APPENDIX N—PROJECT DESCRIPTION

Pebble Project Description

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Pebble Limited Partnership
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ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation and Public Facilities
ADSP	Alaska Dam Safety Program
ANCSA	Alaska Native Claims Settlement Act
ANFO	ammonium nitrate and fuel oil
BMPs	best management practices
CFR	Code of Federal Regulations
cy	cubic yards
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
H:V	horizontal:vertical (horizontal to vertical)
IDF	Inflow Design Flood
ISO	International Organization for Standardization
ML	Metal Leaching
MMPA	Marine Mammal Protection Act
MW	megawatts
NEPA	National Environmental Policy Act
NFK	North Fork Koktuli River
NPAG	Non-Potentially Acid Generating
OCS	Outer Continental Shelf
PAG	Potentially Acid Generating
PHABSIM	Physical Habitat Simulation System
PMF	Probable Maximum Flood
PMP	Probably Maximum Precipitation
ROW	right-of-way
SAG	semi-autogenous grinding
SFK	South Fork Koktuli River
TSF	Tailings Storage Facility
TSS	Total suspended solids
USGS	U.S. Geological Survey
UTC	Upper Talarik Creek
WMP	Water Management Pond
WTP	Water Treatment Plant

1. PROJECT OVERVIEW

Pebble Limited Partnership (PLP) is proposing to develop the Pebble copper-gold-molybdenum porphyry deposit (Pebble Deposit) as an open-pit mine, with associated infrastructure, in southwest Alaska. This project description summarizes information about the environmental setting, engineered facilities and operations for the proposed Pebble Project (Project) from initial construction through closure and reclamation. It is intended to support the National Environmental Policy Act (NEPA) review process and other permitting efforts for the Project.

1.1. Pebble Project Summary Information[1]

- Project operating life of 20 years.
- A total of 1.44 billion tons of material mined over the life of the Project.
- Final pit dimensions of 6,800 feet in length, 5,600 feet in width, and 1,950 feet in depth.
- Mining rate up to 73 million tons per year, average rate of 70 million tons per year.
- Milling rate up to 66 million tons per year.
- Average annual copper-gold concentrate production (dry concentrate) of 613,000 tons.
- Average annual molybdenum concentration production (dry concentrate) of 15,000 tons.
- Final bulk tailings storage facility (TSF) capacity of 1,140 million tons.
- Temporary storage of 155 million tons of pyritic tails in the pyritic TSF.
- Temporary storage of up to 93 million tons of Potentially Acid Generating (PAG) and/or Metal Leaching (ML) waste rock in the pyritic TSF until closure.
- Power plant generating capacity of 270 megawatts (MW).
- Project operating schedule of two 12-hour shifts per day for 365 days per year.
- An 82-mile transportation corridor from the mine site to a year-round port site located north of Diamond Point in Iliamna Bay on Cook Inlet consisting of:
  - A private two-lane unpaved road that connects to the existing Iliamna/Newhalen road system.
  - A buried concentrate pipeline to transport copper-gold concentrate from the mine site to the port and a return water pipeline to the mine site.
- Bulk lightering of concentrate between the Diamond Point Port and an offshore lightering location in Iniskin Bay for loading onto bulk carriers.
- A port facility and jetty with docking for lightering and supply barges.

[1] Design criteria as presented are approximate and have been averaged and rounded as appropriate for ease of reference.

    - Annual vessel traffic of up to 27 concentrate vessels and 33 supply barges.
- A 164-mile gas pipeline from the Kenai Peninsula across Cook Inlet to the Project site with a compressor station on the Kenai Peninsula.
- Employment of 850 to 2,000 personnel for operations and construction, respectively.

1.2. Background

The Project is located on land acquired by the State of Alaska in 1974 via a three-way land swap with the federal government and Cook Inlet Region, Inc. The land was selected by the state specifically for its mineral development potential. The initial discovery of the Pebble Deposit was made in 1988 by Cominco Alaska, a division of Cominco Ltd. (Cominco). Cominco (later acquired by Teck Resources Limited) discontinued work on the project in 1997, and in 2001 the Pebble claims were optioned by a subsidiary of Northern Dynasty Minerals Ltd. (Northern Dynasty).

Northern Dynasty began exploring the property, with significant success, expanding the Pebble Deposit from one billion to four billion tons by the end of 2004. An extensive environmental baseline data collection program commenced in that year, as well as geotechnical investigation and preliminary engineering studies. In 2005, Northern Dynasty exercised its option to acquire the Project and in the same year discovered a significant, higher grade eastern extension to the deposit. Over the next seven years, the Pebble Deposit was expanded through drilling.

In 2007, Northern Dynasty formed PLP with another company and placed the Project into the partnership. Over the next six years, PLP continued to advance the Project through additional drilling, environmental data collection, and engineering studies. In 2013, the other company left PLP and it reverted to a wholly owned subsidiary of Northern Dynasty.

To date, more than one million feet of drilling has been conducted on the Pebble Deposit.

Products from mining this deposit can supply important mineral resources for alternative energy and other purposes of strategic national significance. The Pebble Deposit has significant regional economic importance for southwest Alaska and the entire state through the creation of high-wage jobs and training opportunities, supply and service contracts for local businesses, and government revenue.

1.3. Project Design Considerations

Plans for the design and operation of the Project have focused on the avoidance and minimization of environmental impacts to waterbodies, wetlands, wildlife and aquatic habitat, areas of cultural significance, and areas of known subsistence use and addressing stakeholder concerns. In addition to meeting or exceeding local, state, and federal regulatory requirements, the Project incorporates the following concepts into the design:

- The Project plan is to mine the near-surface portion of the Pebble Deposit. This has significantly reduced the footprint of the open pit, TSF, and mine facilities, as well as eliminated the need for a permanent waste rock storage facility.

- The layout is designed to consolidate the majority of site infrastructure in a single drainage – the North Fork Koktuli River (NFK) – and avoid placing waste rock or tailings in the Upper Talarik Creek (UTC) drainage.
- The Diamond Point Port design includes a caisson-supported dock facility rather than an earth-filled causeway or pile-supported dock. The caisson design significantly reduces the Waters of the US footprint compared to an earth-filled design, and effectively eliminates in-water impact noise generated by pile driving that might adversely affect sensitive marine species.
- A natural gas pipeline and gas-fired electrical generation are being used to power the Project, thereby eliminating the need to transport and store large amounts of diesel fuel for power generation.
- To address stakeholder concerns regarding the transportation and use of cyanide, there is no secondary recovery of gold from the pyritic tailings using a cyanide leach.

The Project adopts a design-for-closure philosophy that considers closure and post-closure site management requirements during all operating phases. Examples include:

- Segregated storage facilities for bulk and pyritic tailings. Bulk tailings will remain in place at closure.
- A lined pyritic TSF. PAG and ML waste rock will be stored with pyritic tailings in the lined pyritic TSF during operations. At closure the stored waste rock will be backhauled to the pit and the pyritic tailings pumped to the pit for sub-aqueous storage in the pit lake. Storage of PAG/ML waste rock and pyritic tailings within the pit lake will avoid post-closure management of the pyritic TSF.

The Project has a comprehensive water management plan that utilizes strategic discharge of surplus treated water to downgradient streams to reduce the effect of stream flow fluctuations and minimize impacts to fish habitat.

1.4. Project Areas

The Project is located in a sparsely populated region of southwest Alaska near Iliamna Lake, within the Lake and Peninsula and Kenai Peninsula boroughs (Figure 1-1). The Project comprises four primary components: the mine site at the Pebble Deposit location, the port site at Diamond Point on Cook Inlet, the transportation corridor connecting these two sites, and a natural gas pipeline connecting to existing infrastructure on the Kenai Peninsula.

The transportation corridor consists of a road, concentrate pipeline, and return water pipeline from the mine site to the Diamond Point Port at the entrance to Iliamna Bay on Cook Inlet. The road will intersect the existing road network and connect the mine site to the villages of Iliamna and Newhalen (Figure 1-2). The gas pipeline will tie into existing gas supply infrastructure at Anchor Point on the Kenai Peninsula, cross Cook Inlet and come ashore at Ursus Cove, then cross Ursus Head and Cottonwood Bay to the Diamond Point port. From the port the pipeline will parallel the access road to the mine site (Figure 1-1 and Figure 1-2).

The Bristol Bay watershed encompasses approximately 41,900 square miles and is defined by the Alaska Range to the east and southeast, the Kuskokwim Mountains to the west, and a range of hills to the north that separate it from the Kuskokwim River watershed. The largest rivers that drain into Bristol Bay are the Nushagak and Kvichak rivers, which together drain 49 percent of the Bristol Bay watershed, or approximately 20,000 square miles (Figure 1-3).

1.4.1. Mine Site

The Pebble Deposit is located under rolling, permafrost-free terrain in the Iliamna region of southwest Alaska, approximately 200 miles southwest of Anchorage and 60 miles west of Cook Inlet. The closest communities are the villages of Iliamna, Newhalen, and Nondalton, each approximately 17 miles from the Pebble Deposit (Figure 1-2).

The fully developed mine site will include the open pit, bulk TSF, pyritic TSF, overburden stockpiles, material sites, water management ponds (WMPs), milling and processing facilities, and supporting infrastructure such as the power plant, water treatment plants, camp facilities, and storage facilities (Figure 1-4).

The site is currently undeveloped and not served by any transportation or utility infrastructure.

1.4.2. Diamond Point Port and Lightering Locations

The port site (Figure 1-5) will be located north of Diamond Point in Iliamna Bay on the western shore of Cook Inlet, approximately 165 miles southwest of Anchorage and approximately 75 miles west of Homer.

The port site will include shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the Project. The shore-based facilities will include facilities for the dewatering of the concentrate and the receipt and storage of freight containers. Other facilities will include fuel storage and transfer facilities, power generation and distribution facilities, a pump station for the return water pipeline, maintenance facilities, employee accommodations, and offices.

The natural gas pipeline from the Kenai Peninsula will have an offtake to distribute natural gas to the port power generation facility.

The marine component includes a concrete caisson-supported access causeway, marine jetty, and barge loader with a 18-foot deep dredged access channel. Dredged material will be stored in on-shore stockpiles.

The port site area is not served by any surface transportation or utility infrastructure.

Copper-gold concentrate will be loaded onto lightering barges using an enclosed conveyor system at the Diamond Point Port and then transported to the lightering location in Iniskin Bay approximately 8 miles from the port (Figure 1-5) for transfer to bulk carriers.

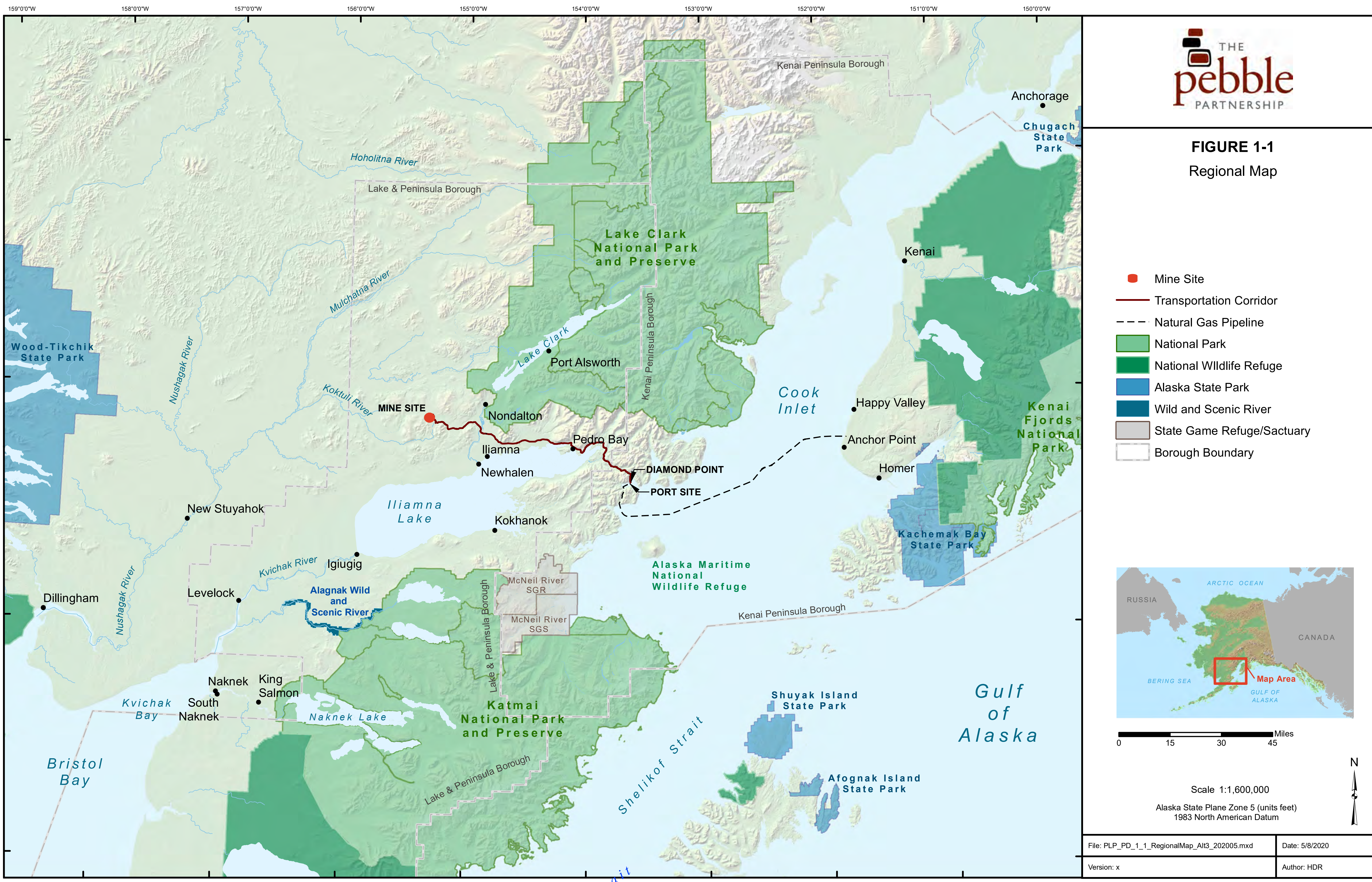

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FIGURE 1-1
Regional Map
Mine Site
Transportation Corridor
Natural Gas Pipeline
National Park
National WIldlife Refuge
Alaska State Park
Wild and Scenic River
State Game Refuge/Sactuary
Borough Boundary
ARCTIC OCEAN
RUSSIA
CANADA
BERING SEA
GULF OF ALASKA
Map Area
Miles
0 15 30 45
N
Scale 1:1,600,000
Alaska State Plane Zone 5 (units feet)
1983 North American Datum
File: PLP_PD_1_1_RegionalMap_Alt3_202005.mxd
Date: 5/8/2020
Version: x
Author: HDR
Anchorage
Chugach State Park
Kenai Peninsula Borough
Lake & Peninsula Borough
Hoholitna River
Lake Clark National Park and Preserve
Kenai
Mulchatna River
Wood-Tikchik State Park
Nushagak River
Lake Clark
Port Alsworth
Kenai Peninsula Borough
Koktuli River
MINE SITE
Nondalton
Cook Inlet
Happy Valley
Kenai Fjords National Park
Iliamna
Pedro Bay
Anchor Point
Newhalen
DIAMOND POINT
Homer
PORT SITE
New Stuyahok
Iliamna Lake
Kokhanok
Kachemak Bay State Park
Kvichak River
Iguigig
Alaska Maritime National Wildlife Refuge
Alagnak Wild and Scenic River
McNeil River SGR
Dillingham
Levelock
McNeil River SGS
Kenai Peninsula Borough
Lake & Peninsula Borough
Nushagak River
Naknek
King Salmon
Katmai National Park and Preserve
Kvichak Bay
South Naknek
Naknek Lake
Shuyak Island State Park
Gulf of Alaska
Bristol Bay
Shelikof Strait
Lake & Peninsula Borough
Afognak Island State Park

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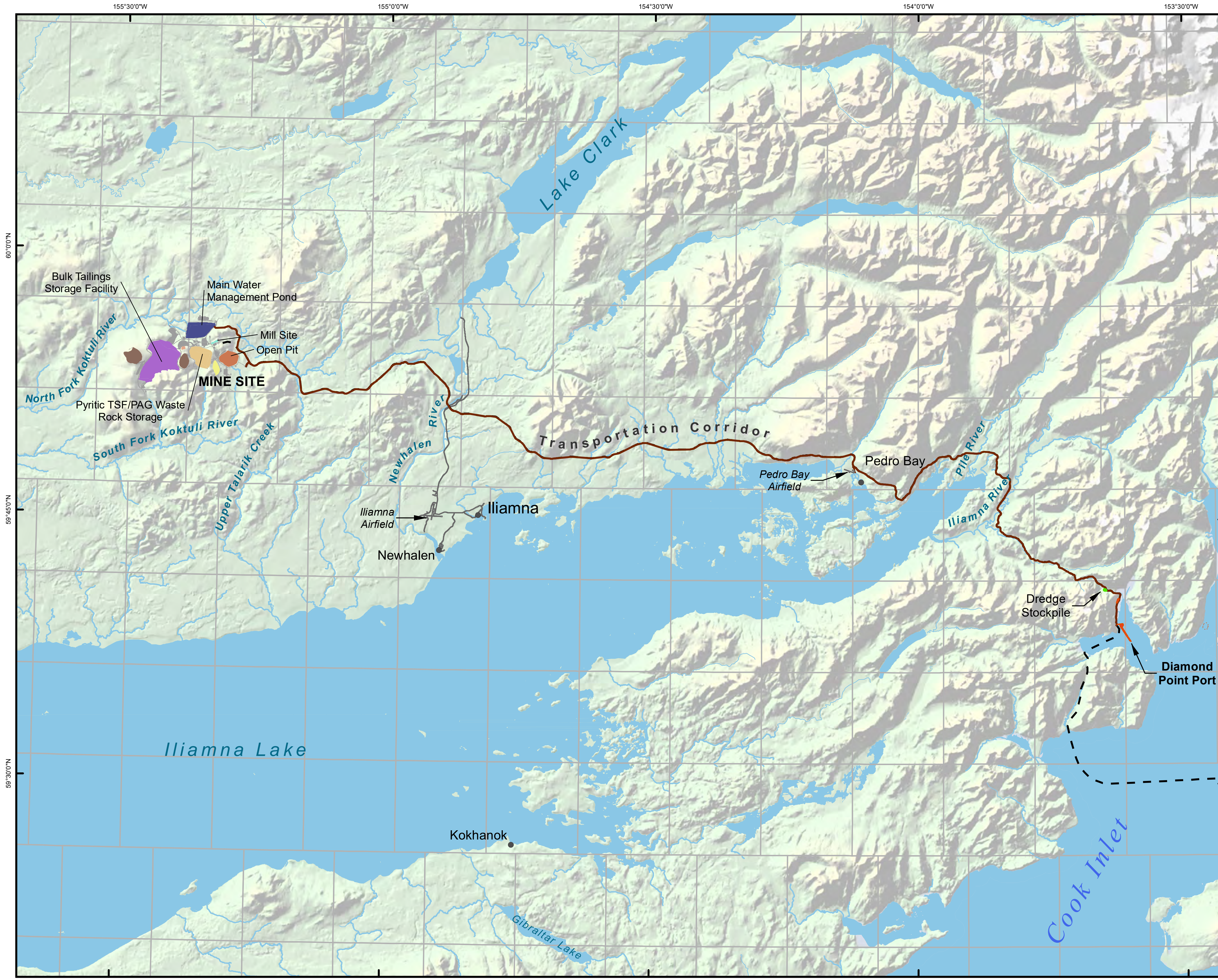
FIGURE 1-2

