Appendix 1.0-T SRK, Tenas Project Conceptual Site Model

TELKWA COAL
LIMITED

BC EAO EAC Application – Tenas Project

Section 1.0 Overview of Project Proponent Description

Appendix 1.0-T Tenas Project Conceptual Site Model

May 2022

VERSION 1.0

Submitted to:	BC Environmental Assessment Office
Pursuant to:	Environmental Assessment Act, S.B.C. 2002, c.43
Submitted by:	Telkwa Coal Limited Suite 1410 – 409 Granville Street Vancouver, BC V6C 1T2

Tenas Project

Section 1.0 Overview of Project Proponent Description
Appendix 1.0-T Tenas Project Conceptual Site Model

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ABBREVIATIONS AND ACRONYMS

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
AQMP	Air Quality Management Plan (S13.0-C2)
ALR	Agricultural Land Reserve
ARD	acid rock drainage
ASILs	acceptable source impact levels
BAF	bioaccumulation factors
BC	British Columbia
BCF	bioconcentration factors
BC AAQO	British Columbia Ambient Air Quality Objectives
BC ALG	British Columbia Aquatic Life Guidelines
BC AWQG	British Columbia Approved Water Quality Guidelines
BC EAO	British Columbia Environmental Assessment Office
BC MECCS	British Columbia Ministry of Environment and Climate Change Strategy
BC MEM	British Columbia Ministry of Energy and Mines
BC MEMLI	British Columbia Ministry of Energy, Mines and Low Carbon Innovation
BC MOE	British Columbia Ministry of Environment
BC MOF	British Columbia Ministry of Forests
BC MWLAP	British Columbia Ministry of Water, Land and Air Protection
BC WWQG	British Columbia Working Water Quality Guidelines
BC SDWQG	British Columbia Source Drinking Water Quality Guidelines
BMPs	best management practices
C	Chapter
CCME	Canadian Council of Ministers of the Environment
CCME WQG	Canadian Council of Ministers of the Environment Water Quality Guidelines
CEMP	Construction Environmental Management Plan (S13.0-C4)
CEPA	*Canadian Environmental Protection Act*, SC 1999, c 33 (Government of Canada [GovCan] 1999)
CMSTHP	Chemicals and Materials, Storage, Transfer, and Handling Plan (S13.0-C3)
CNR	Canadian National Railway
Code	Health, Safety and Reclamation Code in British Columbia (British Columbia Ministry of Energy, Mines and Low Carbon Innovation [BC MEMLI 2021])
COC	Contaminants of Concern
COPC	Contaminants of Potential Concern
CPP	Coal Processing Plant
CSM	conceptual site model

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
DMP	Discharge Management Plan (S13.0-C5)
EA	environmental assessment
EAA	*Environmental Assessment Act,* SBC 2002, c 43 (Government of British Columbia [GovBC] 2002b)
EAC	Environmental Assessment Certificate
EMA	*Environmental Management Act*, SBC 2003, c 53 (Government of British Columbia [GovBC] 2003)
EMP	Explosives Management Plan (S13.0-C6)
EMS	Environmental Management System (S13.0-C1)
FMSCP	Fuel Management and Spill Control Plan (S13.0-C7)
FSR	Forest Services Road
GovBC	Government of British Columbia
GovCan	Government of Canada
GPS	Global Positioning System
GPS	Global Positioning System
HRMP	Heritage Resources Management Plan (S13.0-C8)
IDZ	Initial Dilution Zone
IEM	Independent Environmental Monitor
IFC	Issued For Construction (drawings)
JAIR	Joint Application Information Requirements for *Mines Act* and *Environmental Management Act* Permits (British Columbia Ministry of Energy, Mines and Petroleum Resources [BC MEMPR] and British Columbia Ministry of Environment and Climate Change Strategy [BC MECCS] 2019).
OHS	occupational health and safety
OHSC	Occupational Health and Safety Committee
LOM	life-of-mine
LSA	Local Study Area
LTI	Lost Time Incident
MA/EMA	Mines Act, RSBC 1996, c 293 and Environmental Management Act, SBC 2003, c 53
MAP	Mean annual precipitation
MIC	Mine Infrastructure Complex
MEhg	methyl mercury
MERP	Mine Emergency Response Plan (S13.0-C9)
ML	metal leaching
ML/ARDMP	Metal Leaching (ML)/Acid Rock Drainage (ARD) Management Plan (S13.0-C12)
MOC	Management of Change
MTCP	Minesite Traffic Control Plan (S13.0-C10)

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
MWMP	Minesite Water Management Plan (S13.0-C11)
NCD	Non-classified Drainages
non-PAG	non-potential acid generating
OECD	Organisation for Economic Co-operation and Development
OHSC	Occupational Health and Safety Committee
OHSP	Occupational Health and Safety Program (S13.0-C13)
PAG	potentially acid generating
PAMP	Public Access Management Plan (S13.0-C14)
POCs	Parameters of Concern
POPCs	Parameters of Potential Concern
Project	Tenas Project
QEP	Qualified Environmental Professional
QP	Qualified Professional
RCP	Reclamation and Closure Plan (S13.0-C15)
ROC	Receptor of Concern
ROW	right-of-way
RSA	Regional Study Area
S	Section
SARA	*Species at Risk Act,* SC 2002, c 29 (GovCan 2002).
SDS	Safety Data Sheet
SEMP	Socio-economic Management Plan (S13.0-C16)
SEPSCP	Surface Erosion Prevention and Sediment Control Plan (S13.0-C17)
SPO	site performance objective
SPPs	Standard Policies and Procedures
SMP	Soil Management Plan (Appendix 13.15-B of the Reclamation and Closure Plan [S13.0-C15] [RCP] of the EAC Application
TAC	Tenas Access Corridor
TCL	Telkwa Coal Limited
TCEQ	Texas Commission on Environmental Quality Effects Screening Levels
TK	Traditional Knowledge
TSP	total suspended particulates
TSS	total suspended solids
VMP	Vegetation Management Plan (S13.0-C18)
VRMP	Visual Resources Management Plan (S13.0-C19)
WMPRE	Waste Management Plan for Refuse and Emissions (S13.0-C20)
WMP	Wildlife Management Plan (S13.0-C21)

UNITS OF MEASURE

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
µ	micron
%	percent
ha	hectare
km	kilometre
kV	kilovolt
L/s/km^2	litre per second per square kilometre
m	metre
mg/L	milligrams per litre
mg-N/L	milligrams per litre of nitrite as nitrogen
mm	millimetre
Mt	million tonnes

EXECUTIVE SUMMARY

To assist with effects assessments for the Valued Components (VCs) identified for the Tenas Project (Project), it is helpful to develop a visual model that illustrates the various pathways such as water that Parameters of Potential Concern (POPC) which can encounter receptors such as wildlife. TCL has developed a conceptual site model (CSM) for the Project, following provincial guidelines on the topic and is provided in this report. Four (4) receptors have been identified:

1. fish and aquatic life (vegetation);
2. wildlife including birds, furbearers, and amphibians;
3. terrestrial vegetation; and
4. people and land use.

Pathways identified are:

- drinking of water both surface and groundwater;
- breathing of air;
- dermal contact; and
- ingestion of items in the food chain.

The following parameters were the POPC, and Parameters of Concern (POC) identified for wildlife, terrestrial vegetation, and fish and aquatic life which were based on a review of the applicable British Columbia (BC) provincial guidelines for the protection of aquatic life:

- nitrate (POPC only as it does not exceed the site performance objective [SPO]);
- selenium (POC as it has been identified a special case parameter);
- cadmium (POC only as it equals the SPO); and
- sulphate (POPC only as it does not exceed the SPO);

The following contaminants were identified as Contaminants of Potential Concern (COPC) and Contaminants of Concern (COC) using the human health risk assessment methodology and requirements provide by federal and provincial regulators. Please note all COPC were then carried forward as a COC as summarized by the list below;

- aluminum;
- arsenic;
- barium;
- boron;
- cadmium;
- chromium;
- cobalt;
- copper;

- iron;
- lead;
- lithium;
- manganese;
- mercury;
- nickel;
- selenium;
- strontium;
- thallium; and
- zinc.

1. INTRODUCTION

The Conceptual Site Model (CSM) provides details to support the water quantity and quality model for the Tenas Project (Project) Environmental Assessment Certificate (EAC) Application.

The CSM is a qualitative tool that provides visual and written descriptions of the processes that determine the transport of Parameters of Potential Concern (POPC) and/or Parameters of Concern (POC) from the Project sources through environmental media and to environmental receptors in the system. POPC are constituents who are identified as having the potential to exceed threshold values based on regulatory guidance. The framework has been adjusted to include the processes that are expected to affect both water quality (i.e., transport of POPC/POC/Contaminants of Potential Concern/Contaminants of Concern (COPC/COC) and water quantity (i.e., change in streamflow) are discussed.

1.1 Site Location and History

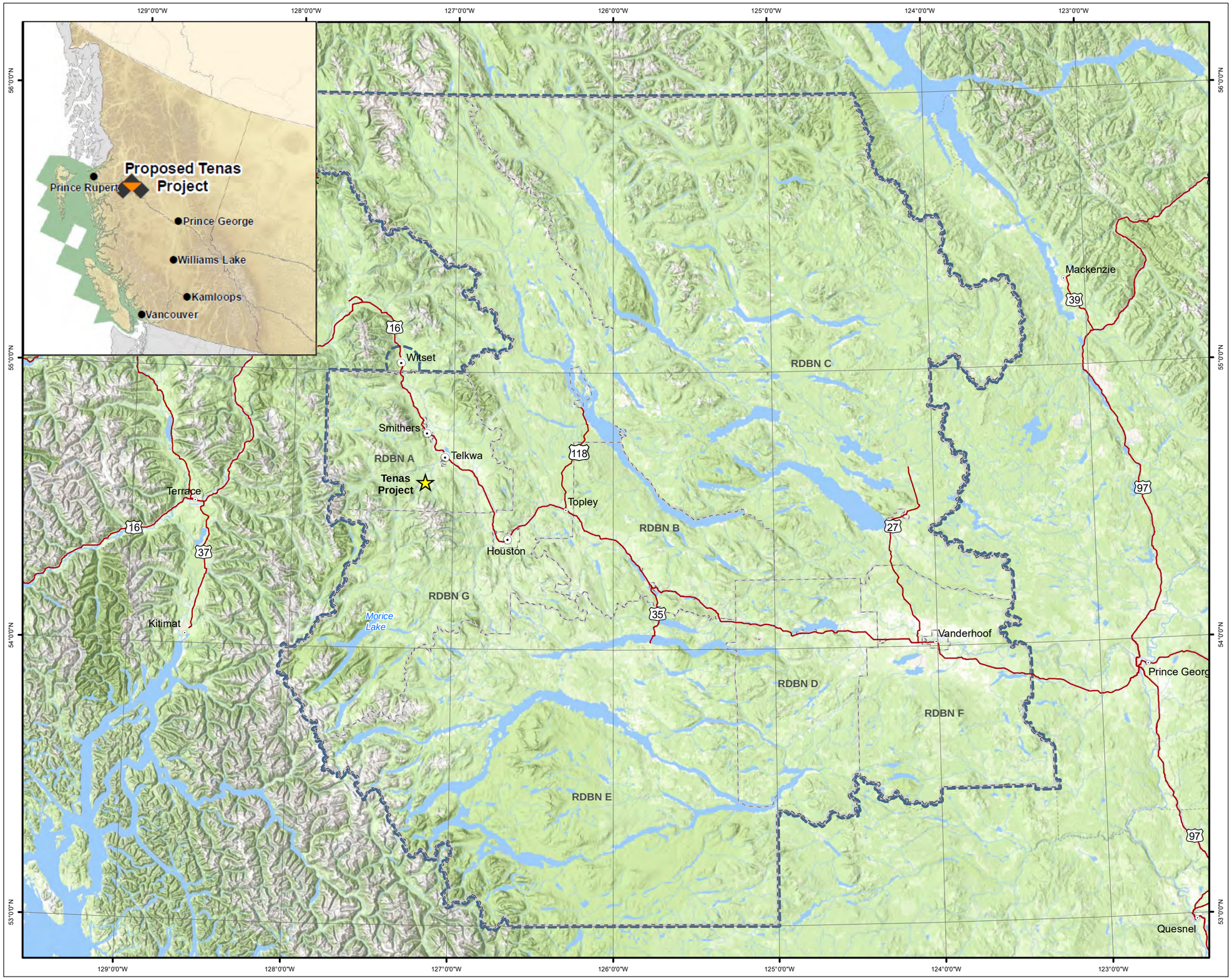
The Project is a proposed surface metallurgical coal mine located in a valley of the Coast Mountains of the Cordilleran Region. The Project, including the open pit, processing facilities, maintenance and service facilities, administrative buildings, ditches, water ponds, piles, and haul and service roads, are located approximately 25 kilometres (km) south of the Town of Smithers and 7 km southwest of the village of Telkwa in northwest British Columbia (BC). The Rail Infrastructure is composed of a 2.5 km Rail Loop and associated infrastructure: Rail Loadout, Rail Infrastructure Sedimentation Pond, Rail Infrastructure Fueling Station, scale, and dust control systems, located on Crown land on the west side of the Bulkley River. The Rail Infrastructure is connected to the Canadian National Rail (CNR) line on one (1) end and is anticipated to service approximately one (1) train, consisting of 116 cars, per week. The Project Area includes the open pit, management ponds, water management infrastructure, Mine Infrastructure Complex, Rail Infrastructure, and the Tenas Access Corridor (TAC).

The scope of the CSM matches the Local Study Area (LSA) and the Regional Study Area (RSA) for the surface water Valued Component (VC) as illustrated by **Figure 1.1-1**.

The Project is designed to produce approximately 16.0 million tonnes (Mt) of processed metallurgical coal, to be used in the manufacture of steel. The mine life of the Project will be approximately 25 years, including Construction, Operation, and Decommissioning and Reclamation phases.

Coal mining has a long history in the Telkwa area, being first discovered around 1900. Small scale underground and surface mining took place in the region from 1918 to 1985, recovering over 400,000 tonnes of coal (Telkwa Coal Limited [TCL] 2018).

