Appendix 4.6-D Fish Habitat Offsetting–Phase 1 Feasibility Planning, prepared by Hemmera, 2021

TELKWA COAL
LIMITED

MEMORANDUM

Date:	November 24, 2021
To:	Angela Waterman, Dan Farmer, Allegiance Coal Ltd.
From:	Amber Chong ; Peter Troffe ; Alyson Lehnart ; Hemmera Envirochem.
File:	989388-05
Re:	Tenas Project Fish Habitat Offsetting – Phase 1 Feasibility Planning

1.0 INTRODUCTION

As requested by the proponent (a subsidiary of Allegiance Coal), Hemmera is pleased to provide a short list of fish habitat offsetting options for harmful alteration, disruption, or destruction (HADD) of fish habitat that may occur because of the Tenas Project (the Project). The contents of this memo are intended to provide the location, target species, a brief description, and recommended steps for two offsetting options to potentially be carried forward into a conceptual fish habitat offsetting plan for the Project.

The primary changes in fish habitat structure are expected to arise from the infill and diversion of water currently conveyed in tributaries to Tenas Creek and Four Creek that are located within the mine footprint. Approximately 98% of the watercourse areas are not fish-bearing; however, they do provide flows and allochthonous inputs to downstream fish-bearing waters and are; therefore, considered fish habitat under the federal *Fisheries Act*. A summary of the channel measurements and relative habitat quality in each tributary under different seepage scenarios is presented in the Environmental Assessment (Chapter 4.6 - Fish and Fish Habitat VC) and in **Table 1** below.

Table 1. Estimates of Fish Habitat Loss (Environmental Assessment)

Fish Habitat Loss		
Watercourse	Instream Area (m^2)	Habitat Quality
TN6	8245	Non-fish bearing (poor quality)
TN7	600	
TN8	1092	
Four Creek	115	Dolly Varden Spawning
	75	Dolly Varden Overwintering
Total	10,127	
High Seepage Scenario		
Watercourse	Instream Area (m^2)	Habitat Quality
TN6	8245	Non-fish bearing (poor quality)
TN7	600	
TN8	1092	
Four Creek	16,525	Resident Dolly Varden population
Total	26,462	

2.0 SITE SELECTION

A fish habitat offsetting options assessment was completed for the Project, and three viable options were compared: 1 – creating off channel/side channel habitat on lower Goathorn Creek, 2 – enhancing a side channel on the Telkwa River downstream of the Goathorn Creek confluence, and 3 – enhancing a tributary to the Telkwa River upstream of the Goathorn Creek confluence or on Tenas Creek. Lower Goathorn Creek was determined to be the best offsetting option for the project and is discussed further in this memorandum. Details of the offsetting options analysis is discussed in the Telkwa Coal Aquatics Fish Habitat Offsetting Options (Hemmera 2021).

Lower Goathorn Creek, downstream of the bridge crossing at Aveline Coalmine Road, provides opportunities for off channel and side channel fish habitat development on both the west and east side of the floodplain. The west side of Goathorn Creek likely provides better options for habitat development as the developable area on the east side of the valley is constrained by steep slopes within 75 to 200 metres of the Goathorn Creek channel. Two conceptual designs for offsetting habitat on the west side of Goathorn Creek near the confluence with the Telkwa River have been provided (**Section 4**).

2.1 Goathorn Creek

The nearest and most applicable BC Hydrometric Station to lower Goathorn Creek is the Goathorn Creek near Telkwa Station (08EE008), located approximately 1 km upstream of the Aveling Coalmine Road and 1.5 km upstream of the proposed offsetting site. Tenas Creek confluences with Goathorn Creek approximately 60 m upstream of the Aveling Coalmine Road, increasing the drainage area (and flow rates) by approximately one-third in the downstream 1.2 km of Goathorn Creek to its confluence with the Telkwa River (Hemmera 2021). There is approximately a 63.7 km^2 increase in drainage area between the Goathorn Creek near Telkwa station (drainage area of 123.5 km^2) and Goathorn Creek at the proposed offsetting location (drainage area of 187.2 km^2); therefore, this increase in drainage area makes for the best location to propose habitat offsetting. The proposed offsetting site location and drainage basin is shown in **Figure 1**. The annual hydrograph for the Goathorn Creek near Telkwa station (**Figure 2)**, illustrates the daily average, daily maximum, and daily minimum discharge using both available historical and provisional data (BC MOE 2021).

