON DRAWING 004
- G CONNECTOR ARM OUTLET CREST TO BE COBBLE LINED (TYP.). GRADATION OF COBBLE SUBSTRATE IS INCLUDED ON DRAWING 004

CONNECTOR CHANNEL NOTES

- H WOOD DEBRIS DEFLECTOR TO BE KEYED INTO THE BANK WITH BOULDERS FOR HABITAT DIVERSITY AND COVER (TYP). SEE DETAIL 2B ON DRAWING 005 FOR ADDITIONAL DETAILS
- I RIFFLES TO BE GRAVEL-LINED (TYP.). GRADATION OF GRAVEL SUBSTRATE IS INCLUDED ON DETAIL 4B ON DRAWING 005
- J NATIVE SUBSTRATE ALONG BOTTOM OF CHANNEL (EXPECTED TO BE GRAVELLY BASED ON LANDFORMS AND TEST PITS IN AREA)
- K FLOODPLAIN TO BE PLANTED WITH NATIVE RIPARIAN VEGETATION. PLANTINGS AND SEED MIXES PROVIDED ON DRAWING 005.

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REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	APR 23, 2021	JL	MF
B	ISSUED FOR REVIEW	MAY 21, 2021	JL	MF
C	ISSUED FOR REVIEW	JUNE 2, 2021	JL	MF
D	ISSUED FOR REVIEW	JUNE 9, 2021	JL	MF
E	ISSUED FOR CONSTRUCTION	JULY 7, 2021	JL	MF
F	ISSUED FOR CONSTRUCTION	JUNE 9, 2022	JL	MF

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SCALE:
1:750 0 15 45m
1:1,500 0 30 90m
1:1,250H 1:125V 0 25 75m 0 2.5 7.5m

DESIGNED:	MB & RM
DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LAKE 15 & 16 CONNECTOR ARM/CHANNEL
OVERALL PLAN AND PROFILE

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-10
DRAWING NO. 003
SHEET: 3 OF 12
REV F

U:\Projects\1824\4\9\10 - Lake 15-16 Connector Channel Design\AutoCAD\1824-4-10- Lake 15 16.dwg
DATE: 11/05/2021 4:17 PM BY: Jesse Lutz

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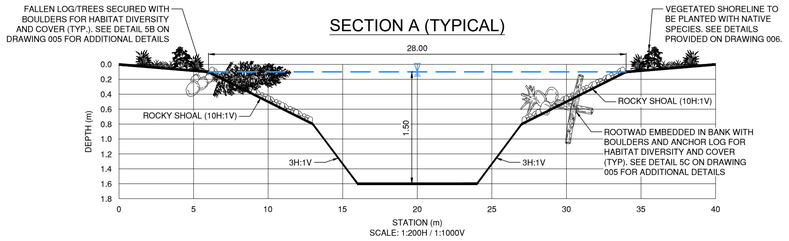
SECTION A (TYPICAL)



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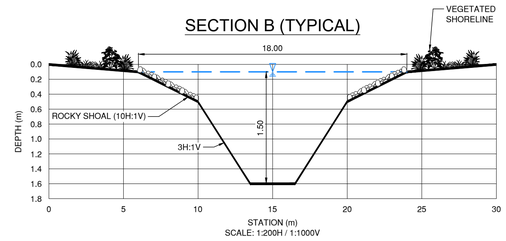

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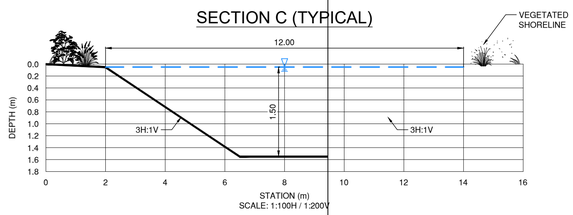
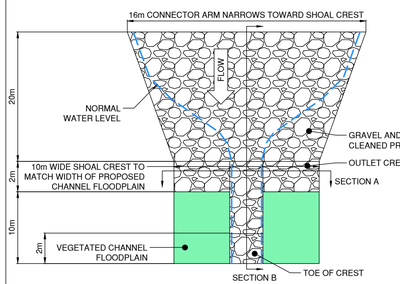
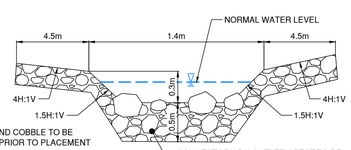


DESIGN TYPICAL FOR CONNECTOR ARM (EXTENDED LAKE) OUTLET

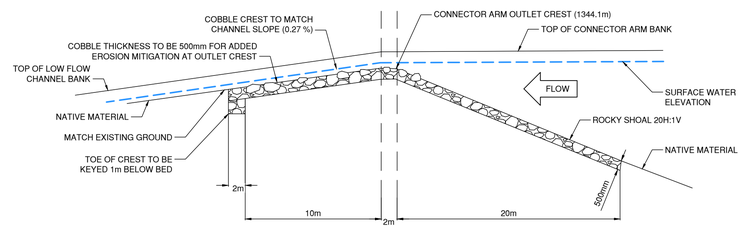
N.T.S.





SECTION A

N.T.S.



SECTION B

N.T.S.

GRADATION FOR SHOALS AND CONNECTOR ARM

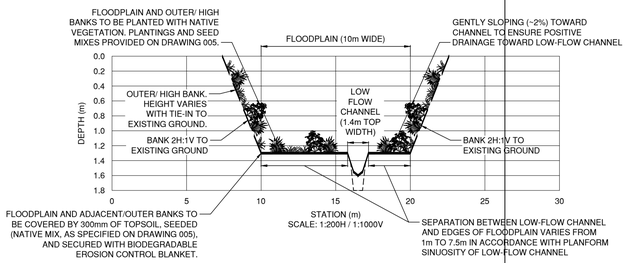
%PASSING BY NOMINAL DIAMETER
20% 200-250mm
30% 100-200mm
30% 50-100mm
20% 10-50mm

THICKNESS FOR SHOALS: 250mm
THICKNESS FOR CONNECTOR ARM OUTLET: 500mm

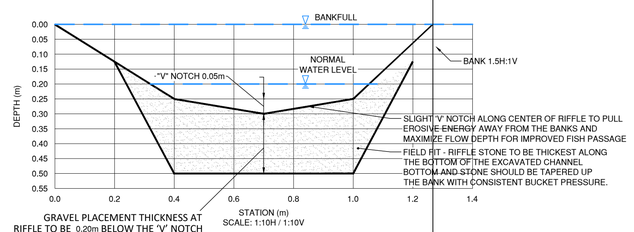
MATERIALS SHOULD BE ROUNDED TO SUB-ANGULAR.

GRAVELS/COBBLES TO BE CLEANED PRIOR TO PLACEMENT, THEN CAREFULLY DISTRIBUTED, UNDER THE GUIDANCE OF ON-SITE INSPECTOR.

SECTION D - CONNECTOR CHANNEL FLOOD CORRIDOR (TYPICAL)



CONNECTOR CHANNEL LOW FLOW RIFFLE SECTION



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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LAKE 15 & 16 CONNECTOR ARM/CHANNEL
SECTIONS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-10
DRAWING NO. 004
SHEET: 3 OF 12
REV F

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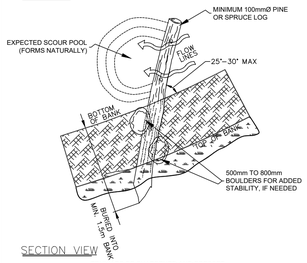
DATE: 1/05/2021 4:17 PM BY: Jesse Lutz

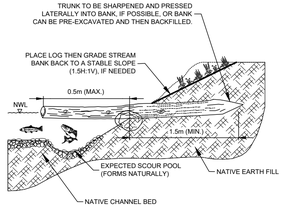
NOT FOR CONSTRUCTION

DETAIL 2B
WOODY DEBRIS CHANNEL DEFLECTION (WDdeflect)
N.T.S.

PLAN VIEW



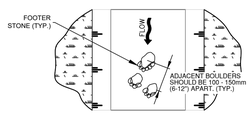
SECTION VIEW



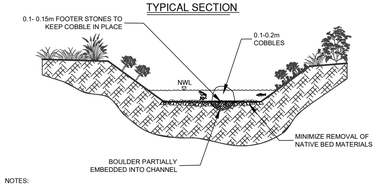
NOTES:
1. LARGE WOODY DEBRIS TO BE MINIMUM 100mm Ø NATIVE PINE OR SPRUCE LOG, 3m TO 5m LENGTH.
2. LOG TO BE EMBEDDED A MINIMUM OF 1.5m, LOG TO PROTRUDE INTO CHANNEL A MAXIMUM OF 0.5m.

DETAIL 4A
BED TREATMENT: COBBLE CLUSTERS (CC)
N.T.S.

PLAN VIEW



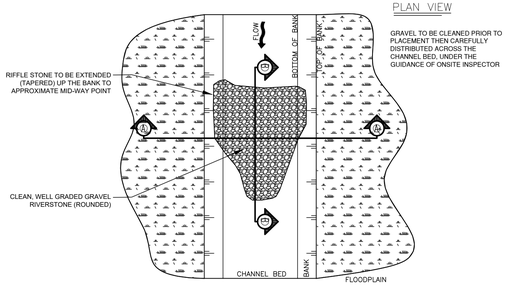
TYPICAL SECTION



NOTES:
1. COBBLE SHOULD BE 0.1-0.2m STONE.
2. COBBLES ARE NOT TO BE PLACED IN DEPOSITIONAL ZONES.
3. COBBLES SHOULD OCCUPY LESS THAN 1/5 OF THE CHANNEL WIDTH AFTER PARTIAL EMBEDMENT.
4. COBBLES SHOULD BE A MINIMUM OF TWO STONE SIZES AWAY FROM THE CHANNEL'S BANKS.

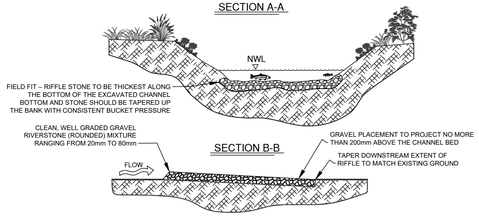
DETAIL 4B
BED TREATMENT: GRAVEL PLACEMENT (GP)
N.T.S.

PLAN VIEW



GRAVEL TO BE CLEANED PRIOR TO PLACEMENT THEN CAREFULLY DISTRIBUTED ACROSS THE CHANNEL BED, UNDER THE GUIDANCE OF ONSITE INSPECTOR

SECTION A-A

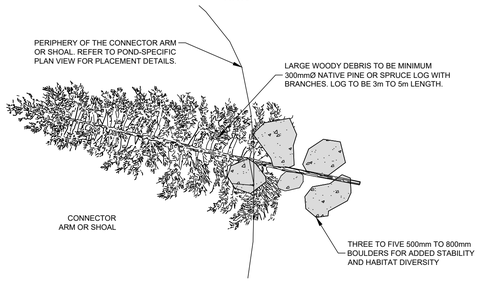


SECTION B-B

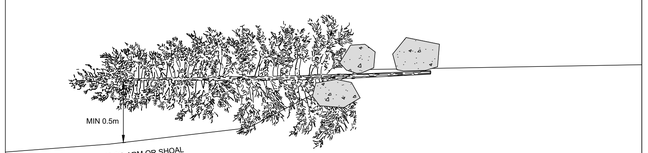
NOTES:
1. GRAVEL PLACEMENT FOR RIFFLES TO BE COMPLETED IN THE DRY

REMOVAL OR REGRADING
NATIVE VEGETATION
NWL NORMAL WATER LEVEL
NATIVE BED MATERIAL
NATIVE EARTH
SILT AND SAND

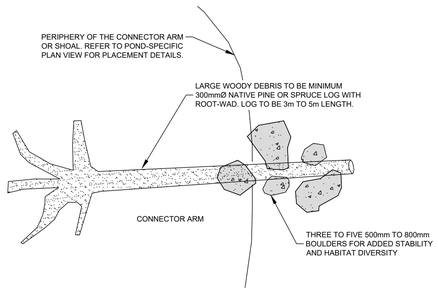
DETAIL 5B
CONIFEROUS TREE PLACEMENT - PLAN VIEW
N.T.S



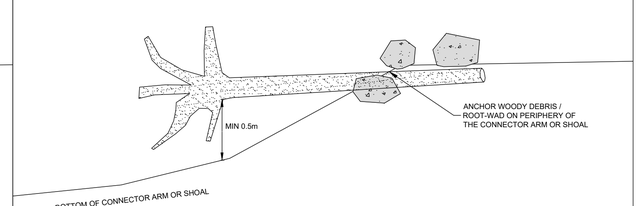
CONIFEROUS TREE PLACEMENT - SECTION VIEW
N.T.S



DETAIL 5C
ROOT-WAD PLACEMENT - PLAN VIEW
N.T.S



ROOT-WAD PLACEMENT - SECTION VIEW
N.T.S



DESIGN DETAIL NOTES:
DETAIL NUMBERING (E.G. 2B, 4A, ETC.) CORRESPONDS TO NUMBERING ON OTHER BLACKWATER PROJECT OVERWINTERING POND AND RANCHLAND STREAM DRAWING SETS.

SITE-SPECIFIC CONTEXTUAL REFINEMENT OF DESIGN DETAILS WERE COMPLETED TO BETTER FIT CONTEXT BUT THE FUNDAMENTALS REMAIN UNCHANGED FROM OTHER BLACKWATER PROJECT OVERWINTERING POND AND RANCHLAND STREAM DRAWING SETS

PROVISIONAL PLANTING NOTES

SITE PREPARATION:

- STRIP AND STOCKPILE TOPSOIL PRIOR TO CHANNEL GRADING WORKS. REAPPLY THE STOCKPILED TOPSOIL TO THE 'AREA OF DISTURBANCE' BEFORE PLANTING.

PLANT MATERIAL:

- PLANT MATERIAL MUST BE LOCALLY SOURCED AND SPECIES MUST BE NATIVE TO THE REGION.
- PLANT STOCK MUST BE INSPECTED UPON DELIVERY TO ENSURE THAT THE MATERIAL CONSISTS OF APPROPRIATE NATIVE SPECIES IN GOOD CONDITION.
- TREES TO BE CONTAINER GROWN OR BAREROOT STOCK RANGING FROM 1m TO 1.5m IN HEIGHT.
- SHRUBS TO BE CONTAINER GROWN AND RANGING FROM 0.4 TO 1m IN HEIGHT.
- DRY SEEDS OF THE SUGGESTED MIXTURE OR SIMILAR BLEND TO BE MIXED BEFORE THE APPLICATION.

PLANTING DENSITY:

- TREES TO BE PLANTED 1 TREE PER 16m^2 (APPROXIMATELY 4m ON CENTER).
- SHRUBS TO BE PLANTED 1 SHRUB PER 1m^2 IN CLUSTERS OF 4 INDIVIDUAL SHRUBS. EACH SHRUB CLUSTER SHOULD COMPRISE A MINIMUM OF 2 SPECIES. SHRUB CLUSTERS ARE TO BE SCATTERED APPROXIMATELY 4m APART.
- SEED MIX IS TO BE APPLIED AT A RATE OF 20 kg/ha.

TIMING:

- PLANTING OF WOODY MATERIAL SHOULD BE COMPLETED IN THE SPRING (APRIL TO MAY) OR FALL (SEPTEMBER TO OCTOBER).
- SEEDING SHOULD BE COMPLETED IMMEDIATELY AFTER THE PLANTING OF WOODY VEGETATION.

TENDING:

- ALL PLANTINGS SHOULD BE WATERED IMMEDIATELY AFTER INSTALLATION.

PROVISIONAL PLANTING LIST AND QUANTITIES

PLANTING TYPES	COMMON NAME	SCIENTIFIC NAME	QUANTITY
Seed Mix 1 – Connector Arm (SM1)	Sand dropseed	Sporobolus cryptandrus	Dry seed mixed by weight to 10.7kg
	June grass	Koeleria macrantha	
	Tufted Hairgrass	Deschampsia cespitosa	
	Fringed Brome	Bromus ciliatus	
	Thickspike Wildrye	Elymus lanceolatus	
	Purple-leaved Willowherb	Epilobium ciliatum	
Seed Mix 2 – Connector Arm (SM2)	Northern beaked Sedge	Carex utriculata	Dry seed mixed by weight to 7.9kg
	Water Sedge	Carex aquatilis	
	Fowl Bluegrass	Poa palustris	
	Bluejoint Reedgrass	Calamagrostic canadensis	
Shrub Cluster 1 – Connector Arm (SC1)	Sitka Alder	Alnus viridis ssp. sinuata	198
	Thimbleberry	Rubus parviflorus	198
	Black Twinberry	Lonicera involucrata	198
Shrub Cluster 2 – Connector Arm (SC2)	Scouler's Willow	Salix scouleriana	146
	Dwarf Birch	Betula glandulosa	146
	Hardhack	Spiraea douglasii	146
Tree Cluster 1 – Connector Arm (TC1)	White Spruce	Picea glauca	111
	Trembling Aspen	Populus tremuloides	111
	Balsam Poplar	Populus balsamifera	111

A DETAILED PLANTING PLAN TO INCORPORATE UPDATED SITE INFORMATION AND FIRST NATION COMMENTS WILL BE DEVELOPED FOLLOWING THE COMPLETION OF VEGETATION SURVEYS DURING THE SUMMER OF 2022. PLEASE REFER TO THE VEGETATION WORK PLAN PRESENTED IN THE FISHERIES ACT AUTHORIZATION APPLICATION FOR ADDITIONAL DETAILS.

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REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	APR 23, 2021	JL	MF
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C	ISSUED FOR REVIEW	JUNE 2, 2021	JL	MF
D	ISSUED FOR REVIEW	JUNE 9, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JULY 7, 2021	JL	MF
F	ISSUED FOR CONSTRUCTION	JUNE 9, 2022	JL	MF

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SCALE:

NOTE:
DRAWING SCALE MAY BE DISTORTED WITH PRINTING.
ALL MEASURMENTS IN m UNLESS OTHERWISE NOTED.

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DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JUNE 2022

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LAKE 15 & 16 CONNECTOR ARM/CHANNEL
STANDARD DETAILS SHEET 1 OF 1
& PLANTING NOTES FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-10
DRAWING NO. 005
SHEET: 5 OF 12
REV F

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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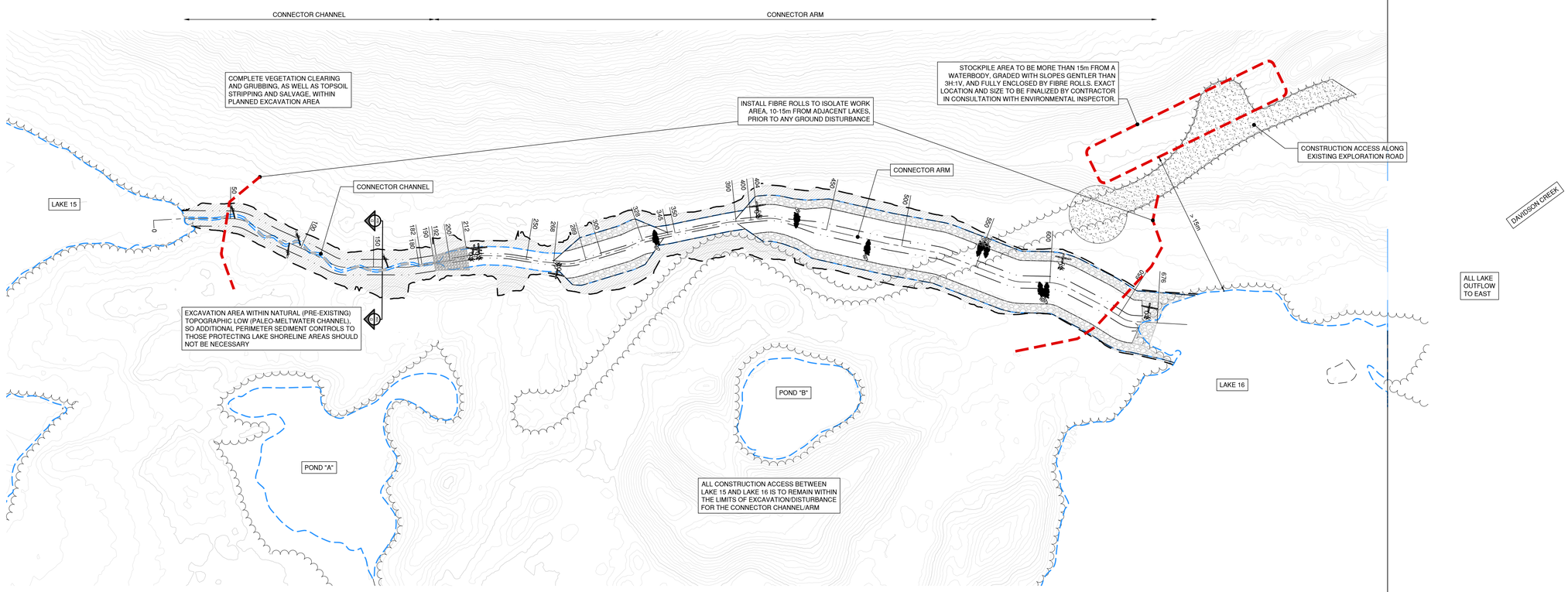
STAGE 1 - CONSTRUCTION ACCESS AND SITE PREPARATION



STAGE 1 - CONSTRUCTION ACCESS AND SITE PREPARATION

1. INSTALL FIBRE ROLLS AROUND LAYDOWN/STAGING AREA AND ALONG THE DOWNSLOPE EDGE OF THE ACCESS ROAD AS IT APPROACHES THE WORK AREA.
2. INSTALL FIBRE ROLLS AT THE EASTERN AND WESTERN ENDS OF THE PLANNED CONNECTOR ARM/CHANNEL, SET BACK APPROX. 10-15m FROM THE SHORELINES OF LAKE 16 AND LAKE 15, RESPECTIVELY. ENSURE THE FIBRE ROLLS ARE CONFIGURED TO FULLY ISOLATE THE EXCAVATION/WORK AREA.
3. COMPLETE VEGETATION CLEARING AND GRUBBING WITHIN THE LIMITS OF PLANNED EXCAVATION/DISTURBANCE FOR THE CONNECTOR ARM/CHANNEL. SALVAGE AND STOCKPILE ANY REMOVED TREES AND/OR STUMPS FOR USE IN THE CONSTRUCTION OF HABITAT FEATURES.
4. STRIP, SALVAGE AND STOCKPILE TOPSOIL WITHIN THE LIMITS OF PLANNED EXCAVATION/DISTURBANCE FOR THE CONNECTOR ARM/CHANNEL. ENSURE THE STOCKPILE IS AT LEAST 15m FROM A WATERBODY (INCLUDING THE PLANNED CONNECTOR ARM/CHANNEL) AND FULLY ENCLOSED BY FIBRE ROLLS.
5. ALL CONSTRUCTION ACCESS BETWEEN LAKE 15 AND LAKE 16, WITHIN SUBSEQUENT STAGES, IS TO BE WITHIN THE LIMITS OF EXCAVATION OF THE CONNECTOR ARM/CHANNEL. NO DISTURBANCE SHOULD BE NECESSARY OUTSIDE THIS CORRIDOR.