The Construction Phase of the Project is anticipated to span approximately 1.5 years. The Operation Phase (coal production) will begin after construction is complete and is anticipated to span 21 years. The Decommissioning and Reclamation Phase activities are intended to begin once operations cease and expected to span 4 years, with the Post-closure Phase continuing for another 25 years thereafter. The Post-closure Phase involves both active and passive stages including monitoring to evaluate and promote successful reclamation of the Project.



Tenas Project

Project Location

Legend

- Tenas Project
- Regional District of Bulkley Nechako (RDBN)
- Electoral Areas
- Highway

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Base

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1.2 Regulatory Context

The Project falls under the BC provincial regulatory framework established by the BC *Mines Act,* RSBC 1996, c 293 (GovBC 1996) and the BC *Environmental Management Act, SBC 2003, c 53 (GovBC 2003) (EMA)*. TCL will be applying for review of applications, approvals and permits under these two (2) Acts. The CSM is a tool used to support the Technical Assessment Report (TAR) required under the *EMA*.

2. BACKGROUND

2.1 Physical Setting

The Project Area is located within the Coast Mountains of the Cordilleran Region, near the Village of Telkwa and approximately 25 km southwest of Smithers, BC (**Figure 2.1-1**). The Project footprint elevation ranges from 750 to 1050 metres above sea level (masl) with a median elevation of 800 masl.

The Project Area is in the Bulkley Valley Airshed and is characterised by four (4) prominent seasons, typical of northern interior BC. Based on climate data measured at the Smithers weather station (Environment Canada and Climate Change Climate Identifier 1077500), the closest active weather station 25 km northeast of the site at an elevation of 522 masl, mean monthly air temperatures typically range between -8.5 degrees Celsius (°C) and 15°C. Mean annual precipitation (MAP) for the Project is approximately 608 millimetre (mm) with about 40 percent (%) occurring as snow (SRK 2021a).

2.1.1 Surficial Hydrology

The Project Area lies within the Goathorn Creek, Tenas Creek, and Four Creek watersheds, encompassing the lower reaches of the Telkwa River, and portions of the Goathorn Creek, Tenas Creek, and Four Creek watersheds. Goathorn Creek and Tenas Creek are tributaries to the Telkwa River, and the Telkwa River is a tributary to the Bulkley River, which ultimately flows into the Skeena River. The Minesite Area of the Project is in proximity to Tenas Creek, which flows along the west and north sides, and Four Creek, a small tributary to Goathorn Creek, that flows along the eastern side**.**

The majority of runoff in these streams (creeks and rivers) occurs during the spring and early summer due to the melting snowpack. Annual low flows occur during the winter season when air temperatures remain below freezing and snowfall is stored in the snowpack. During this period, streamflow is dominated by baseflow from groundwater recharge.

There are four (4) nearby Water Survey of Canada (WSC) stream stations in Goathorn Creek, Telkwa River, and Bulkley River. These stations have data dating back to 1960, 1975, and 1930 in Goathorn Creek, Telkwa River, and Bulkley River, respectively. These data were used to determine the mean annual unit discharge, the mean annual discharge divided by the respective watershed area, of 14 litre per second per square kilometre (L/s/km^2) in Goathorn Creek, 19 L/s/km^2 in Telkwa River, and 20 L/s/km^2 in Bulkley River (SRK 2021a).

2.1.2 Site Hydrogeology

The region is underlain by a thick, fine-textured glacial deposit that forms the sloping terrain in the lower Telkwa River valley. The groundwater flow system underlying the Project comprise two (2) sub-systems: a deep regional bedrock flow system, and a shallow localized overburden flow system. Horizontal gradients indicate groundwater in both systems generally flow in a northerly direction from the Project towards the Telkwa River and its tributaries, Tenas Creek, Four Creek, and Goathorn Creek. Vertical gradients are generally downwards from the overburden system to the bedrock system. The deep bedrock flow system has low permeability, resulting in lower fluxes and longer travel times. In contrast, groundwater flows in the shallow overburden flow system have relatively higher fluxes and travel times owing to the unit's moderate permeability (SRK 2021b).

Tenas Project

Site Plan

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BURNT CABIN BOG ECOLOGICAL RESERVE

Tyhee Lake

CN

TELKWA

TELKWA COALMINE RD

16

Bulkley River

LAWSON RD

AVELING COALMINE RD

Hep's Creek

RAIL LOADOUT

Tenas Creek

BYPASS ROAD

Telkwa River

TELKWA RIVER FSR

Four Creek

Goathorn Creek

Legend

- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Municipal Area
- General Private Property
- 138 kV Transmission Line
- 500 kV Transmission Line

Project Features

- Existing 25 kV Power Line
- 25 kV Power Line
- Haul Road
- Rail Loop
- Discharge Path
- Tenas Access Corridor
- Backfill Area
- Control and Plant Sedimentation Pond
- Explosive Infrastructure
- Management Pond
- Mine Infrastructure Complex (Coal Processing Plant, Mine Administration and Dry Building, Maintenance Facility, Run-of-Mine and Processed Coal Stockpiles)
- Open Pit
- Pit Lake
- Quarry
- Rail Infrastructure
- Topsoil Stockpile
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project Area

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. Project line features are for display only.

Sources

- Project Features: Allegiance Coal, April 21, 2021.
- Basedata: Government of British Columbia
- Basemap: World Topo Base

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2.2 Ecological Setting

The Project Area is in two (2) biogeoclimatic zones and three biogeoclimatic subzones: Sub-Boreal Spruce dry cool subzone (comprising the bulk of the Project Area), Sub-Boreal Spruce moist cold subzone (comprising a lesser portion of the Project Area), and Englemann Spruce-Subalpine Fir moist cold subzone (comprising a minor portion of the Project Area). There are no ecological reserves, protected areas, or parks within the Project Area (TCL 2018).

The region provides suitable habitat for a diversity of mammals, fish, and amphibians. Woodland caribou (*Rangifer tarandus caribou*) and grizzly bear (*Ursus arctos horribilis*) are known to exist in the region and are federally listed under Schedule 1 of the *Species at Risk Act*, SC 2002, c 29 (GovCan 2002) *(SARA)*.

Numerous terrestrial breeding birds and migratory birds are supported by the various habitat types in the region. The olive-sided flycatcher (*Contopus cooperi*) was observed in the area during baseline studies and is listed as threatened under Schedule 1 of the *SARA*.

Several species of amphibians are known to occur in the region including coastal tailed frog (*Ascaphus truei*) and western toad (*Anaxyrus boreas*), which are protected under Schedule 1 of the *SARA*.

Tenas Creek, Goathorn Creek, Four Creek, Telkwa River, and Bulkley River are fish-bearing streams (ERM 2020). These streams support a variety of fish species, with a few being protected under Schedule 1 of the *SARA*. The list of federally protected fish found in the region is presented in **Section 3.1**.

2.3 Population and Land Use

The Project Area is in proximity to four communities; Smithers, Telkwa, Houston and Witset. The Town of Smithers, is 25 km north of the Project, is home to approximately 5,351 residents while the village of Telkwa, 7 km northeast, has a population of approximately 1,327 residents. The district municipality of Houston, approximately 41 km south of the Project, has a population of 2,993 while the town of Witset is located 47 km north of the Project. These figures are from the most recent census completed in 2016 by the federal government.

The Project Area is located within the Gitdumden and Laksilyu territories of the Wet'suwet'en. In the Wet'suwet'en traditional territory there are five bands: Hagwilget Village Council, Moricetown Band (or Witset First Nation), Nee-Tahi-Buhn Band, Skin Tyee Band, and Wet'suwet'en First Nation. There are 3,421 registered Wet'suwet'en members, with 1,165 living on-reserve and 2,256 living off-reserve.

Oral histories indicate that the Wet'suwet'en territories have utilized the region to harvest resources such as wildlife, fish, and vegetation for generations. The region is used for hunting bear, moose, deer, grouse, and furbearers, as well as harvesting chinook and sockeye salmon, kokanee, whitefish, trout, char, suckers, and freshwater lingcod. Traditionally harvested plants include green vegetables, fruits and berries, inner bark-cambium, roots, and rhizomes. The Project Area overlaps with one provincially registered trapline (TR0609T026) and one guide outfitting license (601044). There are several groundwater wells and licenses that currently draw surface water from the shallow groundwater system and near the Telkwa River and along the Telkwa Coalmine Road (TCL 2018) near Goathorn Creek. Eight private groundwater wells are located approximately 3 to 6 km north of the Project on the east side of Goathorn Creek while three wells are located north of the Project south of the Telkwa River.

The Project Area is in the Bulkley Valley Airshed which encompasses Smithers, Telkwa, Witset, and Houston.

2.4 Assessment Cases and Study Boundaries

The following provides the assessment cases and study boundaries for aquatic resources and fish, terrestrial vegetation, wildlife and people and land uses:

- Project Case: the case used for the environmental effects assessment which is based on expected or typical geochemical source terms for all material being affected and/or exposed by Project activities such as mining and construction. It is based on average hydrometeorological conditions for snow, precipitation, and run-off. It is based on expected groundwater seepage values from the management, control and sedimentation ponds and collection and diversion channels and the open pit. It also uses the expected climate change model for the area. It further uses expected dust emissions and emissions of criteria air contaminants (CACs) from Project activities during Construction, Operation, Decommissioning and Reclamation, and Post-closure phases of the Project; and
- Baseline Case: the case that has the Project not being developed and is based on average hydrometeorological conditions for snow, precipitation, and run-off. It is based on baseline groundwater seepage values from the current landform. It also uses the expected climate change model for the area.

For the Aquatic resources receptors, the area of study has been subdivided into the LSA, encompassing the watersheds of Tenas Creek and Goathorn Creek and includes the Project Area, and the RSA, including the Telkwa River Watershed and the tributaries of the Bulkley River. **Figure 2.4-1** shows the LSA and RSA.

Tenas Project

Surface Water Local Study Area (LSA) and Regional Study Area (RSA)

Legend

- RSA Boundary
- LSA Boundary
- City/Town
- Rail Line
- Highway
- Tenas Access Corridor
- Road
- Proposed Water Pipeline
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- First Nation Reserve
- Municipal Area
- Telkwa Coal Private Land
- Private Land
- Project Area

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Base

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3. RECEPTORS

Receptors include people that live or work in the region, as well as species of interest to indigenous, federal, provincial, municipal regulators, non-government organizations, and the general public, comprising fish (aquatics), wildlife, and birds.

Receptors are identified as species at risk according to the federal *SARA* Schedule 1 and/or the provincial Red, Blue, and Yellow Lists maintained by the BC Conservation Data Centre.

3.1 Fish and Aquatic Life

The streams in the region support numerous fish species, which have the potential to be receptors to constituents discharged into the streams and/or affected by changes to streamflow. A full list of fish species known to exist in the RSA is presented in **Table 3.1-1**.

Table 3.1-1: Potential Fish Receptors

Fish Species	Scientific Name	Goathorn Creek	Four Creek	Tenas Creek	Telkwa River	Bulkley River	BC Status
Brassy Minnow	Hybognathus hankinsoni					x	No Status
Bull Trout	Salvelinus confluentus			x		x	Blue
Burbot	Lota					x	Yellow
Chinook Salmon	Oncorhynchus tshawytscha	x			x	x	Yellow
Chum Salmon	Oncorhynchus keta					x	Yellow
Coastrange Sculpin	Cottus cognatus					x	Yellow
Coho Salmon	Oncorhynchus kisutch	x			x	x	Yellow
Cutthroat Trout	Oncorhynchus clarkii					x	Blue
Dolly Varden	Salvelinus malma	x	x	x	x	x	Yellow
Lake Chub	Couesius plumbeus					x	Yellow
Lake trout	Salvelinus namaycush					x	Yellow
Lake whitefish	Coregonus clupeaformis					x	Yellow
Longnose Sucker	Catostomus					x	Yellow
Largescale Sucker	Catostomus macrocheilus					x	Yellow
Longnose Dace	Rhinichthys cataractae					x	Yellow

Fish Species	Scientific Name	Goathorn Creek	Four Creek	Tenas Creek	Telkwa River	Bulkley River	BC Status
Mountain Whitefish	Prosopium williamsoni			x	x	x	Yellow
Northern pikeminnow	Ptychocheilus oregonensis					x	Yellow
Pacific Lamprey	Entosphenus tridentatus					x	Yellow
Peamouth Chub	Mylocheilus caurinus				x	x	Yellow
Pink Salmon	Oncorhynchus gorbuscha	x			x	x	Yellow
Prickly Sculpin	Cottus asper					x	Yellow
Rainbow Trout/Steelhead	Oncorynchus mykiss	x		x	x	x	Yellow
Redside shiner	Richardsonius balteatus					x	Yellow
Slimy Sculpin	Cottus cognatus					x	Yellow
Sockeye Salmon	Oncorynchus nerka					x	Yellow
Sucker (General)	Catostomus spp.				x	x	
Threespine stickleback	Gasterosteus aculeatus					x	Yellow
Unidentifiable Trout	Oncorhynchus spp.		x				
White Sucker	Catostomus commersonii					x	Yellow

Note: *There are no federally listed fish species present in the RSA.*

Culturally sensitive species located in the RSA include chinook salmon, sockeye salmon, kokanee, whitefish, trout, char, suckers, and freshwater lingcod (burbot), which are frequently harvested from the Bulkley River by the Wet'suwet'en (TCL 2018).

Benthic invertebrates of varying abundance and community composition are found in the streams within the RSA. None are listed as species at risk or are culturally important (ERM 2020).

3.2 Wildlife

The Wildlife RSA supports a variety of wildlife species. Potential wildlife receptors to POPCs include the six subcomponents selected to focus the assessment of the Wildlife VC (i.e., Furbearers, Caribou, Moose, Grizzly Bear, Bats, and Western Toad; **Table 3.2-1**). Representative species were selected to inform the assessment for Furbearers and Bats, as summarized in **Table 3.2-1**. The Caribou subcomponent includes the Northern Mountain population - Telkwa herd. The habitat of the Telkwa herd overlaps the proposed Project Area.