The Goathorn Creek near Telkwa Station is located 1 km upstream of the Tenas Creek confluence, and the hydrograph is depicted in **Figure 2** to show the annual trend in flows for the geographic area. Goathorn Creek is characterized by low winter base flows when most of the surface water is held in the snowpack, followed by a spring freshet, mid summer flows depending on annual conditions, and an increase in flow when fall storm events occur. Exact flow values for lower Goathorn Creek at the offsetting site will be calculated in the Habitat Offsetting Plan (Phase 2) for the Project. Predicted peak and low flows will be considered in intake structure and functional design. Low flows are an important consideration in intake and channel design because persistent low flows can result in fish stranding.

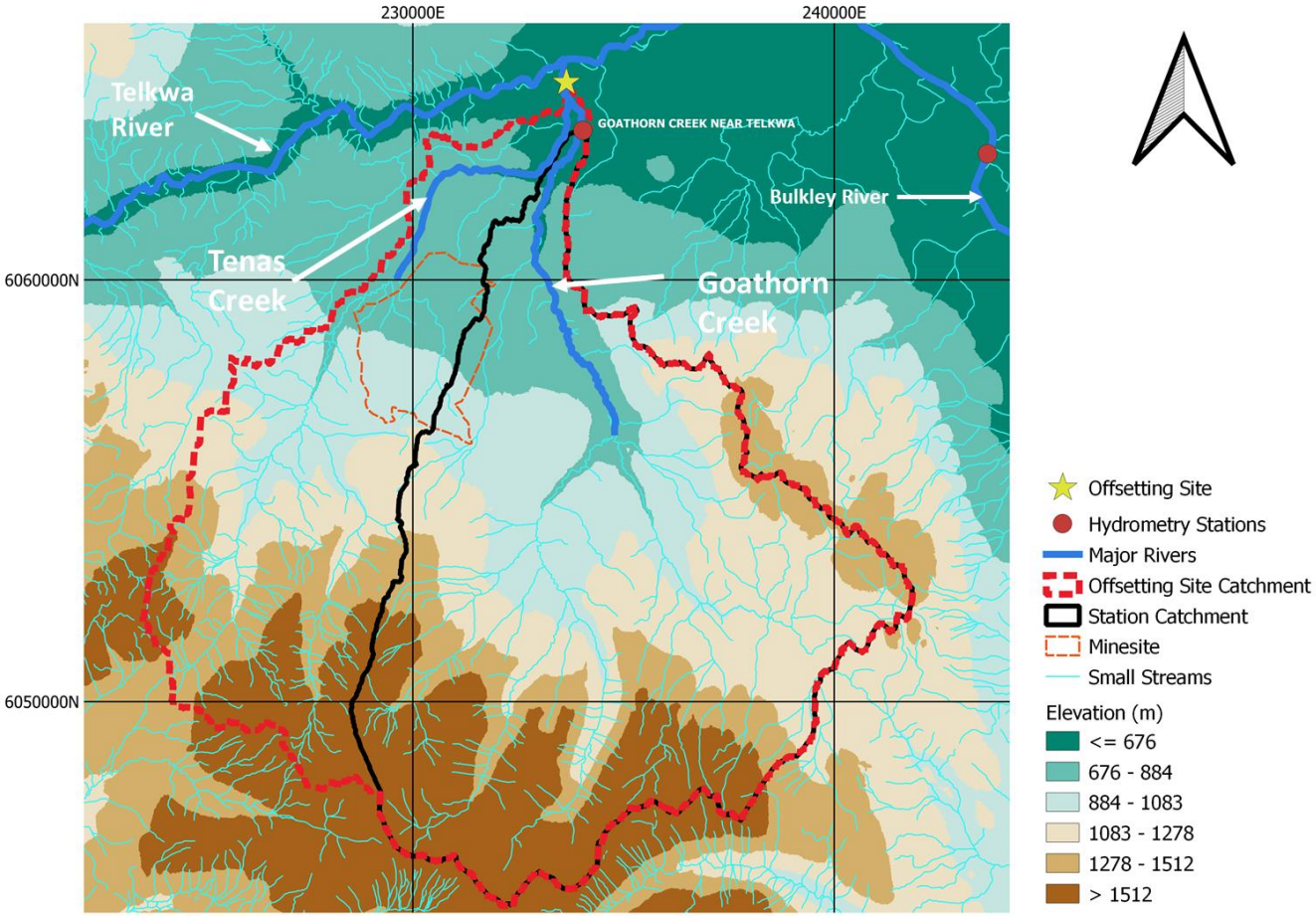

Figure 1. Proposed offsetting site location and drainage basin

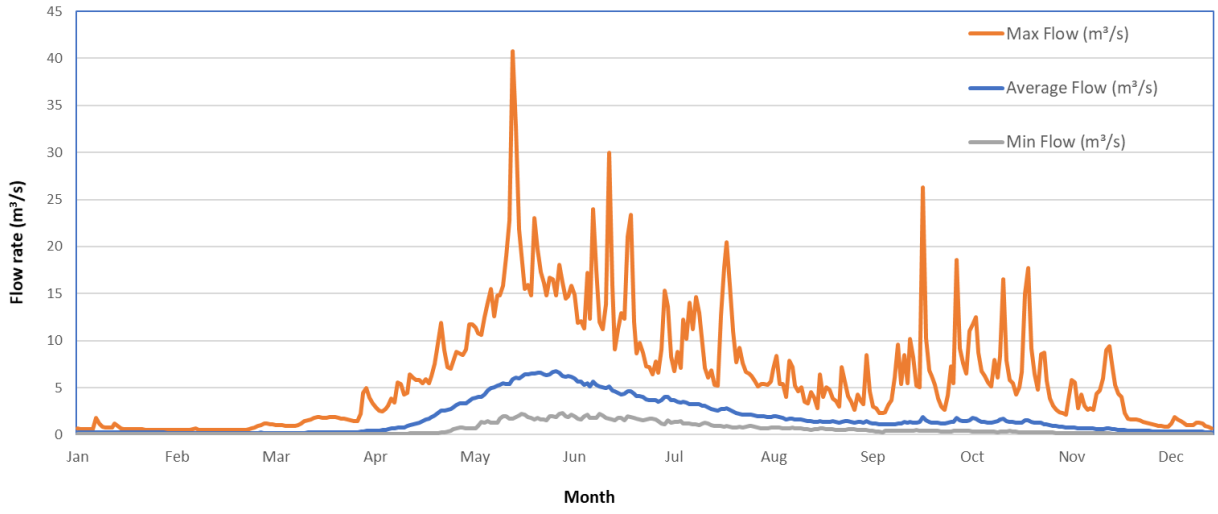

Figure 2. Daily average, maximum and minimum discharge at Goathorn Creek near Telkwa station (08EE0008)

3.0 FISH AND AQUATIC HABITAT

3.1 Lower Goathorn Creek Habitat

The lower 15 km of Goathorn Creek is accessible to fish from the Telkwa River; however, fish presence has been documented in the mainstem up to a 5 m high rock fall approximately 4.5 km upstream of the confluence with Cabinet Creek (Hemmera 2021). The lower reaches of Goathorn Creek have low gradients (2-3%) and a predominantly riffle-pool morphology. The bed material is dominated by cobbles and boulders; however, there are more patches of gravel and small cobble substrates with deeper pools downstream of the confluence with Tenas Creek in comparison to the upstream reaches above the confluence. Streamflow in the lower reaches has been documented to be swift with large woody debris oriented in parallel to the banks (Hemmera 2021). The lower reaches of Goathorn Creek provide good spawning habitat for salmon and resident fish species as well as good rearing and migration habitat (ERM 2019). Over-wintering habitat has been noted as moderate, as there are limited deep pools throughout the winter and severe ice conditions can occur. A highly fluctuating flow regime, especially during spring freshet, poses a risk for juvenile salmonids in the mainstem (Bustard 1998). Most smaller tributaries to Goathorn Creek provide poor access for fish and limited potential fish habitat due to a topographic break creating steep drops into the mainstem.