REFER TO SHEET 011 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 012 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS

U:\Projects\1824\4\9\10 – Lake 15-16 Connector Channel Design\AutoCAD\1824-4-10- Lake 15 16.dwg
DATE: 11/05/2021 4:17 PM BY: Jesse Lutz

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SCALE:
1:1,500 — 0 / 30 / 90m
1:1,250H 1:625V — 0 / 25 / 75m; 0 / 12.5 / 37.5m
1:400H 1:200V — 0 / 8 / 24m; 0 / 4 / 12m

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DRAWN:	JL
CHECKED:	MF
SURVEYED:	-
DATE:	JUNE 2022

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LAKE 15 & 16 CONNECTOR ARM/CHANNEL
CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN
STAGE 1

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-10
DRAWING NO. 006
SHEET: 6 OF 12
REV F

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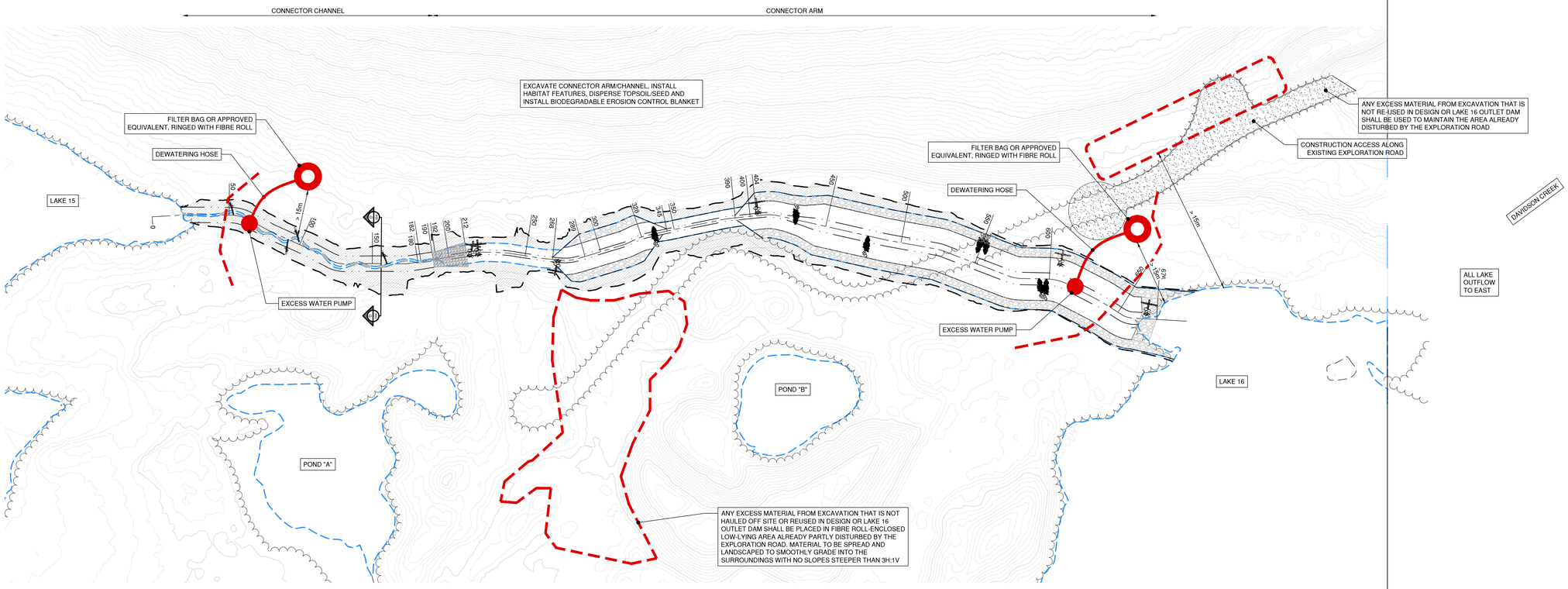
STAGE 2 - EXCAVATION OF CONNECTOR ARM/CHANNEL AND INSTALLATION OF HABITAT FEATURES



STAGE 2 - EXCAVATION OF CONNECTOR ARM/CHANNEL AND INSTALLATION OF HABITAT FEATURES

1. EXCAVATE THE MAIN CORRIDOR OF THE CONNECTOR ARM/CHANNEL, ENSURING NO CUT-SLOPES ARE STEEPER THAN 2H:1V.
2. INSTALL AT LEAST 2 TEMPORARY SUMP PUMPS TO WITHDRAW SEDIMENT-LADEN SEEPAGE WATER THAT PONDS ALONG BOTTOM OF EXCAVATION. WATER TO BE PUMPED TO FILTER BAG IN WELL VEGETATED AREA ENCLOSED BY FIBRE ROLLS MORE THAN 15m AWAY FROM A WATERBODY.
3. STOCKPILE APPROPRIATE MATERIAL FOR USE IN LAKE 16 OUTLET DAM, HAUL EXCESS MATERIAL OFF-SITE FOR USE IN ASSOCIATION WITH MINE ACTIVITIES AND/OR PLACE EXCESS MATERIAL INTO A FIBRE ROLL-ENCLOSED LOW-LYING AREA ALREADY PARTLY DISTURBED BY THE WESTERN END OF THE EXPLORATION ROAD. SPREAD AND SCULPT THE MATERIAL TO SMOOTHLY GRADE INTO THE SURROUNDINGS, NOWHERE EXTENDING TO AN AREA UPSLOPE OF A WATERBODY (E.G. POND A OR POND B). ENSURE ANY EDGE EMBANKMENTS ARE GENTLER THAN 3H:1V.
4. COMPLETE FINE-GRADING OF THE CONNECTOR ARM/CHANNEL, INCLUDING THE FLOODPLAIN BOUNDING THE LOW-FLOW CONNECTOR CHANNEL AND THE BENCHES FOR SHOALS ALONG THE EDGES OF THE CONNECTOR ARM.
5. INSTALL HABITAT FEATURES (I.E. RIFFLES, SHOALS, LARGE WOOD) AT SPECIFIED LOCATIONS AND WITH SPECIFIED TREATMENTS ALONG THE CONNECTOR ARM/CHANNEL, FROM WEST TO EAST.
6. DISPERSE STOCKPILED TOPSOIL ALONG CONSTRUCTED FLOODPLAIN AND EMBANKMENT AREAS TO BE OUTSIDE THE WETTED LIMIT UPON LATER REINTRODUCTION OF WATER.
7. DISPERSE NATIVE SEED MIX ACROSS ALL DISTURBED AND NEWLY TOPSOILED SURFACES. SEE DRAWING 005 FOR COMPOSITION OF SEED MIX.
8. INSTALL AND SECURE (USING UNTREATED WOODEN STAKES) BIODEGRADABLE EROSION CONTROL BLANKET OVER ANY SLOPES WITHIN THE AREA OF DISTURBANCE (OUTSIDE THE WETTED ARM/CHANNEL) TO ALLOW VEGETATION TO ESTABLISH AND NATURALLY STABILIZE THE SOIL AND GROUND SURFACE.
9. EXCAVATED MATERIAL FROM CONNECTOR ARM / CHANNEL TO BE STOCKPILED AND USED AS BULK MATERIAL FOR THE LAKE 16 BERM, IF APPROPRIATE.

REFER TO SHEET 011 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 012 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	ISSUED FOR REVIEW	APR 23, 2021	JL	MF
B	ISSUED FOR REVIEW	MAY 21, 2021	JL	MF
C	ISSUED FOR REVIEW	JUNE 2, 2021	JL	MF
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E	ISSUED FOR CONSTRUCTION	JULY 7, 2021	JL	MF
F	ISSUED FOR CONSTRUCTION	JUNE 9, 2022	JL	MF

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SCALE:
1:1,500 — 0 30 90m
1:1,250H 1:625V — 0 25 75m / 0 12.5 37.5m
1:400H 1:200V — 0 8 24m / 0 4 12m

DESIGNED:	MB & RM
DRAWN:	JL
CHECKED:	MF
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LAKE 15 & 16 CONNECTOR ARM/CHANNEL
CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN
STAGE 2

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-10
DRAWING NO.	007
SHEET:	7 OF 12
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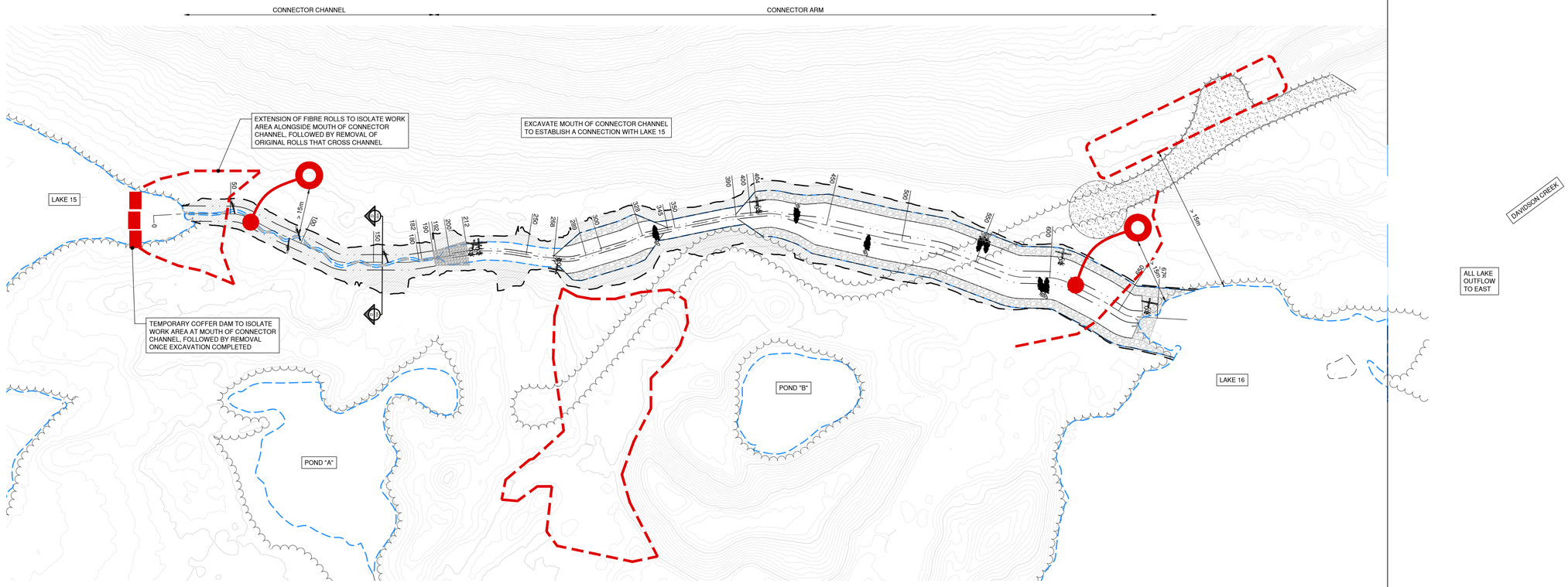
DATE: 11/05/2021 4:17 PM BY: Jesse Lutz

NOT FOR CONSTRUCTION

STAGE 3 - CONNECTION OF CONNECTOR CHANNEL TO LAKE 15



STAGE 3 - CONNECTION OF CONNECTOR CHANNEL TO LAKE 15

1. LIMIT STAGE 3 WORKS TO THE USE OF ONLY SMALL/LIGHTWEIGHT MACHINERY (E.G. BOBCAT OR EQUIVALENT) TO MINIMIZE DISTURBANCE TO CONNECTOR ARM/CHANNEL.
2. ENCLOSE THE SMALL WORK AREA WITH FIBRE ROLLS TO THE LAKE 15 SHORELINE, WHERE THE COFFER DAM WILL BE INSTALLED.
3. INSTALL A COFFER DAM AT THE SHALLOW SHORE OF LAKE 15, ABUTTING THE FIBRE ROLLS, TO ISOLATE THE WORK AREA PRIOR TO CONNECTION TO THE CONNECTOR CHANNEL MOUTH. SEE DRAWING 012 FOR COFFER DAM DETAILS.
4. CAREFULLY EXCAVATE THE MOUTH OF THE CONNECTOR CHANNEL TO ESTABLISH A CONNECTION WITH LAKE 15. ALLOW WATER FROM LAKE 15 TO SLOWLY ENTER THE MOUTH OF THE CONNECTOR CHANNEL.
5. CAREFULLY REMOVE THE COFFER DAM ONCE ANY FINE-GRAINED SEDIMENT HAS SETTLED OUT OF SUSPENSION WITHIN THE ISOLATED AREA.
6. TRANSPORT THE COFFER DAM MATERIALS AND ANY EXCESS SOILS TO THE APPROPRIATE LOCATION.
7. MANUALLY RESTORE ANY DISTURBED PORTIONS OF THE CONNECTOR ARM/CHANNEL.

REFER TO SHEET 011 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 012 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS

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CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN
STAGE 3

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-10
DRAWING NO.	008
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REV	F

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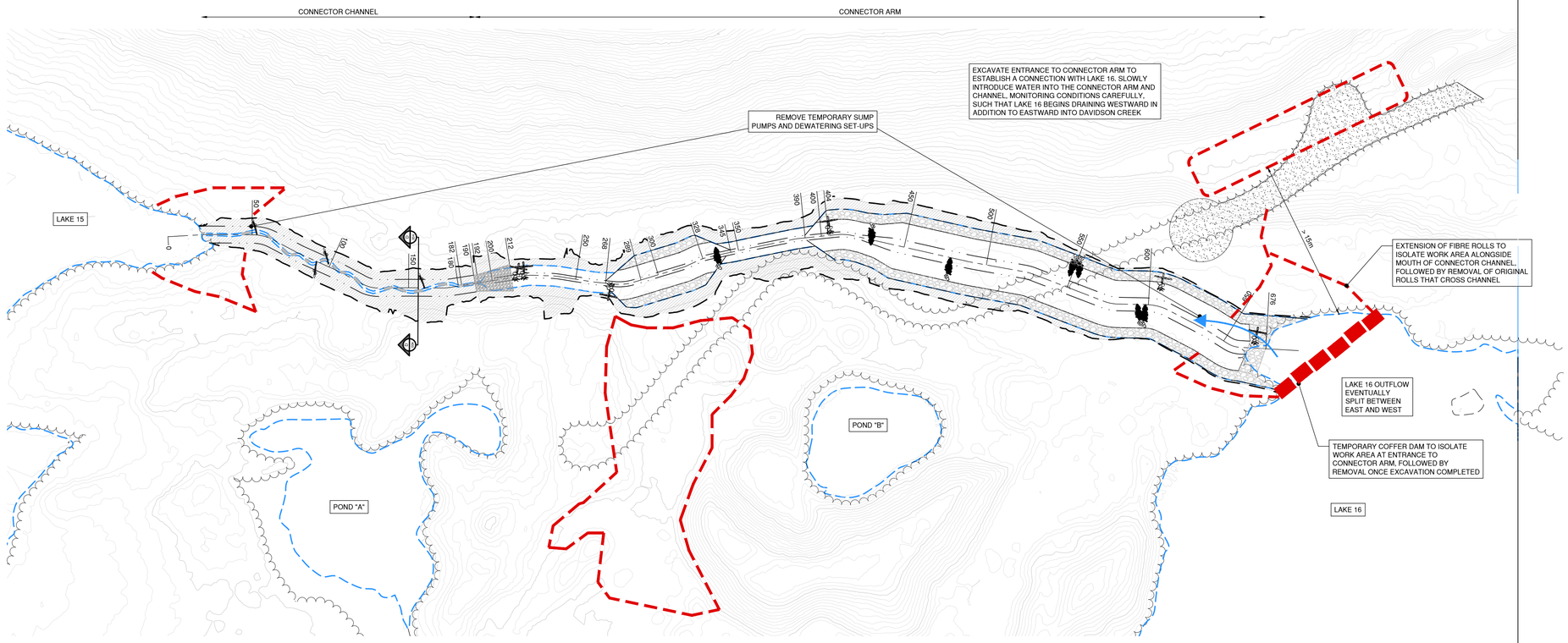
STAGE 4 - CONNECTION OF CONNECTOR ARM TO LAKE 16



STAGE 4 - CONNECTION OF CONNECTOR ARM TO LAKE 16

1. LIMIT STAGE 4 WORKS TO THE USE OF ONLY SMALL/LIGHTWEIGHT MACHINERY (E.G. BOBCAT OR EQUIVALENT) TO MINIMIZE DISTURBANCE TO CONNECTOR ARM.
2. ENCLOSE THE SMALL WORK AREA WITH FIBRE ROLLS TO THE LAKE 16 SHORELINE, WHERE THE COFFER DAM WILL BE INSTALLED.
3. INSTALL A COFFER DAM AT THE SHALLOW SHORE OF LAKE 16, ABUTTING THE FIBRE ROLLS, TO ISOLATE THE WORK AREA PRIOR TO CONNECTION TO THE ENTRANCE TO THE CONNECTOR ARM. SEE DRAWING 012 FOR COFFER DAM DETAILS.
4. CAREFULLY EXCAVATE THE ENTRANCE TO THE CONNECTOR ARM TO ESTABLISH A CONNECTION WITH LAKE 16.
5. INCREMENTALLY LOWER AND ULTIMATELY REMOVE THE COFFER DAM TO ALLOW WATER FROM LAKE 16 TO SLOWLY ENTER THE CONNECTOR ARM.
6. MONITOR THE INTRODUCTION OF FLOW FROM THE CONNECTOR ARM INTO THE CONNECTOR CHANNEL. LAKE 16 WILL NOW BE TEMPORARILY DRAINING OUT OF BOTH THIS NEW OUTLET AND ITS NATURAL OUTLET TO THE EAST.
7. REMOVE THE TEMPORARY SUMP PUMP AND DEWATERING SET-UPS.
8. TRANSPORT THE COFFER DAM MATERIALS AND ANY EXCESS SOILS TO THE APPROPRIATE LOCATION.
9. MANUALLY RESTORE ANY DISTURBED PORTIONS OF THE EASTERN END OF THE CONNECTOR ARM.

REFER TO SHEET 011 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 012 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS

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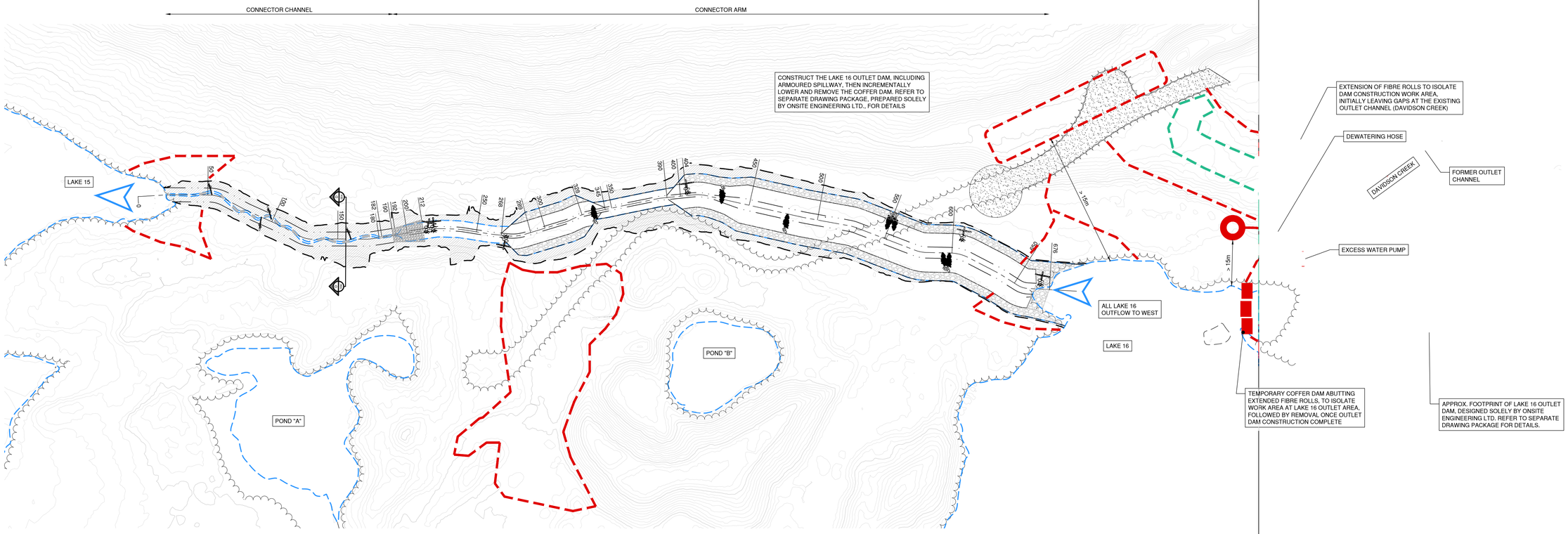
STAGE 5 - CONSTRUCTION OF LAKE 16 OUTLET DAM AND PERMANENT FLOW DIVERSION



STAGE 5 - CONSTRUCTION OF LAKE 16 OUTLET DAM AND PERMANENT FLOW DIVERSION

1. INSTALL FIBRE ROLLS TO ENCLOSE WORK AREA FOR LAKE 16 OUTLET DAM CONSTRUCTION, EXTENDING DOWNSLOPE FROM THE EXISTING EXPLORATION/ACCESS ROAD. GAPS TO REMAIN AT CROSSINGS OF DAVIDSON CREEK.
2. INSTALL A COFFER DAM AT THE SHALLOW SHORE OF LAKE 16, ABUTTING THE FIBRE ROLLS AS APPROPRIATE, TO ISOLATE THE WORK AREA AND DIVERT ALL OUTFLOW FROM LAKE 16 WESTWARD INTO THE CONNECTOR ARM/CHANNEL AND LAKE 15. SEE DRAWING 012 FOR COFFER DAM DETAILS.
3. A QUALIFIED PROFESSIONAL WITH THE APPROPRIATE LICENSE IS TO CONDUCT A FISH SALVAGE ALONG THE HEADWATER REACH OF DAVIDSON CREEK TO BE ABANDONDED IN ASSOCIATION WITH MINE SITE DEVELOPMENT, LIVE RELEASING ANY CAPTURED FISH AT A PRE-APPROVED LOCATION.
4. INSTALL A TEMPORARY SUMP PUMP, UPSTREAM OF THE DAM LOCATION, TO WITHDRAW SEDIMENT-LADEN SEEPAGE WATER FROM THE FORMER OUTLET CHANNEL. WATER TO BE PUMPED TO FILTER BAG IN WELL VEGETATED AREA ENCLOSED BY FIBRE ROLLS MORE THAN 15m AWAY FROM A WATERBODY.
5. FILL THE SMALL GAP IN THE FIBRE ROLL AT THE DOWNSTREAM CROSSING OF DAVIDSON CREEK.
6. CONSTRUCT THE LAKE 16 DAM, INCLUDING ARMOURED SPILLWAY. SEE DRAWINGS 012 FOR DETAILS.
7. INCREMENTALLY LOWER AND ULTIMATELY REMOVE THE COFFER DAM TO ALLOW WATER FROM LAKE 16 TO SLOWLY INUNDATE THE FORMER OUTLET CHANNEL UPSTREAM OF THE DAM.
8. TRANSPORT THE COFFER DAM MATERIALS AND ANY EXCESS SOILS TO THE APPROPRIATE LOCATION.
9. RESTORE ANY DISTURBED PORTIONS OF GROUND WITHIN THE WORK AREA.