Project Area



- Bulk Tailings Storage Facility
- Water Managment Pond
- TSF Laydown
- Pyritic TSF/PAG Waste Rock Storage
- Open Pit
- Overburden Stockpile
- Mill Site Process Plant
- Quarry
- Port Site Features
- Dredge Material Stockpile
- Transportation Corridor
- Natural Gas Pipeline
- Existing Roads
- Township Boundary

Miles 0 5 10 15

N

Scale 1:400,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: PLP_PD_1_2_ProjectArea_Alt3_202005.mxd	Date: 5/8/2020
Version: x	Author: HDR

Document Path: G:\GIS\PLP_GIS\4_MXD\ProjectDescriptionFigures\2020 Final\PLP_PD_1_2_ProjectArea_Alt3_202005.mxd

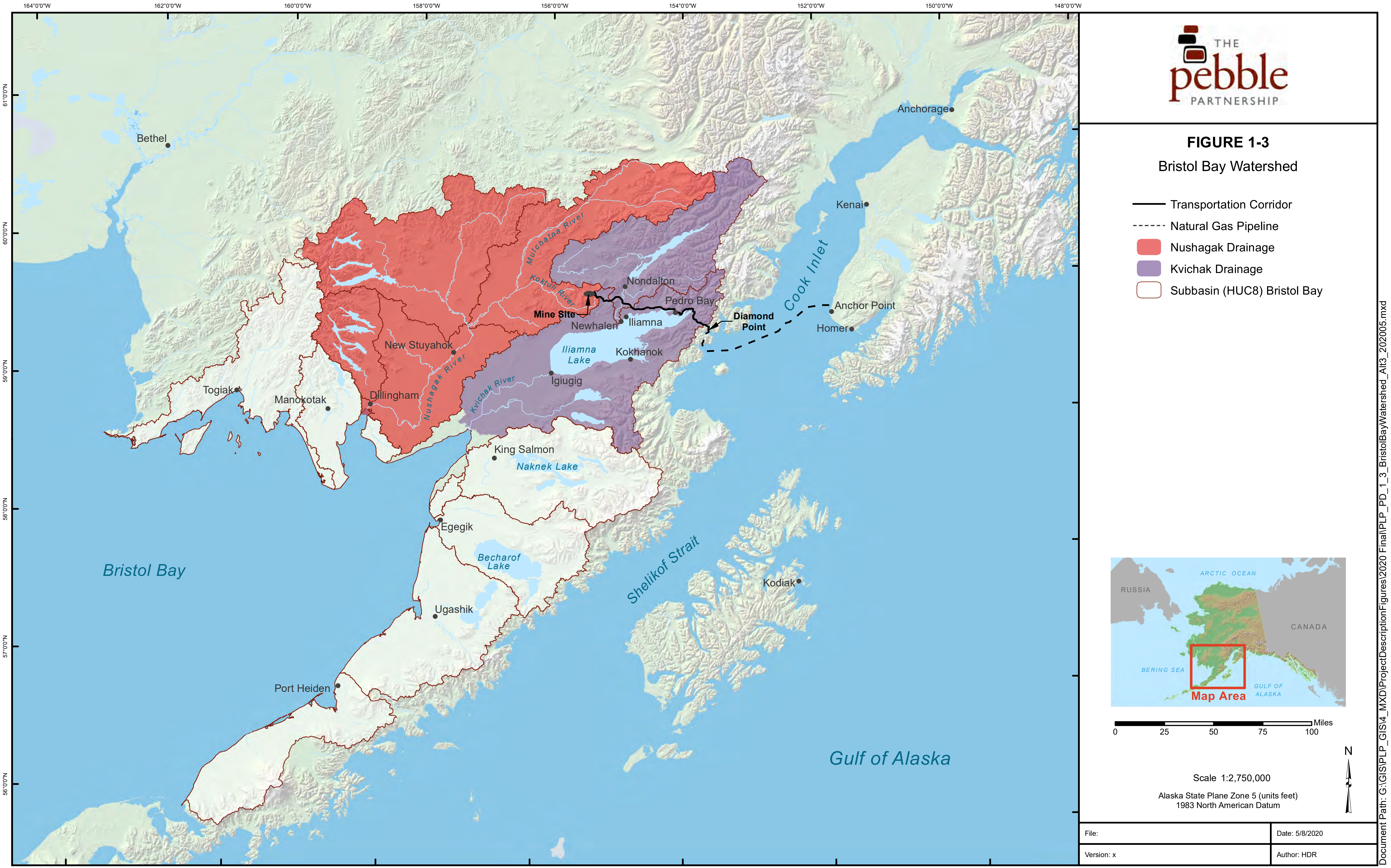


FIGURE 1-3
Bristol Bay Watershed

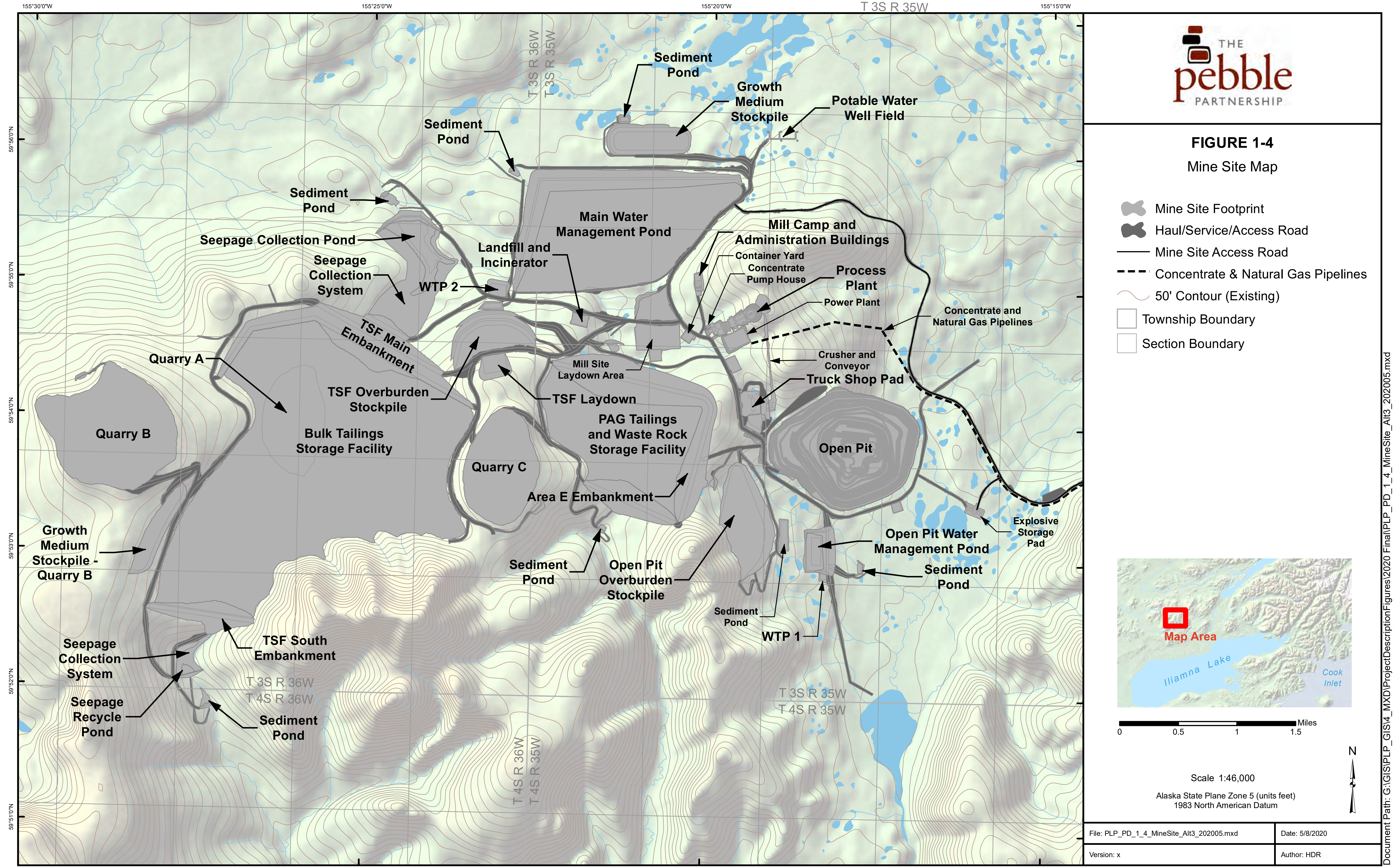
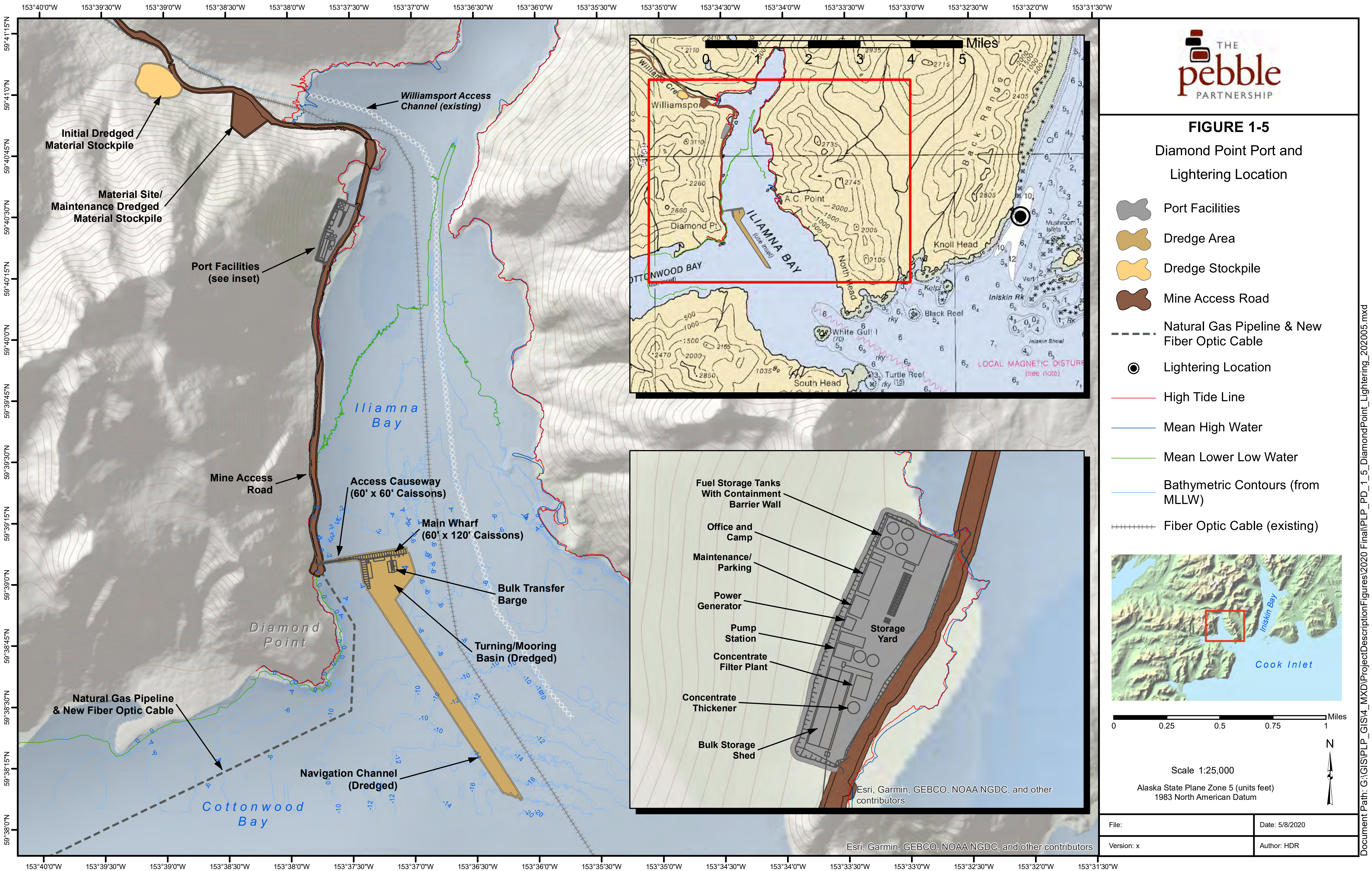


FIGURE 1-4
Mine Site Map


THE pebble PARTNERSHIP
FIGURE 1-5
Diamond Point Port and Lightering Location
Port Facilities
Dredge Area
Dredge Stockpile
Mine Access Road
Natural Gas Pipeline & New Fiber Optic Cable
Lightering Location
High Tide Line
Mean High Water
Mean Lower Low Water
Bathymetric Contours (from MLLW)
Fiber Optic Cable (existing)
Iniskin Bay
Cook Inlet
Miles
0
0.25
0.5
0.75
1
N
Scale 1:25,000
Alaska State Plane Zone 5 (units feet)
1983 North American Datum
File:
Date: 5/8/2020
Version: x
Author: HDR
Document Path: G:\GIS\PLP_GIS\4_MXD\ProjectDescriptionFigures\2020 Final\PLP_PD_1_5_DiamondPoint_Lightering_202005.mxd
Williamsport Access Channel (existing)
Initial Dredged Material Stockpile
Material Site/ Maintenance Dredged Material Stockpile
Port Facilities (see inset)
Iliamna Bay
Mine Access Road
Access Causeway (60' x 60' Caissons)
Main Wharf (60' x 120' Caissons)
Bulk Transfer Barge
Turning/Mooring Basin (Dredged)
Diamond Point
Natural Gas Pipeline & New Fiber Optic Cable
Navigation Channel (Dredged)
Cottonwood Bay
Miles
Williamsport
Diamond Pt
A.C. Point
ILIAMNA BAY
North Head
Knoll Head
Back Range
COTTONWOOD BAY
Black Reef
White Gull I
Turtle Reef
South Head
Iniskin Rk
Iniskin Shoal
Mushroom Islets
LOCAL MAGNETIC DISTURB (see note)
Fuel Storage Tanks With Containment Barrier Wall
Office and Camp
Maintenance/ Parking
Power Generator
Pump Station
Concentrate Filter Plant
Concentrate Thickener
Bulk Storage Shed
Storage Yard
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

1.4.3. Transportation Corridor

The transportation corridor, which will connect the mine site to the Diamond Point Port on Cook Inlet consists of a private, unpaved two-lane road heading 80 miles east from the mine site to the Diamond Point Port in Iliamna Bay with three pipelines buried in a corridor next the road. The State of Alaska operates an existing road between Williamsport on Iliamna Bay and Pile Bay on Iliamna Lake. The proposed road will parallel that existing road for approximately 4.5 miles from Williamsport and will then replace the existing road for approximately 6.5 miles from that point until the existing road turns toward Pile Bay. The proposed road to the mine also intersects the existing road network for the villages of Iliamna and Newhalen.

1.4.4. Natural Gas Pipeline Corridor

Natural gas, sourced through the existing natural gas supply infrastructure for the Cook Inlet area, will be the primary energy source for the Pebble Project. The gas pipeline alignment (Figure 1-1) will connect to existing infrastructure north of Anchor Point. Gas will be taken from the existing pipeline along the Sterling Highway and sent to a compressor station. From the compressor station, the pipeline heads southwest across Cook Inlet, before turning west to a landfall at Ursus Cove. The pipeline crosses Ursus Head and Cottonwood Bay before joining the transportation corridor at the Diamond Point Port.

1.5. LAND OWNERSHIP AND MINERAL RIGHTS

The Pebble Deposit is located on patented state land specifically designated for mineral exploration and development. Pebble Project facilities will straddle parts of five management units described in the Alaska Department of Natural Resources (ADNR) 2005 *Bristol Bay Area Plan* (amended 2013). These management units—known as R06-05, R06-23, R06-24, R06-30 and R10-02 are designated for minerals extraction. This designation allows for mineral exploration and development with oversight from ADNR. The management intent for all five units also stresses the need to protect the anadromous fish streams in the upper Koktuli River corridor and to minimize or avoid effects from mining on habitat and recreational activities near the upper reaches of UTC.

The Pebble Deposit lies within a 417-square-mile claim block held by subsidiaries of PLP. PLP does not currently own surface rights associated with these mineral claims. All lands within the claim block are owned by the State of Alaska. Surface rights may be acquired from the state government once areas required for mine development have been determined and permits awarded.

The transportation corridor crosses both state land and land patented under the Alaska Native Claims Settlement Act (ANCSA). Further detail is provided in Section 2.2.