The Tenas Creek mainstem is accessible to fish from its mouth at Goathorn Creek to approximately chainage 16.5 km, where a 20 m falls exists (Bustard 1998). The lower reaches of Tenas Creek are low-gradient and characterized by cobbles and gravels. Boulders and large woody debris provide cover for fish, and these reaches have been rated as well-suited for char and trout spawning and rearing, but moderate over-wintering and migration habitat due to limited pool habitat (ERM 2019). Large organic debris plays a more significant role in creating habitat diversity in Tenas Creek compared to the lower reaches of Goathorn Creek, and the lower discharge in Tenas Creek has also resulted in more low velocity sections suitable for fry rearing compared to Goathorn Creek.

The Telkwa River is a large fast flowing river system, providing limited habitat for juvenile rearing and over-wintering. Juvenile fish in the Telkwa are determinant on off-channel habitats from the mainstem for over-wintering and rearing life history traits. It is likely that Goathorn and Tenas Creeks provide off-channel over-wintering and rearing habitat to juvenile salmonids in the Telkwa River system.

3.2 Fish Species Use

Rainbow trout (*Oncorhynchus mykiss*), steelhead salmon (*Oncorhynchus mykiss*), coho salmon (*Oncorhynchus kisutch*), pink salmon (*Oncorhynchus gorbuscha*), and Dolly Varden (*Salvelinus malma*) have been documented in the lower reaches of Goathorn and Tenas Creeks. It has not been documented what proportion of the rainbow trout are steelhead (migratory rainbow trout), however historical reports by Bustard et al. (1985) assumed that all rainbow trout in the Goathorn and Tenas systems were potentially steelhead, and that most steelhead spawning likely took place in the lower 5 km of Tenas Creek and lower 2 km of Goathorn Creek.

In addition to these species, other fish species that utilize the Telkwa River include chinook salmon (*Oncorhynchus tshawytscha*), and mountain whitefish (*Prosopium williamsoni*), among others.

3.3 Target Species

The target species for this habitat offsetting design are juvenile salmonids, including, but not limited to coho salmon, chinook salmon, steelhead salmon, and rainbow trout. High-value spawning and rearing habitat for coho salmon has been considerably impacted from rail and road corridors in the Middle Skeena/Bulkley Valley, through the disconnection of side and back channel and riparian habitats or from general fish passage obstructions (PSF 2014).

Off-channel and side channel habitats, particularly with deep pool areas for over-wintering and rearing, are generally limited in Goathorn Creek (and Tenas Creek), potentially limiting salmonid production. Off-channel and side channel habitats provide important rearing and refuge areas, as well as migratory corridors. Off channel habitat is important in Goathorn Creek as it offers relief from the highly fluctuating flow regime, especially during swift freshet flows and low winter flows when freezing conditions occur.

BC Ministry of Environment Habitat Suitability Index (HSI) curves for juvenile salmonids (general), juvenile steelhead, and benthic invertebrates will be used (Ptolemy 2001) to model appropriate depth, velocity, and cover preferences for target species (**Figure 3**). The results of the habitat model assessments will determine appropriate excavated channel and pool depths, as well as inform intake design.