***NOTE: TEMPORARY EROSION & SEDIMENT CONTROL MEASURES TO BE REMOVED ONCE AREA STABILIZED. ALL DISTURBED RIPARIAN/FLOODPLAIN AREAS, INCLUDING BUT NOT LIMITED TO ACCESS ROADS AND LAYDOWN AREAS, TO BE SEEDED/RESTORED AS NEEDED TO PRE-EXISTING CONDITIONS OR BETTER.

REFER TO SHEET 011 FOR FIBRE ROLL DETAILS.

REFER TO SHEET 012 FOR COFFER DAM, FILTER BAG, DE-WATERING HOSE, & DE-WATERING SUMP PUMP DETAILS

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CONSTRUCTION STAGING, WORK AREA ISOLATION AND ESC PLAN
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CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-4-10
DRAWING NO.	010
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REV	F

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SEDIMENT CONTROL BARRIERS

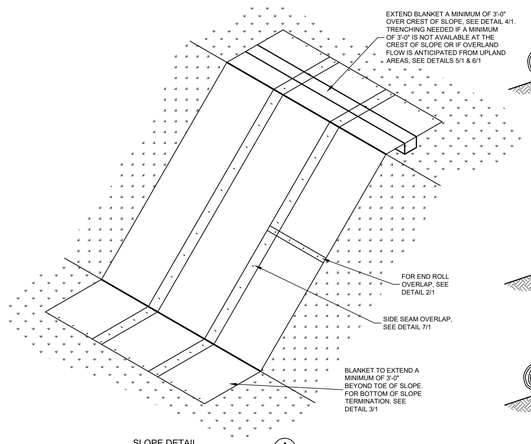
OPTION 1 - FIBRE ROLL

- FIBRE ROLL (E.G FILTREXX SILTSOXX OR APPROVED EQUIVALENT), FILLED WITH WOOD CHIPS, ARE THE PREFERRED TYPE OF SEDIMENT CONTROL BARRIER.
- MIN. DIAMETER = 300mm
- FIBRE ROLLS TO BE REGULARLY INSPECTED FOR TEARS OR HOLES, AND REPAIRED / REPLACED AS NEEDED TO MAINTAIN FUNCTION.
- FIBRE ROLLS MAY BE RE-USED IN A DIFFERENT LOCATION, ONLY IF THEY REMAIN FREE OF TEARS / HOLES, HAVE NOT LOST ANY OF THEIR CONTENTS, AND STILL MAINTAIN THE MINIMUM DIAMETER.
- REMOVE ALL SURFACE OBSTRUCTIONS GREATER THAN 50mm FROM THE GROUND PRIOR TO PLACING FIBRE ROLLS.
- TYPICAL FIBRE ROLL INSTALLATION DETAILS ARE SHOWN ON THIS SHEET FOR A FILTREXX SILTSOXX FIBRE ROLL. THE CONTRACTOR MAY USE THIS BRAND OF FIBRE ROLL OR AN APPROVED EQUIVALENT.

OPTION 2 - SEDIMENT CONTROL FENCE

- SEDIMENT CONTROL FENCE SUPPLIES SHOULD BE AVAILABLE ON SITE FOR USE IN CASES WHERE SURFACE PONDING OCCURS AND ADDITIONAL SILTATION CONTROL IS WARRANTED BEYOND WHAT THE FIBRE ROLLS CAN PROVIDE.
- GEOTEXTILE TO BE NON-WOVEN WITH A MINIMUM EQUIVALENT OPENING SIZE OF 0.15mm AND A MAXIMUM EQUIVALENT OPENING SIZE OF 0.25mm.
- NON-WOVEN GEOTEXTILE TO HAVE A HORIZONTAL OVERLAP OF 1 METER AT JOINTS.
- TYPICAL SEDIMENT CONTROL FENCE INSTALLATION DETAILS ARE SHOWN ON THIS SHEET. THESE DETAILS REPRESENT IDEAL SCENARIOS. ACTUAL SITE CONDITIONS MAY VARY AND SEDIMENT CONTROL FENCE INSTALLATION SHOULD BE TAILORED FOR EACH SITE.

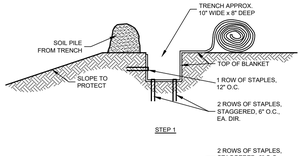
EROSION CONTROL BLANKET - TYPICAL DETAILS

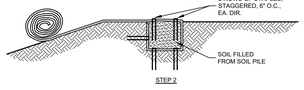


SLOPE DETAIL
NO SCALE — 1/1

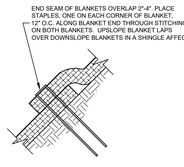
OVER SLOPE
CREST METHOD
NO SCALE — 4/1

DO NOT NEED TO TRENCH BLANKET IN IF IT CAN BE EXTENDED A MINIMUM OF 3'-0" OVER THE CREST OF THE SLOPE.

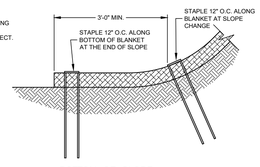




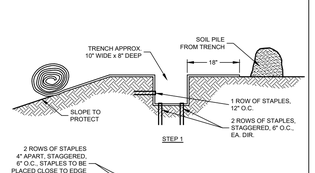
SLOPE TRENCHING
METHOD "A"
NO SCALE — 5/1

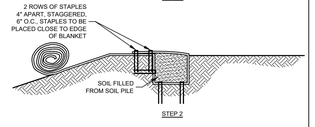


END ROLL OVERLAP
NO SCALE — 2/1



BOTTOM OF SLOPE
TERMINATION
NO SCALE — 3/1

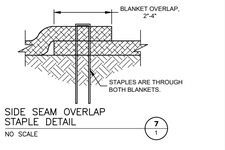




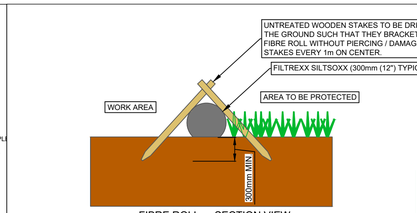
SLOPE TRENCHING
METHOD "B"
NO SCALE — 6/1

EROSION CONTROL BLANKETS

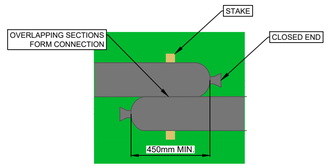
- BIODEGRADABLE EROSION CONTROL BLANKETS (E.G WOVEN JUTE, COIR MESH, GREAT LAKES ASPEN, ETC) TO BE AVAILABLE ON SITE IN CASE THEY ARE NEEDED TO HELP MITIGATE EROSION OF TEMPORARILY EXPOSED SOILS ON THE FLOODPLAIN
- DRAWINGS SHOWN ON THIS SHEET ILLUSTRATE TYPICAL INSTALLATION DETAILS FOR AN AMERICAN EXCELSIOR CURLEX NETFREE SLOPE PROTECTION EROSION CONTROL BLANKET. THE CONTRACTOR MAY USE THIS BRAND OF EROSION CONTROL BLANKET OR AN APPROVED EQUIVALENT.



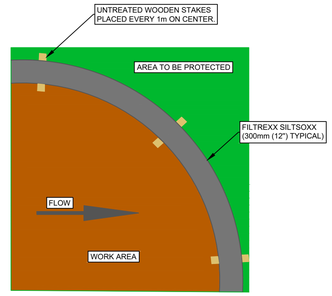
SIDE SEAM OVERLAP
STAPLE DETAIL
NO SCALE — 7/1



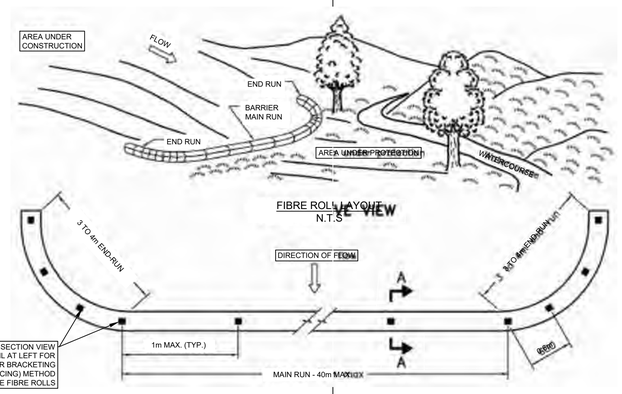
FIBRE ROLL - SECTION VIEW
N.T.S



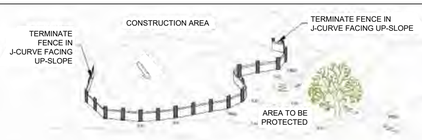
FIBRE ROLL - END CONNECTION DETAIL
N.T.S



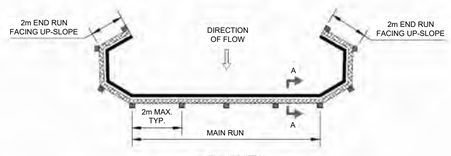
FIBRE ROLL - PLAN VIEW
N.T.S



FIBRE ROLL LAYOUT - PLAN VIEW
N.T.S



PERSPECTIVE VIEW
N.T.S



PLAN VIEW
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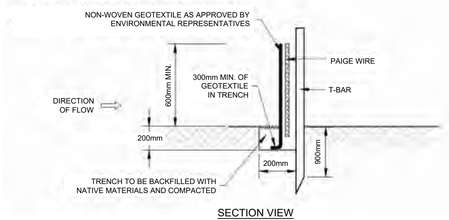

SECTION VIEW
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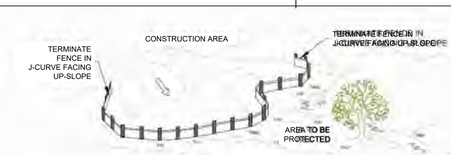
SEDIMENT CONTROL FENCE - UNFROZEN CONDITIONS



PERSPECTIVE VIEW
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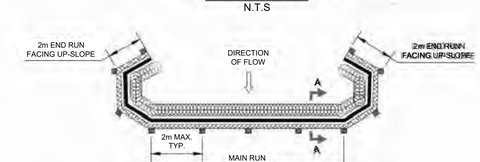

PLAN VIEW
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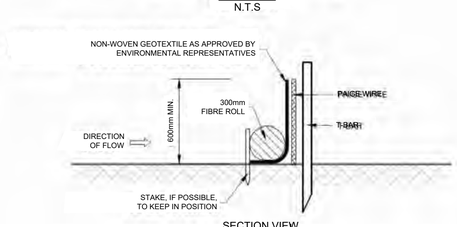

SECTION VIEW
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SEDIMENT CONTROL FENCE - FROZEN CONDITIONS

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A	ISSUED FOR REVIEW	APR 23, 2021	JL	MF
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D	ISSUED FOR REVIEW	JUNE 9, 2021	JL	MF
E	ISSUED FOR PERMIT APPROVAL	JULY 7, 2021	JL	MF
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VANCOUVER, BC V6C 1V5
PH.: 604-629-9075

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INTERIOR OPERATIONS
#201 - 231 TRANS CANADA HIGHWAY
PO BOX 2012, SALMON ARM, BC, V1E 4R1
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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN
LAKE 15 & 16 CONNECTOR ARM/CHANNEL
SEDIMENT CONTROL BARRIERS & EROSION CONTROL
BLANKET DETAILS FOR CHANNEL WORKS

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-10
DRAWING NO. 011
SHEET: 11 OF 12
REV F

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DATE: 25/11/2020 5:12 PM BY: Jesse Lutz

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WORK AREA ISOLATION MEASURES

METRE BAG COFFER DAM

- FOR ISOLATION OF THE LOCALIZED SHORELINE WORK AREAS TO FACILITATE CONNECTION OF THE CONNECTOR CHANNEL AND ARM TO LAKE 15 AND LAKE 16, RESPECTIVELY.
- 1-2 TIER, SINGLE-STACK METRE BAG COFFER DAM PREFERRED GIVEN MINIMAL DISTURBANCE; PYRAMID-STACK METRE BAG COFFER DAM MAY BE NECESSARY IN DEEPER-WATER SCENARIOS.
- METRE BAGS SHOULD BE FILLED WITH PEA GRAVEL AND SHOULD NOT BE OVER-FILLED.
- A WATERPROOF MEMBRANE IS REQUIRED OVER THE PEA-GRAVEL METRE BAGS. THE WATERPROOF MEMBRANE MUST BE KEYED IN UNDER THE BARRIER TO MINIMIZE LEAKAGE.
- COFFER DAM MAY BE CONSTRUCTED OF SMALLER PEA-GRAVEL SANDBAGS OR OTHER SUITABLE EQUIVALENT. SEE BELOW FOR DETAILS.
- CONTRACTOR SHOULD CHECK EXACT SHORELINE DEPTH BEFORE CONFIRMING APPROPRIATE COFFER DAM APPROACH.

PEA GRAVEL COFFER DAM

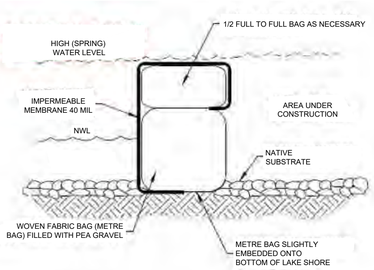
- CAN BE USED AT THE DISCRETION OF THE ENVIRONMENTAL REPRESENTATIVE FOR LOCALIZED ISOLATION OF LAKE SHORE IN, SHALLOW WATER CONDITIONS WHEN LOCAL WORKS CAN BE COMPLETED WITHIN A FAVORABLE WEATHER WINDOW.

DE-WATERING SUMP PUMP

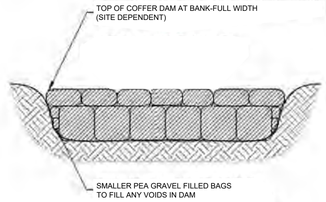
- FOR TEMPORARY MAINTENANCE OF DRY OR SHALLOWER CONDITIONS WITHIN AN ISOLATED WORK AREA.
- A PUMP WITH A MINIMUM RECOMMENDED PUMPING CAPACITY OF 2000GPM MUST BE USED.
- DURING ELEVATED FLOWS, ALL PUMPING WILL BE STOPPED AND COFFER DAMS WILL BE TEMPORARILY REMOVED TO ALLOW FLOWS TO PASS UNOBSTRUCTED.

DE-WATERING FILTER BAG RINGED WITH FILTREXX SILTSOXX (OR APPROVED EQUIVALENT)

- FOR CONTROLLED DEPOSITION OF FINE SEDIMENT PUMPED OUT OF AN ISOLATED WORK AREA, AWAY FROM ANY WATERBODY.
- PLACE FILTER BAG (3.5m X 5.0m TERRAFIX ENVIROBAG OR APPROVED EQUIVALENT) ON A LEVEL, STABILIZED AREA, ON VEGETATED GROUND > 15m AWAY FROM THE CHANNEL. FILTREXX SILTSOXX (300mm (12") DIAMETER) OR APPROVED EQUIVALENT TO BE PLACED AROUND THE FILTER BAG.
- ISOLATED SECTION OF CHANNEL/ARM TO BE PUMPED AND DE-WATERED INTO FILTER BAG.
- REPLACE UNIT WHEN HALF FULL OF SEDIMENT OR WHEN SEDIMENT HAS SIGNIFICANTLY REDUCED THE FLOW RATE OF PUMP DISCHARGE.
- ALLOW SEDIMENT BAG TO DRY IN DESIGNATED SEDIMENT DRYING AREA AND THEN RE-USE THE SEDIMENT AS PART OF RESTORATION OR DISPOSE OF IT OFF SITE UNDER DIRECTION OF THE ON-SITE ENVIRONMENTAL REPRESENTATIVE.



METRE BAG COFFER DAM - SECTION
N.T.S



METRE BAG COFFER DAM - PROFILE
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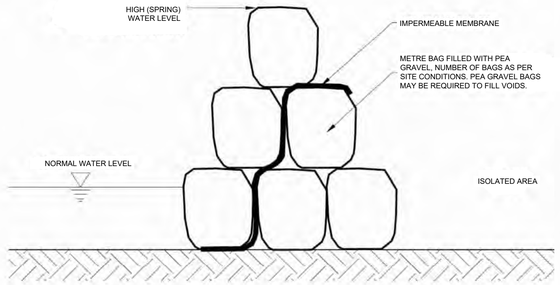

METRE BAG WATERPROOF ISOLATION BARRIER - SECTION
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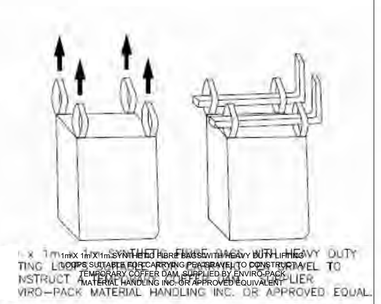
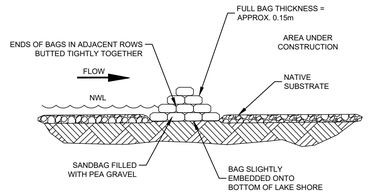


PEA GRAVEL METRE BAG HANDLING
N.T.S



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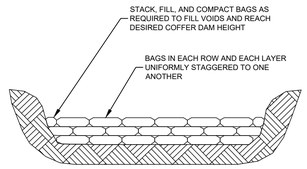
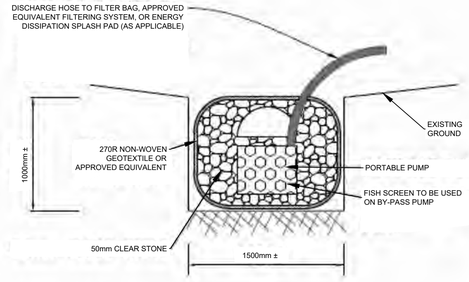


PEA GRAVEL BAG COFFER DAM - PROFILE
N.T.S



DE-WATERING SUMP PUMP DETAIL
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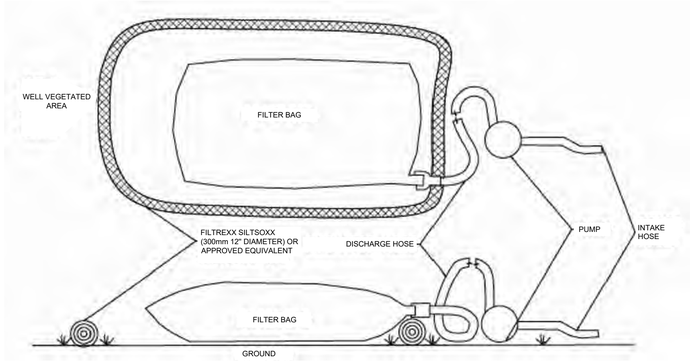

DE-WATERING FILTER BAG WITH FILTREXX SILTSOXX - PLAN & PROFILE
N.T.S

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LAKE 15 & 16 CONNECTOR ARM/CHANNEL
WORK AREA ISOLATION MEASURES

CLIENT PROJECT NO. 2006501
OEL PROJECT NO. 1824-4-10
DRAWING NO. 012
SHEET: 12 OF 12
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DATE: 2021.12.2020.5:12 PM BY: Jesse Lutz

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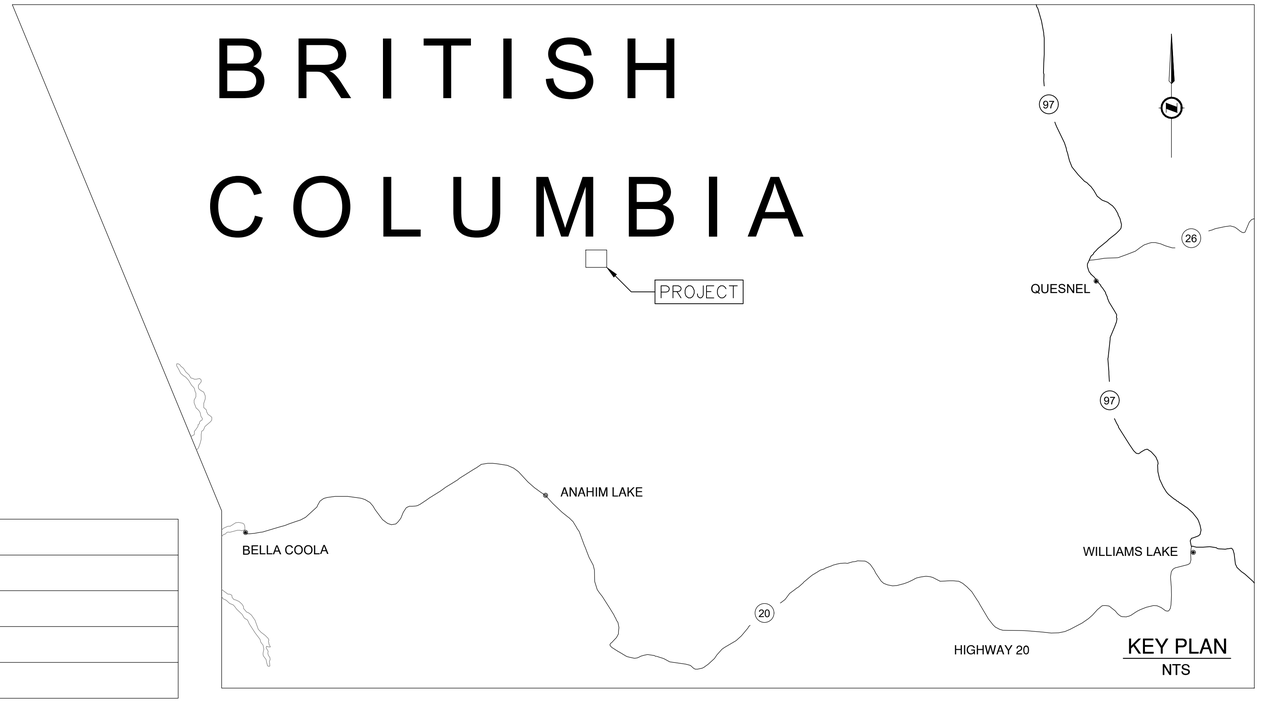
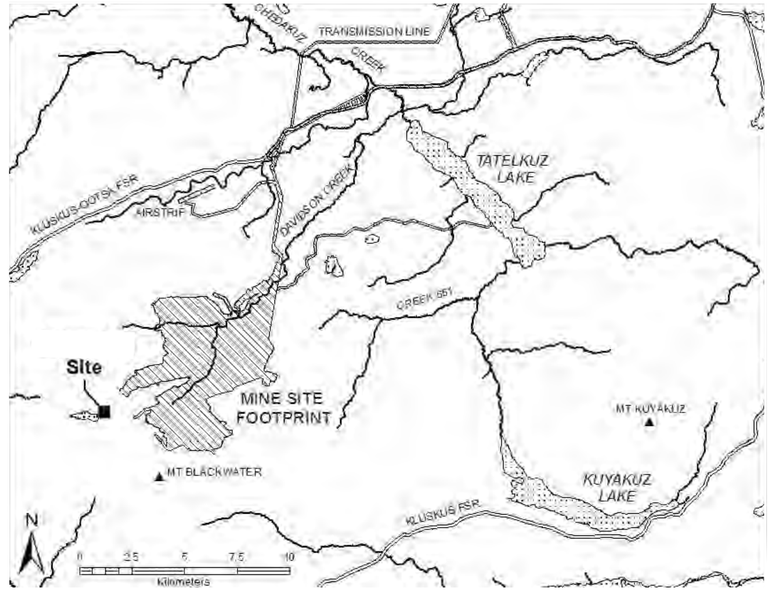
BLACKWATER PROJECT - LAKE 16 DAM - CONCEPT

ISSUED FOR PERMIT APPROVAL

DRAWING INDEX	
SHEET No.	SHEET TITLE
1824-3-8-001	TITLE PAGE
1824-3-8-002	GENERAL NOTES AND PLAN OVERVIEW
1824-3-8-003	PLAN, PROFILE, AND TYPICAL SECTION



KEY PLAN
NTS



LOCATION PLAN
NTS

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DATE: 2021-12-6 3:46 PM BY: Andrew Bridgett

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GENERAL

- CONCEPTUAL DESIGN ONLY. ALL DESIGN ELEVATIONS FOR DAM CREST, SPILLWAY, AND FLOOD EVENTS TO BE CONFIRMED DURING DETAILED DESIGN. ELEVATIONS ARE BASED ON LIMITED SITE INVESTIGATION AND CONCEPTUAL WATER MODELS BY KNIGHT PIESOLD LTD. TO BE UPDATED DURING THE ISSUED FOR CONSTRUCTION DESIGN PHASE.