1.6. CLIMATE

The climate in the area of the Pebble Deposit/mine site is transitional. Winters are characterized by a continental climate as frozen waterbodies and sea ice in Bristol Bay create a land-like mass, while summers have a maritime climate due to the influence of the open water of Iliamna Lake and, to a lesser extent, the Bering Sea, Bristol Bay, and Cook Inlet. Mean monthly temperatures range from about 55 degrees Fahrenheit (°F) in summer to 2°F in winter. Precipitation in the NFK drainage averages approximately 57.4 inches per year and in the South Fork Koktuli River (SFK) drainage averages approximately 50.8 inches per year. About one-third of this precipitation falls as snow. The wettest months are August through October. White-out conditions and windstorms or periods of poor light/visibility can be expected in winter.

Winter weather systems, consisting of cool to cold saturated air, typically travel into the region from the Bering Sea (west), along the Aleutian Island chain (southwest) and the Gulf of Alaska (south), resulting in frequent clouds, rain, and snow. Less frequent incursions of frigid, stable Arctic air masses produce shorter periods of clear, but very cold conditions. During summer, warm air masses from interior Alaska can cause atmospheric instability, which results in cumulus clouds and thunderstorm activity.

1.7. DEPOSIT GEOLOGY

The Pebble Deposit is hosted by Mesozoic, volcanically derived sedimentary rocks, called flysch, of the Kahiltna terrane, as well as a variety of intrusive igneous rocks emplaced into the flysch between approximately 99 and 90 million years ago during the mid-Cretaceous Period. Between 99 and 96 million years ago, early intrusions into the flysch comprised alkalic syenite to biotite pyroxenite bodies, along with subalkalic diorite and granodiorite sills. Kaskanak Suite intrusions were emplaced approximately 90 million years ago and are the most important igneous event in the area. The suite comprises a granodiorite batholith that is exposed west of, but extends beneath, the Pebble Deposit, as well as several smaller intrusive granodiorite apophyses that emanate from the underlying batholith; collectively these Kaskanak intrusions drove the large magmatic-hydrothermal system that formed the Pebble Deposit.

The Pebble Deposit is classified as a porphyry copper deposit and is hosted by the intrusive and sedimentary rock types described above. Copper, gold, molybdenum, and other metals were transported by hot fluids that emanated from the magmas as they crystallized, and precipitated mostly as sulfide minerals in fractures, now preserved as veins, and as disseminations in the spaces between silicate minerals in the host rocks. The effects of the hot fluids are reflected by widespread hydrothermal alteration whereby some minerals originally present in host rocks were dissolved and replaced with suites of new minerals.

During the Late Cretaceous and Early Tertiary periods, the Pebble Deposit was uplifted by regional tectonic forces and eroded. The exposed deposit was rapidly covered by the Copper Lake Formation, a thick sequence of fine- to coarse-grained clastic sedimentary rocks and interbedded volcanic rocks. At a later point in the Tertiary Period, the eastern part of the Pebble Deposit was dropped up to 3,000 feet along normal faults into the East Graben, a structure that was progressively infilled by basalts, andesites, and subordinate clastic sediments as it grew. The Pebble Deposit and its host rocks were later tilted approximately 20 degrees to the east. The deposit was again uplifted in the later Tertiary Period, and its western part was scoured by Pleistocene glaciers that deposited a veneer of till, glacio-lacustrine, and outwash deposits that are mostly tens of feet thick or less, but which rarely are up to 300 feet thick in the vicinity of the Pebble Deposit. The present geometry of the Pebble Deposit comprises the West Zone, which is covered by thin glacial till and exposed in one small outcrop; the East Zone, which remains concealed by an eastward-thickening wedge of the Copper Lake Formation as well as overlying glacial till; and mineralization that extends an undetermined distance farther to the east but at great depth below the East Graben.

1.8. Resource

The current combined measured and indicated resource estimate for the total Pebble Deposit is approximately 7.1 billion tons containing 57 billion pounds of copper, 70 million ounces of gold, 344 million ounces of silver, and 3.42 billion pounds of molybdenum. In addition, the inferred component of the total deposit is approximately 4.9 billion tons, with 24.5 billion pounds of copper, 36 million ounces of gold, 170 million ounces of silver, and 2.2 billion pounds of molybdenum. The Pebble Deposit also contains important quantities of palladium and rhenium.

The Project will mine approximately 1.3 billion tons of mineralized material (measured, indicated, and inferred) over the 20-year mine life containing 7.4 billion pounds of copper, 398 million pounds of molybdenum, and 12.1 million ounces of gold. The metal content of the reported total resource and the 20-year open pit is presented in Table 1-1.

Table 1-1. Pebble Deposit Estimated Resource (Measured, Indicated, and Inferred)

	Total Deposit		20-Year Open Pit	
	Weight	Grade	Weight	Grade
Copper	81.5 Blbs	0.34%	7.4 Blbs	0.29%
Molybdenum	5.64 Blbs	234 ppm	398 MMlbs	154 ppm
Gold	106.4 MMoz	0.30 g/t	12.1 MMoz	0.32 g/t

Blbs: billion pounds
MMoz: million ounces
MMlbs: million pounds
ppm: parts per million
g/t: grams per tonne

2. PROJECT SETTING

The environmental resources of the area surrounding the Pebble Deposit have been studied extensively by PLP. The *Pebble Project Environmental Baseline Document, 2004 through 2008*, which is available online at www.pebbleresearch.com, provides a complete report of environmental baseline studies conducted during those years. Pebble Project supplemental baseline data reports (2009-2013) provide data supplemental to the environmental baseline report and will accompany permit applications as appropriate.

2.1. MINE SITE

2.1.1. Physiography

The geographic location of the Pebble Deposit is described in Table 2-1.

Table 2-1. Pebble Deposit Geographic References

Item	Value
Pebble Deposit Centroid	59° 53' 51" N; 155° 18' 03" W
USGS Quadrangles	Iliamna D-6, D-7
Elevation:	
Minimum	775 ft amsl (SFK valley)
Maximum	2,760 ft amsl (Kaskanak Mountain)
Distance from:	
Cook Inlet	65 miles W
Iliamna Lake	16 miles N
Bristol Bay	100 miles W

amsl = above mean sea level

USGS = U.S. Geological Survey

The Pebble Deposit is located in the Nushagak-Big River Hills physiographic region. The area consists of low, rolling hills separated by wide, shallow valleys. Elevations range from approximately 775 feet in the SFK valley up to 2,760 feet on Kaskanak Mountain. Glacial and fluvial sediment of varying thickness covers most of the study area at elevations below approximately 1,400 feet, whereas the ridges and hills above 1,400 feet generally exhibit exposed bedrock or have thin veneers of surficial material. The hills tend to be moderately sloped with rounded tops. The valley bottoms are generally flat. No permafrost has been identified to date in the project area.

2.1.2. Ecology

The Pebble Deposit area is ecologically diverse, with rivers, tundra, marshy lowlands, and ponds. Much of the land is covered by alpine tundra, shrubs, wetland and scrub communities, or areas of mixed broadleaf and spruce trees, depending on elevation and location.

Rivers near the Pebble Deposit provide habitat for five species of anadromous Pacific salmon. Rainbow trout and other species of fish, such as Dolly Varden and Arctic grayling, are also present. The streams in this area contain many features that support fish spawning and rearing, including complex off-channel habitats, river gravel that promotes spawning, beaver ponds, and combinations of run/glides and riffles. A higher diversity of species and abundance of fish, as well as the most spawning and rearing activity, is found in the lower and middle reaches of these streams, not in the headwater reaches at the Pebble Deposit site.

Various raptors and more than 40 species of water birds are found in the mine area and 22 species have been confirmed as breeding there. The many species of mammals that inhabit this region, while ecologically and economically important, are not particularly abundant. There are moderate densities of brown bear and low densities of black bear, moose, coyotes, wolves, river otters, and wolverines. The mine site is within the historical range of the Mulchatna caribou herd, but radio telemetry and aerial transect surveys suggest that high-density use of the area occurs only during the summer post-calving season when caribou move through the western edge of the project area. No habitat in the mine area has been classified as high value for caribou.

2.1.3. Hydrology

The Pebble Deposit straddles the upper reaches of the SFK and UTC drainages (Figure 2-1). The headwaters of the NFK are immediately north of the Pebble Deposit. The SFK drains south from the Pebble Deposit area, and then west and northwest, where it joins the NFK, which flows west from the Pebble Deposit area. At the confluence, these streams form the Koktuli River, which flows into the Mulchatna River, a tributary to the Nushagak River. The Nushagak River flows into Bristol Bay near the city of Dillingham. Upper Talarik Creek flows south from the Pebble Deposit area and then southwest into Iliamna Lake, which is the source of the Kvichak River.

2.1.3.1 Koktuli River

The NFK and SFK are two of 24 tributaries of similar or larger size in the 315-mile-long Nushagak River system. The north and south forks of the Koktuli River flow for 36 and 40 miles, respectively, to the main stem Koktuli River. The Koktuli River flows for approximately 39 miles before entering the Mulchatna River, which flows another 44 miles before entering the Nushagak River. The Nushagak River flows about 110 miles before it empties into Bristol Bay southwest of Dillingham (Figure 1-1). The total distances from the NFK and SFK headwaters to Bristol Bay are 228 miles and 232 miles, respectively.

2.1.3.2 Kvichak River

The UTC drainage is in the 225-mile-long Kvichak River system. The headwaters of the Kvichak River system are approximately 109 miles northeast of the Pebble Deposit at the source of the Tlikakila River at Lake Clark Pass. UTC flows approximately 39 miles to Iliamna Lake (Figure 2-1). The lake empties into the Kvichak River, which flows approximately 70 miles to Bristol Bay. The total distance from the headwaters of UTC, across the lake, and to Bristol Bay is approximately 140 miles.

2.2. Transportation Corridor

The transportation corridor connects the Diamond Point Port to the mine site via a private, two-lane access road. The road will parallel and replace portions of the existing Williamsport–Pile Bay road and intersect the existing Iliamna/Newhalen road system. The natural gas, concentrate, and return water pipelines will parallel the transportation corridor between the port and mine site. Approximately 30 percent of the corridor land is owned by the State of Alaska, with the remaining 70 percent divided among various ANCSA corporations, as shown in Table 22 and Figure 2-2.

The transportation corridor also crosses two Native Allotments (one in the vicinity of Knutson Bay and one in Iliamna Bay) and one private parcel.

Table 2-2. Transportation Corridor Land Ownership[a]

Land Ownership	Road Segments (Miles)	Percentage
State of Alaska	24	30
Pedro Bay Corporation	33	40
Iliamna Natives Limited	15	18
Tyonek Native Association	5	6
Seldovia Native Association	3	4
Salamatof Native Association Inc.	<1	<1
Native Allotment # AKAA 051014	<1	<1
Native Allotment # AKAA 007150A	<1	<1
Total Corridor Miles	82	100

[a] Distances presented are approximate and have been rounded for ease of reference.

2.2.1. Physiography

The geographic location of the transportation corridor is described in Table 2-3.

Table 2-3. Transportation Corridor Geographic References

Item	Value
USGS Quadrangles	Iliamna C-2, C-3 Iliamna D-3, D-4, D-5, D-6, D-7
Elevation:	
Minimum	Near sea level (Diamond Point Port)
Maximum	1,700 ft (leaving mine site)

The transportation corridor is located within three physiographic divisions: Nushagak-Big River Hills, Nushagak-Bristol Bay Lowlands, and the Alaska Range. The terrain includes a range of types, from flat to moderately undulating near the Pebble Deposit, gently sloping and colluvial terrain along the north shore of Iliamna Lake, and mountainside slopes to narrow valley bottoms through the Alaska Range to Iliamna Bay. No permafrost has been identified in the transportation corridor.

2.2.2. Ecology

The transportation corridor traverses a variety of terrain types. From the mine site eastward along the north shore of Iliamna Lake to Canyon Creek the terrain is generally flat to moderately undulating or gently sloping. This area is composed primarily of dense, low shrub understory and sparse tree cover. Moving eastward to Chinkelyes Creek the terrain is more mountainous and forested. The floodplains along the Pile and Iliamna rivers are complex mosaics of vegetation, dominated by willows in flood channels, bars, and abandoned channels. Crossing the divide between the Bristol Bay and Cook Inlet watersheds, the terrain remains mountainous with more shrubland vegetation. Finally, descending down to Cook Inlet along Iliamna Bay there is steep mountainous terrain with dense alder thickets that slope down to a rocky coast with salt-resistant herbaceous vegetation along the extensive mudflats and bedrock outcrops.

Rivers along the transportation corridor provide habitat for five species of anadromous Pacific salmon. Rainbow trout and other species of fish, such as Dolly Varden and Arctic grayling, are also present.

Forest and wetland habitats in the transportation corridor support types of wildlife similar to those at the mine site. Brown bear density is somewhat higher in the transportation corridor, with densities increasing as the corridor approaches the coast. Black bears occur in very low densities along the transportation corridor. Small numbers of caribou from the Mulchatna herd may be found foraging at higher elevations following calving within the transportation corridor north of Iliamna Lake. The transportation corridor contains migratory stopover and breeding habitats for many species of songbirds, raptors, and waterfowl.

2.2.3. Hydrology

The 80-mile-long access corridor crosses numerous streams within the Bristol Bay and Cook Inlet watersheds. The corridor originates in the Nushagak watershed at the mine site and traverses the Kvichak watershed along the north shore of Iliamna Lake. Both are within the greater Bristol Bay watershed. The corridor terminates at Diamond Point in the Tuxedni-Kamishak Bays watershed of the greater Cook Inlet watershed.

2.3. Diamond Point Port

The Diamond Point Port is located on three land parcels located on the west shore of Iliamna Bay.

Table 2-4. Diamond Point Port Land Ownership[a]

Land Ownership
Native Allotment # AKAA 051014
Seldovia Native Association
Tyonek Native Association

2.3.1. Physiography

The port site is located north of Diamond Point in Iliamna Bay. Diamond Point is a small cape marking the separation between Iliamna and Cottonwood bays. Topography is mountainous with steep slopes dropping to narrow rocky beaches and wide tidal mudflats. The port location is in the Iliamna C-2 USGS Quadrangle.

The Diamond Point port facility is located on three parcels of land—Native Allotment # AKAA 051014 and land belonging to Seldovia Native Association and Tyonek Native Association.

2.3.2. Ecology

The western shorelines from Kamishak Bay north to Iniskin Bay, including Iliamna and Cottonwood bays, are composed of diverse habitats, including steep rocky cliffs, cobble or pebble beaches, and extensive sand/mudflats. Eelgrass is found at a number of locations and habitats; eelgrass, along with macroalgae, is an important substrate for spawning Pacific herring. The port site is located within critical habitat for the Cook Inlet Beluga Whale and the Northern Sea Otter Southwest Distinct Population Segment (DPS). Cook Inlet Beluga Whale critical habitat includes nearshore waters out to two nautical miles. Northern Sea Otter critical habitat includes foraging areas and escape habitat from marine mammal predators.

2.3.3. Hydrology

The Cook Inlet basin is an expansive watershed surrounding the 180-mile-long Cook Inlet waterbody. Covering more than 38,000 square miles of southern Alaska, it receives water from six major watersheds and many smaller ones. More than ten percent of the basin is covered by glaciers and suspended sediment loading in glacier fed rivers without lakes is significant, leading to a high suspended sediment load in portions of Cook Inlet.

Lower Cook Inlet is connected to the Pacific Ocean southwest through Shelikof Strait, and southeast by the Gulf of Alaska and demonstrates complex circulation on variable timescales. The region has the fourth largest tidal range in the world; tidal fluctuations in Iliamna Bay average 16 feet ranging as high as 23 feet. When the tide drops from mean high to mean low water, the inlet loses almost 10 percent of its volume, and exposes approximately 8 percent of its surface area. Most of these tidally exposed areas are in the arms at the north end of Cook Inlet and along the west side of the waterbody.

2.4. Natural Gas Pipeline Corridor

The natural gas pipeline connects the mine site and the port site to the Cook Inlet gas supply infrastructure. It ties to an existing pipeline near Anchor Point on the Kenai Peninsula, connecting to a compressor station, which is located on private land owned by the University of Alaska. The pipeline crosses state and federal Outer Continental Shelf (OCS) waters in Cook Inlet to Ursus Cove, crosses Ursus Head before crossing Cottonwood Bay to the port site north of Diamond Point. It parallels the transportation corridor to the mine site for most of its length before diverging from the road to cross directly to the power plant. (see Table 2-5).

Table 2-5. Natural Gas Pipeline Land Ownership[a]

Land Ownership	Road Segments (miles)	Percentage
Cook Inlet/Cottonwood Bay Crossing	Total miles: 78	
State of Alaska	16	10
Federal Waters – Alaska OCS	62	38
Ursus Head Crossing	Total miles: 6	
Salamatof Native Association Inc.	2	1
Seldovia Native Association	4	2
Transportation Corridor Parallels	Total miles: 79	
State of Alaska	21	13
Pedro Bay Corporation	33	20
Iliamna Natives Limited	15	9
Tyonek Native Association	5	3
Seldovia Native Association	3	2
Salamatof Native Association Inc.	<1	<1
Native Allotment # AKAA 051014	<1	<1
Native Allotment # AKAA 007150A	<1	<1
Mine Segment	Total miles: 2	
State of Alaska	2	1
Total Miles	**164**	**100**

[a] Distances presented are approximate and have been rounded for ease of reference. Totals may not sum.

2.4.1. Physiography

The geographic location of the natural gas pipeline corridor is defined in Table 2-6.

Table 2-6. Natural Gas Pipeline Geographic References

Item	Value[a]
USGS Quadrangles	Iliamna C-2, C-3 Iliamna D-3, D-4, D-5, D-6, D-7 Seldovia D-5
Elevation:	
Minimum	-230 ft
Maximum	1,700 ft

[a] All references in Table 2-3 apply to the natural gas pipeline, but are excluded from this table.

The pipeline is located in four physiographic regions—the Nushagak-Big River Hills, the Nushagak-Bristol Bay Lowlands, the Alaska Range, and the Cook Inlet-Susitna Lowlands. The terrain includes a range of types, from flat to moderately undulating near the Pebble Deposit/mine site, gently sloping and colluvial terrain along the north shore of Iliamna Lake, mountainside slopes to narrow valley bottoms through the Alaska Range. No permafrost has been identified in the pipeline corridor.