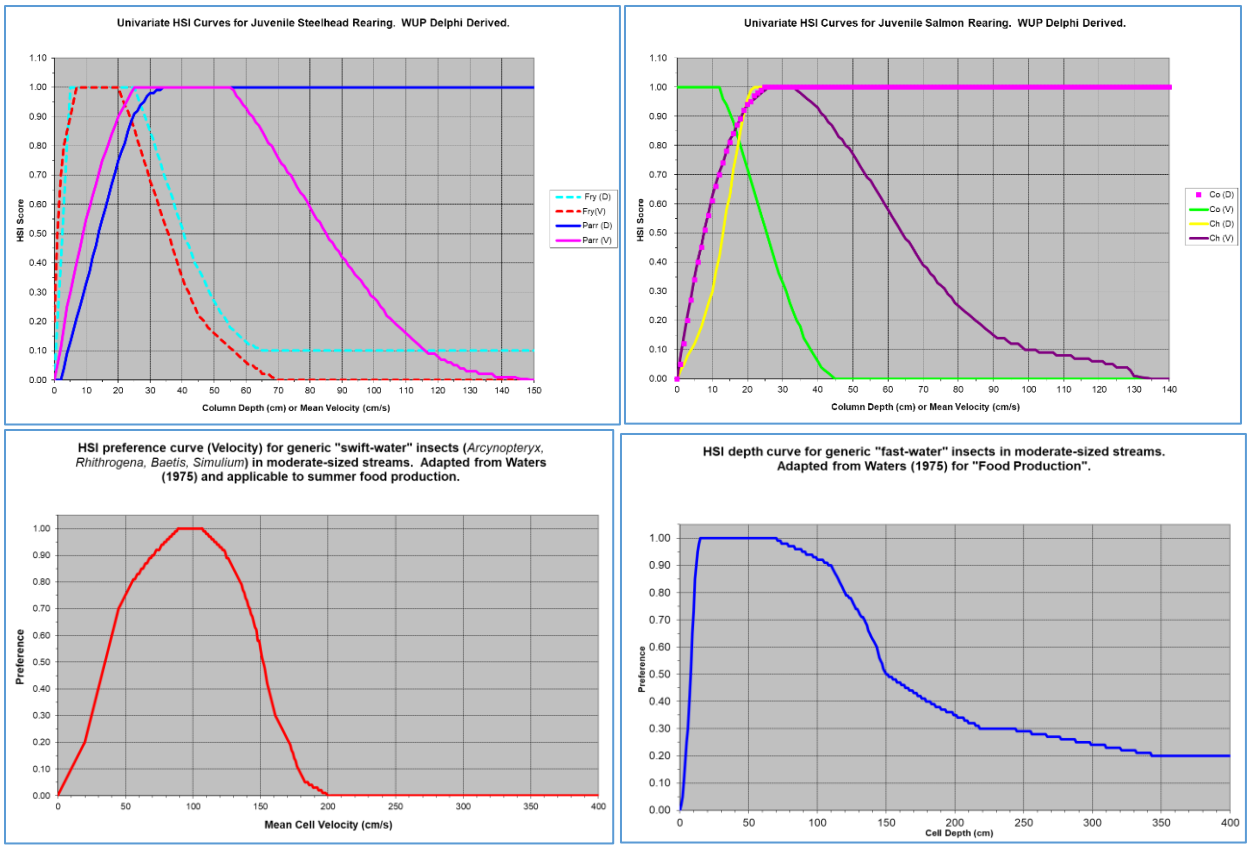

Figure 3. BC Ministry of Environment Habitat Suitability Index (HSI) curves for juvenile salmonids, juvenile steelhead, and benthic invertebrates

4.0 LOWER GOATHORN CREEK OFFSETTING LOCATIONS

Two conceptual designs for offsetting habitat on the west side of Goathorn Creek near the confluence with the Telkwa River have been provided. Concept 1 is located downstream of the Aveling Coalmine Road and upstream of the high-pressure gas line alignment (**Figure 4**), and Concept 2 is located downstream of the high-pressure gas line and upstream of the Telkwa River (**Figure 5**).