LAYDOWNS & ACCESS ROADS

- DAM ACCESS ROAD TO CONNECT TO EXISTING ACCESS ROAD FROM THE MINE SITE AREA.
- ALL LAYDOWNS AND ACCESS ROADS ARE TEMPORARY IN NATURE AND ARE ONLY REQUIRED FOR THE DURATION OF DAM WORKS AND OPERATION, INCLUDING MAINTENANCE, INSPECTIONS, AND DECOMMISSIONING DURING THE MINE RECLAMATION PHASE.
- FINAL LOCATION, SIZE, AND SPECIFICATIONS OF LAYDOWN AREAS AND ACCESS ROADS ARE TO BE REFINED BY THE CONTRACTOR AS REQUIRED. DEPENDING ON CONDITIONS AT THE TIME OF CONSTRUCTION, ACCESS MAY BE A VARIETY OF RIG MATS, FROZEN GROUND, OR BUILT UP GRAVEL ACCESS ROADS WITH GEOGRID.
- AVOID DISTURBANCE TO ANY EXISTING HERITAGE FEATURES

GENERAL STREAM NOTES

- WATER SURFACE ELEVATIONS IN THE LAKES WERE ESTIMATED BASED ON RESULTS OF LOCAL RTK GPS SURVEY AND UNMANNED AERIAL VEHICLE (I.E. DRONE) SURVEY, CONDUCTED BY DWB CONSULTING SERVICES LTD. ON SEPTEMBER 6, 2016.

FLOODPLAIN SOILS

- NO DRILLING OR TEST PITTING HAS BEEN COMPLETED TO INVESTIGATE SOILS WITHIN THE VALLEY BOTTOM FLOODPLAIN SEDIMENTS WHERE DAM WORKS ARE PROPOSED. SOIL MATERIAL TYPES, DEPTHS, AND BORROW SOURCE ASSESSMENTS TAKEN FROM KNIGHT PIESOLD'S *GEOTECHNICAL CHARACTERIZATION REPORT* DATED NOVEMBER 2013. CONDITIONS TO BE VERIFIED BY GEOTECHNICAL INVESTIGATION ALONG THE PROPOSED DAM ALIGNMENT. BEDROCK IS ESTIMATED TO BE BETWEEN 6-10m DEEP IN THE PROPOSED DAM AREA.
- FURTHER REVIEW OR TESTING OF BORROW SOURCE MATERIAL MAY BE REQUIRED FOR THE LOW PERMEABILITY/LINER BEDDING AND TRANSITION LAYERS.

SURVEY NOTES

DATUM: NAD 83 (CSRS) 2002.0

UTM ZONE: 10

THE SURVEY DATA USED TO CREATE THE TIN SURFACE FOR THIS DESIGN WAS PROVIDED TO ONSITE ENGINEERING LTD. BY PALMER. SURVEY DATA INCLUDES LIDAR DATA COLLECTED BY EAGLE MAPPING LTD. AUGUST 8-9, 2011 AND RTK DATA COLLECTED BY DWB CONSULTING SERVICES LTD. SEPTEMBER 6, 2017.

DESIGN GUIDELINES

DAM DESIGN FOLLOWS THE BRITISH COLUMBIA DAM SAFETY REGULATION INCLUDING PART 3 FOR DAMS OVER 2.5m IN HEIGHT.

DESIGN TEAM

ENGINEERING - ONSITE ENGINEERING LTD. MICHAEL FOSTER, P.ENG., KEVIN LEOPOLD, P.ENG.

RELATED DOCUMENTS

PALMER COMPLETED DESIGN OF CONNECTOR CHANNEL SEE LAKE 15 & 16 CONNECTOR CHANNEL PACKAGE.

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BLACKWATER PROJECT - SCHEDULE 35 FISHERIES OFFSETTING PLAN

LAKE 16 DAM - CONCEPT

GENERAL NOTES

CLIENT PROJECT NO. 2006501

OEL PROJECT NO. 1824-3-13

DRAWING NO. 002

SHEET: 2 OF 3 REV B

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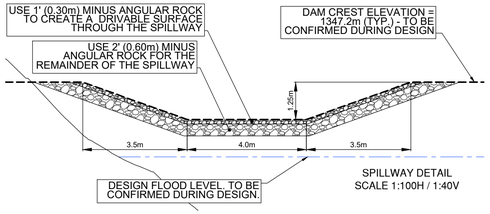
MATERIAL QUANTITIES (UNFACTORED BANK VOLUME)	
TYPE	**VOLUME (m³)**
STRIPPING (ACCESS ROAD AND DAM)	1522
STRIPPING (DAM)*	831
CUT (CONCEPTUAL ACCESS ROAD AND DAM)	1792
CUT (DAM)*	164
BULK FILL (INCL. KEY)	4438 (ASSUME ALL MATERIAL SOURCED FROM CONNECTOR ARM / CHANNEL EXCAVATION
LOW PERMEABILITY LAYER	378
TRANSITION LAYER	378
ROAD COURSE	141
GRAVEL BERMS	32
TOE ANCHOR TRENCH DRAIN FILL (INCL. x2)	550
SPILLWAY 1' MINUS	26
SPILLWAY 2' MINUS	64

*DAM ONLY, DOES NOT INCLUDE ACCESS ROAD. DO NOT ADD TO ACCESS ROAD AND DAM VOLUMES.



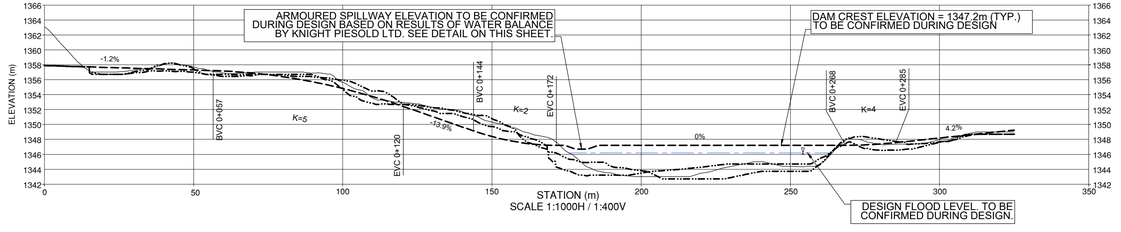
SPILLWAY DETAIL
SCALE 1:100H / 1:40V

PLAN
SCALE 1:1000

LEGEND

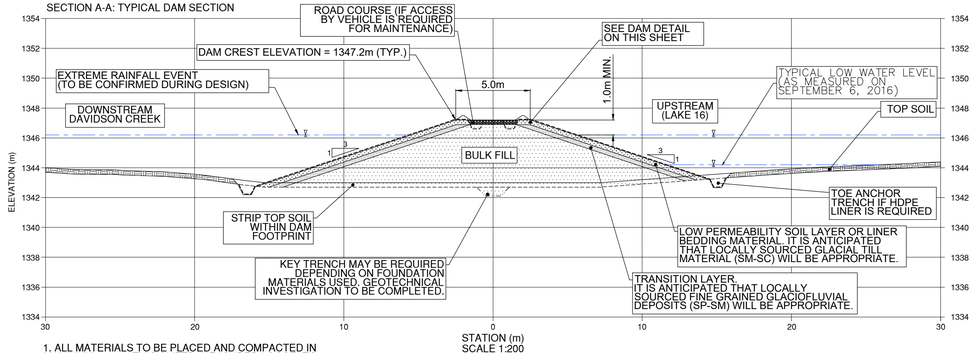
- PROPOSED ROAD / DAM CENTRELINE
- PROPOSED ROAD / DAM EDGES
- EXTENTS OF TOPSOIL STRIPPING / CUT / FILL
- EXISTING ACCESS ROAD EDGES
- EXISTING CHANNEL CENTRELINE
- PRESENT WATER LEVEL
- CONTOUR (1m INTERVAL)
- HDPE LINER
- STRIPPING
- DESIGN LAKE LEVEL (HIGH WATER)

DAM PROFILE



SCALE 1:1000H / 1:400V

SECTION A-A: TYPICAL DAM SECTION

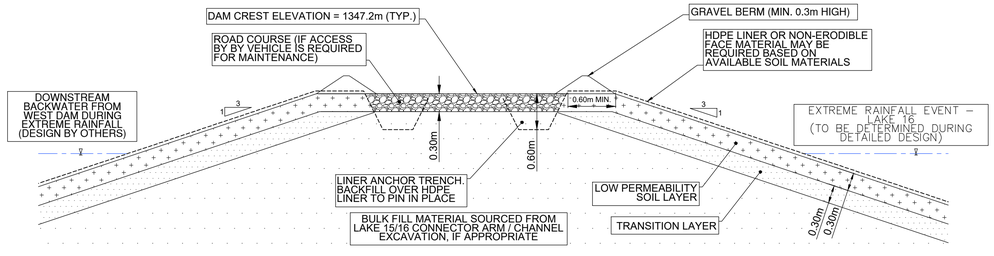


SCALE 1:200

1. ALL MATERIALS TO BE PLACED AND COMPACTED IN MAXIMUM 200mm THICK LIFTS (MEASURED LOOSE) TO MINIMUM 98% STANDARD PROCTOR MAXIMUM DRY DENSITY.

2. BULK FILL, TRANSITION LAYER, AND LOW PERMEABILITY LINER BEDDING MATERIAL DETAILS TO BE REFINED FOLLOWING SITE INVESTIGATION.

SECTION A-A: DAM DETAIL
SCALE 1:50



NOTES:

1. SITE PLAN PREPARED BY DWB CONSULTING SERVICES LTD. BASED ON BLENDING RESULTS OF LOCAL RTK GPS SURVEY, CONDUCTED ON SEPTEMBER 6, 2016, WITH BROADER, HIGH-RESOLUTION LIDAR-DERIVED ELEVATION DATA ACQUIRED BY EAGLE MAPPING LTD. ON AUGUST 8-9, 2011. STATIC DATA WAS OBTAINED AND CORRECTED TO CSRS-PPP (CANADIAN SPATIAL REFERENCE SYSTEM PRECISE POINT POSITIONING). COORDINATE SYSTEM NAD83 UTM ZONE 10.
2. ORTHOIMAGERY CAPTURED BY EAGLE MAPPING LTD. ON AUGUST 8-9, 2011.
3. PRESENT WATER LINE INTERPRETED FROM PHOTOGRAMMETRY, SHOWN FOR ILLUSTRATIVE PURPOSES ONLY.
4. MAXIMUM LAKE WATER ELEVATION AND FINAL DAM CREST ELEVATION TO BE DETERMINED THROUGH DETAILED HYDROLOGY ASSESSMENT (BY OTHERS).

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SCALE:
1:50 (0, 1, 3m)
1:200 (0, 4, 12m)
1:1,000 (0, 20, 60m)

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LAKE 16 DAM - CONCEPT

PLAN, PROFILE, AND TYPICAL SECTION

CLIENT PROJECT NO.	2006501
OEL PROJECT NO.	1824-3-13
DRAWING NO.	003
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Appendix O

Offsetting Plan CEMP

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

Blackwater Project

Offsetting Plan
Construction Environmental Management Plan

Palmer Project #
2006501

Prepared For
BW Gold Ltd.

September 16, 2021

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1. Introduction

BW Gold Ltd. (BW Gold) proposes to construct and operate the Blackwater Project (the Project), an open-pit gold and silver mine located 160 km southwest of Prince George and 110 km southwest of Vanderhoof in British Columbia (BC).

The Project received a Decision Statement on April 15, 2019, under the *Canadian Environmental Assessment Act*, 2012, and Environmental Assessment Certificate #M19-01 (Certificate) on June 21, 2019, under the *Environmental Assessment Act* (2002).

As part of the EAC Application, an effects assessment was completed for fish and fish habitat, which were identified as Valued Components (VCs). It was determined through this process that the Project will likely result in the death of fish or a harmful alteration, disruption, or destruction of fish habitat (HADD), as defined by the federal *Fisheries Act*.

Before construction can commence, the Project will require both an amendment of Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER) and an Authorization under Paragraph 35(2)(*b*) of the *Fisheries Act*. The amendment to Schedule 2 of the MDMER specifically applies to the loss of fish habitat in tailings impoundment areas resulting from the placement of mine waste. *The Fisheries Act* authorization addresses all other effects on fish and fish habitat resulting from Project activities.

A Conceptual Fisheries Mitigation and Offsetting Plan was prepared as part of the Environmental Assessment Application, which outlined Project activities, effects, and offsetting measures proposed at the time of the Application submission (AMEC, 2014; Appendix.5.1.2.6C of the Application). The Conceptual Offsetting Plan has been updated based on comments received from Fisheries and Oceans Canada (DFO) and the Ministry of Forests, Lands and Natural Resource Operations and Rural Development and separated into two plans: an Offsetting Plan for the *Fisheries Act* Authorization and a Compensation Plan for the amendment to Schedule 2 of MDMER. This Construction Environmental Monitoring Plan (CEMP) addresses monitoring of the created and restored fish habitat that is proposed in the *Fisheries Act* Authorization Offsetting Plan. A separate CEMP has been prepared for the Compensation Plan for the MDMER Schedule 2 amendment.

The Offsetting Plan applies DFO's guiding principles, as outlined in its *Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act* (DFO, 2019), and primarily focuses on restoring/enhancing/maintaining fish habitat as stated in paragraph 34.1(1)(f) of the *Fisheries Act*. The Offsetting Plan includes five separate measures to offset the loss of fish habitat resulting from Project activities:

- Greer Creek Stream Restoration/Enhancement
- Murray Creek Stream Restoration/Enhancement
- Creek 661 Off-channel Overwintering Pond
- Flow Augmentation in Davidson Creek from the Freshwater Supply System (FWSS)
- Lake 15/16 Connector Channel

This CEMP outlines the environmental protection measures and mitigation proposed to minimize risk to local and downstream fish and fish habitat during the construction of offsetting habitat proposed in the *Fisheries Act* Authorization Offsetting Plan. Specifically, it applies to construction of four of the five offset measures: Greer and Murray creek restoration/enhancement, Creek 661 off-channel overwintering pond construction, and Lake 15/16 connector channel construction. Flow augmentation in Davidson Creek will be provided by components of the Project's water management infrastructure, and as such, will be addressed by a separate Project-wide Construction Environmental Management Plan required under BC Environmental Assessment Condition #13 during Project construction.

A separate CEMP has been prepared for the construction of compensation measures for MDMER Schedule 2 amendment. All other Project-wide environmental management plans and commitments will be adhered to, in addition to this CEMP, during the construction of the offsetting measures.

1.1 Proposed Offsetting Measures

A brief description of the four proposed offsetting measures is provided below. Detailed design drawings for these measures are provided in Appendix E of the *Fisheries Act* Authorization Offsetting Plan application package.

1.1.1 Murray Creek Habitat Enhancement

Murray Creek is a third-order stream that flows south from its headwaters for approximately 15 km and enters the north bank of the Nechako River at Vanderhoof. The Murray Creek watershed area is 12,056 ha, of which 6,188 ha is in the Agricultural Land Reserve. Restoration is proposed on approximately 2.3 km of Murray Creek, starting 4.5 km upstream from the Nechako River. There are two land parcels (i.e., landowners) along the 2.3 km.

Murray Creek has been impacted by past and current agricultural activities, primarily livestock grazing. The creek has also been impacted by other anthropogenic activities in the watershed such as logging, water withdrawal, and alterations to natural drainage patterns. Impacts to the creek include lowered groundwater tables, lack of riparian vegetation, trampling and collapse of channel banks, and increased local and downstream instream sedimentation. Emergent and aquatic vegetation is abundant throughout much of the channel, obstructing water flow. Culverts along the channel (some of which are damaged) form partial obstructions to flow.

The Nechako Environment and Water Stewardship Society (NEWSS) formed the Murray Creek Rehabilitation Project in 2008 and has implemented restoration projects (e.g., fish passage enhancement at culvert crossings, bank restoration, habitat complexing) at other locations along Murray Creek (NEWSS, 2016). The proposed restoration/enhancement outlined in this Offsetting Plan will build on work already completed by NEWSS by extending improvements further upstream and increasing the continuity of properly functioning habitat.

Stream restoration and enhancement is proposed along 2.3 km of Murray Creek in multiple reaches where degraded habitat has been identified. The impacts of agricultural activity, in particular extensive cattle trampling, has resulted in a need to re-establish natural channel dimensions throughout the proposed

works. For the most part, the proposed channel planform resembles existing conditions. Gravel and boulder clusters are proposed throughout the proposed works to improve instream cover for fish, diversify substrate, and increase spawning potential. Woody debris is proposed in Murray Creek to improve cover and provide refuge during high flows. Fencing is proposed along both sides of the channel throughout the entire area of proposed works to restrict cattle access. Vehicle and cattle crossings and off-channel watering sites (located outside of the fencing) are proposed at strategic locations identified by the landowners.

Riparian vegetation planting is proposed where land adjacent to the stream is bare or has minimal vegetative cover. This will ensure that all instream habitat benefits from fully functioning riparian buffers. The riparian plantings will improve bank stability, provide aquatic food sources, and increase overhanging cover extending up to 15 m from the stream bank. The generally bare riparian areas are proposed to be enhanced with a combination of native seed mix and native tree and shrub plantings (Appendix E) whereas areas with sparse shrub cover are only proposed to be seeded. Densely vegetated areas, and areas with standing water, are proposed to be retained and protected.

The plant selection was based on field reconnaissance, aerial photograph interpretation, multiple years of drone imagery, common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

1.1.2 Greer Creek Habitat Enhancement

Greer Creek is a fifth-order stream that flows generally westward for much of its length and enters the Nechako River approximately 50 km southwest of Vanderhoof. The Greer Creek watershed area is 41,037 ha, and the creek length is approximately 55 km. Restoration is proposed along three sections of Greer Creek: i) lower Greer Creek, a 4.5 km section starting 4 km upstream from the Nechako River; ii) middle Greer Creek, a 3.1 km section, and iii) upper Greer Creek, an 8.6 km section, 24 km upstream from the Nechako River. There is only one landowner for the areas of proposed work along Greer Creek.

Greer Creek has been impacted by past and current agricultural activities, primarily livestock grazing. Impacts include localized trampling and collapse of channel banks, lack of riparian vegetation, and increased local and downstream instream sedimentation.

Channel narrowing and bank regrading are proposed to rehabilitate impacted areas. In lower Greer Creek, bed material throughout the reach is naturally dominated by gravels; however, gravel placement is proposed in strategic areas to support additional spawning habitat. Boulder clusters and woody debris are proposed throughout the lower section to improve cover and provide refuge during high flows. In middle Greer Creek, re-establishment of natural channel dimensions is proposed for the entire length of a small tributary draining Harlow Lake. Gravel and boulder clusters are proposed throughout the creek section to improve instream cover and spawning potential. Woody debris is also proposed to improve cover and provide refuge during high flows. In upper Greer Creek, gravel and boulder clusters are proposed throughout the creek section to improve instream cover and spawning potential. Woody debris is also proposed to improve cover and provide refuge during high flows.

Cattle-exclusion fencing is proposed throughout the sections of Greer Creek as follows:

- In lower Greer Creek, one vehicle/cattle crossing is proposed near the upstream end of the section and three off-channel watering sites (located outside of the fencing) are proposed on alternating sides of the channel.
- In middle Greer Creek, two vehicle/cattle crossing and four off-channel watering sites (located outside of the fencing) are proposed at strategic locations identified by the landowner.
- In upper Greer Creek, two vehicle/cattle crossing and six off-channel watering sites (located outside of the fencing) are proposed at strategic locations identified by the landowner.

Riparian vegetation planting is proposed where land adjacent to the stream is bare or has minimal vegetative cover. This will ensure that all instream habitat benefits from fully functioning riparian buffers. The riparian plantings will improve bank stability, provide aquatic food sources, and increase overhanging cover extending up to 15 m from the stream bank. The generally bare riparian areas are proposed to be enhanced with a combination of native seed mix and native tree and shrub plantings (Appendix E) whereas the areas with sparse shrub cover are only proposed to be seeded. Densely vegetated areas, and areas with standing water, are proposed to be retained and protected. The plant selection was based on field reconnaissance, aerial photograph interpretation, multiple years of drone imagery, common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

1.1.3 Creek 661 Off-channel Overwintering Pond

The lack of overwintering habitat in Creek 661 has been identified in the baseline studies as a key limiting factor in fisheries productivity. To address this limitation, construction of an overwintering pond in the Creek 661 watershed is proposed. The location and physical characteristics of the proposed pond have been specifically designed to maximize the quality of overwintering refuge by targeting areas of naturally high groundwater table and through-flow for minimizing winter ice cover thickness and maximizing dissolved oxygen. The design also incorporates deep water (>2 m), cobble/boulder substrates, and overhead cover.

The proposed pond has an irregular shape and contains a peninsula that is strategically positioned to increase habitat diversity. The connector channel is positioned and shaped to meet the mainstem of the creek in a natural scour to reduce the potential for sedimentation and avulsion (channel cut-off) during floods. Large woody debris (anchored with boulders) will also be positioned along the shoreline of the pond. The pond contains shallow water (0 to 1 m depth) 'shoals' lined with cobble, and deeper (1 to 5 m depth) areas.