Table 3.2-1: Potential Wildlife Receptors

Subcomponent	Scientific Name	BC Status	Federal Status
Furbearers			
American Marten	Martes americana	Yellow	-
Fisher	Pekania pennanti	Red	-
Wolverine	Gulo	Blue	Special Concern
Caribou	Rangifer tarandus	Blue	Special Concern
Moose	Alces americanus	Yellow	-
Grizzly Bear	Ursus arctos	Blue	Special Concern
Bats			
Little Brown Myotis	Myotis lucifugus	Yellow	Endangered
Northern Myotis	Myotis septentrionalis	Blue	Endangered
Western Toad	Anaxyrus boreas	Yellow	Special Concern

Note: *BC=British Columbia*

The Project Area falls within Wildlife Management Unit 6-9, overlaps one provincially registered trapline (TR0609T026), and overlaps one guide outfitting license (601044) (TCL 2018).

Available Traditional Knowledge (TK) specific to wildlife within the Wildlife RSA is primarily related to harvest species and the importance of hunting and trapping and the feast system in Wet'suwet'en culture. Central to Wet'suwet'en values and methods of hunting are conservation measures that work to assure continued hunting and trapping success within their territories.

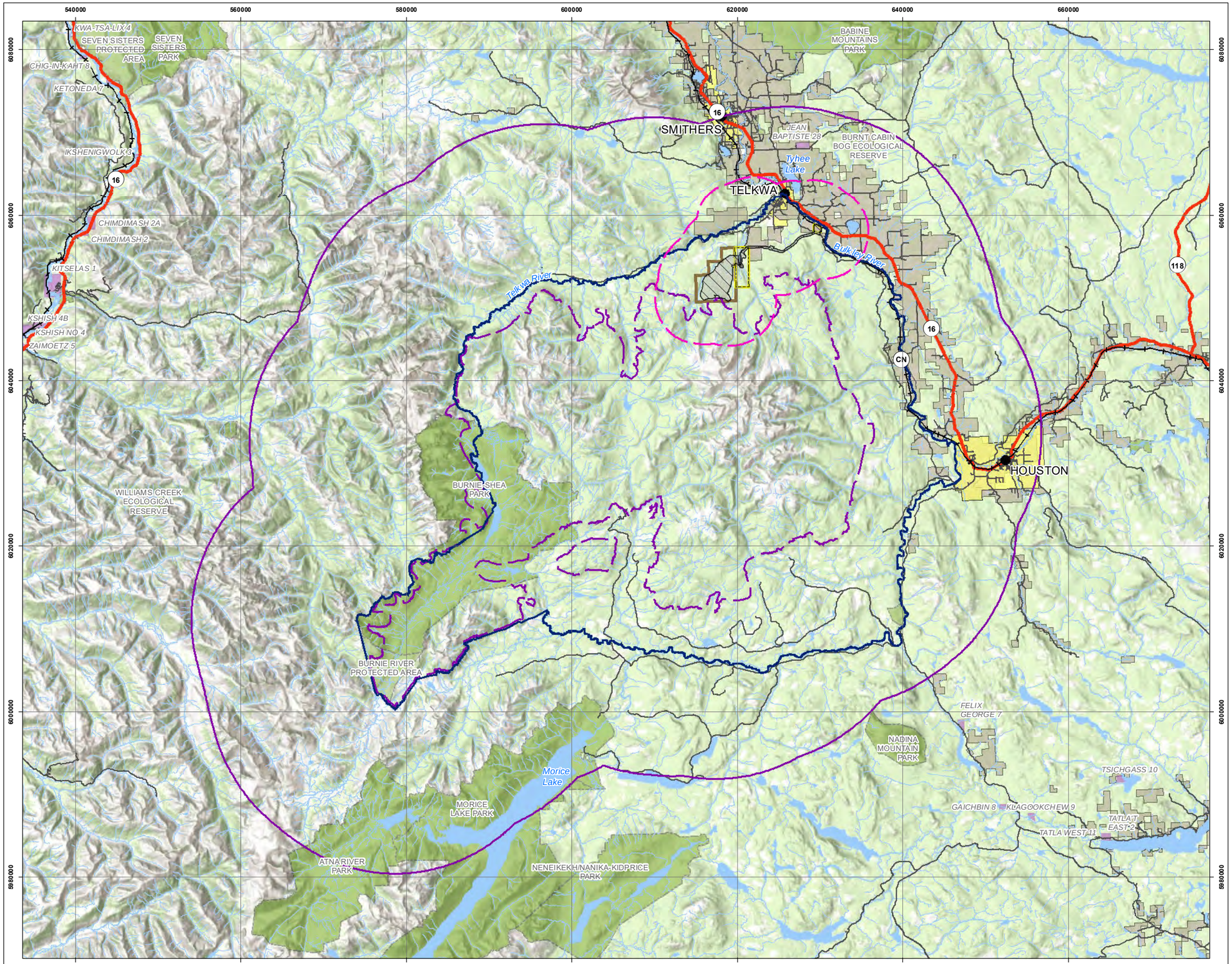
The Wet'suwet'en use game animals for food, cultural goods (e.g., furs, hides, and goods made from furs and hides), and food preservation (i.e., bear grease was used as a preservative) (Warner 1983, Rescan Environmental Services Ltd 2008, Ardea Biological Consulting 2014, Budhwa et al. 2020). Game animals harvested by the Wet'suwet'en for subsistence include, but are not limited to, American black bear (*Ursus americanus*), caribou, coyote (*Canis latrans*), grizzly bear, moose, mountain goat (*Oreamnos americanus*), mule deer (*Odocoileus hemionus*), grey wolf (*Canis lupus*), American beaver (*Castor canadensis*), hoary marmot (*Marmota caligata*), groundhog (*Marmota monax*), lynx (*Lynx canadensis*), marten, American mink

(*Neovison vison*), muskrat (*Ondatra zibethicus*), North American porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), squirrel (*Sciuridae* species), and weasel (*Mustela* species) (Warner 1983, Rescan Environmental Services Ltd 2008, Ardea Biological Consulting 2014, Budhwa et al. 2020). The most frequently harvested wildlife species for food by the Wet'suwet'en are moose and snowshoe hare (Rescan Environmental Services Ltd 2008).

The Wildlife RSA includes several hunting areas important to the Wet'suwet'en, such as the Telkwa Pass. Caribou were historically an important source of food and cultural goods for the Wet'suwet'en (Budhwa et al. 2020). The caribou population in the Bulkley Valley has experienced a significant decline in recent decades and the Telkwa herd is currently considered at risk (Budhwa et al. 2020). They once occurred throughout the Bulkley Valley in relatively large numbers and were known to gather in abundance in the Telkwa Pass. **Figure 3.2-1** provides habitat details for the Telkwa Caribou Herd within the spatial assessment boundaries for the Wildlife VC.

Tenas Project

Spatial assessment boundaries for the Wildlife Valued Component – Caribou subcomponent



Legend

- City/Town
- Rail Line
- Highway
- Road
- Watercourse
- Waterbody
- Park or Protected Area
- First Nation Reserve
- Municipal Area
- General Private Property
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project Area
- Wildlife Local Study Area
- Telkwa Caribou Herd Regional Study Area 1
- Telkwa Caribou Herd Regional Sudy Area 2 Core
- Telkwa Caribou Herd Regional Study Area 2 Matrix

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, April 21, 2021
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:450,000

0 4 8 12 16 20

Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

20P0172	Production Date: Nov 09, 2021	Figure 3.2-1

TELKWA COAL LIMITED

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3.3 Avian Species

The Avian Species RSA supports a variety of avian species. Potential avian receptors to POPC include the three (3) subcomponents selected to focus the assessment of the Avian Species VC (i.e., Migratory Breeding Birds, Listed Bird Species, and Raptors). Representative habitat guilds were selected to inform the assessment for Migratory Breeding Birds and include dominant nesting habitats within the RSA, as summarized in **Table 3.3-1**. Representative avian species were selected to inform the assessment for Listed Bird Species and Raptors and include the species summarized in **Table 3.3-1**.

Table 3.3-1: Potential Avian Receptors

Subcomponent	Scientific Name	BC Status	Federal Status
Migratory Breeding Birds			
Wetlands	Not applicable	Not applicable	Not applicable
Early seral	Not applicable	Not applicable	Not applicable
Old/mature forest	Not applicable	Not applicable	Not applicable
Listed Bird Species			
Bank swallow	Riparia	Yellow	Threatened
Barn swallow	Hirundo rustica	Blue	Threatened
Black swift	Cypseloides niger	Blue	Endangered
Common nighthawk	Chordeiles minor	Yellow	Threatened
Olive-sided flycatcher	Contopus cooperi	Blue	Threatened
Rusty blackbird	Euphagus carolinus	Blue	Special Concern
Short-eared owl	Asio flammeus	Blue	Special Concern
Raptors			
Northern goshawk, *atricapillus* subspecies	Accipiter gentilis atricapillus	Blue	Not applicable
Short-eared owl	Asio flammeus	Blue	Special Concern

Available TK specific to avian species within the Avian Species RSA is limited and primarily related to harvest species, including the past and present harvest of grouse species, particularly in the Telkwa Pass (Rescan Environmental Services Ltd 2008, Budhwa et al. 2020), and the past harvest of migratory birds in the spring (Budhwa et al. 2020) and fall (Warner 1983).

3.4 Vegetation

There are no listed vegetation species within the Project Area and no rare plants have been observed.

Based on a review public information and other projects, **Table 3.4-1** summarizes the current understanding of vegetation species that are culturally important to Indigenous groups based on the methodology provided in the Vegetation VC chapter.

Table 3.4-1: Potential Vegetation Receptors

Common Name	Scientific Name	Primary Uses
Black huckleberry	*Vaccinium membranaceum*	Food
Buckbean	*Menyanthes trifoliata*	Food/Medicinal
Cow parsnip	*Heracleum maximum*	Medicinal
Devil's club	*Oplopanax horridus*	Food/Medicinal
Fireweed	*Epilobium angustifolium*	Food/Medicinal
Highbush cranberry	*Viburnum edule*	Food
Indian hellebore	*Veratrum viride*	Medicinal
Kinnickinnick	*Arctostaphylos uva-ursi*	Food/Medicinal
Oval-leaved blueberry	*Vaccinium ovalifolium*	Food
Red raspberry	*Rubus idaeus*	Food
Soopolallie	*Shepherdia canadensis*	Food/Medicinal
Willows	*Salix* spp.	Medicinal/Baskets

With further consultation and engagement with the Wet'suwet'en during the EAC Application process it is expected that the list provided above will be modified to reflect their unique perspective and traditions.

3.5 People and Land Use

The Project Area is located on the traditional territory of the Wet'suwet'en First Nation. The primary potential human receptors are those living and working in the communities listed in **Table 3.5-1.**

Table 3.5-1: Potential Human Receptors

Community	Population (living on reserve)	Distance from Project (kilometre [km])
Regional District of Bulkley Nechako (RDBN)	40,000	Variable between 3 km and 30 km
Village of Telkwa	1,327	7 km
Wet'suwet'en	3,421 (1,165)	Not applicable
Transient Populations (hunters, hikers, and other recreation users)	Not applicable	Not applicable

Source: *compiled in text*

There are numerous private water wells and licences to draw surface water near the Telkwa River and along the Telkwa Coalmine Road. There are three private wells, located 3 km north of the Minesite area of the Project, that are potentially in the path of groundwater flowing north from the Minesite. There are five (5) other water wells located 5 km northeast of the Minesite area of the Project that are located downgradient of the Minesite and are not anticipated to encounter groundwater flow paths from the Minesite as they are on the east side of Goathorn Creek (SRK 2021b).

The Wet'suwet'en traditionally harvest food, material, and medicine from the RSA. The Wet'suwet'en traditionally hunt bear, moose, deer, furbearers, grouse, and harvest a variety of fish species. Harvested plant foods include green vegetables, fruits, inner bark–cambium, roots and rhizomes, huckleberries, soapberries, cranberries, raspberries, saskatoon berries, high-bush blueberries, gooseberries, salmonberries, juniper berries, thimbleberries, and beverages. Various leaves or foliage, roots, and inner bark are harvested for medicine. The Wet'suwet'en also harvest plant material, including fibrous plants, bark, wood, sap, dyes, and pigments (TCL 2018).

Based on the information above two main land user groups with distinct characteristics were identified to conservatively focus on human receptors of concern with the highest potential for exposure:

- Indigenous and non-Indigenous Resident Land Users (infants to adults): These Receptors of Concern (ROC) live in the Human Health LSA in residential areas, especially closer to the Project (e.g., the Cottonwood neighborhood and rural residences near the Rail Infrastructure) and spend time fishing/hunting/collecting or farming subsistence foods for their own consumption (in addition to eating store-bought foods). They may drink water from groundwater at their residences or surface water while spending time on the land within the LSA; and
- Recreational Land Users: These ROCs do not live in the LSA but may spend some time in the LSA to recreate and hunt. While doing so, they are assumed to drink surface water from within the LSA and eat store-bought and subsistence foods. This group includes campers, hikers, horseback riders, and other recreationists.

4. PARAMETERS OF CONCERN (POC) AND PARAMETERS OF POTENTIAL CONCERN (POPC)

4.1 Potential Loading Sources for Parameters of Concern (POC) and Parameters of Potential Concern (POPC)

The primary loading sources of POPC/POC for the Project are summarized in **Table 4.1-1**, with each of the sources having the potential to be exposed from Project activities. Areas that are cleared and had surface soil salvaged during the Construction, and Operation phases, mine rock that has been submerged within the management ponds and backfilled in the open pit, mine rock placed within management and control pond embankments and buttresses, processed coal, and run-of-mine (ROM) coal stockpiles, processed rock stockpiles, pads for infrastructure such as Rail, Maintenance Building etc., and open pit walls are the potential loading sources during operations and closure.