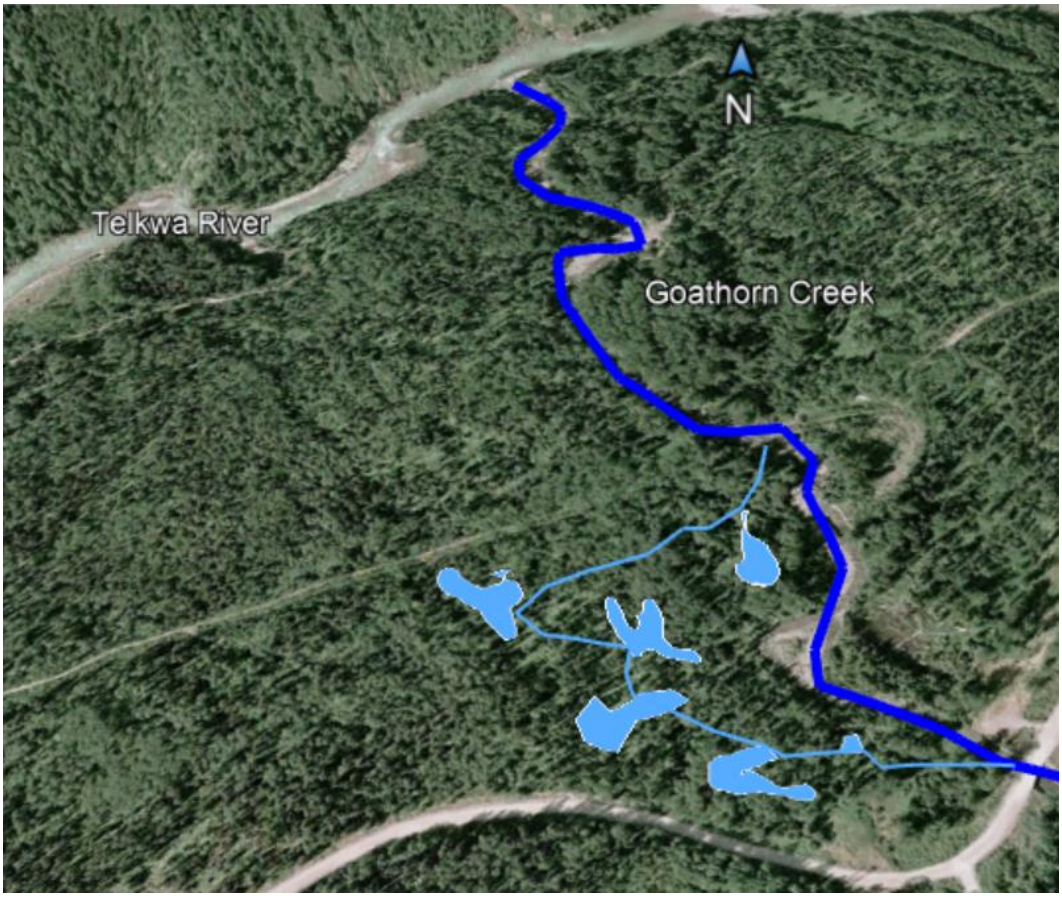

Figure 4 Conceptual Fish Offsetting Design – Lower Goathorn Creek Concept 1

The objective of both Concepts 1 and 2 is to create new wintering and rearing off-channel and side-channel habitat for juvenile salmonids, adjacent to lower Goathorn Creek and the Telkwa River. Flows would enter the channel systems via passive intakes from Goathorn Creek: downstream of the Aveling Coalmine Road at the bridge for Concept 1, and downstream of the pipeline right of way for Concept 2. Water in the systems would flow northwards, following the direction of Goathorn Creek. Flows would re-enter Goathorn Creek approximately 50 m upstream of the gas line for Concept 1, and approximately 250 m upstream of the Telkwa River for Concept 2. Concept 2 shows a braided network of channels at the mouth; however, feasibility of this confluence design will be determined following ground-truthing of the proposed area.