A 'leaky bank' is proposed to separate the pond and adjacent creek along a segment of an up-valley portion of pond shoreline. The leaky bank is composed of coarse gravels that allow for some throughflow of water from Creek 661 into the pond. The morphology and stone gradation of the leaky bank has been designed to allow sufficient flow to provide benefits to the pond but maintain sufficient flows in Creek 661. Incorporating a leaky bank into the design of the overwintering pond aligns with the objectives and approaches of overwintering habitat creation outlined in the *Fish Habitat Rehabilitation Procedures* (BC MOELP 1997).

The leaky bank has several key functions: i) to improve dissolved oxygen within the off-channel pond by encouraging through-flow of surface water (a small hydraulic gradient maintained through the leaky bank will drive slow water movement); ii) to discourage fine sediment accumulation within the pond and its connector channel through periodic flushing; and iii) to limit meander migration that could lead to channel avulsions. An area akin to a 'forebay' in a stormwater management pond is proposed on the downstream side of the leaky bank to help induce deposition of fine sediment that enters the pond through periodic overbank flow during floods. An interceptor channel, excavated below the naturally high groundwater table, will concentrate groundwater discharge into the pond throughout the year, particularly during winter months.

Riparian plantings are proposed along the periphery of the ponds to ensure full riparian benefits to in-pond aquatic habitat. The proposed plantings include a native seed mix and shrub plantings around the periphery of the pond and aquatic (emergent) plantings in the gentle, shallow shoreline area. The plant selection was based on field reconnaissance and common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

1.1.4 Lake 15/16 Connector Channel

Lake 16 currently discharges to the west into the upper reaches of Davidson Creek, but will be cut off from the creek due to development of the open pit. A small dam will, therefore, be constructed at the existing Lake 16 outlet into upper Davidson Creek to prevent Lake 16 discharge from flowing into the mine site. To provide for Lake 16 drainage, a connector channel is proposed to be constructed from Lake 16 into Lake 15, which discharges to the east into the upper reaches of Creek 705. Lake 16 is approximately 0.4 m higher in elevation than Lake 15, resulting in a natural hydraulic gradient between the two lakes.

To connect Lake 16 and Lake 15, a naturalized Lake 16 arm is proposed to be connected via an outlet to a gravel-bed channel that will flow into Lake 15. The extended arm and connector channel will allow fish passage (in both directions) between the two lakes. The new lake connector channel will have an irregular width with deep habitat (1.5 m), shallower cobble shoals, and woody debris structures and boulders to increase habitat diversity and cover. The naturalized lake outlet will intercept the naturally high groundwater table (1,344 to 1,346 meters above sea level (masl) as measured on June 30, 2013), which will potentially minimize low oxygen levels and augment low flow within the connector channel.

The connector channel will have a sinuous planform, along a 10 m-wide floodplain, and a water surface gradient of approximately 0.3%. Some backwatering of Lake 15 into the channel is expected and the extent will vary in accordance with natural lake level fluctuations. The channel will be approximately 1.4 m wide and 0.3 m deep, and flows will access a constructed and vegetated floodplain on either side of the channel during high flows. Fine gravels will be placed along the bed of the channel, with embedded large wood incorporated along the outer banks of pools to increase habitat cover and diversity. Cobble and boulder keystones are proposed in the channel to mimic natural lake outlet conditions and improve overall habitat stability. Surface flow continuity is anticipated to be maintained all year, with the exception of periods of snow and ice cover. Natural lake level fluctuations may result in Lake 16 water levels below 1,344.1 masl, which may lead to occasional periods of discontinuous or no flow from August to October, which is outside expected migratory periods (i.e., late April to July).

The productivity of the Lake 16 Rainbow Trout population is more likely to be maintained (or possibility increased) if the Rainbow Trout have access to the Lake 15 watershed, which contains additional habitat suitable for spawning and foraging.

1.2 General Monitoring Best Practices

Habitat offsetting measures for the Blackwater Project involve instream and riparian area restoration/enhancement work, off-channel overwintering pond creation, and waterbody connections, which have the potential to adversely affect local and downstream fish and fish habitat during the construction phase. All offsetting measures will follow a number of overarching General Monitoring Best Practices that will be applied during construction:

- Marking and flagging of construction boundaries and sensitive areas, including footprint boundaries, sensitive ecological habitat areas (e.g., riparian zones), and sensitive habitat features (e.g., nests or dens), prior to commencement of construction by qualified personnel.
- Minimizing removal of native riparian vegetation and/or aquatic vegetation to complete work and provide access to watercourses. Does not apply to agronomic grass species and other crops.
- Temporarily exposed soils will be covered using a biodegradable erosion control blanket (e.g., woven jute/coir mesh) or as recommended by the QEP.
- Cleaning machinery prior to beginning construction at the site and checking daily to detect leaks before the start on construction.
- Completing oiling, refueling or maintenance of machinery a minimum of 30 metres from the watercourse top of bank.
- Scheduling construction activities associated with instream work to occur during low-flow conditions and within identified fisheries timing windows specified by FLNRORD or others.
- Salvaging and stockpiling topsoil to be reused in a way that reduces erosion risk for subsequent reapplication during final grading and restoration.
- Ensuring that all material (e.g., boulders) placed in the channel is clean of any substances deleterious to aquatic life and was not sourced from a location with known or potential ML/ARD characteristics.
- Supervising of all instream works by a qualified environmental professional (QEP) experienced in stream restoration and protection of aquatic habitat.
- Restoring all disturbed areas to the satisfaction of the QEP and BW Gold.

2. Access Management

The Kenney Dam Road and three temporary access roads will be used to access the habitat offsetting sites along Greer Creek, which are located on privately-owned land.

The Loop Road and Snell Road East will be used alongside two temporary access roads to enter offsetting sites along Murray Creek. These sites are located on privately-owned land.

Both offsetting sites for the proposed overwintering pond alongside Creek 661 and the Lake 15/16 connector channel are located on Crown Land. An unnamed Forest Service Road with a temporary access road will be used to access the proposed overwintering pond site along Creek 661, and the Lake 15/16 connector channel site will be accessed from an existing exploration road.

All proposed access roads are temporary and are required only for the duration of channel works. All disturbed access trails during construction will be restored to their original pre-construction condition to the extent possible after all works are completed. Most sites will be accessed along existing trails with no vegetation clearing required. Where new routes are required, Qualified Professionals will guide the planning to avoid riparian areas. Rig mats will be used as appropriate to minimize impacts to the ground. All felled timbers will be used in reclamation of the road and to prevent access.
Due to the site locations on private properties and Crown Land, access to the habitat offsetting sites will be restricted and only authorized contractors will be granted access to the sites. Signage will be increased and/or improved to mark construction traffic entry points. The Contractor will be responsible for producing a traffic management plan, which will be included in their Environmental Protection Plan. Additional details are provided in the Access Management Plan developed by BW Gold.

3. Vegetation and Invasive Plant Management

Mitigation measures for vegetation removal and to prevent and control the potential introduction and spread of invasive plants include the following:

- Clean earth-moving equipment to remove any foreign soil and vegetation prior to entering the construction area.
- Bag or tarp noxious weeds and other invasive plants, plant parts, and seeds removed for the purpose of pre-construction clearing before transporting to a designated disposal site (e.g., landfill).
- Have erosion controls and water management in place to prevent sediment and contaminants (e.g., oil, fuel, concrete) from entering vegetated areas.
- Remove trees in accordance with jurisdictional legislation and adhere with appropriate wildlife timing windows, including breeding bird timing restrictions for vegetation clearing.
- Use native vegetation for site restoration and erosion control or use alternative methods until re-planting with native vegetation can occur. Detailed information on seed mixes and vegetation prescriptions for each offsetting measures is available in the design drawings provided in Appendix E of the *Fisheries Act* Authorization application package.

4. Waste Management and Handling of Deleterious Substances

4.1 General Wastes

A regular disposal program will be implemented to prevent the accumulation of construction-related wastes. The Contractor will ensure that upon completion of each day's work, and upon completion of substantial portions of construction works, all waste or other materials that may potentially impact watercourses at the habitat offsetting sites are removed to a stable location and secured.

Sanitary facilities provided for the use of workers shall be secured to ensure they are stable and shall be located at least 30 m from the top of bank of any waterbody. In addition, food or other attractants will be stored properly to prevent attracting wildlife and that any food waste will be removed from the construction site and disposed of in bear proof bins.

4.2 Hazardous Waste and Contaminated Material

If hazardous materials are required for construction, the Contractor will be responsible for ensuring that all relevant personnel are adequately trained for the handling and transport of Dangerous Goods and Controlled Products. Disposal of hazardous waste generated during works must be disposed in compliance with the *British Columbia Hazardous Waste Regulation* of the *Environmental Management Act.* Hazardous materials used during works – including Dangerous Goods as defined under the *Transportation of Dangerous Goods Act* and Controlled Products as defined under the *Occupational Health & Safety Regulation* (BC Regulation 296/97) pursuant to the *Workers Compensation Act* – should be stored and handled to avoid loss, and to allow containment and recovery in the event of a spill in accordance with all applicable legislation.

In the event that construction activities encounter possible contaminated materials, including contaminated soils, the Contractor shall stop all work in the vicinity of the possible hazardous materials until further direction is provided.

4.3 Hydrocarbon Products and Equipment

General mitigation measures for hydrocarbon products and equipment are as follows:

- Equipment, vehicles, and machinery shall be in good operating condition, free of leaks, and excess oil and grease, and are to be inspected regularly.
- All hydraulic machinery working in and around a watercourse will use environmentally sensitive hydraulic fluids that are non-toxic to aquatic life and are readily or inherently biodegradable, wherever feasible. Use of appropriate fluids will be confirmed by the contractor and/or environmental monitors.

- Servicing and refueling of equipment (including refilling of small field containers) shall be undertaken a minimum of 30 m away from the top of bank of any watercourse.
- Storage of fuels and petroleum products will comply with safe operating procedures [e.g., A Field Guide to Fuel Handling, Transportation and Storage (BC Ministry of Water, Land, and Air Protection 2002)] and include containment facilities.
- Equipment maintenance and repair sites will be located on flat, stable ground, at least 30 m away from the top of bank of environmentally sensitive areas such as watercourses.
- The Contractor should always have on site and, if necessary, follow a written Spill Prevention and Emergency Response Plan.

5. Spill Prevention and Emergency Response

To prevent the occurrence and minimize the impacts of potential spills, accidents or malfunctions, a Spill Prevention and Emergency Response Plan will be developed by the Contractor and implemented, as needed. Copies should be on site and readily available at all times. The plan should address issues such as procedures required to prevent spills and accidents, as well as appropriate responses for specific events to minimize potential effects. Regular inspections by the QEP should be conducted to ensure adherence to the plan. If standards are followed and care is taken by work crews, risks and effects will be minimized.

Any spill of reportable quantities of a substance that is toxic, polluting, or deleterious to aquatic life should be reported to the Emergency Management BC 24-hour phone line (Northwest Region: 250.615.4800). Additionally, any spills need to be reported to the BC Ministry of Environment and Climate Change Strategy. It will be the responsibility of the Contractor to implement all activities in accordance with applicable legislative requirements.

6. Human-Wildlife Conflict

To avoid human-wildlife encounters during construction, the following mitigation measures will be implemented:

- Ensure all habitat offsetting sites do not contain wildlife attractants such as food, garbage, or other materials with a strong and attracting odor;
- Subcontractors will discourage birds and wildlife from inhabiting work areas (e.g., machinery, temporarily stored materials, and other construction infrastructure). Inspection of work areas will occur regularly to identify wildlife attempting to nest as early as possible. Crews will be instructed to notify the QEP of wildlife nesting attempts. Discouraging wildlife nesting may include installing exclusion measures (fences) and manually sweeping and maintaining equipment and construction infrastructure to discourage wildlife activity on the infrastructure;
- Where garbage containers are required, ensure containers are inaccessible to wildlife (i.e., through the use of bear-proof garbage containers) and are disposed of on a regular basis (e.g., weekly) or when needed (i.e., when full);
- Do not touch, feed, collect, harm or harass wildlife;
- Hunting and/or fishing is not allowed on or near the habitat offsetting sites.

7. Erosion and Sediment Control

The Contractor will submit an Erosion and Sediment Control Plan (ESCP) to BW Gold for approval at least two weeks prior to the start of construction. The Project ESCP will be aligned with BW Gold's overall CEMP and Surface Erosion and Sediment Control Management Plan. The ESCP will also align with the principles, layouts, details and specifications outlined as part of the detailed design drawing packages for Murray Creek, Greer Creek, Creek 661 overwintering pond, and Lake 15/16 connector channel (Appendix C of the Offsetting Plan). The ESCP will contain specific mitigation measures to minimize sedimentation in each waterbody that could be caused by:

- Initial flow diversion.
- Dewatering of the instream work areas, including scouring/erosion at pump intake and outlet.
- Discharge of construction dewatering and runoff water from the dewatered area resulting from isolation structure leakage, groundwater infiltration, or rainfall.
- General construction activities within the dewatered area or near the watercourse, including those relating to access.
- Restoration of stream flows following completion of instream works.

The Contractor's ESCP will provide a detailed description of control measures or structures to minimize erosion and sedimentation, including:

- Limit vegetation clearing to the minimum area necessary for construction and access to avoid exposed soils.
- Establish one stabilized entry/exit point to instream work area to minimize disturbed soils.
- Minimize disturbance to ground cover within the construction area to the extent possible.
- Divert creek water around the instream work areas. Control diversion pump discharge to dissipate velocities and prevent channel bed and bank erosion through the use of a splash pad or similar structure.
- Install sediment barriers such as fibre rolls (e.g., Siltsoxx) or sediment control fencing at all drainages to the waterbody.
- Stabilize/cover disturbed earth using erosion control measures such as erosion control blankets.
- Stockpile materials in a stable area at least 30 m from the watercourse top of bank.
- Discharge silty water to a contained part of the site and allow it to infiltrate to ground.
- Plant riparian vegetation on disturbed areas as soon as possible after construction.
- Only undertake construction works during favourable weather conditions.
- Supervision of instream and near-water works by a QEP.

7.1 Project-Specific Erosion and Sediment Control Measures

Specific erosion and sediment control measures for the restoration and enhancement of Greer and Murray Creek, and the construction of the Creek 661 off-channel overwintering pond and Lake15/16 connector channel, as outlined on engineering design drawings prepared by Palmer and Onsite Engineering Ltd (Appendix C of the Offsetting Plan), include:

- Pond excavation is planned to be completed in winter when groundwater levels are low and soils are frozen, in order to minimize sedimentation. However, work may occur outside of this period with additional erosion and sediment control measures in place.
- Where suitable, prior to equipment access, and to minimize soil disturbance, rig matting may be installed where ground is, or anticipated to be, soft or wet.
- All instream works will be completed in isolation of waterbodies. Site isolation will be completed using a meter bag cofferdam filled with suitable materials and wrapped with an impervious membrane. In low water conditions, pea gravel-filled sandbags with membrane may be used.
- Water level within isolated instream work areas may be drawn down using sump pumps. Dewatering filter bags encircled with Siltsoxx will be used to treat this sediment-laden water prior to discharging to ground.
- Temporarily exposed soils will be covered using a biodegradable erosion control blanket (e.g., woven jute/coir mesh) or as recommended by the QEP.
- Where appropriate, floating turbidity curtains may be used to mitigate siltation.
- Potential transport of sediment will be managed through the installation of sediment barriers such as fibre rolls (e.g., Siltsoxx) or sediment control fencing.
- All stockpiled material will be placed at least 30 m away from the top of bank of any watercourses and will be encircled with Siltsoxx to avoid sediment transport.
- Flow will be connected to / re-established with the waterbody in a controlled manner to minimize sedimentation.

The above measures represent the recommendations of Palmer and Onsite Engineering Ltd. Erosion and sediment control measures to be implemented during Project construction are the responsibility of the Contractor and will be outlined in the Contractor's ESCP as described above. Erosion and sediment control measures must be established prior to starting any works that may result in sediment mobilization.

8. Construction Phasing

The contractor will submit a Construction Phasing Plan (CPP) to BW Gold for approval at least two weeks prior to the commencement of work. The CCP will align with the proposed sequencing outlined as part of the detailed design drawing packages for Greer Creek, Murray Creek, Creek 661 overwintering pond and Lake 15/16 connector channel (Appendix C of the Offsetting Plan). The CPP will outline the approach that will be taken with respect to Project phases, water drawdown/diversion, fish salvage timing, and other construction considerations. Instream work and stream isolation will occur in phases, as determined by the contractor at the outset of the Project.

The QEP will provide environmental regulators (DFO, Environment and Climate Change Canada [ECCC], BC Ministry of Environment and Climate Change Strategy [ENV]) with one week of advance notice prior to the start of construction. The following sequence of events is proposed to be applied in each phase at the offsetting sites as appropriate:

- Complete fish removal and relocation in accordance with the fish salvage plan (Section 9).
- Once the QEP indicates the initial fish salvage is complete, install water management (Section 9) and erosion and sediment control measures (Section 7).
- Commence instream work area dewatering. Supplemental fish salvages will be conducted during this period if residual fish are identified or anticipated to be present.
- Complete construction of stream restoration/enhancement in isolation of flow from the waterbody including all grading and instream feature installations as detailed on design drawings.
- Restore stream flows gradually to minimize potential sedimentation to all waterbodies, while monitoring channel and bank stability and water quality.
- Once instream work is complete, remove any fish stopnets to allow fish passage through the work area.
- Remove temporary erosion and sediment controls (e.g., silt fences) following Project completion, once disturbed areas have been stabilized.

Instream channel works are proposed to be generally completed from upstream to downstream, such that new restoration/enhancement works are not at risk of sedimentation. This planned sequencing of activities is subject to modification based on input from the Contractor, BW Gold, and environmental regulators.

9. Fish Salvage, Timing and Water Management

9.1 Fish Salvage

A fish salvage will be conducted by the QEP(s) at each habitat offsetting site, within each segment of isolated channel, prior to the start of instream works. Because instream works will be staged, a fish salvage will be conducted in advance of each stage prior to isolation and water diversion.

At each site, stopnets will be installed at the upstream and downstream extent of the instream work area. The nets will be anchored to the stream banks and weighted at the bottom to prevent fish from entering the instream work area during construction works. The area between the nets will be systematically fished using a variety of capture methods (e.g., seine netting, minnow trapping, dip netting, and backpack electrofishing) to remove all fish. Captured fish will be identified, measured for length, and released downstream of the instream work area (i.e., downstream of the downstream stopnet) in similar habitat. The fish salvage may continue during water diversion if there is the potential that fish may still be present within the instream work area.

Stopnets will remain in place for the duration of the instream work, and the QEP will periodically check the nets to ensure they are preventing fish from entering the instream work area. If stopnets become breached during the Project (e.g., due to high creek water levels or net failure), instream works will stop until the nets are re-secured and additional fish salvages are undertaken. The QEP will also assess the need for supplementary fish salvaging during instream works.

Fish salvaging will be conducted in accordance with conditions outlined in the provincial *Scientific Fish Collection* permit from FLNRORD and the *Scientific Licence* permit from DFO. A Species-At-Risk-Act (SARA) permit is not required, as there are no SARA-listed fish species present in these waterbodies.

9.2 Timing

The timing for the construction of the instream components of the Greer Creek, Murray Creek, Creek 661 and Lake 15/16 offsetting will follow standard instream construction timing restrictions and best practices, during low-flow conditions, and within the timing window of least risk to fish and fish habitat.

Components of offsetting measures that are not considered instream (e.g., construction of overwintering ponds prior to connection with Creek 661) may be completed outside of timing restrictions provided works are in isolation of Creek 661 flow and erosion and sediment control measures are implemented. Connection of above-stream works to Creek 661 will be completed during timing restrictions.

The offsetting habitat has been designed to restore habitat utilized by rainbow trout. However, the Reduced Risk Work Window for the Omineca Region also includes other fish species present in Greer Creek, Murray Creek, Creek 661, and Lake 15/16. Therefore, the instream window of July 15 to August 31 will be followed, which incorporates timing for rainbow trout, kokanee and salmon species (Government of BC, 2004). Consultation with DFO and FLNRORD will occur to determine if adjustments are needed to the

recommended timing windows prior to the commencement of construction. The QEP will work with the contractor to ensure that all instream works are completed as quickly as possible within this timing window, to minimize risk to fish and fish habitat.

9.3 Water Management

All instream habitat offsetting measures in Greer Creek, Murray Creek, Creek 661 and Lakes 15 and 16 are intended to be undertaken 'in the dry' or within an isolated work area with appropriate erosion and sediment controls. Isolation of instream work areas will involve the installation of a barrier system (i.e., a cofferdam). The contractor will implement best practices to ensure that water at each offsetting site is properly managed to ensure no adverse effects to fish in each waterbody, including:

- Ensuring creek flow downstream of instream work areas is maintained at all times.
- Ensuring water diversion (i.e., bypass) pumps have sufficient capacity to divert instream flows.
- Using pump intake screens if pumps are required and minimizing velocity to prevent impingement or entrainment of fish, in accordance with the DFO *Interim Code of Practice: End-of-pipe fish protection screens for small water intakes in freshwater*.
- Controlling pump discharge to dissipate velocities and prevent channel bed and bank erosion through the use of a temporary splash pad or similar structure.
- Developing a contingency plan to address pump failure and to ensure water diversion operations can continuously control the flow. Isolation and pumping operations should consider future weather events.
- Collecting and discharging any sediment-laden water, including seepage that may collect within the isolated work area, to an appropriate area as outlined in the contractor Erosion and Sediment Control Plan (Section 7) or as directed by the QEP.

Water drawdown in the instream work area should occur at such a rate that the QEP has sufficient time to salvage fish. Drawdown plans should allow for some variation in the time required to complete the fish salvage, as removal efficiency can be variable due to water depth, presence of woody debris, and other factors.

10. Wildlife

10.1 Breeding Birds

The typical breeding bird window is from April 1 to July 31 in the Omineca region. However, based on local expertise, conditions at the offsetting sites and at the mine site (i.e., high elevation), and variability in snow and climate conditions, an April 1 to mid-August window will be followed. Scheduling of vegetation clearing with potential to disturb or harm resident and migratory birds or their active nests should take place outside this window (i.e., should be completed between August 15 and April 1). This is to prevent contravention of the federal *Migratory Birds Convention Act* and pursuant *Migratory Birds Regulations*, as well as Section 34 of the provincial *Wildlife Act*. The onsite QEP will have final authority on when to conduct vegetation clearing and nest surveys.

If any localized vegetation clearing associated with access to the habitat offsetting sites is required and must be conducted during the breeding bird season, an active bird nest survey will be conducted prior to the start of work by a QEP familiar with local avifauna and behaviours associated with nesting and territorial establishment of bird species that may be encountered.

If an active nest is found (i.e., a nest occupied by a bird or its eggs, or if a bird is near the nest and displays signs of breeding or rearing activity), radial buffers based on provincial best management practices will be implemented. No vegetation clearing will be permitted within the target buffer area until the nest is determined to be inactive.

10.2 Reptiles and Amphibians

Prior to construction, a sweep of the area will be conducted by the QEP who is familiar with the life histories of reptiles and amphibian species that may be present in the area.