Table 4.1-1: Potential Loading Sources of Parameters of Concern (POC) and Parameters of Potential Concern (POPC) for the Tenas Project

Source	POPC/POC or COPC/COC	Project Sources
Potentially Acid-Generating (PAG) Mine Rock	Total and dissolved metals and other constituents (selenium, sulphate), acidity, blasting residues, suspended solids.	▪ PAG rock left uncontrolled could lead to acid rock drainage and the potential release of metals and other constituents to the environment. ▪ Of concern during active mining and in closure.
Non-acid Generating (non-PAG) Mine Rock	Total and dissolved metals (selenium, sulphate) and other constituents, blasting residues, suspended solids.	▪ Non-PAG rock left uncontrolled could lead to constituent leaching to the environment. ▪ Of concern during active mining and in closure.
Processed Rock	Total and dissolved metals and other constituents, acidity, suspended solids.	▪ Processed rocks could lead to acid rock drainage (ARD) and the potential release of metals and other constituents to the environment, or dust release during transportation, handling, and/or storage. ▪ Of concern during active mining and in closure.
Disturbed Surface Areas and Road Surfaces	Suspended solids and potential chemical agent run off from dust suppression activities.	▪ Areas effected during Project component construction, surface soil salvage, and road construction and road use, could mobilize sediment into the environment. ▪ Of concern during construction and active mining.
Overburden	Suspended soils	Areas disturbed during construction of the Project components and management and control pond embankments and buttresses.
Surface Soils	Suspended soils	Areas disturbed during construction of Project components that require the salvage of surface soils.

Source	POPC/POC or COPC/COC	Project Sources
Open Pit Walls	Total and dissolved metals and other constituents, acidity, blasting residues.	▪ Exposed walls in the open pit could lead to ARD and the potential release of metals and other constituents to the environment. ▪ Of concern during active mining and in closure
Coal (Processed Coal, Run-of-mine [ROM] coal)	Total and dissolved metals and other constituents and suspended soils.	▪ Coal storage could lead to ARD and the potential release of metals and other constituents to the environment. ▪ Potential dust release during ROM and processed coal transport, handling, and/or storage. ▪ Of concern during active mining.
Hydrocarbons	▪ Volatile Organic Compounds (VOCs), including carbon dioxide, nitrogen oxide. ▪ Fuel spills.	▪ Emissions from diesel or gasoline-burning mining equipment, haul trucks, light vehicles, other transportation equipment (e.g., trains). ▪ Spills at fuel storage and refueling areas, or in equipment operating areas due to equipment malfunctions.

Notes: *COC=Contaminants of Concern; COPC=Contaminants of Potential Concern; POC=Parameters of Concern; POPC=Parameters of Potential Concern*

4.2 Parameters of Concern (POC) for Various Receptors

The following provides a summary of project related sources for the four (4) main receptors:

1. aquatic life;
2. terrestrial vegetation;
3. wildlife including avian species and amphibians; and
4. people and land use.

4.2.1 Parameters of Concern (POC) and Parameters of Potential Concern (POPC) for Aquatic Life, Wildlife/Avian/Amphibians, and Terrestrial Vegetation

POPC are identified as constituents using a similar methodology as provided in **Appendix 1.0-T-A** attached. **Figure 4.2-1** illustrates the flowchart that was used to identify POPC and POC for the Project. TCL decided to use 100 percent (%) of the applicable guidelines available versus using 80% of the applicable guideline as described in **Appendix 1.0-T-A** as the guidelines are conservative by nature and adding another modifying factor is not warranted. TCL selected the maximum average monthly modelled concentration of parameters at various prediction nodes for watercourses within the Project Area over the life of the Project. For any parameters identified as a POPC that are greater than its respective site performance objective (SPO), and water quality guideline, including drinking water, or that does not have a SPO; is classified as a POC.

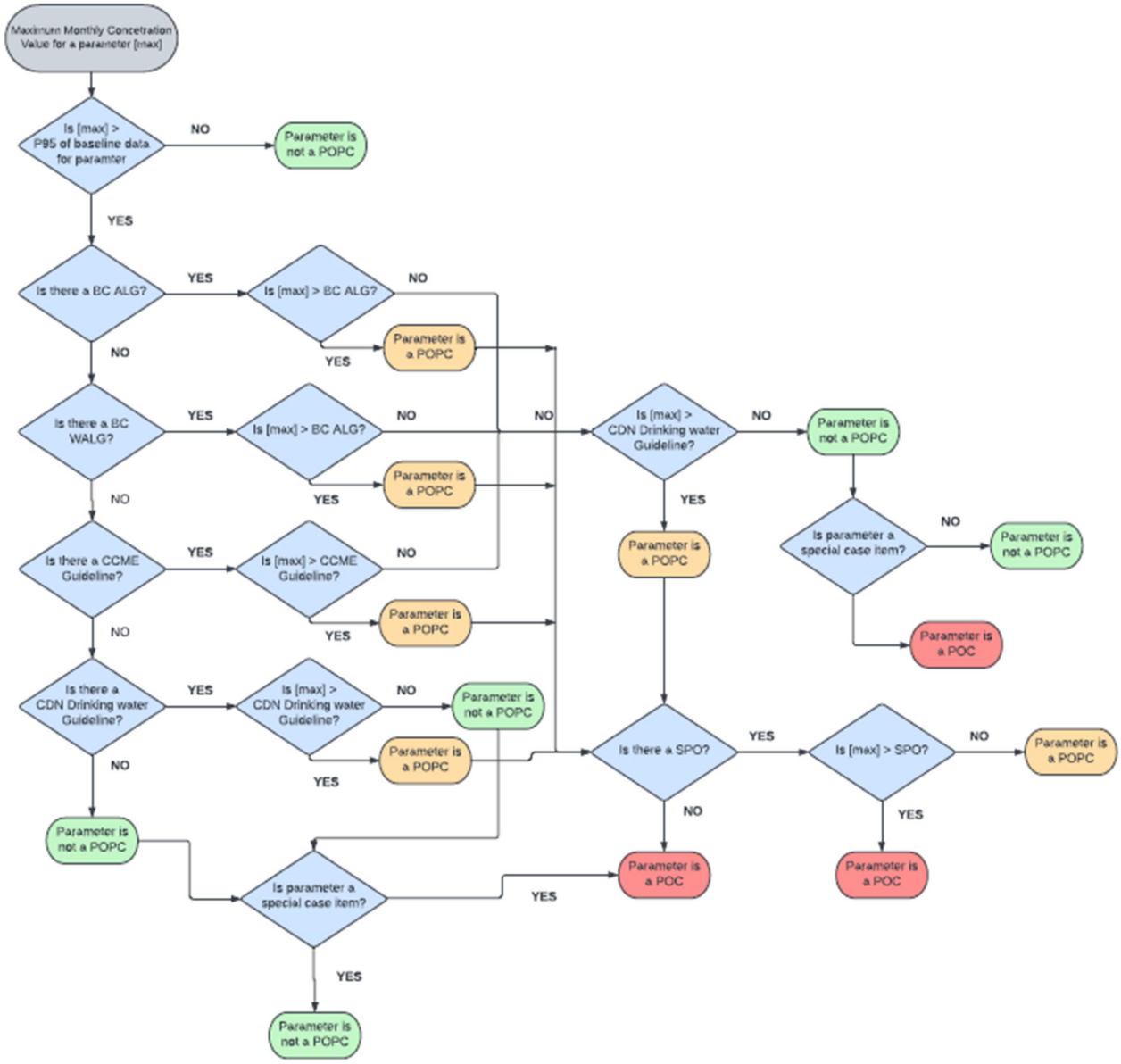

Figure 4.2-1: Flowsheet for Determining Parameters of Potential Concern (POPC)

Screening summaries and source terms for each mining component are described in the Water and Load Balance Modeling Report (SRK 2021c) provided in **Appendix 1.0-E of S1.0** and the Initial Dilution Zone (IDZ) analysis (SRK 2022) provided in **Appendix 1.0-AE of S1.0**. The identified constituents, including the projected location and timescale of exceedance are summarized by **Table 4.2-1**. The water monitoring stations are provided in **Figure 4.2-2** for reference.

Table 4.2-1 summarizes the available water quality guidelines that were used for the determination of POPC for parameters for the Project.

Table 4.2-1: Guidelines for Determining Parameters of Potential Concern (POPC)

Parameter	Units	SPO	BC SDWQG	Tenas Creek			Four Creek			Goathorn Creek			Telkwa River			Bulkley River		
				BC AWQG	BC WWQG	CCME WQG	BC AWQG	BC WWQG	CCME WQG	BC AWQG	BC WWQG	CCME WQG	BC AWQG	BC WWQG	CCME WQG	BC AWQG	BC WWQG	CCME WQG
Ammonia, total*	mg-N/L			1.2			0.95			1.5			1.7			1.7		
Chloride	mg/L			150			150			150			150			150		
Fluoride**	mg/L					0.12			0.12			0.12			0.12			0.12
Nitrate-Nitrogen	mg-N/L			3			3			3			3			3		
Nitrite-Nitrogen*	mg-N/L	0.0524		0.02			0.02			0.02			0.02			0.02		
Sulfate*	mg/L			218			309			218			218			128		
Aluminum, total*	mg/L	0.236				0.1			0.1			0.1			0.1			0.1
Aluminum, dissolved*	mg/L		9.5	0.05			0.05			0.05			0.05			0.05		
Antimony, total	mg/L				0.009			0.009			0.009			0.009			0.009	
Arsenic, total	mg/L			0.005			0.005			0.005			0.005			0.005		
Barium, total	mg/L		5.0		1			1			1			1			1	
Beryllium, total	mg/L				0.00013			0.00013			0.00013			0.00013			0.00013	
Boron, total	mg/L			1.2		1.5	1.2		1.5	1.2		1.5	1.2		1.5	1.2		1.5
Cadmium, diss*	mg/L	Varies*		0.00017			0.00024			0.00016			0.00011			0.00008		
Chromium (Cr(III)), total	mg/L		0.050			0.0089			0.0089			0.0089			0.0089			0.0089
Chromium (Cr(VI)), total***	mg/L					0.001			0.001			0.001			0.001			0.001
Cobalt, total	mg/L	0.0174	0.010	0.004			0.004			0.004			0.004			0.004		
Copper, total*	mg/L		2.0	0.003			0.005			0.003			0.002			0.002		
Iron, total**	mg/L			1		0.3	1		0.3	1		0.3	1		0.3	1		0.3
Iron, dissolved**	mg/L		0.30	0.35			0.35			0.35			0.35			0.35		
Lead, total*	mg/L		0.0050	0.006			0.007			0.005			0.004			0.004		
Manganese, total*	mg/L		0.12	0.94			1.1			0.92			0.79			0.73		
Mercury, total****	mg/L		0.0010	0.00001			0.00001			0.00001			0.00001			0.00001		
Molybdenum, total	mg/L		0.088	1		0.073	1		0.073	1		0.073	1		0.073	1		0.073
Nickel, total*	mg/L		0.080		0.11			0.11			0.11			0.025			0.025	
Selenium, total	mg/L	0.008	0.010	0.002		0.001	0.002		0.001	0.002		0.001	0.002		0.001	0.002		0.001
Silver, total*	mg/L			0.00005		0.00025	0.0015		0.00025	0.00005		0.00025	0.00005		0.00025	0.00005		0.00025
Thallium, total	mg/L				0.0008	0.0008		0.0008	0.0008		0.0008	0.0008		0.0008	0.0008		0.0008	0.0008

Parameter	Units	SPO	BC SDWQG	Tenas Creek			Four Creek			Goathorn Creek			Telkwa River			Bulkley River		
				BC AWQG	BC WWQG	CCME WQG	BC AWQG	BC WWQG	CCME WQG	BC AWQG	BC WWQG	CCME WQG	BC AWQG	BC WWQG	CCME WQG	BC AWQG	BC WWQG	CCME WQG
Uranium, total	mg/L		0.020		0.0085	0.015		0.0085	0.015		0.0085	0.015		0.0085	0.015		0.0085	0.015
Zinc, total*	mg/L		3.0	0.0075			0.023			0.0075			0.0075			0.0075		

***Notes**: BC ALG=British Columbia Aquatic Life Guidelines; BC AWQG=British Columbia Approved Water Quality Guidelines; BC WWQG=British Columbia Working Water Quality Guidelines; BC SDWQG=British Columbia Source Drinking Water Quality Guidelines; CCME WQG=Canadian Council of Ministers of the Environment Water Quality Guidelines; mg/L milligrams per litre; mg-N/L=milligrams per litre of nitrite as nitrogen; SPO=site performance objective*

** Guidelines determined by baseline receiving water quality.*

*** Short-term maximum BC AWQG are provided for fluoride and total and dissolved iron.*

**** All chromium in baseline monitoring data is assumed to be Cr(VI)*

***** The guideline for total mercury is dependent on the methyl mercury (MEhg) concentrations of the receiving environment, which is not measured in the baseline data. The mid-range guideline was selected, which assumes a concentration of MeHg that is 1.% of total mercury. since the lowest limit is below the detection limit of the baseline monitoring data.*

Tenas Project

Water Monitoring Stations

610000 615000 620000 625000 630000 635000

6065000 6060000 6055000 6050000 6045000

BURNT CABIN BOG ECOLOGICAL RESERVE

Tyhee Lake

CN

16

TELKWA

TELKWA COALMINE RD

LAWSON RD

Bulkley River

Telkwa River

AVELING COALMINE RD

Helps Creek

Tenas Creek

BYPASS ROAD

RAIL INFRASTRUCTURE SEDIMENTATION POND

RAIL INFRASTRUCTURE AREA

ROCK QUARRY AND SEDIMENTATION POND

GRAVEL QUARRY AND SEDIMENTATION PONDS

EXPLOSIVE MAGAZINE SEDIMENTATION POND

EXPLOSIVE FACILITY SEDIMENTATION POND

TENAS CONTROL POND

NORTH MANAGEMENT POND

WEST MANAGEMENT POND

TELKWA RIVER FSR

TENAS ACCESS CORRIDOR SEDIMENTATION POND (EAST)

TENAS ACCESS CORRIDOR SEDIMENTATION POND (WEST)

CPP SEDIMENTATION POND

SOIL TREATMENT FACILITY POND

WASTEWATER STORAGE POND

EAST MANAGEMENT POND

POTABLE WATER STORAGE POND

Four Creek

Copathorn Creek

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Legend

- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Municipal Area
- General Private Property
- 138 kV Transmission Line
- 500 kV Transmission Line

Project Features

- 25 kV Power Line
- Haul Road
- Rail Loop
- Discharge Path
- Tenas Access Corridor
- Backfill Area
- Control and Plant Sedimentation Pond
- Explosive Infrastructure
- Management Pond
- Mine Infrastructure Complex (Coal, Processing Plant, Mine Administration and Dry Building, Maintenance Facility, Run-of-Mine and Processed Coal Stockpiles)
- Open Pit
- Pit Lake
- Quarry
- Rail Infrastructure
- Topsoil Stockpile
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project Area

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. Project line features are for display only.