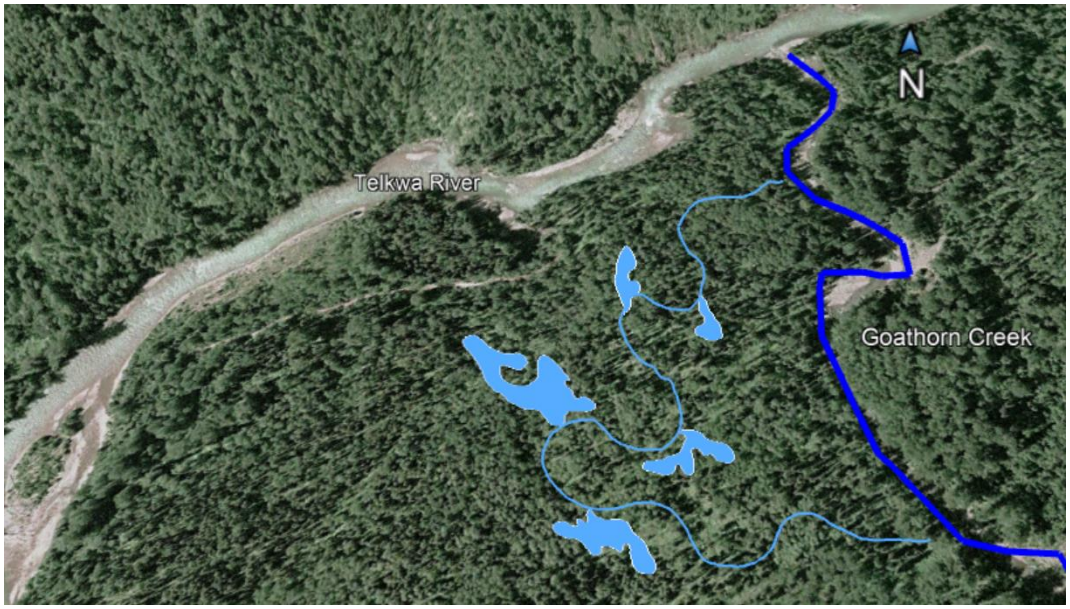

Figure 5 Conceptual Fish Offsetting Design – Lower Goathorn Creek Concept 2

The off-channel habitat for both Concepts 1 and 2 would consist of one mainstem with several pools of varying depths, and numerous alcoves along the length of the channel to provide cover and refuge for fish. The habitat would predominantly be new excavated habitat, utilizing the natural topography to guide habitat development. The channels and pools would be enhanced with rock weirs to create channel complexity, excavated alcoves for refuge and cover, anchored and unanchored large woody debris complexes for channel stability and scour respectively, and a re-planted riparian area to provide bank stability, nutrient inputs, and stream temperature moderation (shade). Existing habitat features, where present, would be used to enhance the overall habitat.

In addition to creating useable habitat for fish in Goathorn Creek, these locations are accessible to fish from Tenas Creek and the Telkwa River systems. An ecosystems-based approach will be used for the offsetting design, taking into consideration other species that utilize the floodplains of Goathorn Creek and the Telkwa River. Ground-truth site reconnaissance visits will aid in the determination and planning phase. Preliminary potential habitat offset gains from development of both Concept 1 and 2 side channels on lower Goathorn Creek are estimated between 13,000 m^2 and 25,000 m^2.

4.1 Limiting Factors

Limiting factors for understanding the feasibility of offsetting options include, but are not limited to:

- Accessibility
  - Construction equipment accessing offsetting location
  - Location of gas pipeline and right of ways
- Topographic restraints
  - Channels need to be excavated around underlying topography and substrates in a way that will allow water to flow downstream
- Groundwater levels
  - Baseflows in channels and pools should be groundwater charged

  - Pools should be excavated deep enough so they are supplemented by groundwater in winter for temperature moderation (to avoid severe ice conditions)
  - Groundwater needs to be at a level where drainage of channels/pools to ground does not occur, throughout entire habitat area
- Available flows
  - Available flow for each Concept will have to be calculated based on the predicted flows in lower Goathorn creek following final water extraction predictions from the Project (construction, operation, and closure)
  - An instream flow requirements determination to ensure extracted flows required for the side channels are below threshold values (side-channels are not predicted to have cumulative water withdrawal impacts due to the location of the Concept 1 rejoining confluence and the Concept 2 intake downstream.
- Intake Design
  - Needs to accommodate seasonal changes in the timing, duration, and frequency of flows
  - Passive system needs to be functional at low flows
- Fish passage issues
  - Excavation (and topography) needs to allow for full fish passage into, exiting, and throughout the channels
  - Instream barriers that may occur post construction
- Historical channels or features
  - Work with or around historical features (e.g., avulsions, isolated oxbows).

5.0 RECOMMENDATIONS

Ground-truthing reconnaissance is recommended to confirm the feasibility of the offsetting designs of Concepts 1 and 2. Site visits will need to confirm various features of the area, including but not limited to:

- Topography of west side of lower Goathorn Creek at the proposed offsetting locations;
- Location of gas pipeline and presence of or proximity to other gas, power, or hydro right of ways;
- Feasibility of working around or over gas pipeline;
- Location for intakes;
- Ground water levels;
- Verifying hydrology of lower Goathorn Creek downstream of the Tenas Creek confluence;
- Investigation for presence of historical fish habitat features in the offsetting location. and
- Bird and wildlife surveys to determine if habitat can be legislated for offsetting.

Following ground-truthing site visits, a preliminary model will be required to determine hydrologic feasibility of the offsetting plan.

6.0 REFERENCES

BC MOE. 2021. Hydrometric Survey Goathorn Creek near Telkwa station (08EE0008)

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Ptolemy, R. 2001. Water use planning (WUP) Delphi curves. BC Ministry of Environment, Victoria, BC.