A salvage of reptiles and amphibians within the work areas may be required prior to the start of construction if such species are identified during the pre-construction sweep, and the salvage would be conducted in coordination with the fish salvage activity described in Section 9.1**Error! Reference source not found.**. A *Wildlife Act* permit will be obtained prior to conducting the reptile and amphibian salvage which authorizes the live capture and release of native turtle and amphibian species. The permit also allows live capture of non-native reptile and amphibian species and mandates their humane euthanization.

The QEP may direct the installation of temporary exclusion fencing to surround the work area and prevent ingress by amphibian and reptile species if they are suspected to be present and active. Exclusion fencing materials and installation methods can be similar to those required for erosion and sediment control (Section 7).

The QEP will conduct regular visual inspections of the exclusion fencing and will alert the Contractor to any identified deficiencies. The QEP will also regularly monitor the construction areas to ensure wildlife is not present.

Any required reptile and amphibian salvage and exclusion fencing installation and maintenance would be conducted following best management practices described in the BC Ministry of Forests, Lands, and Natural Resource Operations (FLNRO) *Best Management Practices for Amphibian and Reptile Salvages in British Columbia* (FLNRO 2016).

11. Surface Water Quality

Water quality in Greer Creek, Murray Creek, Creek 661 and Lakes 15 and 16 will be tested regularly by the onsite QEP to ensure compliance with BC Approved Water Quality Guidelines (BC ENV 2019) and environmental permit conditions (e.g., *Water Sustainability Act* Approval; DFO *Fisheries Act* Authorization) as applicable (Table 1).

Water quality monitoring will be conducted prior to instream works to establish baseline conditions, as well as during and after construction, or release of any materials from the Project area. Water testing and visual assessment will be conducted at the start and end of each shift during construction, at a minimum interval of every four hours, and with supplementary samples taken during changes in construction activity or at the discretion of the QEP.

Water quality monitoring parameters include turbidity (visual and with a turbidity meter), pH, temperature, dissolved oxygen (using a multi-parameter meter), and hydrocarbon sheens from oil and grease (visual). Water quality monitoring stations will be established once the construction areas have been delineated but will include a minimum of one station upstream and downstream of each construction area to establish background and exposure water quality values.

Direct measurement of total suspended solids (TSS) is not feasible outside a laboratory setting. Turbidity, measured using nephelometric turbidity units (NTU), can be directly measured in-situ using a turbidity meter and will therefore be used as a proxy for directly measuring levels of TSS. If TSS exceedances are suspected, a confirmatory sample can be taken for laboratory analysis.

If turbidity or TSS guidelines are exceeded as a result of construction activities, the QEP will have the authority to stop work and sediment control measures will be adjusted as needed to reduce sediment inputs. If pH guidelines are exceeded or hydrocarbons are detected in waterbodies, control measures will be implemented (e.g., bubbling with carbon dioxide to control high pH or implementing spill response protocols to contain hydrocarbons, as described in Section 5).

Table 1. Water Quality Guidelines.

Parameter	Guidelines
Turbidity	- Change from background of 8 Nephelometric Turbidity Units (NTU) at any one time for a duration of 24 h in all waters during clear flows or in clear waters - Change from background of 2 NTU at any one time for a duration of 30 d in all waters during clear flows or in clear waters - Change from background of 5 NTU at any time when background is 8 - 50 NTU during high flows or in turbid waters - Change from background of 10% when background is >50 NTU at any time during high flows or in turbid waters
Total Suspended Solids	- Change from background of 25 mg/L at any one time for a duration of 24 h in all waters during clear flows or in clear waters - Change from background of 5 mg/L at any one time for a duration of 30 d in all waters during clear flows or in clear waters - Change from background of 10 mg/L at any time when background is 25 - 100 mg/L during high flows or in turbid waters - Change from background of 10% when background is >100 mg/L at any time during high flows or in turbid waters
pH	- 6.5 to 9.0: unrestricted change permitted within this range. This component of the freshwater guidelines should be used cautiously if the pH change causes the carbon dioxide concentration to decrease below a 10 µmol/L minimum or exceed a 1,360 µmol/L maximum, as these concentrations may be toxic to fish.
Oil and Grease	- Not detectable by sight or smell

12. Archaeological Chance Finds

Archaeological sites (both recorded and unrecorded) are protected under the *Heritage Conservation Act* and must not be altered or damaged without a permit from the Archaeology Branch. All workers involved in ground disturbance and construction must be aware that activities must be halted if archaeological materials are encountered, and the Archaeology Branch contacted at (250) 953-3334 for direction. BW Gold has a chance find procedure which will be provided to and followed by the construction contractor.

13. Environmental Monitoring During Construction

All instream works will be monitored by a QEP to ensure environmental mitigation measures described in this CEMP have been implemented and are functioning as intended to protect aquatic and terrestrial habitat. The environmental monitoring program will include:

- Ensuring Spill Prevention and Emergency Response measures are implemented and spill kits and other measures are on-site.
- Confirming machinery is clean and leak-free while on site.
- Ensuring erosion and sediment control measures are constructed, installed and maintained appropriately for the full duration of construction works.
- Monitoring diversion works to ensure pumps are in proper working condition and downstream flow is maintained at all times.
- Ensuring water quality is within BC guidelines for the protection of freshwater aquatic life.
- Ensuring diversion pump intakes are screened for fish and aquatic species in accordance with the DFO *Interim Code of Practice: End-of-pipe fish protection screens for small water intakes in freshwater*.
- Notifying the QEP and BW Gold in the event of an environmental incident or non-compliance with any of the terms or conditions of water quality guidelines or environmental permit conditions.
- Stopping work authorized if deemed necessary by the QEP to address risks to the environment.

The QEP will work with BW Gold's mine environmental staff to ensure that the environmental monitoring program is completed satisfactorily during construction.

14. Site Restoration

At the end of the Project, all equipment, supplies, and non-biodegradable materials will be removed from the site. Disturbed areas will be re-graded to a stable angle and returned as closely as possible to their natural state. Restoration of disturbed areas will involve riparian planting, in accordance with the design drawings provided in Appendix C of the Offsetting Plan.

Disturbed areas that are not planted will be protected from surface erosion by re-seeding with an approved seed mixture and/or installing biodegradable erosion control blankets. All seeding and planting shall be planned to allow establishment before the end of growing season; the recommended timing is in the fall during September and October, or spring during March and April, when most plants are dormant. Detailed information on seed mixes and vegetation prescriptions for each offsetting measures is available in the design drawings provided in Appendix E of the *Fisheries Act* Authorization application package.

15. Post-Construction Reporting

A detailed environmental monitoring report will be prepared by the QEP after habitat offsetting construction has been completed, which will summarize:

- Permit number(s);
- Instream works undertaken;
- Timing of the works;
- Total instream area directly affected;
- Frequency of monitoring;
- Water quality sampling and accompanying results along with a description of any levels higher than permitted and what immediate steps were taken (if applicable);
- Representative site photographs;
- Any non-compliance with the terms and conditions of the permits; and
- A description of any environmental incidents, non-compliance or other difficulties, and how these were addressed and reported.

16. Certification

This report was prepared, reviewed and approved by the undersigned:

Prepared By: <original signed by>

Jason Baird, B.Sc., B.Tech., R.P.Bio.
Aquatic Biologist

Reviewed By: <original signed by>

Ian MacLeod, B.Sc., R.P.Bio., P.Biol.
Senior Fisheries Biologist

Approved By: <original signed by>

Rick Palmer, M.Sc., R.P.Bio.
President, Senior Fisheries Biologist

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Appendix P

Effectiveness Monitoring Program (EMP)

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

Blackwater Gold Project

Fisheries Offsetting Habitat Effectiveness Monitoring Plan

Palmer Project #
2006501

Prepared For
BW Gold Ltd.

June 2, 2022

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1. Introduction

BW Gold Ltd. (BW Gold) proposes to construct and operate the Blackwater Project (the Project), an open-pit gold and silver mine located 160 km southwest of Prince George and 110 km southwest of Vanderhoof in British Columbia (BC).

The Project received a Decision Statement on April 15, 2019, under the *Canadian Environmental Assessment Act* (2012), and an Environmental Assessment Certificate (EAC) #M19-01 (Certificate) on June 21, 2019, under the *Environmental Assessment Act* (2002).

As part of the EAC Application, an effects assessment was completed for fish and fish habitat, which were identified as Valued Components (VCs). It was determined through this process that the Project will likely result in the harmful alteration, disruption, or destruction of fish habitat (HADD), as defined by the federal *Fisheries Act*.

Before construction can commence, the Project will require both an amendment of Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER) and an authorization under Paragraph 35(2)(*b*) of the *Fisheries Act*. The amendment to Schedule 2 of the MDMER specifically applies to the loss of fish habitat in tailings impoundment areas and waste rock storage areas resulting from the placement of mine waste. The *Fisheries Act* authorization will address all other effects on fish and fish habitat resulting from Project activities.

A Conceptual Fisheries Mitigation and Offsetting Plan (CFMOP) was prepared as part of the Environmental Assessment Application, which outlined Project activities, effects, and offsetting measures proposed at the time of the application submission (AMEC, 2014; Appendix.5.1.2.6C of the Application). The CFMOP has been updated based on comments received from Fisheries and Oceans Canada (DFO) and the BC Ministry of Forests, Lands and Natural Resource Operations and Rural Development (now the BC Ministry of Land, Water and Resource Stewardship) and separated into two plans: an Offsetting Plan for the *Fisheries Act* authorization and a Compensation Plan for the amendment to Schedule 2 of the MDMER. This Effectiveness Monitoring Plan (EMP) addresses monitoring of the created and/or restored fish habitat that is proposed in the *Fisheries Act* authorization Offsetting Plan. A separate EMP has been prepared for the Compensation Plan for the MDMER Schedule 2 amendment.

The Offsetting Plan applies DFO's guiding principles, as outlined in its *Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act* (DFO, 2019) and focuses on restoring degraded fish habitat as stated in paragraph 34.1(1)(f) of the *Fisheries Act*. The Offsetting Plan includes five separate measures to offset the loss of fish habitat resulting from Project activities:

- Murray Creek Habitat Enhancement
- Greer Creek Habitat Enhancement
- Creek 661 Off-Channel Overwintering Pond
- Flow Augmentation in Davidson Creek from the Freshwater Supply System (FWSS)
- Lake 15/Lake 16 Connector Channel.

The EMP for the five offsetting measures proposes a multi-disciplinary approach involving both qualified biological and fluvial-geomorphological specialists evaluating habitat offsetting success. This EMP outlines three approaches to improve offsetting success based on a review of effectiveness monitoring guidance provided by DFO (Smokorowski et al. 2015):

- A compliance-based approach, using an on-site environmental monitor and qualified environmental professionals (QEPs) during construction to ensure that environmental protection measures and best management practices are implemented as required and that habitat features are constructed in accordance with the design drawings. Post-construction surveys, as-built drawings, and/or photographic documentation will also be completed to ensure design specifications were correctly implemented.
- A functionality-based approach, using post-construction inspection and multiple follow-up evaluations by QEPs to ensure morphological stability and functionality of the constructed fish habitat, based on a qualitative and quantitative monitoring program.
- An effectiveness-based approach, using Before-After-Control-Impact (BACI) design or Control-Impact (CI) methods to assess habitat use by fish.

1.1 Proposed Offsetting Measures

1.1.1 Murray Creek Habitat Enhancement

Murray Creek is a third-order stream that flows south from its headwaters for approximately 15 km and enters the north bank of the Nechako River at Vanderhoof. The Murray Creek watershed area is 12,056 ha, of which 6,188 ha is in the Agricultural Land Reserve. Restoration is proposed on approximately 2.3 km of Murray Creek, starting 4.5 km upstream from the Nechako River. There are two land parcels (i.e., landowners) adjacent to the 2.3 km river section that is intended for offset.

Murray Creek has been impacted by past and current agricultural activities, primarily livestock grazing. The creek has also been impacted by other anthropogenic activities in the watershed such as logging, water withdrawal, and alterations to natural drainage patterns. Observed effects on the creek include lowered groundwater tables, lack of riparian vegetation, trampling and collapse of channel banks, and increased instream sedimentation. Emergent and aquatic vegetation is abundant throughout much of the channel, obstructing water flow. Culverts along the channel (some of which are damaged) form partial obstructions to flow.

The Nechako Environment and Water Stewardship Society (NEWSS) formed the Murray Creek Rehabilitation Project in 2008 and has implemented restoration projects (e.g., fish passage enhancement at culvert crossings, bank restoration, habitat complexing) at other locations along Murray Creek (NEWSS, 2016). The proposed restoration and enhancement outlined in this Offsetting Plan will augment the work already completed by NEWSS by extending improvements further upstream and increasing the continuity of properly functioning habitat.

Stream restoration and enhancement is proposed along a 2.3 km section of Murray Creek (including West Murray, East Murray, and MacIntosh Creeks), in multiple reaches where degraded habitat has been

identified. The impacts of agricultural activity, in particular extensive cattle trampling, has resulted in a need to re-establish natural channel dimensions for the proposed restoration works. The proposed channel planform is designed to reflect existing conditions.

Gravel and boulder clusters are integrated into the design to improve instream cover, diversify substrate, and increase spawning potential. Woody debris is also proposed in Murray Creek to improve cover and provide refuge for fish during high flows. Fencing is proposed along both sides of the channel throughout the entire area of proposed works to restrict cattle access and prevent damage to the riparian area. Vehicle and cattle crossings, and off-channel watering sites (located outside of the fencing), are proposed at strategic locations identified by the landowners.

Riparian vegetation planting is proposed where land adjacent to the stream is bare or areas with minimal vegetative cover. Plantings will facilitate the establishment of riparian buffers to benefit instream habitat. The riparian plantings will improve bank stability, provide aquatic food sources, and increase overhanging cover extending up to 15 m from the stream bank. Riparian areas are proposed to be enhanced with a combination of native seed mix and native shrub and tree plantings in areas that are devoid of vegetation; whereas, seeding is proposed in areas with sparse shrub cover. Densely vegetated areas, and areas with standing water, are proposed to be retained and protected.

Plant and seed mix selection is based on field reconnaissance, aerial photograph interpretation, multiple years of drone imagery, common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

1.1.2 Greer Creek Habitat Enhancement

Greer Creek is a fifth-order stream that flows westward for much of its length and enters the Nechako River approximately 50 km southwest of Vanderhoof. The Greer Creek watershed area is 41,037 ha, and the creek length is approximately 55 km. Restoration is proposed along three sections of Greer Creek: i) lower Greer Creek, a 4.5 km section starting 4 km upstream from the Nechako River; ii) middle Greer Creek, a 3.1 km section, and iii) upper Greer Creek, an 8.6 km section, 24 km upstream from the Nechako River. The proposed works along Greer Creek are entirely located on private land that is registered to one landowner.

Greer Creek has been impacted by past and current agricultural activities, primarily livestock grazing. Impacts include localized trampling and collapse of channel banks, lack of riparian vegetation, and increased local and instream sedimentation.

Channel narrowing and bank regrading are proposed to rehabilitate impacted areas. In lower Greer Creek, bed material throughout the reach is naturally dominated by gravels; however, gravel placement is proposed in strategic areas to support additional spawning habitat. Boulder clusters and woody debris are proposed throughout the lower section to improve cover and provide refuge during high flows. In middle Greer Creek, re-establishment of natural channel dimensions is proposed for the entire length of a small tributary draining Harlow Lake. Gravel and boulder clusters are proposed throughout the creek section to improve instream cover and spawning potential. Woody debris is also proposed to improve cover and provide refuge during high flows. In upper Greer Creek, gravel and boulder clusters are proposed throughout the creek section to improve instream cover and spawning potential. Woody debris is also proposed to improve cover and provide refuge during high flows.

Cattle-exclusion fencing is proposed throughout the sections of Greer Creek as follows:

- In lower Greer Creek, one vehicle/cattle crossing is proposed near the upstream end of the section and three off-channel watering sites (located outside of the fencing) are proposed on alternating sides of the channel.
- In middle Greer Creek, two vehicle/cattle crossing and four off-channel watering sites (located outside of the fencing) are proposed at strategic locations identified by the landowner.
- In upper Greer Creek, two vehicle/cattle crossing and six off-channel watering sites (located outside of the fencing) are proposed at strategic locations identified by the landowner.

Riparian vegetation planting is proposed where land adjacent to the stream is bare or has minimal vegetative cover. This will ensure that all instream habitat benefits from fully functioning riparian buffers. The riparian plantings will improve bank stability, provide aquatic food sources, and increase overhanging cover extending up to 15 m from the stream bank. The generally bare riparian areas are proposed to be enhanced with a combination of native seed mix and native shrub plantings whereas the areas with sparse shrub cover are only proposed to be seeded. Densely vegetated areas, and areas with standing water, are proposed to be retained and protected. The plant selection was based on field reconnaissance, aerial photograph interpretation, multiple years of drone imagery, common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

1.1.3 Creek 661 Off-channel Overwintering Pond

The lack of overwintering habitat in Creek 661 has been identified in the baseline studies as a key limiting factor in fisheries productivity. To address this limitation, construction of an overwintering pond in the Creek 661 watershed is proposed. The location and physical characteristics of the proposed pond have been specifically designed to maximize the quality of overwintering refuge by targeting areas of naturally high groundwater table and through-flow for minimizing winter ice cover thickness and maximizing dissolved oxygen. The design also incorporates deep water (>2 m), cobble/boulder substrates, and overhead cover.

The proposed pond has an irregular shape and contains a peninsula that is strategically positioned to increase habitat diversity. The connector channel is positioned and shaped to meet the mainstem of the creek in a natural scour to reduce the potential for sedimentation and avulsion (channel cut-off) during floods. Large woody debris (anchored with boulders) will also be positioned along the shoreline of the pond. The pond contains shallow water (0 to 1 m depth) 'shoals' lined with cobble, and deeper (1 to 5 m depth) areas.

A 'leaky bank' is proposed to separate the pond and adjacent creek along a segment of an up-valley portion of pond shoreline. The leaky bank is composed of coarse gravels that allow for some throughflow of water from Creek 661 into the pond. The morphology and stone gradation of the leaky bank has been designed to allow sufficient flow to provide benefits to the pond but maintain sufficient flows in Creek 661. Incorporating a leaky bank into the design of the overwintering pond aligns with the objectives and approaches of overwintering habitat creation outlined in the *Fish Habitat Rehabilitation Procedures* (BC MOELP 1997).

The leaky bank has several key functions: i) to improve dissolved oxygen within the off-channel pond by encouraging through-flow of surface water (a small hydraulic gradient maintained through the leaky bank will drive slow water movement); ii) to discourage fine sediment accumulation within the pond and its connector channel through periodic flushing; and iii) to limit meander migration that could lead to channel avulsions. An area akin to a 'forebay' in a stormwater management pond is proposed on the downstream side of the leaky bank to help induce deposition of fine sediment that enters the pond through periodic overbank flow during floods. An interceptor channel, excavated below the naturally high groundwater table, will concentrate groundwater discharge into the pond throughout the year, particularly during winter months.

Riparian plantings are proposed along the periphery of the ponds to ensure full riparian benefits to in-pond aquatic habitat. The proposed plantings include a native seed mix and shrub plantings around the periphery of the pond and aquatic (emergent) plantings in the gentle, shallow shoreline area. The plant selection was based on field reconnaissance and common vegetation community summaries described in BC's Wetland Identification Guide (Mackenzie and Moran 2004) and BC's Biodiversity Atlas (Austin and Eriksson 2009), restoration papers, and guidance documents. All species proposed to be planted are native to the region.

1.1.4 Flow Augmentation in Davidson Creek

A reduction in stream flow of a magnitude that will reduce fish habitat area in Davidson Creek downstream of the mine site facilities was modeled to occur at the start of the Operations Phase. To offset potential flow-related adverse effects in Davidson Creek, instream flow needs (IFN) are proposed to be met by pumping water from Tatelkuz Lake to Davidson Creek via the Freshwater Supply System (FWSS). The use of the FWSS system, and the flows that it will supply to lower Davidson Creek, were developed as part of the Instream Flow Study (Appendix 5.1.2.6D of the EA Application) using hydraulic habitat modeling software (SEFA, or System for Environmental Flow Analysis).

The FWSS will pump water from Tatelkuz Lake to a freshwater reservoir built at the top of Reach 6[1] in Davidson Creek. Water will be discharged from the freshwater reservoir at rates designed to meet the IFN and thereby maintain the availability and sustainability of existing fish habitat. This will include maintenance of channel morphology over the biologically relevant life stages of both Rainbow Trout and Kokanee salmon, and a period of flushing flows in the spring to maintain quality of spawning gravels.

The design of the FWSS is focused on meeting instream flow requirements but also on minimizing potential direct mortality of fish. A barrier to prevent fish from entering the FWSS facility from the downstream reaches of Davidson Creek will, therefore, be specified during the detailed design phase.

1.1.5 Lake 15/16 Connector Channel

Lake 16 currently discharges to the west into the upper reaches of Davidson Creek, but will be cut off from the creek due to development of the open pit. A small dam will, therefore, be constructed at the existing Lake 16 outlet into upper Davidson Creek to prevent Lake 16 discharge from flowing into the mine site. To provide for Lake 16 drainage, a connector channel is proposed to be constructed from Lake 16 into Lake 15, which discharges to the east into the upper reaches of Creek 705. Lake 16 is approximately 0.4 m higher in elevation than Lake 15, resulting in a natural hydraulic gradient between the two lakes.

[1] *Reach numbering is in accordance with the baseline reporting (AMEC, 2014; Appendix.5.1.2.6B of the Application)*

To connect Lake 16 and Lake 15, a naturalized Lake 16 arm is proposed to be connected via an outlet to a gravel-bed channel that will flow into Lake 15. The extended arm and connector channel will allow fish passage (in both directions) between the two lakes. The new lake connector channel will have an irregular width with deep habitat (1.5 m), shallower cobble shoals, and woody debris structures and boulders to increase habitat diversity and cover. The naturalized lake outlet will intercept the naturally high groundwater table (1,344 to 1,346 meters above sea level (masl) as measured on June 30, 2013), which will potentially minimize low oxygen levels and augment low flow within the connector channel.

The connector channel will have a sinuous planform, along a 10 m-wide floodplain, and a water surface gradient of approximately 0.3%. Some backwatering of Lake 15 into the channel is expected and the extent will vary in accordance with natural lake level fluctuations. The channel will be approximately 1.4 m wide and 0.3 m deep, and flows will access a constructed and vegetated floodplain on either side of the channel during high flows. Fine gravels will be placed along the bed of the channel, with embedded large wood incorporated along the outer banks of pools to increase habitat cover and diversity. Cobble and boulder keystones are proposed in the channel to mimic natural lake outlet conditions and improve overall habitat stability. Surface flow continuity is anticipated to be maintained all year, with the exception of periods of snow and ice cover. Natural lake level fluctuations may result in Lake 16 water levels below 1,344.1 masl, which may lead to occasional periods of discontinuous or no flow from August to October, which is outside expected migratory periods (i.e., late April to July).

The productivity of the Lake 16 Rainbow Trout population is more likely to be maintained (or possibility increased) if the Rainbow Trout have access to the Lake 15 watershed, which contains additional habitat suitable for spawning and foraging.