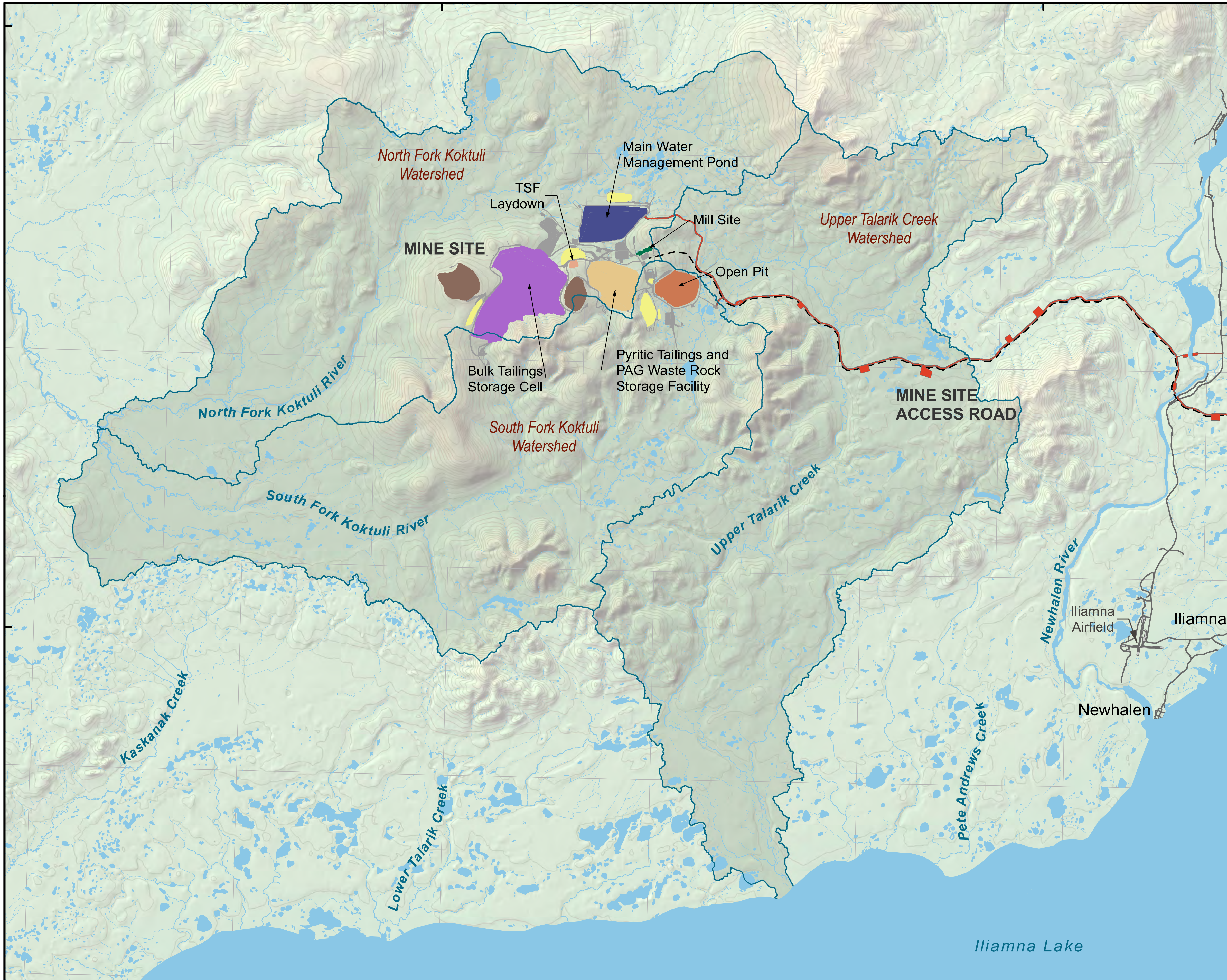
2.4.2. Ecology

The Cook Inlet region is composed of marine, coastal, and estuarine habitats. Pelagic waters within Cook Inlet are influenced by riverine and marine inputs resulting in salinity gradients and horizontal mixing throughout the inlet. Deeper waters of Cook Inlet are characterized by highly variable conditions, ranging from large boulders beds, to dune fields, and unconsolidated sediments on a smooth bottom. Strong tidal currents are present. The variety of habitats in the region support lower trophic organisms, fish, shellfish, marine mammals, and birds. Fish and shellfish are important components of the Cook Inlet food web, as they feed on lower trophic organisms such as plankton, and serve as prey for other fish, birds, and marine mammals.

The Cook Inlet region is a migratory corridor and juvenile rearing area for all five species of Pacific salmon, Dolly Varden, and steelhead trout, which spawn in rivers and streams throughout the region. Nineteen marine mammal species known to occur in Cook Inlet, including the Cook Inlet Beluga whale, which use nearshore waters for feeding in fall and winter. A large seabird nesting colony lies within Kamishak Bay on the western shore of lower Cook Inlet. As outlined in Section 2.3.2 coastal areas of western Cook Inlet, including Kamishak Bay, include critical habitat for the Cook Inlet beluga whale and the Cook Inlet northern sea otter.

2.4.3. Hydrology

See section 2.3.3 for a discussion of Cook Inlet hydrology.



THE pebble PARTNERSHIP

FIGURE 2-1

Mine Site Hydrography

Scale 1:180,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: PLP_PD_2_1_MineSiteHydrography_Alt3.mxd	Date: 4/7/2020
Version: x	Author: HDR

Document Path: G:\GIS\PLP_GIS\4_MXD\ProjectDescriptionFigures\PLP_PD_2_1_MineSiteHydrography_Alt3.mxd

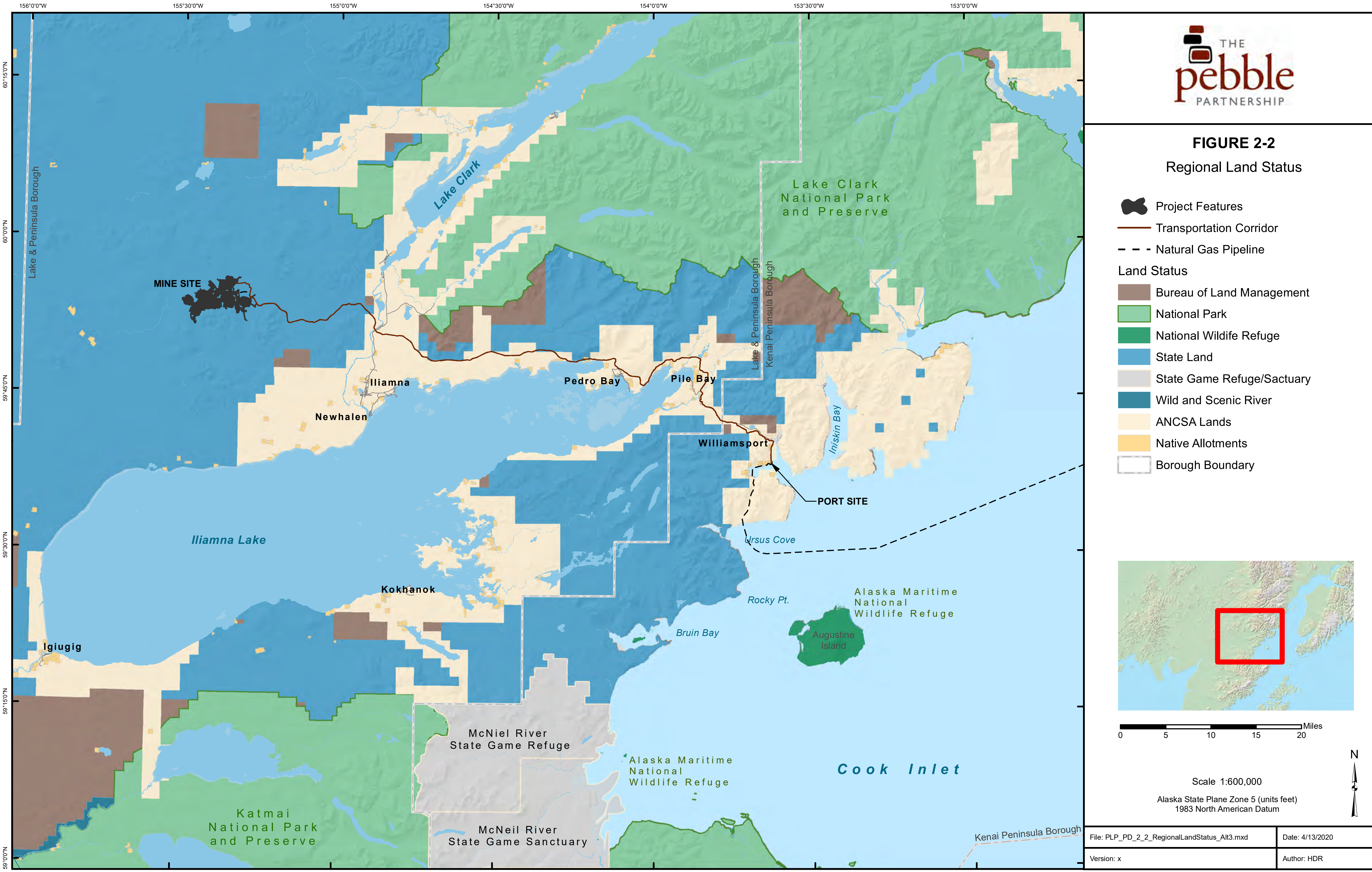


FIGURE 2-2
Regional Land Status

2.5. STATE AND FEDERAL INTEREST LANDS

Several state and federally managed lands lie within a 100-mile radius of the mine site or Diamond Point Port (Figure 2-2). Two large national park units—Katmai National Park and Preserve and Lake Clark National Park and Preserve—lie to the south and northeast of the mine site, respectively. Both parks straddle the Bristol Bay/Cook Inlet watershed divide, although most recreational use in both parks occurs in the Bristol Bay drainage, west of the divide. The Alagnak Wild and Scenic River flows west from Katmai National Park and Preserve and into the Kvichak River, which flows into Bristol Bay. The McNeil River State Game Refuge and Sanctuary, which lies north of Katmai National Park and Preserve, is in the Cook Inlet watershed. West of the mine site is Wood-Tikchik State Park, which is in the Bristol Bay watershed.

2.6. LOCAL AND REGIONAL COMMUNITIES

The Pebble Deposit is located in southwest Alaska's Lake and Peninsula Borough, home to an estimated 1,600 people in 18 local villages. Distances to various communities are shown in Figure 1-1. At more than 30,000 square miles, the Lake and Peninsula Borough is among the least densely populated boroughs or counties in the country. There are no roads into the borough, and few roads within it, contributing to an extremely high-cost of living and limited job and other economic opportunities for local residents.

The communities closest to the mine site are Nondalton, Iliamna, and Newhalen. Pedro Bay is also proximal to transportation infrastructure proposed for the Project. While PLP has generated employment for residents of villages throughout the Lake and Peninsula Borough and broader Bristol Bay region over the past decade, the communities surrounding Iliamna Lake have provided the greatest proportion of the local workforce.

With project infrastructure planned to connect the proposed mine site to the villages of Iliamna, Newhalen, and Pedro Bay, residents of these and other communities are expected to continue playing an important role in staffing the Project in the future.

The Bristol Bay Borough is the only other organized borough in the Bristol Bay region, with some 900 full-time residents in three villages. A significant portion of the Bristol Bay region is not contained within an organized borough; the Dillingham Census Area comprises 11 different communities. A total of about 7,500 people call the Bristol Bay region home, with the largest population centers in Dillingham, King Salmon, and Naknek.

Most Bristol Bay villages have fewer than 150–200 full-time residents. A majority of the population is of Alaska Native descent and Yup'ik or Dena'ina heritage. Virtually all of the region's residents participate to some degree in subsistence fishing, hunting, and gathering activities. Subsistence is central to Alaska Native culture and provides an important food source for local residents.

There are 13 incorporated first- and second-class cities in the Bristol Bay region and 31 tribal entities recognized by the U.S. Bureau of Indian Affairs. There are also 24 Alaska Native Village Corporations created under the ANCSA, five of which – Iliamna Natives Limited, Pedro Bay Corporation, Seldovia Native Association, Salamatof Native Association Inc. , and Tyonek Native

Association – hold surface rights for significant areas of land near the Pebble Deposit and along the proposed transportation infrastructure corridor.

The commercial fishing, guiding, and tourism-related sectors provide many jobs in the region, but the work is highly seasonal; year-round employment is the exception rather than the norm. A lack of employment and economic opportunity has contributed to a declining population in many Lake and Peninsula Borough and regional villages, resulting in the closure of several schools over the past decade.

2.7. LEGAL DESCRIPTION

The legal description of lands on which major project elements will be located is shown in Table 2-6. Sections are within the Seward Meridian Survey of the Public Land Survey System.

Table 2-7. Project Location (Public Land Survey System)

Range	Township	Section
15 West	4 South	14
26 West	4 South	31
	5 South	29, 30, 32, 33, 34, 35
	6 South	1, 2, 12, 13, 24, 27, 34
	7 South	3, 9, 10, 16, 21
27 West	4 South	20, 21, 22, 23, 24, 25, 28, 29, 30, 31, 36
	5 South	2, 3, 10, 14, 15, 23, 24, 25
28 West	4 South	19, 20, 28, 29, 33, 34, 35, 36
	5 South	3, 4
29 West	4 South	17, 18, 19, 20, 21, 22, 23, 24, 27, 28
30 West	4 South	13, 14, 15, 18, 19, 20, 21, 22, 23
31 West	4 South	13, 19, 20, 21, 22, 23, 24, 27, 28, 29, 30
32 West	3 South	31
	4 South	7, 8, 9, 10, 15, 16, 22, 23, 24, 25
33 West	3 South	20, 21, 22, 26, 27, 28, 29, 30, 31, 35, 36
	4 South	1, 12
34 West	3 South	29, 30, 32, 33, 34, 35, 36
	4 South	2, 3, 4, 5
35 West	3 South	7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 33
	4 South	4
36 West	3 South	11, 12, 13, 14, 15, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 33, 34
	4 South	3

3. PROJECT COMPONENTS AND OPERATIONS

This section describes the various project components and the operations associated with those components through the active life of the Project. Construction will last for approximately four years, followed by a commissioning period and 20 years of mineral processing. Mining preproduction will start during construction with removal of overburden and waste rock material and active mining from the pit will continue through the 20-year operations period. Figure 1-4 shows the layout of the mine site, including the major facilities and site infrastructure.

3.1. SUMMARY PROJECT INFORMATION

A summary of mining and process related information is shown in Table 3-1.

Table 3-1. Summary Project Information[a]

Item	Value
General Operation	
Construction	4 years
Total project operations	20 years
Daily schedule	24 hours
Annual schedule	365 days
Mine Operation	
Preproduction mined tonnage	33 million tons
Average annual mining rate	70 million tons
Operations mined tonnage	1,410 million tons
Mine life strip ratio	0.12:1 (waste: mineralized material)
Open pit dimensions	6,800 x 5,600 ft, 1,950 ft deep
Process Operation	
Daily process rate	180,000 tons
Annual process volume	66 million tons
Copper-gold concentrate	613,000 tons per year (average)
Molybdenum concentrate	15,000 tons per year (average)
Pyritic Tailings Storage Facility	
Approximate capacity (tailings)	155 million tons
Approximate capacity (PAG waste)	93 million tons
South embankment (height)	215 feet
North embankment (height)	335 feet
East embankment	225 feet

Item	Value
Bulk Tailings Storage Facility	
Approximate capacity	1,140 million tons
Main embankment (height)	545 feet
South embankment (height)	300 feet
Main Water Management Pond	
Approximate capacity	2,450 million cubic feet (56,000 ac-ft)
Embankment height	190 feet
Concentrate Pipeline	
Diameter	6.25 inches

[a] Design criteria as presented are approximate and have been averaged and rounded as appropriate for ease of reference.

3.2. MINING

3.2.1. Methods and Phasing

The Pebble Mine will be a conventional drill, blast, truck, and shovel operation with an average mining rate of 70 million tons per year and an overall stripping ratio of 0.12 ton of waste per ton of mineralized material.

The open pit will be developed in stages, with each stage expanding the area and deepening the previous stage. The final dimensions of the open pit will be approximately 6,800 feet long and 5,600 feet wide, with depths to 1,950 feet.

Mining will occur in two phases – Preproduction and Production.

The mine operation will commence during the last year of the Preproduction Phase and extend for 20 years during the Production Phase. Approximately 1,300 million tons of mineralized rock and 150 million tons of waste rock and overburden will be mined. Non-potentially acid generating (NPAG) and non-ML waste will be used in construction of the tailings embankments. The PAG and ML waste rock will be stored in the pyritic TSF until closure, when it will be back-hauled into the open pit. Fine- and coarse-grained soils will be stored southwest of the pit and north of the TSF embankments and will be used for reclamation during mine closure.

The Preproduction Phase consists of dewatering the pit area and mining of non-economic materials overlying the mineralized material from the initial stage of the open pit. Dewatering will begin approximately one year before the start of Preproduction mining. Approximately 33 million tons of material will be mined during this phase (Table 3-2).

Table 3-2. Mined Material—Preproduction Phase

Material Type	Quantity
Overburden	22 million tons
Waste rock	11 million tons

The Production Phase encompasses the period during which economic-grade mineralized material will be fed to the metallurgical process plant that produces concentrates for shipment and sale. The Production Phase is planned to last for 20 years. Mineralized material will be mined and be fed through the process plant at a rate of 180,000 tons/day. The open pit will be mined in a sequence of increasingly larger and deeper stages. Approximately 1.4 billion tons of material are planned to be mined during the Production Phase (Table 3-3).

Table 3-3. Mined Material—Production Phase

Material Type	Quantity
Overburden	38 million tons
Mineralized material process plant feed	1,291 million tons
Waste rock	82 million tons

3.2.2. Blasting

Most open pit blasting will be conducted using emulsion blasting agents manufactured on site. In dry conditions, a blend of ammonium nitrate and fuel oil (ANFO) can be used as the blasting agent. However, most ammonium nitrate will be converted to an emulsion blasting agent because of its higher density and superior water resistance. Initial operations during the Preproduction Phase may use pre-packed emulsion blasting agents or a mobile bulk emulsion manufacturing plant. After the explosives plant is completed, the emulsion-based ANFO explosive will be used as the primary blasting agent.