Sources

- Project Features: Allegiance Coal, April 21, 2021.
- Basedata: Government of British Columbia
- Basemap: World Topo Base

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Kilometres

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

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ALLEGIANCE COAL LIMITED

Constituents are anticipated to exceed water quality guidelines in the winter when groundwater discharge contributes the most to total flow conditions in Tenas and Four creeks. Exceedances in the summer are due to the low dilution capacity of the creeks during low-flow summer months. Most constituent concentrations are expected to decrease below water quality guidelines during the post-closure period. Monitoring will continue throughout closure to verify that this occurs.

The list of POPCs identified by the flowchart illustrated by **Figure 4.2-1** were then summarized by **Table 4.2-2,** and TCL developed SPOs based on a scientific review of latest information and site-specific toxicity testing if warranted to determine if any of the POPC could be screened out prior to identifying the final list of POCs for the Project. The SPOs for the Project are provided in **Appendices 13.5-C through I of the Discharge Management Plan (DMP) (S13.0-C5)** of the **EAC Application**.

The following two (2) elements were reviewed as potential special case parameters of concern for aquatic life, wildlife, and terrestrial vegetation:

- mercury, and
- selenium

As the 95th percentile mercury concentrations for the Project are four times lower than any guideline it was not selected as a COPC to be carried forward. Selenium has already been selected as a COPC due to its 95th percentile concentration exceeding the BC Aquatic Life Guidelines (BC ALG) but not as a POC as it does not exceed its SPO. Based on its rating as a special case parameter, selenium has been identified as a POC to be carried forward.

After their development and review only cadmium and selenium were carried forward to a POC.

Table 4.2-2 below summarizes the location and expected average seasonal parameter concentration compared to the SPO developed for POPC. As summarized, there are no specific locations where the SPOs for any parameters identified as POPC are exceeded.

Table 4.2-2: Parameters of Potential Concern (POPC) and Parameters of Concern (POC) for Aquatic Life, Wildlife (Avian and Amphibians included), and Terrestrial Vegetation

Parameter	Units	Maximum Modelled Mean Monthly Concentration	Location of Greatest Exceedance of WQG	95th Percentile Baseline Concentration[1]	SPO[2]	Lowest BC MOE WQG (Aquatic Life, Drinking Water)[3]	Exceedance Factor WQG (Maximum Modelled Result/95th Percentile Baseline Concentration)	Exceedance Factor WQG (Maximum Modelled Result/Guideline)	Exceedance Factor with SPO (Maximum Modelled Result/SPO)	Special Case Parameter	POPC	POC
Aluminum, dissolved	mg/L	0.16	Four Creek, WQS03_DS	0.49	0.208	0.05	0.33	3.2	0.77	NO	NO	NO
Aluminum, total	mg/L	0.26	Telkwa River, WQS09	1.7 (P50=0.17)	0.208	0.1	0.15	2.60	1.25	NO	NO	NO
Ammonia, total	mg-N/L	0.25	Tenas Creek, WQS04	0.0074	-	1.2	33.78	0.21	-	NO	NO	NO
Antimony, dissolved	mg/L	0.00083	Four Creek, WQS03_DS	0.00012	-	0.009	6.92	0.09	-	NO	NO	NO
Arsenic, total	mg/L	0.0016	Four Creek, WQS03_DS	0.0011		0.005	1.45	0.32	-	NO	NO	NO
Barium, total	mg/L	0.13	Four Creek, WQS03_DS	0.13		1	1.00	0.13	-	NO	NO	NO
Beryllium, total	mg/L	0.000082	Four Creek, WQS03_DS	0.0001		0.00013	0.82	0.63	-	NO	NO	NO
Boron, total	mg/L	0.21	Four Creek, WQS03_DS	0.02		1.2	10.50	0.18	-	NO	NO	NO
Cadmium, dissolved	mg/L	0.00026	Four Creek, WQS03_DS	0.000012	0.00026	0.00008	21.67	3.25	1.00	NO	YES	YES
Chloride	mg/L	13	Four Creek, WQS03_DS	0.5		150	26.00	0.09	-	NO	NO	NO
Chromium, total	mg/L	0.0021	Four Creek, WQS03_DS	0.0016		0.0089	1.31	0.24	-	NO	NO	NO
Cobalt, total	mg/L	0.0011	Four Creek, WQS03_DS	0.00047	0.0174	0.004	2.34	0.28	0.10	NO	NO	NO
Copper, total	mg/L	0.0041	Four Creek, WQS03_DS	0.044		0.0047	0.09	0.87	-	NO	NO	NO
Fluoride	mg/L	0.095	Four Creek, WQS03_DS	0.068		0.12	1.40	0.79	-	NO	NO	NO
Iron, dissolved	mg/L	0.12	Four Creek, WQS03_DS	0.27 (P50=0.08)		0.3	0.44	0.40	-	NO	NO	NO
Iron, total	mg/L	0.47	Telkwa River, WQS09	1.5 (P50=0.31)		0.3	0.31	1.57	-	NO	NO	NO
Lead, total	mg/L	0.0004	Four Creek, WQS03_DS	0.00028		0.004	1.43	0.10	-	NO	NO	NO
Manganese, total	mg/L	0.057	Four Creek, WQS03_DS	0.0074		0.12	7.70	0.48	-	NO	NO	NO
Mercury, total	mg/L	0.0000025	Four Creek, WQS03_DS	0.000013		0.00001	0.19	0.25	-	NO	NO	NO
Molybdenum, total	mg-N/L	0.0036	Four Creek, WQS03_DS	0.00038		0.073	9.47	0.05	-	NO	NO	NO

Parameter	Units	Maximum Modelled Mean Monthly Concentration	Location of Greatest Exceedance of WQG	95th Percentile Baseline Concentration[1]	SPO[2]	Lowest BC MOE WQG (Aquatic Life, Drinking Water)[3]	Exceedance Factor WQG (Maximum Modelled Result/95th Percentile Baseline Concentration)	Exceedance Factor WQG (Maximum Modelled Result/Guideline)	Exceedance Factor with SPO (Maximum Modelled Result/SPO)	Special Case Parameter	POPC	POC
Nickel, total	mg/L	0.004	Four Creek, WQS03_DS	0.0018		0.025	2.22	0.16	-	NO	NO	NO
Nitrate	mg/L	1.9	Tenas Creek, WQS04	0.06		3	31.67	0.63	-	NO	NO	NO
Nitrite	mg/L	0.045	Tenas Creek, WQS04	0.002	0.0524	0.02	22.50	2.25	0.90	NO	YES	NO
Selenium, total	mg/L	0.0058	Four Creek, WQS03_DS	0.000095	0.008	0.002	61.05	2.90	0.70	YES	YES	YES
Silver, total	mg/L	0.000005	Four Creek, WQS03_DS	0.000022		0.00005	0.23	0.10	-	NO	NO	NO
Strontium, total	mg/L	0.89	Four Creek, WQS03_DS	0.24		7	3.71	0.13	-	NO	NO	NO
Sulfate	mg/L	360	Four Creek, WQS03_DS	28	593	128	12.86	2.81	0.60	NO	YES	NO
Thallium	mg/L	0.00027	Four Creek, WQS03_DS	0.0022		0.0008	0.12	0.34		NO	NO	NO
Uranium, total	mg/L	0.0022	Four Creek, WQS03_DS	0.00025		0.0085	8.80	0.26	-	NO	NO	NO
Zinc, total	mg/L	0.0074	Four Creek, WQS03_DS	0.0059		0.023	1.25	0.32	-	NO	NO	NO

Notes: *BC MOE=British Columbia Ministry of the Environment; mg/L=milligrams per litre; mg/N-L=milligrams per litre of nitrate as nitrogen; POPC=Parameters of Potential Concern; POC=Parameters of Concern; SPO=site performance objective; WQG=water quality guideline*

1 = P95 from baseline monitoring for stream with highest modelled concentration

2 = WQG for stream with highest modelled concentration

3 = SPO for stream with highest modelled concentration

Tables 4.2-3 presents the sources of potential interaction between the Project and streamflow in the adjacent streams. Quantitative changes to streamflow is reported in SRK (2021c) and in the **S4.0-C3 Surface Water VC.**

Table 4.2-3: Potential Sources of Interaction to Streamflow Quality from the Tenas Project

Source	Project Interaction	Interaction with Streamflow Water Quality
Groundwater Recharge	Groundwater drawdown from open pit mining	Reducing water flows in creeks causing an increase in POPC concentrations due to loss of dilution.
	Groundwater mounding (increase of groundwater table) from water storage facilities	Increasing water flows in creeks causing an increase in POPC concentrations due to loads from Project
Surface Water Runoff	Project footprint collecting surface runoff and discharging water further downstream than existing conditions	Reducing water flows in creeks causing an increase in POPC concentrations due to loss of dilution.
	Project footprint collecting surface runoff and storing permanently as water cover for PAG materials, and lost to evaporation	Reducing water flows in creeks causing an increase in POPC concentrations due to loss of dilution.
	Diversion structures collecting surface runoff and discharging water further upstream than existing conditions	Increasing water flows in creeks causing a decrease in POPC concentrations due to increase of dilution.

Notes: *POPC= Parameters of Potential Concern*

4.2.2 Parameters of Concern (POC)/(Contaminants of Concern/COC) for People and Land Use

The methodology for the selection of POC for human health is described in the human health risk assessment (**HHRA; Appendix 8.0-A** of the **EAC**), while a summary is described for the following:

- air (atmospheric);
- soil;
- surface water;
- groundwater;
- subsistence foods; and
- special case parameters.

4.2.2.1 Parameters of Concern (POC) for People and Land Use related to Air

The following provides a summary of POC/COC related to air for people.

4.2.2.1.1 Criteria Air Contaminants (CACs)

To identify POCs for people receptor of concern groups, Baseline and Project Case predicted concentrations of CACs were compared to the BC Ambient Air Quality Objectives (BC AAQO) for the applicable averaging periods (1-hour, 8 hour, 24-hour, and/or annual) for each CAC. The BC AAQOs include objectives for total suspended particulates (TSP), PM_{10}, $PM_{2.5}$, NO_2, and SO_2.

Based on the screening rationale outlined in the HHRA (Entia 2022), the following CACs were selected as POCs for further assessment as both exceeded AAQOs in Telkwa under baseline condition:

- PM_{10} (24-hour); and
- $PM_{2.5}$ (24-hour and annual),

4.2.2.1.2 Metals in Air

Metals can be associated with inhalable particulates (PM_{10}) and could potentially be inhaled by people. To identify metal POCs in air, Baseline Case and Project Case concentrations were compared to the lowest of the health-based chronic screening levels from the Texas Commission on Environmental Quality Effects Screening Levels (annual) (TCEQ 2020), the Ontario Ministry of Environment (OMOE), Ambient Air Quality Criteria (AAQC) (OMOE 2012) or the Washington State Acceptable Source Impact Levels (ASILs) (Washington State 2019).

Parameters were identified as POPC requiring an effects assessment if the maximum Project Case concentration of metals in air was higher than the lowest guideline value (Entia 2022).

Based on the screening approach, no metal POC was identified in air. However, since there was an incremental change predicted in total chromium concentration between Baseline and Project Case, chromium was conservatively retained as a POC in air. Total chromium was not detectable in Baseline air and the Baseline concentration is an artifact of the calculation, which substituted half of the detection limit as the concentration for chromium, and was then compared to the guideline for chromium (VI), as there is no guideline for total chromium even though it is expected that a guideline for total chromium would be higher than chromium (VI)

4.2.2.2 Parameters of Concern (POC) for People and Land Use related to Soil

Parameters were identified as POCs requiring an effects assessment if the maximum Baseline and Project Case concentration of metals in soil were higher than of the most stringent of applicable soil quality guideline considering:

- BC CSR Schedule (B.C. Reg. 375/96) 3.1 Soil Standards for reverted wildlands or agricultural land use based on intake of contaminated soils; or
- Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines for soil (SQG) for the protection of human health for residential/parkland or agricultural land uses (where available, guidelines specific to the protection of human health were preferentially used, otherwise, the generic CCME SQG was used).

Based on the maximum concentrations in soils in the Human Health LSA exceeding the most stringent of applicable agriculture and parkland or wildlands CCME and BC CSR guidelines or standards in both the Baseline and Project Case, aluminum, arsenic, boron, cadmium, and iron were selected as POC in soil (Entia 2022).

4.2.2.3 Parameters of Concern (POC) for People and Land Use related to Surface Water

Parameters were identified as POCs for Temporary Land Users or Full-time Residents if the maximum surface water concentration at any location was higher than the most conservative health-based drinking water quality guideline (collectively referred to as DWQGs) considering:

- BC Source Drinking Water Quality Guidelines;
- Health Canada Drinking Water Quality Guidelines; and
- BC CSR Schedule 3.2 Drinking Water Standards.

Parameters that were innocuous (e.g., calcium, magnesium, potassium) were excluded as exposure concentrations are not high enough to have the potential to cause effects on people.

Chromium, lithium, and selenium screened in as POC in surface water based on maximum concentrations exceeding the most conservative health-based screening benchmark in either the Baseline Case, Project Case, or both (Entia 2022).

4.2.2.4 Parameters of Concern (POC) for People and Land Use related to Groundwater

To identify POCs for Full-time Resident ROCs, the groundwater chemistry data were compared to the same DWQG as used for surface water quality.

Maximum Baseline concentrations of the following metal parameters exceeded drinking water guidelines in groundwater sampled from residential wells downgradient of the Project:

- arsenic;
- cobalt;
- iron;
- lithium; and
- manganese (Entia 2022).