1.2 Purpose and Objectives

The overall goal of the monitoring program is to document mitigation and offsetting effectiveness and identify when and where adaptive management actions may be required. To meet this goal, three levels of monitoring are proposed:

- Level 1: Compliance Monitoring
    - Monitor the construction of the offsetting habitat to ensure habitat features/components are constructed in accordance with the design drawings and guide the contractor through any required field-fit refinements. Field measurements will be compared to design drawing specifications to ensure the areal extent of created and/or restored habitat is consistent with the Offset Plan habitat balance.
- Level 2: Functional Monitoring
    - Monitor performance of bed, bank, and constructed habitat features (e.g., boulders, brush layers, woody debris) to determine signs of erosion, migration or sedimentation that may impact habitat fish functionality (e.g., water depths, water velocity, cover percentage suitable for fish life stages).
- Level 3 Effectiveness Monitoring

- Complete a ten-year, post-construction effectiveness monitoring program to evaluate fish use of the rehabilitated and enhanced works (e.g., fish diversity, fish density per 100 m^2).

Effectiveness monitoring includes science-based field monitoring to evaluate whether management measures achieve the intended ecological milestones set out in the terms of the Fisheries Act authorization (Braun et al., 2019). The commitments described in this EMP will be updated upon receipt of the *Fisheries Act* authorization or confirmation of monitoring conditions in discussion with DFO. The effectiveness monitoring program is intended to:

- confirm predicted Project effects on fish productivity;
- identify whether there are any unanticipated effects on fish productivity as a result of Project construction or operation;
- evaluate whether offsetting measures are effective in counterbalancing the effects of the Project on fish productivity; and
- identify whether additional offset measures are required to counterbalance the Project effects on fish and fish habitat as a result of construction and operation of the Project.

This EMP describes the survey methods, proposed schedule and reporting commitments for all three levels of monitoring described above. In addition, this EMP provides specific metrics and methods for the Effectiveness Monitoring approach. .

2. Methods

2.1 Measurable Parameters for the Effectiveness Monitoring Program

The Offsetting Plan intends to promote fish productivity through measures of habitat creation, restoration, and enhancement. Quantitative and qualitative surrogate metrics of habitat are proposed to evaluate whether the offsets are counterbalancing the loss of productive capacity of fish habitat in the Davidson Creek Watershed.

Fish productivity is defined as the 'sustained yield of all component populations and species and their habitat which support and contribute to a fishery' (Randall et al., 2013). In order to defensibly monitor and evaluate change in fish productivity, a monitoring program that focuses on habitat evaluations and fish utilization is proposed (Bradford et al., 2014). Monitoring habitat quality and quantity as it pertains to indicator species and life stages will provide indication of overall change in the aquatic ecosystem and its capacity for fish productivity. In addition, information on fish presence (i.e., presence / absence at timing periods of interest), relative abundance, and size class distribution will indicate whether habitat is being utilized for its intended objectives.

A combination of metrics is proposed for habitat evaluation and fish utilization in the EMP as indicators of fish productivity. Metrics and indicators of offset performance that are included in the EMP include:

- Physical Stability of the Works: qualitative measurements will be obtained of the offsets during each year of monitoring to document the stability of the works as it pertains to fish habitat. Documentation of physical stability of the works is considered a surrogate for fish habitat establishment and can indicate whether the offsets are functioning as intended.

- Riparian Vegetation: riparian vegetation contributes to fish productivity through bioenergetic links between the aquatic and terrestrial food webs and supports water quality parameters that are require for aquatic life through sediment and thermal stability.

- Hydraulic function: water quantity and flow provide an indication of the instream flow needs and habitat suitability for target species and life stages. Hydrology data also provides a measurement of the overall habitat areas that are realized through offset construction (i.e., wetted area) and will support habitat characterizations.

- Water Quality: water quality provide indication that the offsets are contributing to conditions that support target fish species and life stages. Parameters include but are not limited to temperature, dissolved oxygen, turbidity, and pH.

- Habitat Characterization: fish habitat metrics will be collected as surrogates of fish habitat productivity. Fish habitat metrics will vary for each offset site (further described below), and will be characterized using the *Reconnaissance 1:20,000 Fish and Fish Habitat: Standards and*

Procedures (BC Resource Inventory Committee, 2001) and the *Fish Habitat Assessment Procedures* (FHAP; Johnston and Slaney, 1996). Habitat metrics include (where applicable) physical variables for each habitat category (e.g., substrate, depth, cover type and density, velocity), and qualitative habitat potential ratings.

- Fish Presence: provides an indication of habitat use of different life stages of different fish species (i.e., biologically sensitive periods). Fish inventories will be completed to evaluate species composition, relative abundance, size class distribution at seasons that correspond to the offset design basis targets.

- Effects of the Environment: it is expected that the offsets included in the Offset Measures Plan will provide long-term benefits to fish populations near the Project. External elements, particularly with respect to beaver dams, may temporarily alter the intended habitat quality and channel morphology of the offsets. The offsets will be monitored for change over time as a result of the environment.

The habitat and fish metrics as they correspond to each offset design are presented in Table 2-1. Success criteria and approach to monitoring for each component of the program is further described in the subsections below as it pertains to each offset.

Table 2-1. Habitat and Fish Metrics as they Correspond to Each Offset Design

Offset Measure	Offset Design Objectives	Measurable Parameters	Indicators of Success
Murray Creek Habitat Enhancement	Riparian enhancements will contribute to fish productivity by increasing or improving habitat potential for the following: - Rainbow trout at all life stages - Chinook salmon at all life stages	- Physical Stability of the Works - Riparian Vegetation - Hydrology - Water Quality - Habitat Characterization - Fish utilization - Effects of the Environment	Constructed offsets are stable, no substantial signs of erosion, migration, or sedimentation that may impact habitat functionality Riparian establishment of at least 70% within planted areas by the third-year post-construction, and riparian plantings are contributing to fish habitat potential (e.g., cover, allochthonous inputs). Water quality meets BC guidelines for the protection of freshwater aquatic life Habitat characterization indicates that the offsets provide habitat for rainbow trout and chinook salmon at all life stages Fish use is demonstrated within the area of the constructed offsets Rainbow Trout and chinook salmon relative abundance and condition in offsetting area is comparable to pre-restoration and/or reference site data Rainbow Trout and chinook salmon size class structure is comparable to pre-restoration and/or reference site data Beaver dams do not permanently block fish access to habitats (i.e., beaver dams are viewed as temporary structures within the ecosystem)
Greer Creek Habitat Enhancement	Instream cover, cattle exclusion fencing, and riparian enhancements will contribute to fish productivity by increasing or improving habitat potential for the following: - Rainbow trout at all life stages - Chinook salmon at all life stages	- Physical Stability of the Works - Riparian Vegetation - Hydrology - Water Quality - Habitat Characterization - Fish utilization - Effects of the Environment	Constructed offsets are stable, no substantial signs of erosion, migration, or sedimentation that may impact habitat functionality Riparian establishment of at least 70% within planted areas by the third-year post-construction, and riparian plantings are contributing to fish habitat potential (e.g., cover, allochthonous inputs). Water quality meets BC guidelines for the protection of freshwater aquatic life Habitat characterization indicates that the offsets provide habitat for rainbow trout and chinook salmon at all life stages Fish use is demonstrated within the area of the constructed offsets Rainbow Trout and chinook salmon relative abundance and condition in offsetting area is comparable to pre-restoration and/or reference site data Rainbow Trout and chinook salmon size class structure is comparable to pre-restoration and/or reference site data Beaver dams do not permanently block fish access to habitats (i.e., beaver dams are viewed as temporary structures within the ecosystem)
Creek 661 Off-Channel Overwintering Pond	Construction of an overwintering pond will contribute to fish productivity by increasing or improving habitat potential for the following: - Rainbow trout fry and juvenile summer rearing, adult summer foraging, and overwintering	- Physical Stability of the Works - Riparian Vegetation - Hydrology - Water Quality - Habitat Characterization - Fish utilization - Effects of the Environment	Constructed offsets are stable, no substantial signs of erosion or habitat feature (e.g., large woody debris) movement that could impact habitat functionality Water depths and through-flow remain consistent and at a level which will provide habitat for fish during periods where ice cover is present Water quality in the Creek 661 pond meets guidelines, particularly during the overwintering period Fish use is demonstrated within the pond during the target life stages (i.e., rearing, overwintering) Rainbow Trout relative abundance, condition, and size class structure in offsetting area is comparable to reference site data Riparian establishment of at least 70% within planted areas by the third-year post-construction, and riparian plantings are contributing to fish habitat potential (e.g., cover, allochthonous inputs). Beaver dams do not permanently block fish access to habitats (i.e., beaver dams are viewed as temporary structures within the ecosystem)
Flow augmentation in Davidson Creek	Water will be pumped from Tatelkuz Lake to Davidson Creek via the Freshwater Supply System (FWSS) to meet instream flow needs of Davidson Creek. The management of instream flow needs will maintain fish productivity in Davidson Creek for the following: - Rainbow trout at all life stages - Kokanee spawning and egg incubation	- Hydrology - Water Quality - Habitat Characterization - Fish utilization	Water depth and flow remain consistent and at a level which will provide habitat for rainbow trout at all life stages and kokanee during the spawning and egg incubation period. Water quality parameters are within normal ranges to support kokanee spawning and egg incubation, and rainbow trout at all life stages Existing habitat unit quantities remain relatively consistent in Davidson Creek baseline conditions Kokanee spawning activities persist with the present of the offset measures Rainbow trout continue to use Davidson Creek to carry out all their life stages Rainbow Trout relative abundance, size class structure, and condition in offsetting area is comparable to pre-restoration and/or reference site data

Lake 15/16 Connector Channel	A connector channel will be constructed to provide drainage and fish passage between Lake 15 and Lake 16. The channel will contribute to fish productivity by increasing or improving habitat potential for the following: - Rainbow trout at all life stages	- Physical Stability of the Works - Riparian Vegetation - Hydrology - Water Quality - Habitat Characterization - Fish utilization - Effects of the Environment	Constructed offsets are stable, no substantial signs of erosion or habitat feature (e.g., large woody debris) movement that could impact habitat functionality Lake 15/Lake 16 channel remains connected with no barriers to fish passage Water depths and through-flow remain consistent and at a level which will provide habitat for rainbow trout at all life stages Water quality parameters are within normal ranges to support rainbow trout at all life stages Habitat characterization indicates that the offsets provide habitat for rainbow trout at all life stages Riparian establishment of at least 70% within planted areas by the third-year post-construction, and riparian plantings are contributing to fish habitat potential (e.g., cover, allochthonous inputs) Fish species are present in the connector channel and abundance is comparable to the reference site and is consistent over the ten-year monitoring period Beaver dams do not permanently block fish access to habitats (i.e., beaver dams are viewed as temporary structures within the ecosystem)

2.2 Murray Creek and Greer Creek Habitat Restoration

The Murray Creek and Greer Creek habitat offset measures have been designed to restore sections of degraded fish habitat. Monitoring of the restoration projects will consist of measurement and assessment of physical stability and hydraulic function, water quality, fish utilization, and riparian vegetation.

To quantitatively measure the success of the restoration plans, effectiveness monitoring will be implemented at sites where restoration is proposed. Monitoring of physical characteristics, surface water chemistry, and biological conditions will occur over a ten-year period (1, 3, 5 and 10 years after implementation). A suitable reference site with comparable biophysical characteristics will be selected prior to conducting the monitoring program.

2.2.1 Offset Objectives

2.2.1.1 Restoration Objectives

The offset measures for Murray and Greer creeks included the following restoration objectives:

- Restore and maintain a channel with a natural shape, dimensions, and bed material, such that water flow and sediment transport are in a natural balance.
- Exclude livestock from property.
- Maintain opportunities for small machinery and pedestrians to cross Mathews Creek at one managed/controlled location.
- Remove dilapidated crossings.
- Restore natural meander migration rates through re-establishment of riparian vegetation on re-graded banks.
- Remove in-stream obstructions that are unnatural, impede or prevent fish passage, or cause extensive and/or prolonged backwatering (habitat impact).

2.2.1.2 Enhancement Objectives

The offset measures for Murray and Greer creeks included the following enhancement objectives:

- Increase riparian cover for fish (e.g., planting trees and shrubs, stream bank live stakes).
- Increase instream habitat cover features (e.g., root wads, boulders).
- Improve hydraulic condition for spawning (same as restoration objective in Section 2.2.1.1).

2.2.2 Effectiveness Monitoring Program

2.2.2.1 Summer Program

The summer program will include the following tasks:

- Completion of an initial drone survey to collect baseline pre-construction images, video and digital elevation mapping at each offsetting fish sampling and water quality stations, the overwintering pond reference site, and the Murray Creek and Greer Creek banks where restoration is planned.

- Representative photographs will be taken prior to construction, immediately following completion, and during each subsequent site visit. Photographs will be collected from the same vantage point and with the same field of view to allow for time series comparison. Repeat channel cross-sections will be measured at benchmarked locations representative of the diversity of local morphology, especially in areas of complete earth works (e.g., bank regrading), to help substantiate visual interpretations.
- Monitoring of physical stability and flow will include detailed site evaluations to document any changes to side slopes, shoreline, large woody debris stability (slumping, erosion, substrate deposition/scouring), and hydraulic function (connectivity to mainstem channels and water depth during periods of high and low flow).
- Rainbow Trout utilization of the offsetting habitat will be assessed through the collection of presence/absence, relative abundance, condition (length, weight), and size-class distribution (age or length-frequency) data at each monitoring station. Fish sampling techniques may include minnow trapping, single-pass electrofishing, or a combination of methods and will be consistent throughout the monitoring program. Three fish monitoring stations and one reference station are proposed for the Murray Creek habitat offsetting area, the Lower Greer Creek offsetting area, and mid, upper, and tributary areas of Greer Creek. Stations will be established at locations where instream fish cover (i.e., rootwads, logs, and boulder clusters) will be constructed. The reference station is proposed upstream of the offsetting area, in similar habitat, at each of the restoration areas.
- Habitat will be characterized at the fish sampling locations identified above using methods described in Reconnaissance 1:20,000 Fish and Fish Habitat: Standards and Procedures (BC Resource Inventory Committee, 2001) and the Fish Habitat Assessment Procedures (FHAP; Johnston and Slaney, 1996). Results of the habitat assessment will be compared with the habitat quality and characteristics that have been proposed in the Offset Measures Plan. Habitat surveys will document characteristics that pertain to salmonid habitat potential, including but not limited to:
  - Channel morphology (e.g., gradient, channel pattern, bar type, woody debris characteristics)
  - substrate composition
  - Flow and velocity measurements will also be obtained during the habitat assessment. In addition, a network of hydrometric monitoring stations is maintained and monitored throughout the region and these data will be compared with direct hydrology measurements at each offsetting stream to describe baseline conditions and will be used to assess the success of the enhancement works.
- Three surface water monitoring stations will be located at each restoration area: one reference station upstream of each area, one station within each area, and one station downstream of each area. Date collection will include water temperature, pH, conductivity, turbidity, and dissolved oxygen.
- Riparian vegetation will be assessed for survivorship and percent cover. Plantings will be initially inspected following installation to document species, diversity, and vigour. Follow-up inspections will be conducted once-yearly during years 1, 3, 5, and 10 following planting to record the survivorship and general vegetation cover, including competition from agronomic species. Riparian assessments will include an evaluation of species composition (i.e., planting schedule and identification of weeds), survivorship, density (i.e., cover). As a large number of shrubs, herbaceous vegetation, and aquatic plants will be planted over a large areal extent, the survivorship and ground cover assessment will be conducted using a subsampling approach at a number of vegetation plots. Representative photos will

be taken of the planted vegetation and any growth or survival issues during each visit, to illustrate growth over time.

- Effects of the environment on the offsetting sites also will be measured using indicators for animal activities. Potentially detrimental animal activities can include the effects of new beaver dams to Greer Creek. The low gradient and current beaver dam activity can minimize flow velocities and maintain a deep channel dominated by run and pool habitats during all seasons. Due to these potential benefits for fish populations (e.g., summer low-flow and overwintering habitat, increased stream productivity) beaver management is not planned for this site unless it is determined that permanent structures prohibiting upstream fish passage requires adaptive management.

2.2.2.2 Winter Program

Winter fieldwork will comprise of measuring water quality conditions as an indication of fish use (i.e., assumes that fish habitat potential is present based on the results of water quality parameters). Water quality will be measured at habitat enhancement sites and the reference site. If ice conditions do not allow for fish surveys, data may be collected through visual methods (e.g., fish finders, cameras). Monitoring will be conducted once-yearly during years 1, 3, 5, and 10 following construction.

2.2.3 Success Criteria

Using the monitoring components discussed above, the success of the Murray Creek and Greer Creek habitat restoration measures achieving their objectives will be assessed using qualitative and quantitative metrics or indicators (Table 1-1).

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Table 2-2. Success Criteria for the Murray Creek and Greer Creek Habitat Enhancement Projects

Measurable Parameter	Program Timing	Indicators of Success	Field Methods
Physical Stability	Summer	Bed, bank, and constructed habitat features (boulders, brush layers, woody debris) show no significant signs of erosion, migration or sedimentation that may impact habitat functionality	Qualitative characteristics and representative photographs obtained through the fish habitat assessment.
Hydraulic Function	Summer	Restored habitat remains wetted with sufficient flow and depth for use by Rainbow Trout	Flow and velocity measurements will form part of the habitat assessment.
Water Quality	Summer and Winter	Water quality meets BC guidelines for the protection of freshwater aquatic life. Temperature below lethal levels for Rainbow Trout	Surface water temperature, pH, conductivity, turbidity, and dissolved oxygen will be measured at each monitoring station. Water quality parameters will be evaluated against the BC Water Quality Guidelines for the protection of aquatic life.
Habitat Characterization	Summer	Habitat characterization indicates that the offsets provide habitat for rainbow trout and chinook salmon at all life stages	Habitat will be characterized at the fish sampling locations identified above using methods described in *Reconnaissance 1:20,000 Fish and Fish Habitat: Standards and Procedures* (BC Resource Inventory Committee, 2001) and the *Fish Habitat Assessment*

			Procedures (FHAP; Johnston and Slaney, 1996).
Fish Utilization	Summer	Restored areas provide habitat for Rainbow Trout of various life stages relative to pre-restoration and reference site data	Fish surveys will be completed to provide indication of species composition in the offset area.
	Summer	Rainbow Trout relative abundance and condition in offsetting area is comparable to pre-restoration and/or reference site data	Fish surveys will be completed to provide indication of relative abundance in the offset area.
	Summer	Rainbow Trout size classes are comparable to pre-restoration and/or reference site data	Fish surveys will be completed to provide indication of size class distribution in the offset area
Riparian Vegetation	Summer	Survivorship: No more than 30% mortality of planted riparian vegetation from natural causes or competition from agronomic species after the third year	Fish habitat assessment of monitoring stations and reference stations, plant identification including weeds
	Summer	Vegetation percent cover: Increase in the percent cover between monitoring years	Fish habitat assessment of monitoring stations and reference stations, plant identification including weeds
Effects of the Environment	Summer	Beaver dams do not block fish access to upstream habitat in Greer Creek	Fish habitat assessment of monitoring stations and reference stations
		Beaver dams evaluated as temporary structures	Fish habitat assessment of monitoring stations and reference stations

2.3 Creek 661 Off-channel Overwintering Pond

The construction of the Creek 661 off-channel overwintering ponds will result in the creation of new overwintering habitat for rainbow trout. The objective of the EMP is to quantitatively determine the success of the Creek 661 off-channel pond to provide fish habitat, as designed, following construction. A Control-Impact design will be used, where the created offsetting habitat will be compared with a reference habitat. A suitable reference site with comparable biophysical characteristics will be selected prior to conducting the monitoring program. Proposed effectiveness monitoring programs will be undertaken in summer and winter, 1, 3, 5 and 10 years after construction of the offsetting habitat.

2.3.1 Offset Objectives

The offset measures for Creek 661 included the following enhancement objectives:

- Increase riparian cover for fish (e.g., planting trees and shrubs, stream bank live stakes).
- Increase instream habitat cover features (e.g., root wads, boulders).
- Improve the quantity and quality of overwintering habitat (e.g., side channel pond construction).

2.3.2 Effectiveness Monitoring Program

2.3.2.1 Summer Program

The summer program will include the following tasks:

- Monitoring of physical stability and flow will include detailed site evaluations to document any alterations to side slopes, shoreline and large woody debris stability (slumping, erosion, substrate deposition/scouring), and hydraulic function (connectivity to lakes and water depth during periods of high and low flow).
- Representative photographs will be taken during each subsequent site visit. Photographs will be collected from the same vantage point and with the same field of view to allow for time series comparison.
- Rainbow Trout utilization of the offsetting habitat will be assessed through the collection of presence/absence, relative abundance, condition (length, weight), and size-class distribution (age or length-frequency) data at each monitoring station. Fish sampling techniques may include minnow trapping, single-pass electrofishing, or a combination of methods and will be consistent throughout the monitoring program. Fish sampling is proposed within the lake and a comparable. reference station
- Habitat will be characterized at the fish sampling locations identified above using methods described in *Reconnaissance 1:20,000 Fish and Fish Habitat: Standards and Procedures* (BC Resource Inventory Committee, 2001) and the *Fish Habitat Assessment Procedures* (FHAP; Johnston and Slaney, 1996). Results of the habitat assessment will be compared with the habitat quality and characteristics that have been proposed in the Offset Measures Plan. Habitat surveys will document characteristics that pertain to salmonid habitat potential, including but not limited to:
  - Channel morphology (e.g., gradient, channel pattern, bar type, woody debris characteristics)
  - substrate composition

- Surface water temperature, pH, conductivity, turbidity, and dissolved oxygen. In addition, a network of surface water monitoring stations is maintained and monitored throughout the Project area and these data will be accessed for description of baseline and assessment of the enhancement works.
- Flow and velocity measurements will also be obtained during the habitat assessment. In addition, a network of hydrometric monitoring stations is maintained and monitored throughout the region and these data will be accessed for description of baseline and assessment of the enhancement works.

- As part of the habitat assessment. riparian vegetation will be assessed for survivorship and vegetation percent cover. Plantings will be initially inspected following installation to document the species, diversity, and vigour. Follow-up inspections will be conducted once-yearly during years 1, 3, 5, and 10 following planting to record the survivorship and general vegetation cover, including competition from agronomic species. Riparian assessments will include an evaluation of species composition (i.e., planting schedule and identification of weeds), survivorship, density (i.e., cover). As a large number of shrubs, herbaceous vegetation, and aquatic plants will be planted over a large areal extent, the survivorship and ground cover assessment will be conducted using a subsampling approach at a number of vegetation plots. Representative photos will be taken of the planted vegetation and identified growth or survival issues during each visit to illustrate growth over time.
- Effects of the environment on the offsetting sites also will be measured using indicators for animal activities. Potentially detrimental animal activities can include the effects of new beaver dams to Creek 661. The current local abundance of beaver dams can minimize flow velocities and maintain a deep channel dominated by run and pool habitats during all seasons. Due to these potential benefits for fish populations (e.g., summer low-flow and overwintering habitat, increased stream productivity) beaver management is not planned for this offsetting site unless it is determined that permanent structures prohibiting fish access to the offsetting pond require adaptive management.