The ANFO will be stored separately as a safety precaution. All explosive magazines will be constructed and operated to meet mine safety and health regulations. The ammonium nitrate solution will be mixed with diesel fuel and emulsifying agents in a mobile mixing unit on the mining bench where blasting is to take place. The emulsion will become a blasting agent only once it is sensitized using the sensitizing agent while in the drill hole.

Based on knowledge of the rock types in the Pebble Deposit, blasting will require an average powder factor of approximately 0.5 pounds per ton of rock. Blasting events during the Preproduction Phase will occur approximately once per day. The frequency will increase during the Production Phase, with events occurring as often as twice per day.

3.2.3. Waste Rock and Overburden Storage

Waste rock is mined material with a mineral content below an economically recoverable level that is removed from the open pit, exposing the higher-grade production material. Waste rock will be segregated by its potential to generate acid. NPAG and non-ML waste rock may be used for embankment construction. PAG and ML waste rock will be stored in the pyritic TSF until mine closure, when it will be back-hauled into the open pit. Quantities of material mined are outlined in Table 3-1 and Table 3-2.

During the Preproduction Phase, approximately 33 million tons of non-mineralized and mineralized material will be removed from the open pit. Non-mineralized waste and overburden will be stockpiled or used in construction, mineralized waste will be stockpiled and relocated to the pyritic TSF once complete, or if grades are sufficient, stockpiled for milling once the mill is complete. Material will be stockpiled within the pit footprint, or in designated stockpiles as appropriate.

Overburden is the unconsolidated material lying at the surface. At the Pebble Deposit, the overburden depth ranges from 0 to 140 feet. Overburden removal will commence during the Preproduction Phase and will recur periodically during the Production Phase at the start of each pit stage. The overburden will be segregated and stockpiled in a dedicated location southwest of the open pit. A berm built of non-mineralized rock will surround the overburden to contain the material and increase stability. Overburden materials deemed suitable will be used for construction. Fine- and coarse-grained soils suitable for plant growth will be stockpiled for later use as growth medium during reclamation. Growth medium stockpiles will be stored at various locations around the mine site and stabilized to minimize erosion potential.

3.2.4. Equipment

The Project will use the most efficient mining equipment available in the production fleet to minimize fuel consumption per ton of rock moved. Most mining equipment will be diesel-powered. This production fleet will be supported by a fleet of smaller equipment for overburden removal and other specific tasks for which the larger units are not well-suited. Equipment requirements will increase over the life of the mine to reflect increased production volumes and longer cycle times for haul trucks as the pit is lowered (Table 3-4). All fleet equipment will be routinely maintained to ensure optimal performance and minimize the potential for spills and failures. Mobile equipment (haul trucks and wheel loaders) will be serviced in the truck shop; track-bound equipment (shovels, excavators, drills, and dozers) will be serviced in the field under appropriate spill prevention protocols.

Table 3-4. Production Phase Equipment

Equipment Unit	Class	Year 1 Quantity	Average Quantity	Peak Quantity
Electric shovel	73 cy	1	2	2
Diesel hydraulic shovel	53 cy	1	1	1
Wheel loader	53 cy	1	1	1
Electric drill	12.25 in	1	2	2
Diesel drill	12.25 in	1	1	1
Diesel drill	6.5 in	1	1	1
Diesel haul truck	400 ton	7	11	17
Diesel haul truck	150 ton	5	5	5

cy = cubic yards

Track-mounted electric shovels will be the primary equipment unit used to load blasted rock into haul trucks. Each electric shovel is capable of mining at a sustained rate of approximately 30 million tons per year. Diesel hydraulic shovels, due to their greater flexibility, will be used to augment excavation capacity, depending on the mining application.

Wheel loaders are highly mobile, can be rapidly deployed to specific mining conditions, and are highly flexible in their application. Diesel off-highway haul trucks will be used to transport the fragmented mineralized material to the crusher.

Track-mounted drill rigs are used to drill blast holes into the waste rock and mineralized material prior to blasting. Hole diameters will vary between 6 and 12 inches. Drill rigs may be either electrically powered, as is the case for the larger units, or diesel powered.

This equipment will be supported by a large fleet of ancillary equipment, including track and wheel dozers for surface preparation, graders for construction and road maintenance, water trucks for dust suppression, maintenance equipment, and light vehicles for personnel transport. Other equipment, such as lighting plants, will be used to improve operational safety and efficiency.

3.2.5. Mining Supplies and Materials

Fuel, lubricants, tires, and blasting agents (Table 3-5) will be the primary materials used in mining.

Table 3-5. Mining Supplies

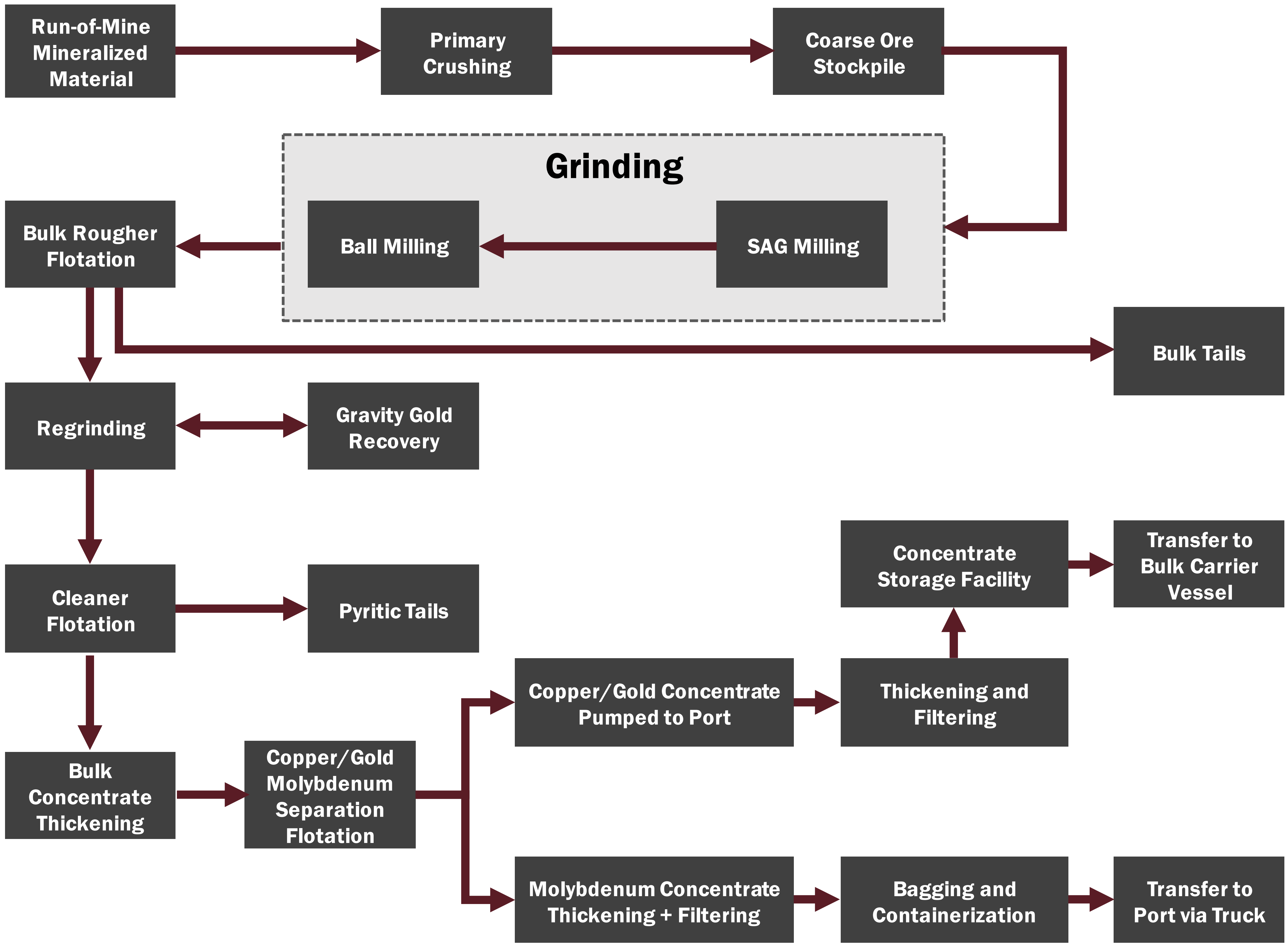
Consumable	Use	Shipping
Diesel fuel	Vehicles and blasting	6,350-gallon ISO tank-containers
Lubricants	Vehicles and equipment	Drums and totes in containers
Ammonium nitrate prill	Blasting	Bulk containers
Primers, detonators, and detonating cord	Blasting	Specialized packaging as required
Blasting emulsion ingredients	Blasting	Specialized packaging as required
Packaged explosives	Blasting	Specialized packaging as required
Haulage truck & other tires	Vehicles	Bulk containers/break bulk
Ground-engaging tools	Drilling and loading	Bulk containers

ISO = International Organization for Standardization

3.3. MINERAL PROCESSING

Mineral processing facilities will be located at the mine site. Blasted mineralized material from the open pit will be fed to a crushing plant to reduce the maximum particle size to approximately six inches. This crushed material will be conveyed to a coarse ore stockpile, which in turn feeds a grinding plant within the process plant. In the grinding plant, semi-autogenous grinding (SAG) mills and ball mills further reduce the plant feed to the consistency of very fine sand. The next step is froth flotation, in which the copper and molybdenum minerals are separated from the remaining material to produce copper-gold and molybdenum concentrates. The copper-gold concentrate slurry will then be pumped to the port site where it will be filtered, loaded onto the lightering barges, and then unloaded directly into the holds of Handysize bulk carriers for shipment. The molybdenum concentrate will be filtered at the mine site and placed in large sacks which are in turn placed in conventional shipping containers. The containers will be trucked to the port and shipped with the remaining empty shipping containers to refineries located outside Alaska, Gravity concentrators will be placed at strategic locations to recover free gold, which will be shipped off site for refining. Other economically valuable minerals (gold, silver and palladium in the copper-gold concentrate and rhenium in the molybdenum concentrate) will be present in the concentrates. Figure 3-1 shows the process flowsheet.

Over the life of the Project, approximately 1.3 billion tons of mineralized material will be fed to the process plant at a rate of 180,000 tons/day. On average, the process plant will produce approximately 613,000 tons of copper-gold concentrate per year, containing approximately 318 million pounds of copper, 362,000 ounces of gold and 1.8 million ounces of silver, and approximately 15,000 tons of molybdenum concentrate, containing about 14 million pounds of molybdenum.



THE pebble PARTNERSHIP

FIGURE 3-1

Process Flow Sheet

File: WTPSchematics_20191212.vsd	Date: 04/07/2020
Rev: 0	Author: HDR

3.3.1. Crushing

3.3.1.1 Primary Crushing

Mineralized material from the open pit will be delivered by 400-ton haul trucks to primary gyratory crushers located adjacent to the rim of the open pit. The crushers will reduce the mineralized material to a maximum size of six inches. The crushed mineralized material from both crushers is delivered via a single, covered, overland conveyor to the coarse ore stockpile.

3.3.1.2 Coarse Ore Stockpile

The coarse ore stockpile is contained within a covered steel frame building to minimize fugitive dust emissions and control mineralized material exposure to precipitation. The stockpile provides surge capacity between the crushers and the process plant, improving the efficiency of the latter and enabling it to operate if the feed from the crushers is not available.

The stockpiled material will be reclaimed by apron feeders mounted below the pile that deliver it onto two conveyor belts feeding the SAG mills. Baghouse-type dust collectors will be provided at each transfer point to control fugitive dust emissions. Water will be added to the process at the SAG mill, thereby eliminating the need for additional baghouses. A sump will be located in each reclaim tunnel to collect any excess water; however, such drainage is likely to be minimal, as it is preferable to handle coarse material dry to prevent freezing during cold conditions. An escape tunnel also will be provided for worker safety, with ventilation as required.

3.3.2. Grinding

The primary grinding circuit will use two parallel, 40-foot-diameter SAG mills and associated ball mills to grind mineralized material to the finer consistency necessary to separate the valuable minerals. Steel balls are added to the SAG mill to aid in grinding the mineralized material. Coarse mineralized material, water, and lime are fed into the SAG mills and the mineralized material is retained within the SAG mills by grates until the particles reach a maximum size of one to two inches.

Discharge from each SAG mill will be screened to remove larger particles ranging from one to two inches ("pebbles"). Material passing through the screens will be sent to the ball mills while the large particles will be conveyed to the pebble-crushing facility where they will be crushed and re-introduced to the SAG mill.

The next grinding step is ball milling. Ball mills have a lower diameter-to-length ratio than SAG mills and use a higher percentage of smaller steel balls compared to SAG mills, allowing them to grind the feed to a finer size. Two ball mills will be matched with each SAG mill.

The slurry from the ball mills will be pumped into the hydro-cyclones, which separate the finer material from the larger material through centrifugal force. The slurry with the coarser material will be recycled back to the ball mills for additional grinding. The slurry containing the finer material will be pumped to the flotation cells. Grinding circuit slurry pH levels will be adjusted to 8.5 by adding lime slurry to minimize corrosion on the mill liners and promote efficient mixing prior to flotation.

3.3.3. Concentrate Production

Copper-gold and molybdenum concentrates will be produced via flotation, which will separate the metal sulfides from pyrite and non-economic minerals. Two tailings streams will be produced: bulk tailings and pyritic tailings.

3.3.3.1 Bulk Rougher Flotation

The rougher flotation circuit is designed to separate the sulfide minerals, predominantly copper, molybdenum, and iron sulfides (pyrite) within the process plant feed from the non-sulfide minerals. Slurry from the ball mills is split between two banks of bulk rougher flotation cells. Reagents added to the slurry promote mineral separation by inducing mineral particles to attach to air bubbles created by blowing air through the flotation cells. Additional reagents are added to promote froth bubble stability. This froth, with the mineral particles attached, rises to the surface and is collected as a bulk rougher concentrate for the next phase of flotation.

Bulk rougher concentrate slurry is then routed to the regrind circuit. Material that does not float – the bulk flotation tailings from which most of the sulfide minerals have been removed – will be pumped to two tailings thickeners.

3.3.3.2 Regrind

The bulk rougher concentrate is reground to sufficiently liberate minerals and enable the separation of the copper-molybdenum sulfide minerals from iron and other sulfides, thus producing concentrates with commercially acceptable grades. A gravity gold recovery circuit is attached to the regrind circuit to recover free gold that might otherwise be lost.

3.3.3.3 Cleaning

Reground bulk rougher concentrates will be upgraded through a two-stage cleaning process. The concentrate from the cleaning process will report to copper-molybdenum separation, while the tailings will report to the pyritic tailings thickener for thickening prior to pumping to the pyritic TSF. The same reagents used in the rougher flotation circuit will be used in the cleaning circuit, with additional reagents used to aid in the suppression of gangue minerals. The cleaning stage is operated at an elevated pH—through lime addition—to suppress pyritic minerals, which would lower the grade of final concentrates.

3.3.3.4 Bulk Concentrate Thickener

Water will be removed from the bulk concentrate in a conventional thickener. This will remove as much of the bulk flotation reagents as possible before the slurry enters the copper-gold/molybdenum separation circuit, thus increasing separation process efficiency. Reagents will be recycled to the rougher process with the thickener overflow. The resulting slurry will contain 50 percent solids by weight and will go forward to copper-gold/molybdenum separation.

3.3.3.5 Copper-Gold/Molybdenum Separation Flotation

The final flotation process is designed to separate copper-gold and molybdenum concentrates by adding reagents. The concentrate from the separation stage is the molybdenum concentrate, while the tailings comprise the final copper-gold concentrate.

3.3.3.6 Concentrate Dewatering, Filtration, and Pumping

The upgraded copper-gold concentrate will be thickened to 55 percent solids by weight in a high-rate thickener. The thickener overflow will return to various circuits for use as process water. The thickener underflow will be fed to a pump to transfer it via the concentrate pipeline to the port. At the port, pressure filters will reduce the moisture to approximately eight percent. The filter product will be stored in a covered building at the port site.

The molybdenum concentrate will be thickened in a high-rate thickener to 55 percent solids by weight. The thickener underflow will be pumped to the molybdenum concentrate filter press, where the moisture content will be reduced to 12 percent. The filtered concentrate will be further dewatered by a dryer to five percent moisture before being bagged, containerized, and shipped offshore.

3.3.4. Processing Reagents and Materials

Table 3-6 provides a list of commonly used reagents for this type of process, along with their typical packaging for transportation. The final reagent list will be determined during detailed design.

Table 3-6. Processing Reagents and Materials

Reagent	Use	Shipping/Preparation
Calcium Oxide (quick lime)	pH modifier; depresses pyrite in the copper-molybdenum flotation process.	Calcium oxide pebbles (80 percent) shipped in specially adapted shipping containers. Pebbles will be crushed and mixed with water to form lime slurry at the lime plant.
Sodium Ethyl Xanthate	Copper collector; used in the rougher flotation circuit.	Pelletized reagent shipped in 1-ton bags. Mixed with process water to form 20 percent solution and stored in collector storage tank. Mix and storage tanks vented externally with fans.
Fuel Oil (Diesel)	Used in the flotation process.	Shipped in ISO tank-containers and stored in the main head tank in the copper-molybdenum concentrator area.
Sodium Hydrogen Sulfide (NaHS)	Copper depressant used in the copper-molybdenum separation processes.	Pelletized reagent shipped in 1-ton bags. Mixed with process water to form 20 percent solution and stored in the NaHS storage tank.