The predicted worst-case (High Case) groundwater concentrations for residential wells was used for screening POC in Project Case groundwater. Concentrations of cobalt and lithium were predicted to exceed the BC CSR DW standard, and cobalt was also predicted to exceed the BC source drinking water quality guidelines in the Post-closure Phase (Entia 2022).

4.2.2.5 Parameters of Concern (POC) for People and Land use related to Subsistence Foods

Except for mercury and selenium in fish tissue, there are no guidelines for metals in subsistence food tissues. To complete a screening for POCs for subsistence foods, screening benchmarks were calculated (Entia 2022). A parameter was identified as a POC and carried forward for effects assessment if the concentration was higher than the screening benchmark.

Baseline fish tissue concentrations and predicted Project fish tissue concentrations of selenium and mercury did not exceed the BC tissue quality guideline for selenium or the BC MECCS and Health Canada guidelines for mercury.

POC concentrations in subsistence foods (moose, deer, black bear, hare, grouse) were predicted for Baseline and Project Case using a food chain model (Entia 2022). Predicted concentrations in subsistence

foods exceeded the calculated screening benchmarks for the following POC: aluminum, arsenic, barium, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, nickel, selenium, strontium, thallium, and zinc.

4.2.2.6 People and Land Use Special Case Parameters of Concern for People and Land Use

The assessment of bioaccumulation potential for special case POC for people is typically based on bioconcentration factors (BCFs) and bioaccumulation factors (BAFs) (Health Canada 2019a). Site-specific BCFs from water to fish tissue and BCFs from soil to plant tissues were considered in this screening step for people and land use (human health). If the BCF was greater than 5000, then the parameter was considered to have bioaccumulative properties (Environment Canada 2003; Health Canada 2019) and was retained as a POC. If the BCF was less than 5,000 the parameter was not identified as a special case POC.

Calculated BCFs for POCs in plants (BCF_{plant}) due to the uptake from soil, BCFs for POCs in fish (BCF_{fish}) due to uptake from water, and biotransfer factors (BTFs) for terrestrial mammals and birds are presented in Entia (2022). None of the BCF_{plant} or BTFs were greater than 5000. However, the BCF_{fish} exceeded 5000 for cadmium, mercury, phosphorus, potassium, and zinc. Phosphorus and potassium are unlikely to be detrimental to human health at concentrations present in the aquatic food chain and in fish and, thus, were not considered further for the assessment of human health. Selenium was included as a bioaccumulative substance in the aquatic food chain (Beatty and Russo 2014). Final COPCs retained as special case COPCs were: **cadmium, mercury, selenium, and zinc**, and are included in **Section 4.2.2.7**.

4.2.2.7 Summary of Parameters of Concern for People and Land Use

Based on the above information, **Table 4.2-4** below summarizes the POC for the various environmental media and subsistence foods that can come into contact and/or be inhaled or ingested by people. Note that the POC are any parameter that screened in for one or more exposure media; if the parameter screens in as a POC in a single media, assessment of the cumulative exposures from all exposure media was evaluated in the HHRA.

Table 4.2-4: Summary of Parameters of Potential Concern (POPC) and Parameters of Concern (POC) for People and Land Use (Human Health)

Parameter	Screened in as Potential Parameter of Concern (POPC)														Final POC Selection
	Groundwater			Surface Water			Air		Soil		Subsistence Food			Special Case	
	Baseline Measured	Baseline Predicted	Post-closure Phase	Baseline Measured	Operation	Closure*	Baseline	Operation	Baseline	Operation	Baseline	Operation	Closure*		
Aluminum	-	-	-	-	-	-	-	-	YES	YES	YES	YES	YES	-	YES
Antimony	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	YES	YES	-	-	-	-	-	-	YES	YES	-	-	YES	-	YES
Barium	-	-	-	-	-	-	-	-	-	-	YES	YES	YES	-	YES
Beryllium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bismuth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron	-	-	-	-	-	-	-	-	YES	YES	YES	YES	YES	-	YES
Cadmium	-	-	-	-	-	-	-	-	YES	YES	-	YES	YES	YES	YES
Calcium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-	YES	-	-	-	YES	YES	-	YES
Cobalt	YES	YES	YES	YES	YES	YES	-	-	-	-	YES	YES	YES	-	YES
Copper	-	-	-	-	-	-	-	-	-	-	-	YES	YES	-	YES
Iron	YES	-	-	-	-	-	-	-	YES	YES	YES	YES	YES	-	YES
Lead	-	-	-	-	-	-	-	-	-	-	YES	YES	YES	-	YES
Lithium	-	-	YES	-	YES	YES	-	-	-	-	-	YES	YES	-	YES
Magnesium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	YES	YES	-	-	-	-	-	-	-	-	YES	YES	YES	-	YES
Mercury	-	-	-	-	-	-	-	-	-	-	YES	YES	YES	YES	YES
Molybdenum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-	-	-	-	YES	YES	YES	-	YES

Parameter	Screened in as Potential Parameter of Concern (POPC)														Final POC Selection
	Groundwater			Surface Water			Air		Soil		Subsistence Food			Special Case	
	Baseline Measured	Baseline Predicted	Post-closure Phase	Baseline Measured	Operation	Closure*	Baseline	Operation	Baseline	Operation	Baseline	Operation	Closure*		
Potassium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	YES	-	-	-	-	YES	YES	YES	YES	YES
Silver	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strontium	-	-	-	-	-	-	-	-	-	-	YES	YES	YES	-	YES
Thallium	-	-	-	-	-	-	-	-	-	-	-	YES	YES	-	YES
Tin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	-	-	-	-	-	-	-	-	-	-	-	-	YES	YES	YES

Note: *POC=Parameter of Concern*

Table 4.2-5 summarizes the sources and type of POPC and POC.

Table 4.2-5: Types, and Sources for Parameters of Potential Concern (POPC)

Receptor	Existing Sources	Project-related Sources
Aquatic Life	Total aluminium, copper, and iron exceed the 95th percentile in Tenas, Goathorn, Four and creeks and the Telkwa and Bulkley rivers based on baseline monitoring. Mercury only exceeds in Four Creek	Project Activity causing parameter concentrations to increase aquatic life by consuming surface water.
Terrestrial Vegetation	n/a	Project activities causing parameter concentrations to increase in vegetation by absorbing direct surface water run off, groundwater seepage and dust fall on soils that are then absorbed by the vegetation.
Wildlife	Total aluminium, copper, and iron exceed the 95th percentile in Tenas, Goathorn, Four and creeks and the Telkwa and Bulkley rivers based on baseline monitoring. Mercury only exceeds in Four Creek	Project activities causing parameter concentrations to increase in wildlife by drinking surface water, ingesting vegetation and other wildlife and soils.
People	People are exposed to existing sources of parameters in air, groundwater wells used for drinking, surface water, soil, and subsistence and market foods (criteria air contaminants [CAC], threshold, and non-threshold contaminants). These can either be naturally occurring or due to existing anthropogenic activities. People utilizing private wells are also exposed to parameters currently that are above drinking water guidelines such as E.coli.	Project activities causing changes in parameter concentrations in air, surface water, groundwater, soil, or subsistence foods, resulting in changes in exposure of people to parameters of potential concern (POPC).

4.3 Pathways and Exposure Pathways

The following provides an overview of the general potential pathways for transporting parameters from source to receptors.

4.3.1 Pathways

Additional information is provided below on the three (3) primary pathways which are:

1. groundwater;
2. surface water; and
3. air (atmospheric).

Receptors along the food web use one or all these pathways to encounter POC/POPC.

4.3.1.1 Groundwater Pathways

There are distinct groundwater pathways for each groundwater flow system:

- overburden system – shallow and relatively quicker pathways between loading sources and close by reaches of Telkwa River tributaries (e.g., Four Creek, and Tenas Creek). Travel times for this pathway are expected to be of the order of decades; and
- bedrock system – deeper and slower pathways between loading sources and farther tributaries (e.g., Goathorn Creek), the Telkwa River itself, and down gradient private wells near the Telkwa River. Travel times for this pathway are expected to be of the order of centuries.

Accidental spills also have the potential to infiltrate into groundwater if not contained and cleaned up in a timely manner. This has not been modelled and management plans are in place in the event of an accidental spill.

4.3.1.2 Surface Water Pathways

Surface water for the Project is generally collected from surface runoff in the Tenas Creek and Four Creek watersheds. Effluent will be discharged to a tributary and into Goathorn Creek during the operational period. After closure, pre-development surface runoff catchments will be restored. Surface runoff that contacts Project Infrastructure during operations will be collected in a series of management ponds where it will be recycled for use in the Coal Processing Plant (CPP), and/or stored to maintain water cover over PAG materials. Runoff will be treated for suspended sediments prior to being released offsite. Discharge rates will be variable over the mine life and post-closure, but generally mimic pre-development patterns (i.e., higher discharge during freshet periods and lower discharge during winter, so hydrologic patterns downstream of Goathorn Creek are expected to be unchanged). More information regarding surface water discharge at the Project is available in the Surface Water Valued Component Assessment (SRK 2021d).

4.3.1.3 Atmospheric Pathways

The Project Area is in the Bulkley Valley Airshed. The Bulkley Valley is located 200 km inland from the west coast of Canada and is frequently characterized by stable air masses, resting over the valley. The stable air is also subject to temperature inversions, as the ground surfaces lose heat, and get cooler than the overlaying atmosphere. Both processes prevent mixing - trapping air, and constituents, in the valley (BC MOE 2000). Dust and emissions, primarily from equipment primarily trucks using haul roads and working in the mining function, tend to remain close to their source height and deposit readily around their source. Dust and emission modelling for the Project anticipates that POPC/POC are unlikely to travel beyond the Project Area in the atmosphere at concentrations that are measurable above the current baseline values. As stated, earlier COPC and POC contained within the dust generated by the Project that then goes into the atmosphere and falls onto vegetation, water bodies, soils and organisms is expected to have negligible effect on water quality concentrations due to their low concentrations versus parameter concentration from seepage and runoff. Furthermore, the dermal contact due to this falling material is also not expected to have a measurable effect on receptors such as Wildlife, Terrestrial Vegetation and People and Land use.

During the Post-closure Phase, vehicle emissions will effectively cease, and during the decommissioning and reclamation phase disturbed surfaces will be revegetated to limit dust production. Furthermore, the Project will maximize the area that can be progressively reclaimed to further reduce dust generation during the operation phase of the Project.

4.3.2 Exposure Pathways

An exposure pathway is the way in which a POPC migrating through an environmental medium encounters a potential receptor. In the case of the Project, constituents can contact receptors in three (3) ways:

- Directly through ingestion and/or inhalation (e.g., consumption of water or plants that are dust covered and/or have taken up POPC from soil, incidental ingestion of soil, ingestion of water and inhalation of dust in air);
- Ingestion via the food web (e.g., consumption of other biota that have ingested water, soil, plants, or prey items that have POPC); or
- Dermal contact with water and soil.

4.3.2.1 Exposure Pathways for People and Land Use

Exposure pathways are routes by which people can be exposed to POC in various exposure media. These pathways can either be direct (e.g., ingestion of surface water) or indirect (e.g., ingestion of an animal that has been drinking surface water).

There are three (3) main potential transport and exposure pathways through which POC may be transferred from the Project to the environment where people could encounter them:

1. Atmospheric transport of gases and particulates, where Project sources of CAC and metals are conveyed into the environment via dispersion in the air, which is then inhaled by humans;
2. Atmospheric transport of fugitive dust, where dust generated by Project activities can be deposited from the air onto the ground or plant surfaces, which can then be taken up by plant roots into plant tissue, which can then be ingested by people and terrestrial biota; and
3. Effluent discharge (to surface water) and seepage (to groundwater) that may contain Project-related POCs from Project activities or infrastructure, which can then be ingested by people and terrestrial biota.

Once POC enter the environment they can be taken up into the aquatic or terrestrial food chain; this is considered an indirect transport and exposure pathway for exposure (through ingestion of subsistence foods) of people.

Exposure pathways are classified as complete or incomplete. Pathways are considered complete when a link is established between the POC source and people. All pathways considered complete are carried forward for further assessment. Exposure pathways are considered incomplete when there is no documented or anticipated link; these pathways are not carried forward for further assessment.

Table 4.3-1 below summarizes the complete exposure routes (green), the incomplete exposure routes (red), and the exposure routes that may be complete but are not considered further (yellow) for people and land use (human health).

Table 4.3-1: Potential Exposure Pathways for People and Land Use (Human Health)

Receptor of Concern	Potential Exposure Pathway									
	Ingestion					Dermal Contact				Inhalation
	Surface Water	Groundwater	Soil	Sediment	Subsistence Food	Surface Water	Groundwater	Soil	Sediment	Air
Resident Land User*										
Recreational Land User										

Notes:
** This includes Indigenous and non-Indigenous Resident Land Users.*
Green – pathway is complete.
Yellow – pathway may be complete but is not considered further (additional rationale for exclusion is provided in text).
Red – pathway is incomplete.

Complete (green) exposure pathways were identified for the Indigenous and non-Indigenous Resident Land User for the ingestion of surface water, groundwater, soil, and subsistence food, and for the inhalation of air. Complete exposure pathways were identified for the Recreational Land User for the ingestion of surface water and soil, and for the inhalation of air.

The Recreational Land User has incomplete (red) exposure pathways for the ingestion of and dermal contact with groundwater as they don't reside within the LSA and are not expected to obtain drinking water from groundwater wells while visiting the LSA, but rather will use surface water for drinking and recreational purposes.

The rationale for excluding the potentially complete exposure pathways shown in yellow is:

- For exposure to sediments, significant exposure is not expected for either ROC group:
  - Indigenous and non-Indigenous Resident Land Users: individuals may contact sediment while fishing. It is anticipated that individuals would be wearing boots or waders; thus, clothing is expected to block this pathway;
  - Recreational Land Users – individuals may contact sediment while on shorelines or while swimming. Exposure while swimming is not complete as sediment is washed off while an individual is in the water. Exposure while on a shoreline is expected to be low as limited beach areas are available for use within the LSA. Additionally, assessment of soil exposure is considered a conservative surrogate; and
- For dermal exposure to water, as per BC Ministry of Environment and Climate Change Strategy's (BC MECCS) Technical Guidance 7 (BC MECCS 2017) "*The dermal exposure pathway from water for metals does not require evaluation.*" This pathway is typically excluded for metals because the amount of metal uptake that occurs through the skin is negligible compared to other, more significant exposure pathways such as eating subsistence foods or drinking water. As the COPC for this Project are metals, the dermal exposure pathway from metals in water was not evaluated further.