2.3.2.2 Winter Program:

Winter fieldwork will comprise of measuring water quality conditions as an indication of fish use (i.e., assumes that fish habitat potential is present based on the results of water quality parameters). Water quality will be measured at Creek 661 overwintering pond and the reference site. If ice conditions do not allow for fish surveys, data may be collected through visual methods (e.g., fish finders, cameras). Monitoring will be conducted once-yearly during years 1, 3, 5, and 10 following construction.

2.3.3 Success Criteria

Creek 661 off-channel overwintering pond offsetting measures have been designed to provide overwintering habitat for all life stages of Rainbow Trout as well as summer rearing habitat for Rainbow Trout within the Creek 661 watershed. Physical stability and hydraulic function, fish utilization, water quality, and planted riparian vegetation success will be monitored and assessed against design objectives. A summary of success criteria for these parameters is outlined in Table 1-2.

Table 2-3. Success Criteria for the Lake 15/Lake 16 Connector Channel and the Creek 661 Off-Channel Pond

Measurable Parameter	Program Timing	Indicators of Success	Field Methods
Physical Stability	Summer	Creek 661 overwintering pond shows no signs of slumping/erosion or habitat feature (e.g., large woody debris) movement that may affect habitat functionality	Qualitative characteristics and representative photographs obtained through the fish habitat assessment.
Hydraulic Function	Summer	Pond remains hydraulically connected to Creek 661 mainstem with no barriers to fish passage	Qualitative characteristics and representative photographs obtained through the fish habitat assessment.
	Winter	Water depths and through-flow remain consistent and at a level that provides habitat for fish during periods where ice cover is present	Flow and velocity measurements will form part of the fish habitat assessment.
Water Quality	Summer / Winter	Water quality in the Creek 661 pond meets guidelines, particularly during the overwintering period.	Surface water temperature, pH, turbidity, and dissolved oxygen will be measured at each monitoring station. Water quality parameters will be evaluated against the BC Water Quality Guidelines for the protection of aquatic life: surface water temperature (e.g., lakes and pond ± 1C change from ambient background; connector channel minimum incubation temperature of 2C), pH of (e.g., 6.5-9), turbidity (e.g., change from background of 8 NTU at any one time for a duration of 24 h in all waters during clear flows or in clear waters); and dissolved oxygen (e.g., minimum 8 mg/L).

Habitat Characterization	Summer	Habitat characterization indicates that the offsets provide habitat for rainbow trout at all life stages	Habitat will be characterized at the fish sampling locations identified above using methods described in *Reconnaissance 1:20,000 Fish and Fish Habitat: Standards and Procedures* (BC Resource Inventory Committee, 2001) and the *Fish Habitat Assessment Procedures* (FHAP; Johnston and Slaney, 1996).
Fish Utilization	Summer / Winter	Creek 661 pond provides overwintering and rearing habitat for Rainbow Trout of various life stages relative to reference site, including water depth and through-flow.	Fish surveys will be completed in the summer to provide indication of species composition in the offset area. Winter fieldwork will comprise of measuring water quality conditions as an indication of fish use.
	Summer	Rainbow Trout relative abundance (fish per 100 m) is comparable to reference site	Fish surveys will be completed to provide indication of relative abundance in the offset area.
	Summer	Rainbow Trout size classes are comparable to reference site	Fish surveys will be completed to provide indication of size class distribution in the offset area
Riparian Vegetation	Summer	Riparian survivorship: No more than 30% mortality of planted riparian vegetation from natural causes or competition from agronomic species after the third year	Fish habitat assessment of monitoring stations and reference stations, plant identification including weeds
	Summer	Vegetation percent cover: Increase in the percent	Fish habitat assessment of monitoring stations and reference stations, plant identification including weeds

		cover between monitoring years	
Effects of the Environment	Summer	Beaver dams do not block fish access to offsetting pond at Creek 661	Fish habitat assessment of monitoring stations and reference stations
		Beaver dams evaluated as temporary structures	Fish habitat assessment of monitoring stations and reference stations

2.4 Flow Augmentation in Davidson Creek

Effectiveness monitoring field programs are proposed for spring, summer, and winter during years 1, 3, 5, 7 and 11 after completion of the offset measures. The monitoring frequency is based on a four-year return period for Kokanee. Three areas will be monitored in lower Davidson Creek between Reaches 1 to 6. The Davidson Creek monitoring program will closely follow and build upon the baseline data collected for the creek in 2021 and 2022.

A monitoring plan has been developed to satisfy monitoring condition 3.14 of the Decision Statement. Monitoring at Davidson Creek for the purposes of the Decision Statement issued under Section 54 of the Canadian Environmental Assessment Act, 2012. The monitoring commitments of the Decision Statement compliment the offset monitoring requirements that are required as part of the Application for Authorization, and the details of this program are included in Attachment A. Methods from this monitoring plan are summarized within this document, with more detailed protocol included in Attachment A.

2.4.1 Effectiveness Monitoring Program

2.4.1.1 Spring Program

2.4.1.2 Davidson Creek Kokanee Fry Outmigration Survey

Monitoring Kokanee fry outmigration over time will be part of the FWSS EMP to assess abundance as a surrogate metric for adult Kokanee spawning success.

The spring Kokanee fry outmigration survey will comprise the following tasks:

- Assess presence and timing of outmigrating Kokanee fry using a sub-sampling mark-recapture method deploying fine-mesh nets of known dimensions into the channel at predetermined locations, according to the methods of Fraley and Clancey (1984). Each net will be sampled at a set interval and the fry captured will be enumerated and recorded. Capture efficiency of the nets will be determined using a mark-recapture approach by marking captured fry with Bismarck Brown Y and releasing them upstream of the capture location. Recaptured marked fish will be counted and the proportion of recaptured fish will indicate the trap's effectiveness.
- Surface water quality monitoring (temperature, dissolved oxygen, pH, and conductivity)
- Stream flow measurements.

2.4.1.3 Davidson Creek Rainbow Trout Spawner Survey

The spring Rainbow Trout spawner survey field program will include the following tasks:

- Installation of paired (i.e., upstream- and downstream-facing) hoop nets at two sites (one site in the lower extent of Reach 1, one site in the upper extent of Reach 5)
- Daily hoop net checks for spawning Rainbow Trout, which will include:
- Marking of adult Rainbow Trout with t-bar (floy) tags to track fish movement
- Collection of Rainbow Trout abundance, length, age class, weight, and body condition data
- Surface water quality monitoring (temperature, dissolved oxygen, pH and conductivity)
- Stream flow measurements.

2.4.1.4 Summer Program

2.4.1.5 Davidson Creek Young-of-Year and Juvenile Rainbow Trout Abundance

Similar to the monitoring of Kokanee fry abundance, the monitoring for density of young-of-year (age 0^+) and juvenile (age 1^+ to 3^+) Rainbow Trout will provide another metric during sensitive life stages that can be monitored over time to evaluate the effectiveness of the FWSS flow regime. The young-of-year and juvenile Rainbow Trout abundance field program will comprise the following tasks:

- Three-pass depletion electrofishing of stream sections 100 to 150 m in length, isolated with block nets, at nine sites:
  - Lower Davidson Creek sites will be assessed first (early July) due to the expected limited amount of Rainbow Trout spawning activity and to avoid spawning Kokanee.
  - Middle Davidson Creek sites will be sampled later in July due to no Kokanee spawning activity and to minimize the impact early in the development of Rainbow Trout embryos.
- Collection of Rainbow Trout length, weight, age class, weight, and body condition data
- Surface water monitoring for temperature, dissolved oxygen, pH, and conductivity.

2.4.1.6 Davidson Creek Kokanee Spawner Survey

The summer Davidson Creek Kokanee spawner survey field program will comprise the following tasks:

- Visual assessment of Kokanee spawners and redds via two-person bank walks over the same sections of Reaches 1 to 4 of Davidson Creek previously sampled by AMEC (2013). Information collected during the bank walk surveys will include:
  - Live Kokanee and carcass counts
  - Redd abundance, approximate area, and substrate type
  - A subset of carcasses will be qualitatively assessed for egg or milt retention to assess spawning success.
- Surface water quality monitoring (temperature, dissolved oxygen, pH and conductivity)
- Stream flow measurements.
- Habitat Assessment
- Habitat will be characterized at the fish sampling locations identified above using methods described in *Reconnaissance 1:20,000 Fish and Fish Habitat: Standards and Procedures* (BC Resource Inventory Committee, 2001) and the *Fish Habitat Assessment Procedures* (FHAP; Johnston and Slaney, 1996). Results of the habitat assessment will be compared with the habitat quality and characteristics that have been proposed in the Offset Measures Plan. Habitat surveys will document characteristics that pertain to salmonid habitat potential, including but not limited to:
  - Channel morphology (e.g., gradient, channel pattern, bar type, woody debris characteristics)
  - substrate composition
  - Surface water temperature, pH, conductivity, turbidity, and dissolved oxygen.

- Flow and velocity measurements

2.4.1.7 Winter Program

Winter fieldwork will comprise of measuring water quality conditions as an indication of fish use (i.e., assumes that fish habitat potential is present based on the results of water quality parameters). Water quality will be measured at potential and identified overwintering locations. If ice conditions do not allow for fish surveys, data may be collected through visual methods (e.g., fish finders, cameras). Monitoring will be conducted once-yearly during years 1, 3, 5, and 10 following construction.

2.4.1.8 Davidson Creek Overwintering Habitat Assessment

The overwintering habitat assessment program will assess overwintering habitat quality in pools of sufficient depth to juvenile rainbow trout using:

- Snowpack depth
- Ice depth
- Water depth
- Water quality (i.e., temperature, dissolved oxygen, pH and conductivity).
- Underwater camera monitoring to establish overwintering habitat use by Rainbow Trout.

2.4.2 Success Criteria

The flow augmentation in Davidson Creek has been designed to maintain flow in the creek to support all fish life stage requirements. Fish utilization, spawning success of Rainbow Trout and Kokanee, and overwintering usage will be monitored and assessed against design objectives. A summary of success criteria for these parameters is outlined in Table 1-3.

Table 2-4. Success Criteria for Davidson Creek Flow Augmentation

Monitoring Component	Program Timing	Indicators of Success	Field Methods
Kokanee Spawning and Outmigration	Spring / Summer	Kokanee spawn in Davidson Creek, and Kokanee fry outmigrate, within the normal range of baseline abundance and timing.	Water quality will be analyzed for dissolved free amino acids (DFAA; related to salmonid homing to natal streams);
	Spring / Summer	Temperature, pH, conductivity, and dissolved oxygen remain within normal range for Kokanee spawning and outmigration	Water quality parameters will be evaluated against the BC Water Quality Guidelines for the protection of aquatic life.
	Spring	Water depth and flow remain consistent and at a level that will provide habitat for fish during outmigration	Flow and velocity measurements will form part of the fish habitat assessment.
Rainbow Trout Spawning	Spring	Rainbow Trout continue to spawn in Davidson Creek; spawner abundance and timing is comparable to baseline.	Redd surveys and fish habitat assessments to characterize spawning habitat potential.
	Spring	Temperature, pH, conductivity, and dissolved oxygen remain within normal range.	Water quality parameters will be evaluated against the BC Water Quality Guidelines for the protection of aquatic life.
	Spring	Water depth and flow remain consistent and at a level which will provide habitat for Rainbow Trout during the spawning period.	Flow and velocity measurements will form part of the fish habitat assessment and will inform HSI values for rainbow trout spawning life stages
Rainbow Trout YoY and Juvenile Abundance	Summer	Rainbow Trout young-of-year and juveniles are present	Fish surveys will be completed to provide indicate of YOY and juvenile rainbow trout habitat use.

Monitoring Component	Program Timing	Indicators of Success		Field Methods
	Summer	Rainbow Trout relative abundance and condition are relatively consistent with baseline conditions of Davidson Creek		Fish surveys will be completed to provide indication of relative abundance in the area.
	Summer	Rainbow Trout size classes are relatively consistent with baseline conditions of Davidson Creek		Fish surveys will be completed to provide indication of size class distribution in the area
Habitat Characterization		Summer	Existing habitat unit quantities remain relatively consistent in Davidson Creek baseline conditions	A fish habitat assessment will be used to develop HSI interpretation of habitat as it pertains to rainbow trout at all life stages. Habitat characteristics will be recorded at each monitoring station and HSI values will be inferred for the remaining portions of the offset area. HSI will be used to calculate HUs and evaluate offset compliance.
Overwintering Habitat	Winter	Rainbow Trout young-of-year and juveniles are present		Underwater cameras or fish finders will be used to evaluate fish habitat use in Davidson Creek during the winter.
	Winter	Overwintering habitat is present in lower Davidson Creek at selected overwintering locations identified during baseline studies.		A fish habitat assessment will be used to develop HSI interpretation of habitat as it pertains to rainbow trout at all life stages, including overwintering habitat. Habitat characteristics will be recorded at each monitoring station and HSI

Monitoring Component	Program Timing	Indicators of Success	Field Methods
			values will be inferred for the remaining portions of the offset area.
	Winter	Temperature, pH, conductivity, and dissolved oxygen remain within acceptable range.	Surface water temperature, pH, conductivity, turbidity, and dissolved oxygen will be measured at each monitoring station. Water quality parameters will be evaluated against the BC Water Quality Guidelines for the protection of aquatic life.

2.5 Lake 15/Lake 16 Connector Channel

Fish habitat offset plans include construction of the Lake 15/Lake 16 connector channel, which will result in the creation of new habitat. The objective of the EMP is to quantitatively determine the success of the Lake 15/Lake 16 connector channel to provide fish habitat as designed following construction. A Control-Impact design will be used, where the created offsetting habitat will be compared to reference habitat. A suitable reference site with comparable biophysical characteristics will be selected prior to conducting the monitoring program.

2.5.1 Effectiveness Monitoring Program

Proposed effectiveness monitoring programs will be undertaken in the summer and winter during years 1, 3, 5 and 10 after completion of the offsetting habitat.

2.5.1.1 Summer Program:

The summer program will include the following tasks:

- Physical Assessment of Offsets
- Completion of a drone survey to collect images, video and digital elevation mapping information at the fish sampling and water quality stations in the connector channel and reference site.
- Representative photographs will be taken during each subsequent site visit. Photographs will be collected from the same vantage point and with the same field of view to allow for time series comparison. Repeat channel cross-sections will be measured at benchmarked locations representative of the diversity of local morphology, especially in areas of complete earth works (e.g., bank regrading) to help substantiate visual interpretations.
- Monitoring of physical stability and flow will include detailed site evaluations to document any alterations to side slopes, shoreline and large woody debris stability (slumping, erosion, substrate deposition/scouring), and hydraulic function (connectivity to lakes and water depth during periods of high and low flow).
- Fish Sampling
- Collection of data in the Lake 15/Lake 16 connector channel and at the reference area. Data to be collected in each area will include:
    - Rainbow Trout utilization of the offsetting habitat will be assessed through the collection of fish presence and relative abundance in the connector channel. Fish sampling techniques may include minnow trapping, single-pass electrofishing, or a combination of methods and will be consistent throughout the monitoring program.
- Fish Habitat Assessment
- Collection of data from each of the monitoring stations at Lake 15 / Lake 16 Connector, as well as a reference station. Habitat will be characterized at the fish sampling locations identified above using

methods described in *Reconnaissance 1:20,000 Fish and Fish Habitat: Standards and Procedures* (BC Resource Inventory Committee, 2001) and the *Fish Habitat Assessment Procedures* (FHAP; Johnston and Slaney, 1996). Results of the habitat assessment will be compared with the habitat quality and characteristics that have been proposed in the Offset Measures Plan. Habitat surveys will document characteristics that pertain to salmonid habitat potential, including but not limited to:

  - Channel morphology (e.g., gradient, channel pattern, bar type, woody debris characteristics)
  - substrate composition
  - Surface water temperature, pH, conductivity, turbidity, and dissolved oxygen.
  - Flow and velocity measurements will also be obtained during the habitat assessment.
- As part of the habitat assessment, riparian vegetation will be assessed for survivorship and vegetation percent cover. Plantings will be initially inspected following installation to document the species, diversity, and vigour. Follow-up inspections will be conducted once-yearly during years 1, 3, 5, and 7 following planting to record the survivorship and general vegetation cover, including competition from agronomic species. Riparian assessments will include an evaluation of species composition (i.e., planting schedule and identification of weeds), survivorship, density (i.e., cover). As a large number of shrubs, herbaceous vegetation, and aquatic plants will be planted over a large areal extent, the survivorship and ground cover assessment will be conducted using a subsampling approach at a number of vegetation plots. Representative photos will be taken of identified growth or survival issues as well as of the planted vegetation during each visit to illustrate growth over time.
- Effects of the environment on the offsetting sites also will be measured using indicators for animal activities. Potentially detrimental animal activities can include the effects of new beaver dams to lake connectivity. Potential beaver activity in the channel may minimize flow velocities and maintain a deep channel on the upstream side during all seasons. Due to these potential benefits for fish populations (e.g., summer low-flow and overwintering habitat, increased channel productivity) beaver management is not planned for this offsetting site unless it is determined that permanent structures prohibiting fish passage between the two lakes requires adaptive management.

2.5.1.2 Winter Program:

Data to be collected during the winter field program will include:

- Surface water temperature, pH, conductivity, turbidity, dissolved oxygen in the Lake 15/Lake 16 connector channel

Monitoring will be conducted once-yearly during years 1, 3, 5, and 10 following construction.

2.5.2 Success Criteria

The connector channel has been designed to connect Lake 15 and Lake 16. Physical stability and hydraulic function, fish utilization, water quality, and planted riparian vegetation success will be monitored and assessed against design objectives. A summary of success criteria for these parameters is outlined in Table 1-4.

Table 2-5. Success Criteria for the Lake 15/Lake 16 Connector Channel

Measurable Parameter	Program	Indicators of Success	Field Methods
Physical Stability	Summer	Lake 15/Lake 16 connector channel shows no significant signs of slumping/erosion or habitat feature (e.g., large woody debris) movement that may affect habitat functionality	Qualitative characteristics and representative photographs obtained through the fish habitat assessment
Hydraulic Function	Summer	Lake 15/Lake 16 channel remains connected with no barriers to fish passage	Qualitative characteristics and representative photographs obtained through the fish habitat assessment.
	Summer	Water depths and through-flow remain consistent and at a level which will provide habitat for fish	Flow and velocity measurements will form part of the fish habitat assessment.
Water Quality	Summer / Winter	Water quality in the Lake 15/Lake16 connector channel meets guidelines	Surface water temperature, pH, conductivity, turbidity, and dissolved oxygen will be measured at each monitoring station. Water quality parameters will be evaluated against the BC Water Quality Guidelines for the protection of aquatic life.
Habitat Characterization	Summer	Habitat characterization indicates that the offsets provide habitat for rainbow trout at all life stages	Habitat will be characterized at the fish sampling locations identified above using methods described in *Reconnaissance 1:20,000 Fish and Fish Habitat: Standards and Procedures* (BC Resource Inventory Committee, 2001) and the *Fish Habitat Assessment Procedures* (FHAP; Johnston and Slaney, 1996).
Fish Utilization	Summer	Fish species are present in the connector channel and abundance is comparable to the reference site and is consistent over the ten-year monitoring period	Fish surveys will be completed to provide indication of species composition and relative abundance in the offset area.

Measurable Parameter	Program	Indicators of Success	Field Methods
Riparian Vegetation	Summer	Riparian survivorship: No more than 30% mortality of planted riparian vegetation from natural causes or competition from agronomic species after the third year	Fish habitat assessment of monitoring stations and reference stations; plant identification including weeds
	Summer	Vegetation percent cover: Increase in the percent cover between monitoring years	Fish habitat assessment of monitoring stations and reference stations, plant identification including weeds
Effects of the Environment	Summer	Beaver dams do not block fish migration between the two lakes	Fish habitat assessment of monitoring stations and reference stations
		Beaver dams evaluated aemporary structures	Fish habitat assessment of monitoring stations and reference stations

3. Annual Report with Adaptive Management

The data collected using the methods described above will be summarized in an annual monitoring report for each monitoring year of the program (1, 3, 5, and 10 years after implementation). Results will be interpreted by comparing data from the offsetting sites with data collected pre-Project (for Murray Creek and Greer Creek Restoration, and Davidson Creek flow augmentation offsetting measures only) and from appropriate reference sites. In addition, data interpretation will be based on comparisons of the current year's data with those of previous monitoring years to illustrate trends, if any.

The report will discuss and interpret results for each offset project site to determine whether a particular site is meeting the success criteria (e.g., Rainbow Trout relative abundance is comparable to reference site) for each monitoring component (e.g., fish utilization). Additionally, the report will discuss whether the project sites are generally progressing effectively in achieving the habitat function intended by the design (i.e., temporal improvements in habitat).

The monitoring program will also incorporate adaptive management if offsetting habitat deficiencies are identified (i.e., do not meet identified success criteria) and will include recommending alternate or additional remedial measures, if necessary, to achieve offsetting objectives, EAC and Decision Statement conditions. The determination of whether an offsetting site is not functioning as designed will be based on monitoring data, assessment of results, and professional judgment on the part of the QEP. Additionally, if effectiveness monitoring identifies beaver activity has created permanent conditions that prohibit fish passage or offsetting pond access, adaptive management may be implemented to re-instate fish access (e.g., pond leveler, fish ladders). Regulators, however, will have final determination on whether the offsetting measures, as a whole or in each of its components, have achieved the objective of offsetting fish habitat losses.

If regulators deem that the offsetting fish habitat is not progressing effectively towards functioning as designed, they may direct specific remedial actions to ensure Project conditions are met. If, at the end of the first three years of monitoring, it appears that remedial work is not likely to achieve offsetting objectives, BW Gold (in consultation with DFO) will propose alternative offsetting works or modifications to existing works. If remedial measures are implemented, monitoring may be required for longer than the total ten-year period proposed here.

4. Certification

This report was prepared, reviewed, and approved by the undersigned:

Prepared By: <original signed by>

Dave Huebert., R.P.Bio., P.Biol., Ph.D.
Senior Environmental Scientist

Prepared By: <original signed by>

Jason Baird, B.Sc., B.Tech., R.P.Bio.
Aquatic Biologist

Reviewed By: <original signed by>

Ian MacLeod, B.Sc., R.P.Bio., P.Biol.
Senior Fisheries Biologist

Approved By: <original signed by>

Rick Palmer, M.Sc., R.P.Bio.
President, Senior Fisheries Biologist

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6. Attachment A

Follow-up Programs for Condition 3.14 of the Blackwater Gold Project Decision Statement

BW GOLD LTD
a subsidiary company of Artemis Gold Inc

Blackwater Gold Project

Follow-up Programs for Condition 3.14 of the Blackwater Gold Project Decision Statement Issued under Section 54 of the Canadian Environmental Assessment Act, 2012

April 2022

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Client name	BW Gold LTD.

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Version control:

We follow a two-part numbering system to keep track of revisions. Letters of the alphabet denote drafts that have been sent to the client, and numbers denote internal revisions. For example:

0.1 1st version of report by author

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A.1 1st draft sent to the client

A.2 1st round of addressing client comments

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