Reagent	Use	Shipping/Preparation
Carboxy Methyl Cellulose	Depressant; anionic polymer used to depress clay and related gangue material in the bulk cleaner flotation circuit.	Pelletized reagent shipped in 1-ton bags. Mixed with process water in the agitated dispersant tank to form 20 percent solution and stored in dispersant storage tank.
Methyl Isobutyl Carbinol	Frother; maintains air bubbles in the flotation circuits.	Shipped in 20-foot specialized ISO containers and stored in the frother storage tank.
Depressant (sodium silicate)	Clay or silica gangue mineral depressant used in the copper-molybdenum separation process.	Pelletized reagent shipped in 1-ton bags. Mixed with process water to form 20 percent solution and stored in the sodium silicate storage tank.
Anionic polyacrylamide	Thickener aid.	Pelletized reagent shipped in 1-ton bags. Vendor package preparation system composed of a bag breaking enclosure to contain dust, dry flocculent metering, and a wet jet system to combine treated water with the powdered flocculent in an agitated tank for maturation. Prepared in small batches and transferred to a flocculent storage tank.
Polyacrilic acid	Antiscalant for the lime production process.	Viscous pale amber liquid shipped in 35-cubic-foot specialized container tanks within protected rectangular framework.
Nitrogen	Nitrogen used in the molybdenum flotation circuit to depress copper sulfides.	Nitrogen will be provided by a vendor-supplied pressure swing adsorption nitrogen plant. This equipment separates nitrogen from air for use in the mineral-process plant.

3.3.5. Process Water Supply System

Process water will be drawn from the main WMP and the tailings thickener overflow streams. The primary process water source is the bulk tailings thickener overflow. Precipitation runoff will either be diverted by non-contact water diversion channels, or collected in sediment ponds as appropriate, and pumped to the main WMP. Some treated water will be diverted to the process for pump glands and other similar applications.

3.3.6. Tailings Production

Processing mineralized material to recover copper, gold, and molybdenum will produce two types of tailings: bulk flotation and pyritic. Bulk flotation tailings will be pumped to the bulk tailings thickener, where flocculant will be added as necessary to help the settling process. Tailings thickener underflow, at approximately 55 percent solids, will be pumped to the bulk TSF. The pyritic tailings will be thickened, mixed with WTP sludge, and pumped to the pyritic TSF. The overflow streams from each thickener will be returned to the process. Supernatant water in the bulk and pyritic TSFs will be reclaimed to the mill site WMP. Some of this water will be pumped to the process water tank for re-use in the process plant. Any surplus water will be treated in the WTP and discharged.

3.4. Tailings Storage Facilities

Separate TSFs will be constructed for the bulk and pyritic tailings located primarily within the NFK watershed (Figure 1-4). Total TSF capacity will be sufficient to store the 20-year mine life tailings volume (1.3 billion tons). Approximately 88 percent of the tailings will be bulk tailings, and approximately 12 percent will be pyritic tailings.

The unlined bulk TSF has two embankments – main and south. The pyritic TSF will be lined and has three embankments – north, south, and east.

Starter embankments for both facilities will be constructed as part of the initial TSF construction. The main embankment of the bulk TSF will function as a permeable structure to maintain a depressed phreatic surface in the embankment and in the tailings mass in proximity to the embankment. A basin underdrain system will be constructed at various locations throughout the bulk TSF basin to provide preferred drainage paths for seepage flows. The pyritic TSF will be a fully lined facility with an underdrain system below the liner.

The pyritic TSF, which will also contain the PAG waste, will have a full water cover during operations, while the bulk tailings cell will have a small supernatant pond, located away from the embankments, to promote large tailings beach development upstream of the embankments.

The bulk TSF downstream embankment slopes will be maintained at approximately 2.6H:1V (horizontal:vertical), including buttresses established at the downstream toe of the main embankment. The final embankment crest elevation will be approximately 1,730 feet above sea level for bulk TSF. Embankment heights, as measured from lowest downstream slope elevation, will be 545 feet (main) and 300 feet (south).

The pyritic TSF downstream embankment slopes will be maintained at 2.6H:1V. The final crest elevation will be 1,620 feet above sea level. The north embankment height will be 335 feet, the south embankment height will be 215 feet, and the east embankment height will be 225 feet.

3.4.1. Siting Criteria

PLP conducted a multi-year, multi-disciplinary evaluation to select TSF locations that meet all engineering and environmental goals while allowing for cost-effective integration into the site waste and water management plans. During this evaluation, more than 35 tailings disposal options were tested against a range of siting criteria, including:

- **Minimize potential impact to environmental resources.** The selected sites are within valleys supporting mixed uplands and wetland shrub/herbaceous shrub. The valleys include tributaries to the NFK that have experienced intermittent flows. Index counts indicate lower fish presence than at other locations. Potential impacts to waterfowl are likewise reduced by avoiding areas with high-value habitats for nesting, breeding, molting, or migration.

- **Provide adequate storage capacity.** The sites will accommodate tailings for the 20-year life of the Project.
- **Reasonable proximity.** The sites minimize the distance to the process plant, which reduces power consumption and the overall project footprint.
- **Facilitate closure.** Segregating the pyritic tailings and PAG waste allows for placement of both in the pit at the end of the mine life, thus eliminating this structure from the long-term closure plan.

3.4.2. Design Criteria

The TSFs will be designed to meet or exceed the standards of the updated 2017 *Guidelines for Cooperation with the Alaska Dam Safety Program* (ADSP) prepared by ADNR. The TSFs will be designed to the standards of a Class I hazard potential dam (the highest classification).

The final TSF designs will incorporate the following:

- Permanent, secure, and total confinement of bulk tailings solids within an engineered disposal facility.
- Secure, and total confinement of pyritic tailings and PAG waste rock within a fully lined, engineered facility, with these materials relocated to the pit at closure.
- Control, collection, and recovery of tailings water from within the tailings impoundments for recycling to the process plant operations as process water, or treatment prior to discharge to the environment.
- Providing seepage collection systems below the impoundment structures to prevent adverse downstream water quality impacts.
- The inclusion of sufficient freeboard within the bulk TSF that the entire volume of the Inflow Design Flood (IDF) will not flood the entire tailings beach, maintaining the beach between the maximum operating pond and the bulk TSF embankments.
- Limiting the volume of stored water within the bulk TSF and keeping the operating pond away from the dam face.
- Maintaining the pyritic tails and PAG waste in a sub-aqueous state to prevent oxidation.
- The consideration of long-term closure management at all stages of the TSF design process.
- The inclusion of monitoring instrumentation for all aspects of the facility during operations and after closure.

- The design includes flattened slopes to increase the static factor of safety.

3.4.3. Tailings Deposition

Each tailings stream will be delivered to its respective TSF using two pump stations, one located in the process plant and one booster station positioned approximately mid-way along the pipeline route. The bulk tailings will be discharged via spigots spaced at regular intervals along the interior perimeter of the bulk tailings cell to promote beach development, which will allow the supernatant pond to be maintained away from the main embankment.

PAG waste rock will be placed in a ring around the interior of the pyritic TSF. Pyritic tailings from the cleaner scavenger flotation circuit will be discharged into the pyritic TSF at sub-aqueous discharge points, with the level maintained just below the upper bench level for the PAG waste being stored. The sub-aqueous discharge is necessary to prevent oxidation and potential acid generation.

3.4.4. Construction

A "Certificate of Approval to Construct a Dam" is required from ADNR for the construction of impounding structures meeting the minimum height or impounding thresholds. The TSFs, seepage collection ponds, and WMPs will be jurisdictional dam structures regulated by ADSP. The certificate will include any special conditions or limitations on the construction.

The embankments will be constructed using suitable rockfill or earthfill materials, including quarried rock, NPAG and non-ML waste rock excavated from the open pit, if available, and stripped overburden.

3.4.4.1 Bulk TSF

Main Embankment

The main embankment will be constructed using the centerline construction method with local borrow materials. The centerline construction method provides a high level of embankment stability while reducing the embankment material requirements associated with the downstream method.

The embankment foundation will be prepared by removing overburden materials to competent bedrock prior to the placing structural fill materials. Construction begins with a cofferdam to capture upstream runoff during starter embankment construction. The starter embankment will be constructed to a height of approximately 265 feet and provide capacity to store tailings for the first 24 months of operation.

The material for the starter embankments will be sourced from a quarry located within the impoundment area. The bulk TSF embankments will be raised progressively during the mine life. After the quarry within the impoundment is inundated with tailings, material will be sourced from two quarries immediately west and east of the impoundment.

The earthfill/rockfill embankment will include engineered filter zones and a crushed or processed aggregate drain at the topographic low point. This drain will provide a preferable seepage path from the tailings mass to downstream of the embankment toe. Additional underdrains running parallel to the embankment will allow for drainage of seepage collected along the embankment.

South Embankment

The south embankment will be constructed using the downstream construction method to facilitate lining of the upstream face, which is constructed at a 3H:1V slope. The downstream slope will be at 2.6H:1V. Overburden materials will be removed to competent bedrock below the embankment. The earthfill/rockfill embankment will include engineered filter zones and a grout curtain to reduce seepage below the embankment.

3.4.4.2 Pyritic TSF

The embankments will be constructed using the downstream method with an overall downstream slope of 2.6H:1V. The embankments will be constructed using select borrow materials and include a liner bedding layer, overlain by a liner, on the upstream slope and over the entire internal basin. Basin underdrains will collect and convey any seepage to the downstream seepage collection ponds.

3.4.4.3 Main Water Collection Pond

The Main Water Management Pond is the primary water management structure at the mine site. It will be a fully lined facility and constructed using quarried rockfill materials founded on competent bedrock. The embankment is approximately 190 ft high with an overall downstream slope of approximately 2H:1V and an upstream slope of 3H:1V to accommodate the liner. It will be constructed to its final height during the initial construction period. In addition to the geomembrane liner the embankment will include a filter/transition zone. The basin and upstream embankment face will include a layer of materials above the liner to provide ice protection during freezing conditions.

3.4.4.4 TSF Embankment Lifts

TSF embankments will be constructed in stages throughout the life of the Project, with each stage providing the required capacity until the next stage is completed. A 'Certificate of Approval to Modify a Dam' is required from ADSP for each construction lift. Planned embankment raises will be evaluated each year and sized according to a review of the process plant throughput, actual tailings settled densities (TSF ponds are typically sounded to establish the size of the supernatant pond and the density of the deposited tailings in the TSF), and water storage requirements.

3.4.5. Freeboard Allowance

All stages of embankment design include a freeboard allowance above the maximum operating TSF pond level and tailings beach. The freeboard allowance includes containment of the IDF and wave run-up protection, as well as an allowance for post-seismic embankment settlement. The IDF for the facility has been selected as the Probable Maximum Flood (PMF).

The embankment freeboard requirements will be reviewed as part of each dam lift and dam safety review, and will be adjusted, as required to reflect actual mine water management conditions.

3.4.6. Surface Water

The hydrologic input to the TSF design consists of two primary factors –operating conditions based on the 76-year climate record and the IDF. The IDF for the TSF, pyritic TSF, and the main WMP is the PMF, which in turn is calculated using the 24-hour Probable Maximum Precipitation (PMP) event plus the snow water equivalent from a 1-in-100-year snowpack. Available storage, or freeboard, will always be maintained within the storage facilities to account for the IDF. Maximum operating conditions will not encroach on the freeboard allowance.

Pumps located at the bulk tailings cell supernatant pond will control the water level by transferring excess water to either the seepage control pond or the main WMP.

The pyritic TSF will be a fully lined, water retention facility. The primary means of controlling the water level within pyritic TSF will be by pumping from this cell to the main WMP or the mill.

The main WMP will be a fully lined, water retention facility used to store surplus water for milling, or for managing surplus water from other impoundment and seepage structures. The primary means of controlling the water level in the main WMP is by treating surplus water and discharging to the environment. The design of the main WMP will also incorporate an emergency spillway.

3.4.7. Seepage

The main embankment of the bulk TSF will be designed to promote seepage to the seepage collection pond, thereby minimizing the volume of water contained within the impoundment and enhancing consolidation of the tailings solids.

For the other embankments, seepage controls will include grout curtains, liners, and low-permeability zones. The low-permeability zones, in conjunction with the low-permeability tailings mass, will function as the primary seepage control barriers of the internal and east embankments.

The seepage management system will also include seepage control measures downstream of the TSF embankments. These include seepage recycle ponds with grout curtains and low-permeability core zones, and downstream monitoring wells. Embankment runoff and TSF seepage collecting in the downstream seepage collection ponds will ultimately be transferred to the main WMP to be used in mining operations or treated for discharge.

3.5. MINE SITE INFRASTRUCTURE

Due to the remote location and the absence of existing infrastructure, the Project will be required to provide basic infrastructure, as well as the support facilities typically associated with mining operations. These facilities require reasonable access from the Pebble Deposit, and they have been situated foremost for stability and safety. Figure 1-4 shows the mine site layout.

3.5.1. Power Generation and Distribution

There is no existing power infrastructure in the Project vicinity. All required generating capacity, distribution infrastructure, and backup power will be developed by the Project.

To meet the projected power requirement while providing sufficient peaking capacity and N+1 redundancy (one generating unit held in reserve for maintenance or emergency use) will require a plant with an installed nameplate capacity of 270 MW. The plant will use high-efficiency combustion turbine generators operating in a combined-cycle configuration. The units will be fired by natural gas provided to the site via pipeline. Design-appropriate controls will be used to manage airborne emissions and meet Alaska Department of Environmental Conservation (ADEC) air quality criteria and best management practices (BMPs). A closed-loop glycol system will capture some heat from the system for space heat with the unused waste heat rejected through a closed-loop, water cooled system that circulates water through the steam condenser to a mechanical draft cooling tower.

The various mine load centers would be serviced by a 69-kilovolt distribution system using a gas-insulated switchgear system located at the power plant.

Emergency backup power for the mine site will be provided by both standby and prime-rated diesel generators connected into electrical equipment at areas where power is required to ensure personnel safety, avoid the release of contaminants to the environment, and allow for the managed shutdown and/or ongoing operation of process-related equipment.

3.5.2. Heating

Waste heat from the power plant will be used to heat mine site buildings and supply process heating to the water treatment plant. Low-pressure steam, via heat exchangers, will heat a closed-loop glycol system that distributes heat to various buildings. Warm water from the steam condenser discharge will be routed to the water treatment plant to provide process heating.

3.5.3. Shops

The truck shop complex will house a light-vehicle maintenance garage, a heavy-duty shop that can accommodate 400-ton trucks, a truck wash building, a tire shop and a fabrication and welding shop. The layout is designed to maintain optimal traffic flow and minimize the overall complex footprint. An oil-water separation system will be designed for water collected from the wash facility and floor drains.

3.5.4. On-site Access Roads

There will be several access roads within the mine site area, including a road from the gatehouse to the mine site and secondary roads linking with the various facilities around the mine. Roads will be sized according to the operating requirements and the types of equipment using them. Traffic associated with in-pit activity will be segregated from access road traffic to avoid cross-contamination of vehicles with mud and dust from the pit.

3.5.5. Personnel Camp

The first camp to be constructed at the mine site will be a 250-person fabric-type camp to support early site construction activities and throughout the Preproduction Phase as required for seasonal peak overflows. The main construction camp will be built in a double-occupancy configuration to accommodate 1,700 workers. This facility will later be refurbished for 850 permanent single-occupancy rooms for the operations phase. The camp will include dormitories, kitchen and dining facilities, incinerator, recreation facilities, check-in and check-out areas, administrative offices and first aid facilities.

The mine will operate on a fly-in, fly-out basis, except for those personnel residing in the communities connected to the access road corridor. Non-resident personnel will be flown in and out of the Iliamna Airport and transported to the site by road. Workers will remain on site throughout their work period. Site rules will prohibit hunting, fishing, or gathering while on site to minimize impacts to local subsistence resources.

3.5.6. Potable Water Supply

A series of groundwater wells located north of the mine site will supply potable water to the mine site. Preliminary tests indicate that minimal water treatment will be required. Treatment will likely include multimedia filtration, chlorination with sodium hypochlorite, and pH adjustment with sodium hydroxide. The treatment plants will be designed to meet federal and state drinking water quality standards.

Potable water will be distributed through a pump and piping network to supply fresh water to holding tanks at the personnel camp and process plant. Holding tank capacity will be sufficient for a 24-hour supply. Diesel-fired backup pumps will also be installed to provide potable water during an electrical outage.

3.5.7. Communications

Communications to site will be via fiber optic cable with satellite backup for critical systems. The fiber optic cable will connect to existing fiber optic infrastructure in the region or a dedicated fiber optic cable laid in conjunction with the gas pipeline.

The process plant communication system will use a dedicated ethernet network to support mine process control system communications. A separate network will connect various main components of the fire-detection and alarming system. Closed-circuit television, access control, and voice over internet protocol telephone systems will be integrated with the local area network. Mine operations will use two-way radios, cell phones, and similar equipment for communications.

Diamond Point Port operations will be serviced by the fiber optic cable. Radio and/or cell service will be provided for communications at the port with the antenna located with the port facilities.

3.5.8. Laboratories

Two laboratories will operate at the mine site during the Production Phase.

Staff affiliated with the process plant will operate the metallurgical laboratory to support process plant operations. This work will include routine operations support tests to confirm the metallurgical response of near-term plant feed, and development analysis to evaluate alternate treatment strategies. The laboratory will use state-of-the-art equipment and have fully equipped facilities for sample receiving and storage, sample preparation, and flotation.

The assay laboratory will be equipped with the necessary analytical instruments to provide routine assays to support mine and process plant operations. Some environmental samples will also be tested in this laboratory, although many of these samples will likely be submitted to external, third party laboratories.

Each laboratory will be equipped with fume hoods (with exhaust treatment, if required) and drains connected to a central receiving tank. Chemical wastes will be disposed of in accordance with all applicable laws and regulations.

3.5.9. Fire and Emergency Response

The mine site and Diamond Point Port site will be equipped for fire and emergency response. Water for fire suppression will be stored within the freshwater supply tanks at the mine and port and distributed via an insulated pipeline system that meets all pertinent code requirements. A fire truck and ambulance will be located at the mine site. An ambulance will be located at the Diamond Point Port and a pump truck will be used to deliver fire suppression water. A senior member of the safety and health management team, with appropriate training and experience, will have designated responsibility for emergency response. Emergency response teams at the mine and Diamond Point Port sites will be staffed by volunteers and will be trained in fire suppression and mine rescue in accordance with regulations.