Metal POC may also be present in foods in the market (retail or commercial) food system. As per guidance from the BC Ministry of Health and Health Canada (Health Canada 2019b; BC MOH 2021), in addition to subsistence foods, the assessment also includes background exposure from ingestion of market foods to estimate the overall exposure to POCs from food ingestion. The doses from market foods are independent of Project phase as it is assumed that people will consume the same amount of market foods or the same quality every year (in addition to subsistence foods). Thus, the same dose of POCs from market foods is applied to both the Base Case and Project Case. **Figure 4.3-1** provide the exposure pathways for people and land use pathways.

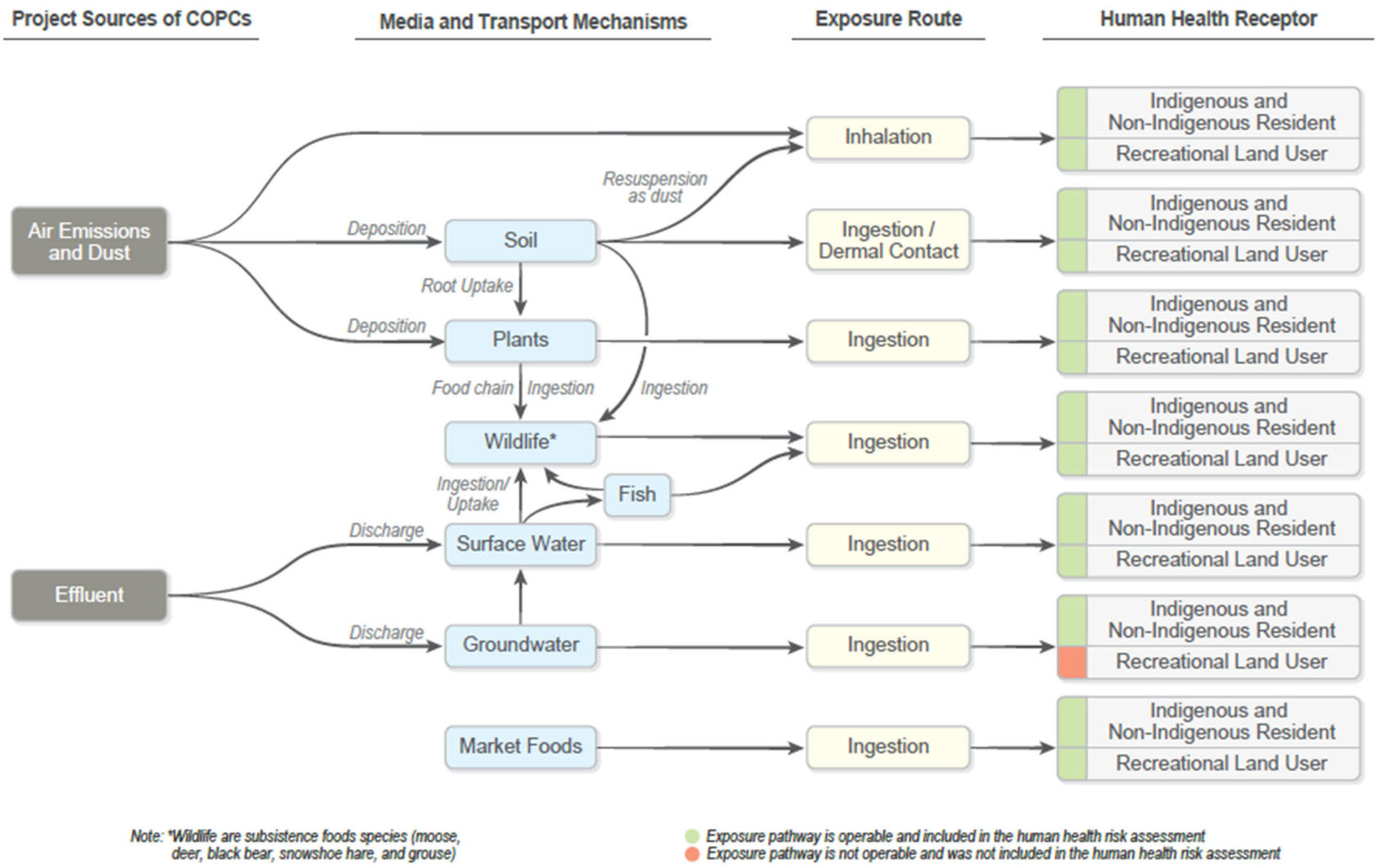


Figure 4.3-1: Potential Exposure Pathways for People and Land Use

4.3.2.2 Exposure Pathways for Aquatic Life, Wildlife, and Terrestrial Vegetation

Figure 4.3-2 provides a visual representation of the primary exposure pathways for the Project for aquatic life, wildlife, and terrestrial vegetation. **Table 4.2-1** previously summarizes the POPC that are projected to be contained within the LSA for the surface water BC. The extent of exposure of POPC can be determined by comparing the streams in **Table 4.2-1** and **Figure 4.2-1.** Concentrations of POPC are expected to decrease downstream towards the Telkwa and Bulkley Rivers because of dilution and natural attenuation. The concentrations due to the Project at the downstream node on the Bulkley River due to the Project is expected to not be measurable and hence further downstream in the Skeena River, Project effects will not be present (the latter is not accounted for in water quality projections as predicted concentration at the downstream node in the Bulkley River are like baseline concentrations). **Table 4.3-2** summarizes the potential pathways that parameters can become exposed to aquatic life, wildlife, and terrestrial vegetation.

Table 4.3-2: Exposure Pathways to Selected Receptors

Selected Receptors	Potential Exposure Pathways			
Wildlife	Ingestion of biota and vegetation	Drinking surface and groundwater	Dermal Contact with soils	Inhalation of dust
Terrestrial Vegetation	Uptake of seepage	Uptake of Runoff	Deposition onto vegetation	n/a
Fish	Ingestion of biota and vegetation	Discharge of seepage into water bodies	Runoff into streams	Direct dust fall on water bodies

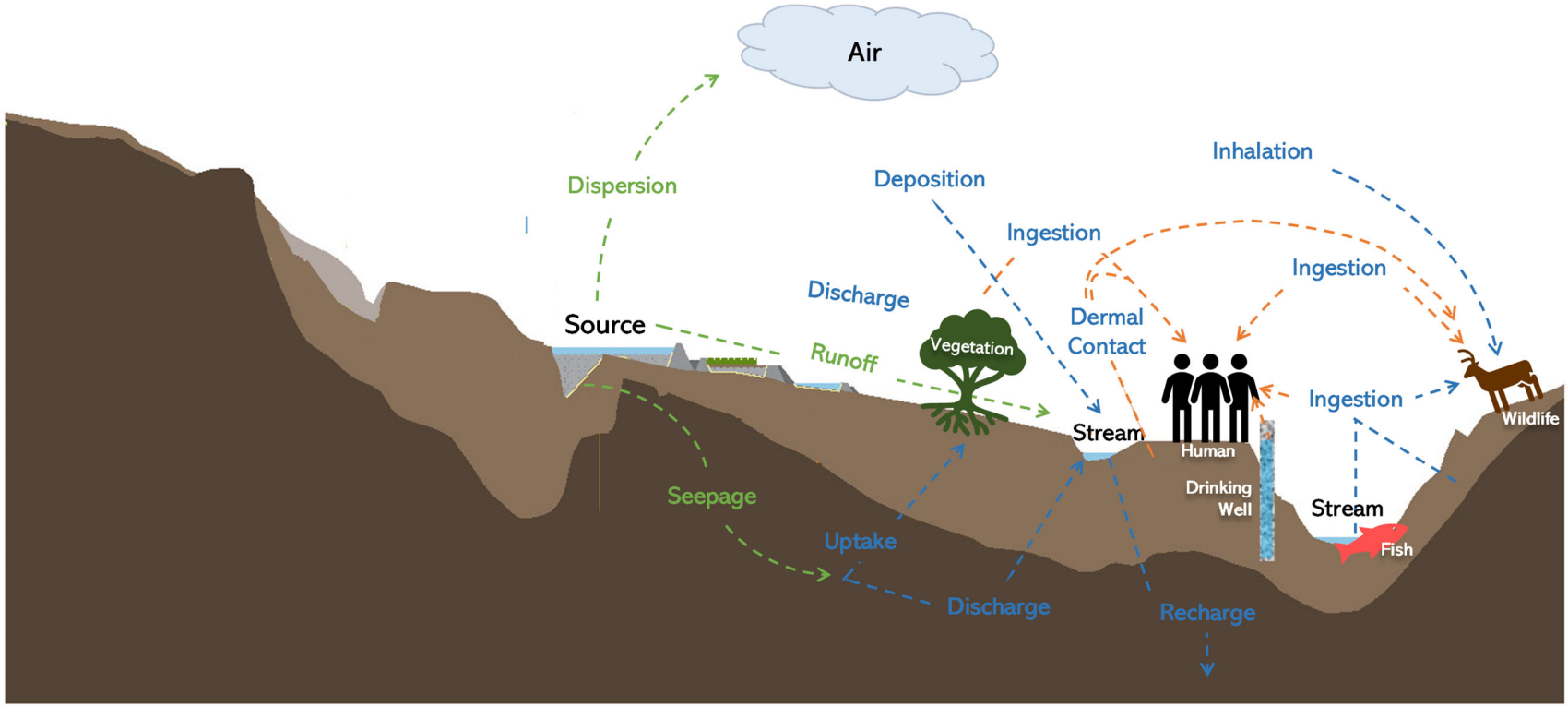


Figure 4.3-2: Source, Migration, and Exposure Pathways to Receptors for the Project's Parameters of Potential Concern (POPC)

5. CONTROLS, MITIGATIONS, AND CONTINGENCIES

The Project has incorporated numerous engineering and design controls to minimize constituent migration through the identified pathways to the receptors and cause potential effects on the receptors.

5.1.1 Controls

Table 5.1-1 and **Table 5.1-2** summarize the controls associated with water quality and dust fall quantities, applied to each of the sources outlined in **Section 4.1.**

Table 5.1-1: Water Quality Controls to Minimize Parameters of Potential Concern (POPC) Migration

Source	Potential Pathway	Receptor	Control
Potentially acid generating (PAG) mine rock	▪ PAG mine rock exposed to oxygen and water oxidizes and potentially releases metals and sulfate (i.e., acid rock drainage). ▪ Surface runoff transports constituents. ▪ Discharge to groundwater or surface water creeks.	▪ Aquatic and terrestrial habitat ▪ Humans	▪ All PAG rock is placed in a water storage facility. Sub-aqueous disposal limits risk of acid drainage. It also minimizes the potential for dust dispersion. ▪ Water storage facilities are lined to reduce groundwater seepage.
Non-acid generating (non-PAG) mine rock	Exposed non-PAG mine rock encounters surface runoff, resulting in potential release of selenium and other constituents into groundwater or surface water creeks.		All non-PAG mine rock is covered with low-permeability overburden material prior to end of operations. Water in contact with non-PAG rock is minimized by construction of upstream surface water diversions, reducing leaching. Also a high percentage of this material is also placed under water for Post-closure.
Processed rock	Processed rock is co-disposed with PAG mine rock. As such, the same pathways apply.		Processed rock is co-disposed with PAG mine rock. As such, the same controls apply.
Processed Coal	Coal storage encounters surface runoff resulting in potential release of metals into groundwater or surface water creeks.		▪ All surface water in the Project Area is collected in channels for diversion into the Tenas Control Pond. ▪ Liners incorporated to reduce groundwater seepage.
Disturbed surface areas	Surface runoff encounters constituents and discharges to groundwater or surface water creeks.		All surface water encountering disturbed surface areas is collected in channels for diversion into the Tenas Control Pond.
Open Pit walls	Rock in open pit walls encounters surface runoff and discharges to groundwater or surface water creeks.		Open pit is progressively backfilled with neutral overburden material and non-PAG rock, and is partially flooded at closure, providing a barrier against oxidation and material to provide a permanent buffering effect on the open pit walls. Furthermore,

Source	Potential Pathway	Receptor	Control
			blasting best practices will be used to limit the thickness of disturbed rock left in the open pit walls and reduced the amount of fugitive dust emissions.
Fuel	▪ Spills at fuel storage and refuelling area seeping into groundwater or surface runoff. ▪ Emissions from heavy machinery.		Operating procedures to reduce accidental spills.

Table 5.1-2: Dust fall Controls to Minimize Parameters of Potential Concern (POPC) Migration

Source	Potential Pathway	Receptor	Control
Potentially acid generating (PAG) mine rock	PAG mine rock exposed to wind and air could be disbursed to the Project Area.	▪ Aquatic and terrestrial habitat ▪ Humans	All PAG rock is placed in a water storage facility. Sub-aqueous disposal limits the potential for dust dispersion.
Non-acid generating (non-PAG) mine rock	Exposed non-PAG mine rock exposed to the wind and air could be disbursed to the Project Area.		All dust from non-PAG mine rock will be monitored and mitigated via the use of water trucks and best management practices. Also a high percentage of this material is also placed under water for Post-closure Phase or under overburden during Operation Phase. Progressive reclamation will also limit the amount of exposed non-PAG mine rock.
Processed rock	Processed rock is co-disposed with PAG mine rock. As such, the same pathways apply.		Processed rock is co-disposed with PAG mine rock. As such, the same controls apply. Furthermore, processed rock is produced with a moisture content of approximately 20 percent (%) which limits dust emissions.
Processed Coal	Dust is potentially released during transportation and storage of these materials due to wind and vehicle movement.		All marketable coal is treated with agents to reduce dust generation during transport and storage. Also the trucks transporting coal to the Rail Infrastructure are covered to reduce dust emissions. All stockpiles will have systems in place if monitoring requires further dust mitigation such a rain birds, addition of chemical agents, and screening. After loading the rail cars they are covered with a proven chemical topping agent to prevent dust generation.
Disturbed surface areas	Wind encounters disturbed areas.		Phased development to reduce the amount of disturbed surfaces and

Source	Potential Pathway	Receptor	Control
			progressive reclamation as well to reduce disturbed areas. Furthermore, disturbed areas can have water added to them to reduce dust and if monitoring requires even temporary ground-based covers could be used.
Open pit walls	Rock in open pit walls encounters wind and transports dust to adjacent lands.		Open pit is progressively backfilled with neutral overburden material, and is flooded at closure, providing a barrier against oxidation and dust generation.
Blasting	Dust generated during the blasting process is picked up by the atmosphere and transported to receptors.		Use of blasting best practices such as correct use of stemming materials and thicknesses to reduce dust emissions from blasting.