Both the mine and Diamond Point Port site will be staffed with an emergency medical technician to provide advanced medical care; appropriate facilities will be established at both locations. As necessary, this person may draw on the capabilities of the existing clinic in Iliamna. Arrangements will be made in advance for emergency evacuation via the airport in Iliamna. Designated locations for helicopter pads will be defined at the mine and Diamond Point Port sites.

Equipment will be installed at the mine site and the Diamond Point Port to deal with oil spills; crews will be appropriately trained for such response.

3.6. Material Management and Supply

General supplies and bulk reagents will typically be stored in, or adjacent to, the areas where they will be used. The location of the explosives storage and emulsion manufacturing plant is based on the need to minimize transfer distances and to provide a safety buffer between the explosives plant and other facilities. Descriptions of mining and process related supplies are provided in Table 3-5 and Table 3-6. Average annual quantities of fuel, mining, milling, and miscellaneous consumables are listed in Table 3-7.

Table 3-7. Supply Quantities

Supply	Average Annual Quantity
Fuel	16 million gallons
Ammonium Nitrate	17,500 tons
Grinding Media, Process and Water Treatment Reagents, and Miscellaneous Supplies	295,000 tons

3.6.1. Diesel Fuel

Diesel fuel to support the mining operation and logistics systems will be imported to the Diamond Point Port using marine barges. The expected maximum parcel size for delivery is four million gallons, which will allow for extended periods between shipments in winter months. The Diamond Point Port will accommodate sufficient bulk fuel storage to provide one month of buffer and allow for the offloading of bulk fuel carriers.

Diesel fuel will be transferred from the Diamond Point Port to the mine site using ISO tank-container units, which have a capacity of 6,350 gallons. These units will be loaded at the port and transported by truck to the mine site. Additional containers will be stored at the mine site to provide for a fuel reserve in the event of a supply disruption.

The main mine site fuel storage area will contain fuel tanks in a dual-lined and bermed area designed to meet regulatory requirements. Sump and truck pump-out facilities will be installed to handle any spills. There will also be pump systems for delivering fuel to the rest of the mine site. Dispensing lines will have automatic shutoff devices, and spill response supplies will be stored and maintained on site wherever fuel will be dispensed.

Fuel will be dispensed to a pump house located in a fuel storage area for fueling light vehicles. It will also be dispensed to the fuel tanks in the truck shop complex, which are used for fueling mining equipment. These tanks will also be in a lined and bermed secondary containment area.

3.6.2. Lubricants

Lubricants will be packaged in drums and/or totes and stored on site within a secondary containment area.

3.6.3. Explosives

The materials used to manufacture blasting agents include ammonium nitrate prill, fuel oil, emulsifying agents, and sensitizing agents (gaseous). The containers used to transport the prill will be offloaded, using a container tilter, to a bucket elevator, which will unload the prill to three silos, each sized for 150,000 pounds. As a safety precaution, ammonium nitrate prill will be stored and prepared for use at a location approximately 0.75 mile southeast of the final pit rim. Electrical delay detonators and primers will be stored in the same general area, but in a separate magazine located apart from each other and separate from the prill. All facilities will be constructed and operated and blasting operations conducted in accordance with Mine Safety and Health Administration (MSHA) regulations as set forth in 30 CFR Subpart N.

Other explosives required for the mining operation include detonating cord, which connects to each blast hole and fires a detonator, initiating the explosion in each blast hole. The detonators, in turn, fire explosive primers, which propagate the explosion to the blasting agent. Small amounts of pre-packaged blasting agents and minor amounts of other explosives may be used for specific purposes.

3.6.4. Reagents

Reagents will arrive at the mine site by truck in 20-ton containers, depending on the reagent. They will be stored in a secure bulk reagent storage area and segregated according to compatible characteristics. The reagent storage area will be sufficient to maintain a two-month supply at the mine site. As needed, reagents will be loaded onto a truck and delivered to the appropriate reagent receiving area.

Reagents will be used in very low concentrations throughout the mineral processing plant and are primarily consumed in the process; low residual reagent quantities remain in the tailings stream and will be disposed in the TSF where they will be diluted and decompose.

The metallurgical and assay laboratories will also use small amounts of reagents. Any hazardous reagents imported for testing will be transported, handled, stored, reported, and disposed of as required by law, in accordance with manufacturers' instructions, and consistent with industry best practices.

3.7. Waste Management and Disposal

3.7.1. Used or Damaged Parts

Used tires and rubber products will be reused to the extent practicable. Additional used tires, along with other damaged parts and worn pipes, will be packaged for shipment and disposal off site. Wood pallets and packaging will be incinerated with domestic waste. Scrap steel, such as broken grinding balls and used mill liners, truck body liners and ground engaging tools, will be shipped off-site to appropriate disposal sites.

3.7.2. Laboratory Waste

Most inorganic aqueous wastes from the metallurgical and assay laboratories will be collected in a sump, with the remainder routed to the domestic sewage treatment plant. Fugitive organics will be skimmed from the surface of the sump prior to discharging the aqueous portion to the main WMP. Generally, non-aqueous waste will be collected in specific and separate bulk containers before being returned to an appropriate place in the plant. If there is no suitable place in the main plant, it will be sent to the general waste storage area where it will be packaged and sent off site for disposal at an appropriate facility.

3.7.3. Waste Oils

Waste oil will be reused as fuel in used oil heaters to augment heating in the truck shop and/or other buildings on site. Waste oils not suitable for burning, including lubricants, will be collected into drums, sealed, and stored in containers for shipment to be recycled or disposed of off-site at an approved facility.

3.7.4. Container Wash Wastewater

Water from the container wash at site will be routed to the main WMP for use in the mill and processing plan or treated for discharge.

3.7.5. Reagent Packaging

Reagent packaging will include wooden boxes, bulk poly-propylene containers, bulk bags, laboratory packaging, and/or glass containers. Spent reagent packaging will be evaluated against applicable regulations, permits and health and safety plans for possible incineration in the on-site incinerator. Glass containers will be rinsed and packed for removal and disposal off site. Broken sharp products will be collected and packaged appropriately for removal and disposal off site.

3.7.6. Hazardous Waste

Miscellaneous hazardous wastes that may accumulate on site, such as paint, used solvents, and empty reagent containers with residual chemicals, will be managed and shipped off site to approved facilities according to applicable BMPs and regulations.

3.7.7. Nuclear Instrumentation

Nuclear instrumentation such as densitometers will be shipped off site to approved facilities in accordance with applicable BMPs and regulations.

3.7.8. Domestic Refuse

Domestic refuse from the camp kitchen, living quarters, and administration block will be disposed of on site in a permitted landfill, or shipped off-site to appropriate disposal sites. Some wastes, including putrescible wastes, will be incinerated on site, and the remaining ashes will be disposed of in accordance with applicable BMPs and regulations.

3.7.9. Sewage and Domestic Wastewater Disposal

Separate sewage treatment plants will be located at the camp and the process plant. Plans for each plant will be reviewed and approved by ADEC prior to construction.

Personnel accommodations will produce grey water from the kitchen, showers, and laundry facilities that will be treated in a water treatment plant (WTP). The WTP will be designed to remove biological oxygen demand, total suspended solids (TSS), total phosphate, total nitrogen, and ammonia to meet ADEC domestic waste-discharge criteria.

The process plant sewage WTP will receive effluent that may have metallic residues from the workers' change house and associated laundry. This WTP will be designed for metals removal in addition to biological oxygen demand, TSS, total phosphate, total nitrogen, and ammonia to meet ADEC domestic waste-discharge criteria.

Sludge from both plants will be stabilized and disposed of on site.

3.8. TRANSPORTATION CORRIDOR

The Pebble Project mine site is located approximately 82 miles west of Cook Inlet. There are limited existing road networks in the region. The transportation corridor will extend 82 miles from Diamond Point to the mine site along the north shore of Iliamna Lake.

The transportation corridor was designed to avoid wetlands where feasible, minimize disturbance area, minimize stream crossings, avoid geological and avalanche hazards, avoid culturally significant sites, minimize effects on subsistence hunting and gathering, optimize the alignment for the best soil and geotechnical conditions, and minimize road grades.

The mine access road will run east from the mine site to the port site at on Cook Inlet at Diamond Point. It will parallel or replace portions of the existing Pile Bay/Williamsport road and intersect with the existing Iliamna/Newhalen road network (Figure 12).

The concentrate, water return, and gas pipelines and the fiber optic cable will be buried in a corridor adjacent to the road that parallels the road from the mine site to the port.

3.8.1. Road Design

The mine access road will be a private 30-foot-wide gravel road, which will enable two-way traffic, and will be capable of supporting anticipated development and operational activities during construction and supply truck haulage from the port to the mine site.

The access road will include seventeen bridges, eight of which will be single-span, two-lane bridges that range in length from approximately 40 to 90 feet. There will be one large (550 feet) multi-span, two-lane bridge across the Newhalen River and eight other multi-span, two-lane bridges that range in length from approximately 125 to 245 feet. Road culverts at stream crossings are divided into categories based on whether the streams are fish bearing. Culverts at streams without fish will be designed and sized for drainage only, in accordance with ADOT&PF standards. Culverts at streams with fish will be designed and sized for fish passage in accordance with ADOT&PF standards and will meet USFWS guidelines (Culvert Design Guidelines for Ecological Function, U.S. Fish and Wildlife Service Alaska Fish Passage Program, Revision 5, February 5th, 2020).

The natural gas pipeline, concentrate pipeline, water return pipeline, and fiber optic cable will be buried in a corridor adjacent to the access road. For bridged river crossings, the pipelines will be attached to the bridge structures.

3.8.2. Concentrate and Water Return Pipelines

The concentrate pipeline will consist of a single approximately 6.25-inch diameter API 5L X60 grade (or similar) steel pipeline with an internal HDPE liner to prevent corrosion. A cathodic protection (zinc ribbon or similar) system will be included for prevention of external corrosion. A pressure-based leak detection system, with pressure transmitters located along the pipeline route, will monitor the pipeline for leaks. Two electric pump stations will be required, one at the mine site and one at an intermediate point. Both pump stations will utilize positive displacement pumps in the 1000 horsepower range and the intermediate one will require a power generation facility (1-2-megawatt range). Rupture discs at the intermediate and terminal stations and pressure monitoring will be utilized to protect the pipeline from overpressure events. Manual isolation and drain valves will be located at intervals no greater than 20 miles apart.

The return water pipeline is sized to accommodate water from flushing operations with a diameter of approximately 8 inches. The HDPE lined steel pipeline will have similar corrosion protection and safety controls to the concentrate pipeline. No intermediate pump station is required for the water return pipeline.

3.8.3. Transportation Corridor Traffic

To facilitate efficient cargo movement most material will be transported in shipping containers. Inbound Project cargo and consumables will be transported using standard ISO containers for ocean freight (either 20- or 40-foot size). Diesel fuel will be transferred from the Diamond Point Port to the mine site using ISO tank-container units, which have a capacity of 6,350 gallons. Truck/trailer units will be designed to haul up to three loaded containers per trip.

Daily transportation of fuel, reagents and consumables will require up to 18 round trips per day for each leg of the road, including three loads of fuel per day.

3.9. Diamond Point Port and Lightering Location

Incoming supplies such as equipment, reagents, and fuel will be barged to the Diamond Point Port and then transported by truck to the mine site. To a lesser extent, some supplies, such as perishable food, may be transported by air to the Iliamna Airport and trucked to the mine site. Bulk concentrate will be lightered by barges to Handysize bulk carriers at a mooring point located in Iniskin Bay. The port facilities layout is shown in Figure 1-5. The proposed lightering location is also shown in Figure 1-5.

The Diamond Point Port will include shore-based facilities to dewater, store, and load the copper-gold concentrate, a pumping station for the water return pipeline, facilities to receive and store containers and fuel, as well as natural gas-powered generators, maintenance facilities, employee accommodations, and offices.

The marine component includes a causeway extending out to a marine jetty located in an 18-foot deep dredged basin. A dredged access channel will lead to deep water. Concentrate will be transferred from the shore-based facilities to the barge loader using an enclosed conveyor that follows the road before transitioning onto the causeway and jetty. Fuel will be pumped from fuel barges to the on-shore storage tanks using an 8-inch pipeline.

3.9.1. Dredging Plan

A 1994 USACE dredging study was completed for the evaluation of a dredged access channel and port facility at Williamsport. PLP completed a bathymetric survey of the Iliamna Bay area in 2008. The information from the USACE report and the bathymetric survey data were used to inform the dredge planning and design.

Based on available geophysical data bedrock in the vicinity of the dredged channel and basin occurs at depths greater than 100 feet, well below the proposed dredge depth. Sediments are expected to be composed of greater than 70% fines, with the remainder consisting of sand and gravel. Dredge slopes of 4H:1V are proposed to address sediment stability and the potential for seismic induced slumping.

Draft requirements for the concentrate and supply barges and tugs used during construction and operations are 15 feet. The dredged depth for the access channel and turning basin is 18 feet below Mean Lower Low Water (MLLW) to provide access to the jetty under all tidal conditions. This allows an additional three feet to accommodate for accumulated sedimentation between forecast maintenance dredging (estimated at 20 inches over 5 years) and over depth excavation.

The channel will be approximately 2.9 miles in length and 300 feet wide (3 times the maximum expected barge width), while the turning basin will incorporate an area of approximately 1,100 feet by 800 feet. The total volume of dredged material for the initial dredging is estimated at 1,100,000 cubic yards. Maintenance dredging (estimated at 20 inches every 5 years) is expected to total 700,000 cubic yards over twenty years (four times).

Dredging will be accomplished using a barge mounted cutterhead suction dredge. Dredged material would either be pumped directly to shore from the dredge barge, or placed into a small barge (200 ft x 40 ft) and hauled to shore. The dredged material will be placed into two bermed stockpiles located in uplands adjacent to the port facility. Consolidation and runoff water would be channeled into a sediment pond and suspended sediments would be allowed to settle before discharge to Iliamna Bay. Boulders encountered during dredging would be removed using a grab bucket or cable net placed by divers and transported to shore for placement in the stockpiles or use in construction.

The proposed dredge channel and port facility is located approximately 1,700 feet to the west of the existing fiber optic cable and Williamsport access channel. Barges accessing Williamsport follow the naturally incised channel north towards the head of Iliamna Bay before turning west towards the dredged Williamsport landing basin and dredging operations will not impede access to the facility. Activities will also be located north of the access corridor to the existing Cottonwood Bay gravel mining operation and would not impede access to that facility. Marine vessels not in active use for construction and dredging would be anchored in deeper water west of the main passage into the bay or moved offsite to avoid impeding access. Initial dredging of the facility is expected to commence in May of the second year of construction and will take four to six months to complete. Maintenance dredging will take place at five-year intervals and is expected to last three to four weeks. Maintenance dredging would be completed during the early summer months.

3.9.2. Port Design

The Diamond Point Port will include shore-based facilities to dewater, store, and load the copper-gold concentrate, a pumping station for the water return pipeline, facilities to receive and store containers and fuel, as well as natural gas powered generators, maintenance facilities, employee accommodations, and offices.

The marine component includes a causeway extending out to a marine jetty located in the 18-foot deep dredged basin. The jetty will be constructed along the northern and western limits of the basin and consist of 120 x 60 foot concrete caissons up to 58 feet high that would be separated by 60 feet. The caissons will be covered with a concrete deck. Fuel and freight barges will be moored to the jetty for loading and unloading. Fuel will be pumped to the storage tanks located at the shore-based facility through an 8-inch pipeline. The concentrate conveyor will be located on the causeway and jetty deck. In addition to the jetty, a series of three caissons will be placed within the dredged basin to provide mooring and loading for the concentrate lighter barges. A gantry will support an enclosed conveyor from the jetty to a barge loader mounted on the caissons. The causeway will also be constructed using concrete caissons to support a concrete deck.

To prepare for caisson placement, the basin footprint under the caissons will be excavated and leveled to a depth of approximately 5 feet below the dredged basin or seabed using a barge mounted excavator. The caissons would then be floated into place using a tug for guidance at high tide and seated on the leveled seabed on the falling tide or slowly lowered by pumping water into the caisson. Cranes may be used to place caissons in shallower water. Once set in place, the caissons would be filled with coarse material from the dredging and additional quarried material of a size that would achieve proper compaction when filled to avoid settlement over time. The additional fill material would be sourced from onshore material sites. Fill would be transported from shore to the caissons using a barge. Initially, only enough fill would be placed into the caisson to achieve proper seating, avoiding displacement and overflow of any water within the caisson. Fill materials would be stored temporarily on a barge moored adjacent to the construction area. Any water accumulated within the caisson would be pumped out to avoid saturation in the top fill layers and, if necessary, run through tanks on a barge for sediment settlement before discharge into the marine environment. Pre-cast bridge beams (T-sections) would be placed on the caissons to create the main service deck and the access trestle. These pre-cast beams would then be tied together with rebar and topped with a cast-in-place concrete deck for the final surface. For the shore transition, concrete pedestals would be constructed from shore to support the final bridge beams leading to the causeway. At the dock area, the caissons would be used to mount the fendering system and barge ramp equipment for the marine operations.

Construction the dock and causeway would take place following completion of the dredging and would occur late in the summer/fall of the second year of construction.

3.9.3. Port Operations

Copper-gold concentrate will be transferred from the mine site to the Diamond Point Port by concentrate pipeline, then dewatered at the port site, and stored between vessel sailings in a dedicated concentrate storage building. The concentrate will be transported by an enclosed conveyor to a barge loader that will load lightering barges with approximately six thousand tons of concentrate. The two lightering barges will have dust covers to control dust emissions. Once loaded, the barges will be transported to and secured against Handysize size vessels at the mooring location in Iniskin Bay. Wheel loaders will reclaim the concentrate from the barge deck and transfer it to a ship loader, which will load the ships. The barge location will be adjusted along the ship during the loading process. The loading trunk will extend down into the hold of the ship to minimize dusting and mist sprays will be utilized to further control dust generation. Due to the high density of the concentrate the holds will not be loaded to the top, further reducing any potential for concentrate dust to escape the hold. About five to six trips by the lightering barges will be required to load a bulk carrier, which would be anchored for three to four days at the lightering location. The bulk carrier ships will transport the concentrate to out of state smelters.