5.1.2 Contingencies

As stated earlier there are only two (2) POC based on the analysis conducted for this Project. It is expected that the POCs identified will not be above the developed SPOs due to the water quality model not accounting for the following processes that are expected to reduce that actual measured parameter concentrations in receiving waters:

- geochemical attenuation processes in the management ponds not accounted for such as the anoxic environment;
- geochemical attenuation processes in the deep-water groundwater system not accounted for;
- conservative source term concentrations and mobility; and
- progressive reclamation and associated reduction of infiltration of non-PAG rock and availability of contact.

5.1.3 Additional Mitigations

A full water monitoring program will be put in place during the Construction Phase and actual measured values will be compared to predicted parameter concentrations. If actual measure values are trending higher then predicted values over a multiple year time series and by amount that is considered outside of the normal variability and measurement accuracy the following mitigations can be put in place:

- Increase of the liner thicknesses in the management ponds with a resultant decrease of seepage and POC concentrations in groundwater and surface water especially in low flow conditions in winter;
- Submerge PAG materials under water quicker than an average of six (6) months decreasing flush source term from this material and reducing concentrations of POC in groundwater, and surface water and a reduction in dust fall quantities;
- Covering non-PAG rock with geomembrane liners until it is ready for reclamation reducing infiltration of water and oxygen into non-PAG rock and reducing oxidization of these materials and reducing concentrations of POC in surface and groundwater and a reduction in dust fall quantities;

- Covering of open pit footwalls with geomembrane liners until backfill can occur reducing infiltration of water and oxygen into non-PAG rock and reducing oxidization of these materials and reducing concentrations of POC in surface and groundwater and a reduction in dust fall quantities;
- Ability to allow non-contact water into the system during spring freshet to provide additional assimilative capacity of the management and control ponds prior to water discharge reducing POC concentrations in surface and groundwater;
- Semi-passive water treatment of open pit dewatering with wetlands and Bio reactors; and
- Active water treatment using the Sehawk^{tm} system which has been approved by British Columbia Environmental Assessment Office (BC EAO) for treatment at other Projects.

6. CONCEPTUAL SITE MODEL (CSM)

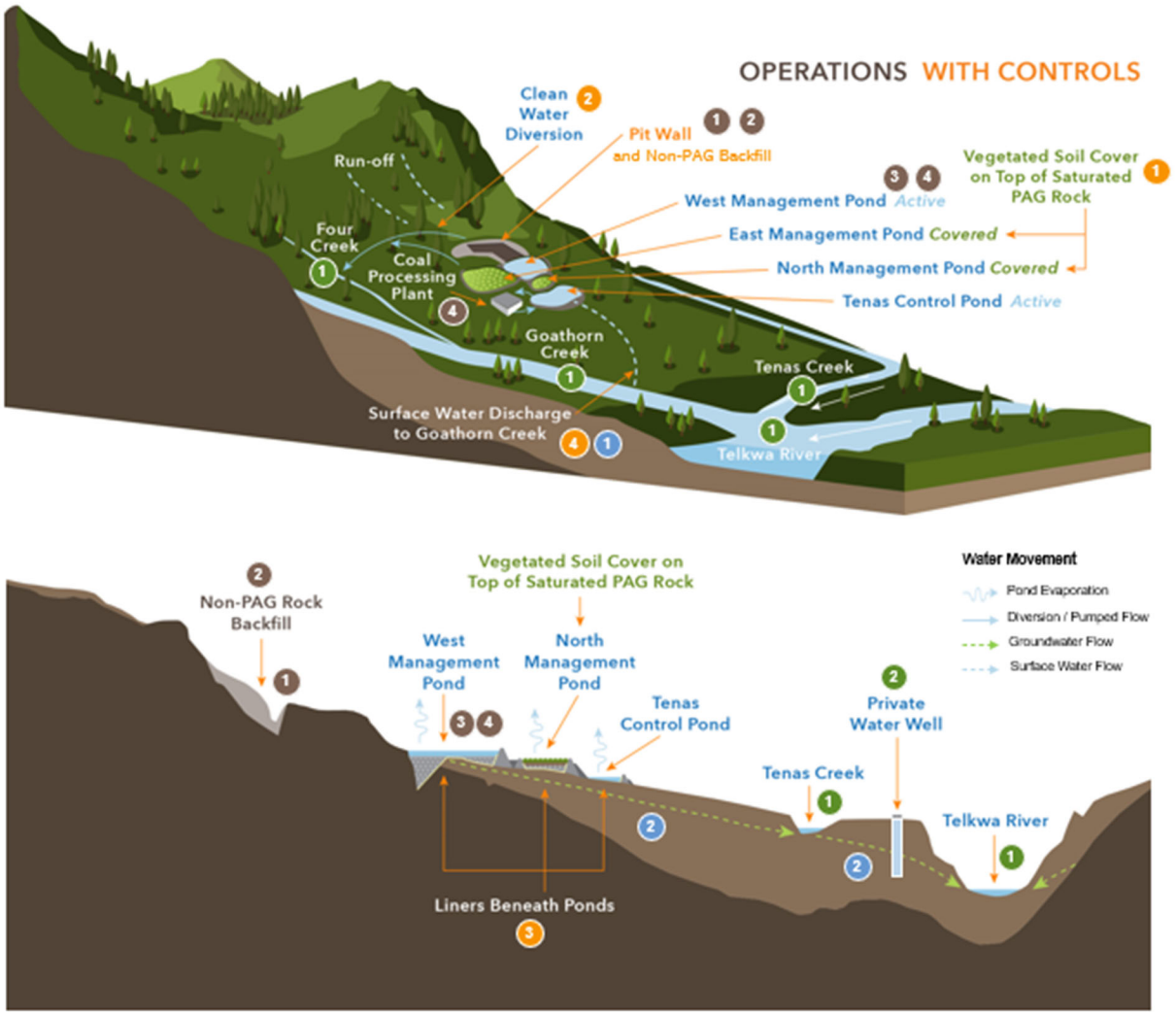
Figure 6-1 presents the CSM for operating conditions. **Figure 6-2** shows Post-closure Phase conditions. Elements of the CSM include:

- Sources of POPCs: management ponds, coal processing plant, Tenas Control Pond, and open pit walls;
- Controls on sources: vegetated soil cover, clean water diversion, liners;
- Transport mechanisms: runoff and seepage;
- Migration pathways: seepage pathways, groundwater flow systems, and runoff pathways;
- Receiving streams: Four Creek, Tenas Creek, and Goathorn Creek; and
- Closure and reclamation processes: vegetated soil cover and decommissioning, flooded end pit lake.

Aerial exposure pathways and biotic migration pathways are not shown by the CSM but are shown in **Figure 4.3-1** and **4.3-2** previously. Other controls not shown in the CSM include:

- The control structure on the diversion into Four Creek to limit the increase in flows discharging into Four Creek; and
- Reduced Project footprint through mine area optimizations to limit the catchment area reduction in areas adjacent to sections of Four, Goathorn, and Tenas creeks.

Rail Infrastructure has not been included in the CSM figure as the watercourse adjacent to Rail Infrastructure is the Bulkley River, has considerable dilution capacity compared to the small footprint of the Rail Infrastructure and therefore is not anticipated to be a receptor for POPC. The complete list of receptors is provided in **Section 3** previously.



Controls

ID	Control Description
1	Water cover on PAG rock prevents ARD. Evaporative losses from water cover are reduced by placing Non-PAG rockfill and vegetation over PAG rock
2	Surface water diversion upstream of open pit to reduce volume of water captured on-site and minimize change to streamflow
3	Management Ponds are lined to reduce seepage into groundwater
4	Controlled surface water discharge to Goathorn Creek after sedimentation in Tenas Control Pond

Pathways

ID	Pathway Description
1	Surface Water Pathway
2	Groundwater Pathway

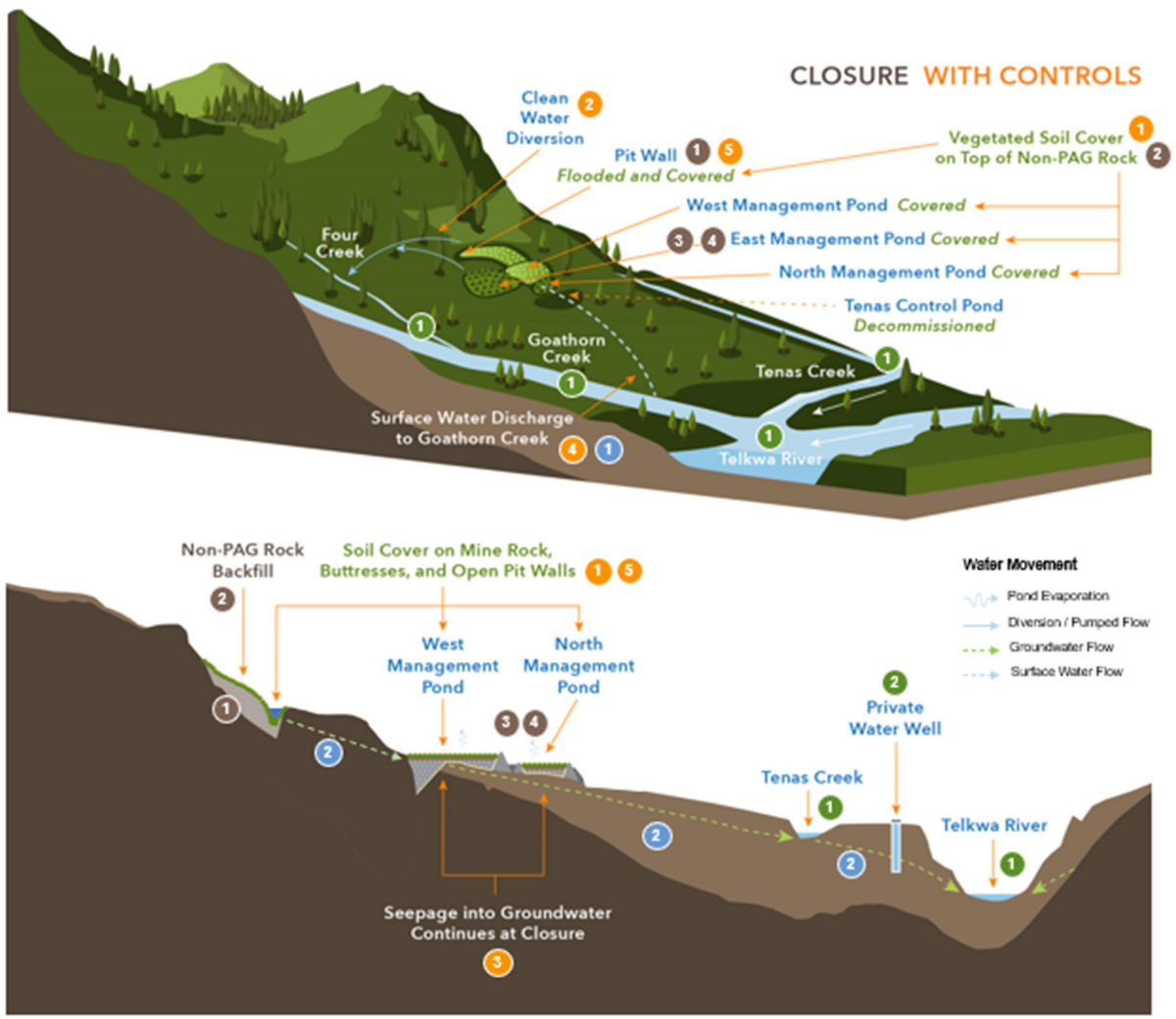
Sources

ID	Source Description
1	Exposed open pit walls
2	Exposed Non-PAG material
3	Exposed PAG material deposited in Management Ponds
4	Coal Processing Plant and processed rock

Receptors

ID	Receptor Description
1	Aquatic life in the receiving environment
2	Humans

Figure 6-1: Conceptual Site Model, Operation Phase with Controls



Controls

ID	Control Description
1	Water cover on PAG rock prevent ARD. Evaporative losses from water cover are reduced by placing Non-PAG rockfill and vegetation over PAG rock
2	Surface water diversion upstream of open pit to reduce volume of water captured on-site and minimize change to streamflow
3	Management Ponds are lined to reduce seepage into groundwater
4	Controlled surface water discharge to Goathorn Creek after sedimentation in Tenas Control Pond
5	Open Pit is flooded and all exposed open pit walls above the final water level, as well as all Non-PAG rock backfill is covered with overburden and topsoil to reduce metal leaching

Pathways

ID	Pathway Description
1	Surface Water Pathway
2	Groundwater Pathway

Sources

ID	Source Description
1	Exposed open pit walls
2	Exposed Non-PAG material
3	Exposed PAG material deposited in Management Ponds
4	Coal Processing Plant and processed rock

Receptors

ID	Receptor Description
1	Aquatic life in the receiving environment
2	Humans

Figure 6-2: Conceptual Site Model, Post-closure Phase with Controls

7. ONGOING REVIEW OF CONCEPTUAL SITE MODEL (CSM)

A CSM is intended to be a living document and will be updated as new information becomes available. This will continue as data interpretation continues and the permitting process progresses. During the Minesite Operation Phase, and Post-closure Phase, the CSM will be reviewed and updated as required. Updates can include new concepts regarding potential release mechanisms, migration pathways, exposure routes, receptors, changes to mine planning/operations, and/or new mitigation measures and/or new controls.

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