Up to 27 Handysize ships will be required annually to transport concentrate. Up to 33 marine line-haul barge loads of supplies and consumables will be required annually. Two ice-breaking tugboats will be used to support marine facility operations.

3.10. Natural Gas Pipeline

Natural gas will be supplied to the Diamond Point Port and the mine site by pipeline (Figure 1-1). The pipeline will connect to the existing gas pipeline infrastructure near Anchor Point on the Kenai Peninsula and will be designed to provide a gross flow rate of approximately 50 million standard cubic feet per day. A fiber optic cable will be buried in the pipeline trench or ploughed in adjacent to the pipeline.

A metering station will be constructed at the offtake point that connects to a compressor station located on a land parcel on the east side of the Sterling Highway. The steel pipeline will be designed to meet all required codes and will be a nominal 12 inches in diameter.

The compressor station will feed a 75-mile subsea pipeline across Cook Inlet that will be constructed using heavy wall nominal 12-inch-diameter pipe designed to have negative buoyancy and provide erosion protection against tidal currents. Horizontal directional drilling will be used to install pipe segments from the compressor station out into waters that are deep enough to avoid navigation hazards. From this point, the heavy wall pipe will be trenched into the sea floor as required to maintain pipe integrity.

The pipeline will come ashore in Ursus Cove utilizing trenching, cross Ursus Head and Cottonwood Bay before reaching the port site north of Diamond Point. Natural gas will be fed to the port site power station and used for site heating. The distance from the Diamond Point Port to the mine site is approximately 82 miles. The pipeline will be buried with concentrate and water return pipelines in a trench adjacent to the road prism and will follow the mine access road to the mine site. At bridged crossings the pipeline will be attached to the bridges, otherwise the pipeline will utilize trenching or horizontal directional drilling to cross streams.

Long-term corrosion protection and control will be provided by an external coating on the pipeline and components, combined with an impressed current and/or galvanic current cathodic protection system. The cathodic protection system will be installed and activated, as soon as is practical, after pipe installation to maximize the effect of corrosion protection. Metering stations and pig launching and receiving facilities would be located at the compressor station and offtake points as appropriate. Mainline sectionalizing valves will be installed as required by code, with a spacing of no more than 20 miles for the onshore sections of the pipeline.

4. WATER MANAGEMENT

PLP recognizes the importance of effectively managing water resources in the area surrounding the Pebble Deposit and will implement a comprehensive water management program that will minimize impacts to water flow and quality and will minimize and mitigate impacts associated with all waters affected or used by the Project.

4.1. MINE SITE

The main objective of water management at the mine site is to manage, in an environmentally responsible manner, water that originates within the project area while providing an adequate water supply for operations. A primary design consideration is to ensure that all contact water that requires treatment prior to release to the environment will be effectively managed. This includes carefully assessing the Project facility layout, process requirements, area topography, hydrometeorology, aquatic habitat/resources, and regulatory discharge requirements for managing surplus water. All runoff water contacting the facilities at the mine site and water pumped from the open pit will be captured to protect the overall downstream water quality.

4.1.1. Water Balance

The foundation of the water management program is the water balance. The Pebble Water Balance is comprised of three primary models: the Watershed Model, the Groundwater Model, and the Mine Plan Model. These three models, which are all numerical water balance models, are very different, yet complementary. They collectively provide the means of quantifying the numerous water flows in the streams, in the ground, and in the various pipes, ponds, and mine structures associated with the mine development. The Watershed Model focuses on water flows throughout the NFK, SFK, and UTC drainages. The Groundwater Model focuses on the detailed simulation and understanding of groundwater flows within those drainages, and serves to inform the watershed model, and vice versa. The Mine Plan Model focuses on mine site water inflows and uses.

Complementing the water balance models is an instream fish habitat-flow model, which was used to assess the effects of changes in water flow to the fish habitat in the adjacent streams.

4.1.1.1 Watershed Model

The Watershed Model for the NFK, SFK, and UTC drainages considers both surface and groundwater. This model incorporates all key components of the hydrologic cycle, including precipitation as rain and snow, evaporation, sublimation, runoff, surface storage, and groundwater recharge, discharge, and storage. The primary input is monthly precipitation and temperature data collected at the Iliamna Airport from 1942 through 2017. The model was calibrated to measured site flow data collected at various locations in all three drainages over a nine-year period. The Watershed Model also provided input for the instream fish habitat-flow model, as well as the initial boundary parameters associated with groundwater recharge and runoff conditions for the groundwater model.

4.1.1.2 Groundwater Model

The Groundwater Model focuses on the sub-surface movement of water within the NFK, SFK, and UTC drainages. It models hydrogeological conditions in a more sophisticated and detailed manner than the Watershed Model, and its outputs provide a check of reasonableness for the Watershed Model. In addition, the Groundwater Model simulates groundwater flow rates and groundwater-surface water interactions throughout the study area, whereas the Watershed Model considers surface and groundwater flow rates only at the streamflow gaging stations.

4.1.1.3 Mine Plan Model

The Mine Plan Model focuses on water movement within the Pebble Project footprint area. The Mine Plan Model is a site-wide water balance and considers all mine facilities including the bulk TSF, pyritic TSF, open pit, process plant, and the WMPs. This model tracks water movement throughout the Pebble Project footprint area including runoff from the mine facilities, water contained in the ore, groundwater inflows, evaporation and water stored in the tailings voids.

The Mine Plan Model is used to predict the flow regime on the mine site and whether there is a water surplus or deficit. It will also be used to estimate the water storage capacity requirements for the mine under normal operating conditions.

4.1.1.4 Physical Habitat Simulation System (PHABSIM) Instream-flow Model

The PHABSIM model is an integral component of the site water balance design and is used to determine the most effective way of releasing the treated contact water that is surplus to the project needs. This model assesses the effects of changes in water flow to the instream fish habitat in streams downstream of the project site. It quantifies the areal extent of specific habitat changes that result from changes in flow throughout the year:

- for each of the three streams in the area (NFK, SFK, and UTC),
- at multiple locations throughout the whole length of each stream,
- for different salmon and resident fish species within each stream, and
- for different life history stages of each species.

Output from the model, together with a consideration of site-specific fish production limiting factors, will be used to inform and optimize the discharge of water from the site to minimize the effects of reduced flow and/or enhance instream fish habitat below the discharge points.

4.1.2. Preproduction Phase

The water management and sediment control plan during the preproduction phase consists of multiple aspects that will focus on minimizing contact water volumes. Runoff and associated sediment control measures will be managed with BMPs and adaptive control strategies. Where water cannot be diverted, it will be collected, treated, and discharged.

4.1.2.1 Water Management Plan

The water management plan during the Preproduction Phase can be summarized as follows:

- Water diversion, collection, and treatment systems will be installed around the site to address the effect of construction ground disturbance.
- Water management and sediment control structural BMPs, including temporary settling basins and silt fences, will be installed to accommodate the initial mine site construction.
- Among the first permanent facilities to be constructed will be the water management structures that will be maintained for use in adaptive management during operations, such as diversion and runoff collection ditches to minimize water contact with disturbed surfaces, and sediment control measures such as settling ponds to stop sediment from reaching downstream water courses.
- Preproduction Phase mining cannot commence until the water table in the open pit area has been lowered by groundwater pumping. The open pit dewatering system will be installed prior to Preproduction Phase mining to provide sufficient time to draw down the water table in the area. This will allow uninterrupted overburden removal in preparation for production mining of mineralized material. A series of dewatering wells will be drilled into and around the perimeter of the open pit, with the exact well number and location determined by testing the overburden aquifers. The number of wells will include an allowance for wells with poor or no water yields and wells lost through sanding, equipment loss, or other interference with water production. Pump sizes for each well will be based on well-specific yields. Water will be discharged to the environment if it meets water quality criteria; otherwise, it will be treated in a water treatment plant prior to discharge.

Design considerations for the Preproduction Phase water management structures include the following:

- Diversion channels, berms, and collection ditches will be sized for the 100-year, 24-hour rainfall event.
- Diversion channels, berms, and collection ditches will be constructed with erosion-control features, such as geotextile or riprap lining, as appropriate, for site-specific condition. Energy dissipation structures, such as spill basins or similar control measures, will be included where required to reduce erosion at the outlets of the diversion channels and collection ditches.
- Sediment control ponds will be sized to attenuate and treat up to the 10-year, 24-hour rainfall event volume and to safely manage the 100-year, 24-hour rainfall event.
- Water management and sediment control ponds will be constructed using non-PAG rock and earthen fill embankments.

- A temporary cofferdam will be constructed upstream of the main TSF embankment to manage water during the initial construction phase. Runoff from the undisturbed upstream catchment will be collected behind the cofferdam will be pumped downstream of all construction activities and released within the same watershed.

4.1.2.2 Water Treatment

Minimal water storage will be available on site until initial construction activities are completed. Therefore, prior to completion of the TSF embankments and water management structures, all water that does not meet water quality standards will be treated and released. Water from the following sources and activities may require treatment prior to release:

- Preproduction Phase pit dewatering (dewatering of the overburden aquifer near the pit may require treatment).
- Water, primarily from precipitation, accumulating in the open pit during Preproduction Phase mining.
- Runoff from TSF embankment construction.
- Runoff from excavation for site infrastructure such as the process plant, camps, power plant, or storage areas will be routed to settling ponds prior to release.
- Prior to the operations WTPs being brought on-line, modular WTPs will be used to treat contact water that does not meet discharge requirements.

4.1.3. Production Phase

The water management and sediment control plan during the Production Phase focuses on minimizing contact water. Runoff and associated sediment control measures will be managed with BMPs and adaptive control strategies. Where water cannot be diverted, it will be collected for use in the mining process or treated and discharged.

4.1.3.1 Water Management Plan

The water management plan during the Production Phase can be summarized as follows (Figure 4-1 shows a simplified schematic of the site water balance):

- Water collected from the pit dewatering wells and the open pit will be pumped to the open pit water management pond (WMP). From there, water will be pumped to the open pit WTP for treatment and discharge. WTP sludge will be directed to the process plant where it will be added to the pyritic TSF via the pyritic tailings slurry line.

- Bulk tailings slurry from the mill will be directed to the bulk TSF. Additionally, precipitation and runoff water will collect in the TSF. The bulk TSF will maintain a small operating pond.

- The main bulk TSF embankment will operate as a flow-through facility. Water collecting in the bulk tailings storage cell will flow through the embankment to the main embankment seepage collection pond. From there, water will either be directed to the main WMP for use in the mill or to the main WTP for treatment and discharge. Any excess surface water in the bulk tailings TSF will be pumped to the main WMP.

- Contact water will be pumped to the main WMP. Water treatment by-product sludge and reject water will be directed to the process plant and added to the pyritic TSF via the pyritic tailings slurry line. A portion of the treated water from the main WTP will be returned for use in the process plant and power plant cooling towers.

- Pyritic tailings slurry from the mill will be directed to the lined pyritic TSF. Additionally, precipitation and runoff water will collect in the pyritic TSF. A pond will be maintained in the pyritic TSF, fully submerging the pyritic tailings and all but the upper lift of the PAG waste rock. Excess water from the pyritic TSF will be pumped to the main WMP.

- A water surplus for the Production Phase is anticipated under normal and wetter-than-normal climatic conditions. Although the mine site will have a water surplus, the water volume available to discharge will be less than the pre-mine flows within the mine footprint as some water will be consumed in the tailings voids and some will be lost to evaporation and other minor uses. The site water surplus will vary during operations as the mine footprint expands and additional site runoff is collected. Surplus water will be treated and discharged throughout the year.

- The accuracy of water balance models is limited by many factors, including the stochastic nature of the inputs and the potential effects of climate change. In recognition of these limitations, an adaptive water management strategy is planned. Adaptive water management includes the ability to provide additional temporary water storage capacity in the TSFs, to provide surplus storage capacity within the WMPs, and to provide for expansion of the WTP treatment rate by building in excess capacity. In addition to the redundancy built into the pumping and treatment systems, additional storage capacity is available under extreme flood conditions by directing water to the open pit, allowing it to flood until the pumping and treatment systems can restore the water stored in the system to its design level.

- A comprehensive water management system will be implemented to monitor water quantity and quality. All discharged waters will be monitored for compliance with state and federal permit requirements. Water from both water treatment plants will be strategically discharged to optimize fish habitat in the downstream reaches of nearby streams. Discharge locations for the treated water have been identified in the NFK, SFK, and UTC. The treated water discharge will be distributed to these locations in a manner that optimizes downstream aquatic habitat conditions. Optimal conditions will be determined using a PHABSIM habitat instream-flow model and in accordance with ADEC and Alaska Department of Fish and Game (ADF&G) permit conditions.

Design considerations for the Production Phase water management include the following elements:

- Diversion channels, berms, and collection ditches will be sized for the 100-year, 24-hour rainfall event.
- Diversion channels, berms, and collection ditches will be constructed with erosion-control features, such as geotextile or riprap lining, as appropriate, for site-specific conditions. Energy dissipation structures, such as spill basins or similar control measures, will be included where required to reduce erosion at the outlets of the diversion channels and collection ditches.
- Sediment control ponds will be sized to attenuate and treat up to the 10-year, 24-hour storm event volume and to safely manage the 100-year, 24-hour rainfall event.
- Water management and sediment control ponds will be constructed using non-mineralized rock and earthen fill embankments.
- IDF for all WMPs will be the 100-year, 24-hour rainfall event; IDF for the TSFs and main WMP will be the 24-hour PMP plus the 100-year snowpack equivalent water volume.
- Surplus water will be treated to meet the specified water quality criteria prior to discharge.

Water collection, management, and transfer will be accomplished through a system of water management channels, ponds, and pump and pipeline configurations. These systems will be designed to handle the large flows that occur during spring freshet and late summer/fall rains. Spare parts for pump systems will be maintained on site to maintain continuous and effective water management. Leak detection systems that report to a central control system will be employed, as will monitoring systems to control pump cycling, high and low water-level switches, no-flow (or low-flow) alarms, vibration overheating alarms, and other systems as appropriate to monitor water management systems.

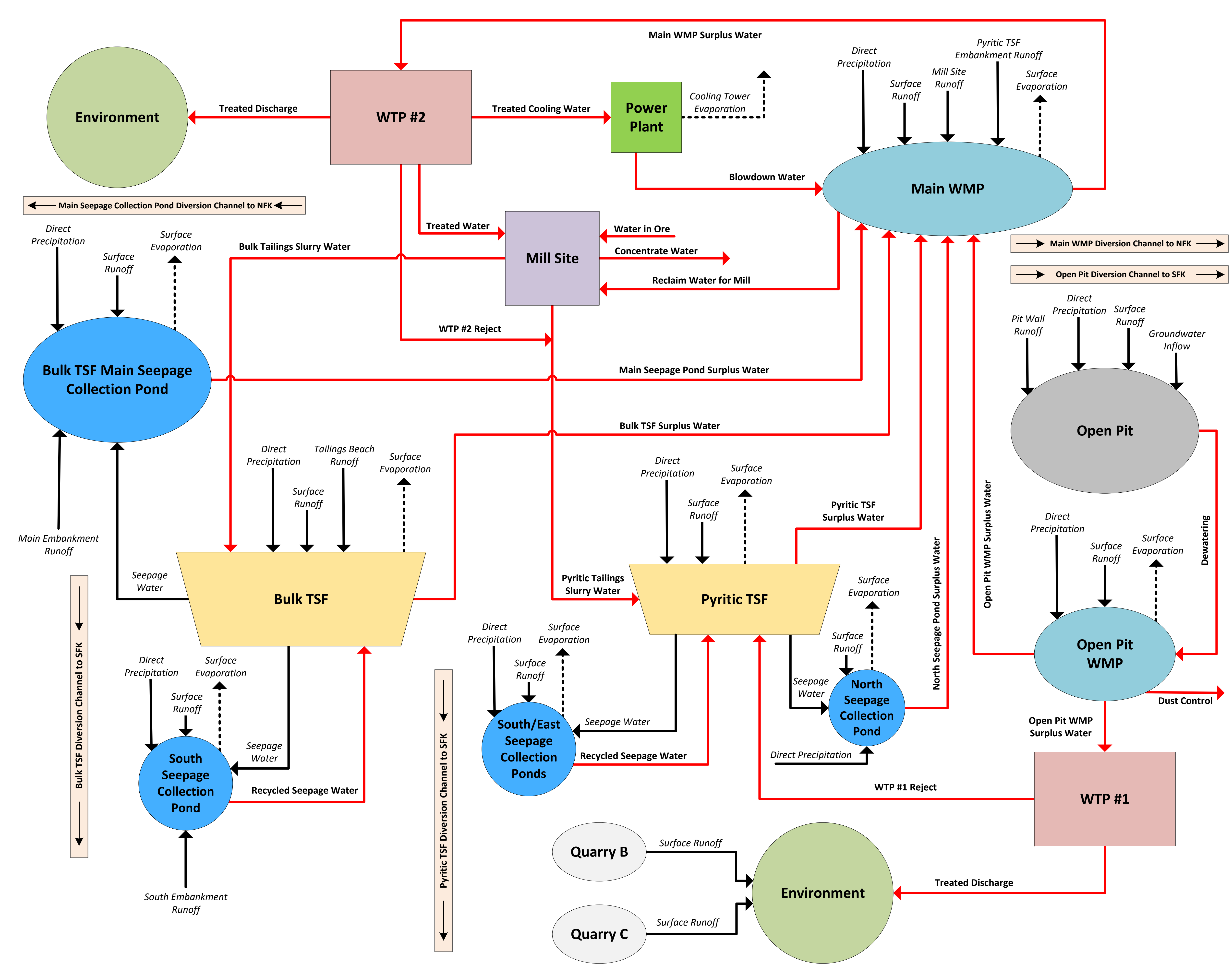


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Figure 4-1

Water Balance Flow Schematic - Operations

Pumped Flow Pathway

Runoff, Groundwater, or Seepage Pathway

Evaporation

File: Figure4-1WaterBalSchematic.vsd	04/07/2020
Rev: 0	Author: PLP

4.1.3.2 Water Treatment

Water collected around the mine area will require treatment prior to discharge to the environment. Treatment methods will include a mixture of settling for sediment removal, chemical additions to precipitate dissolved elements, and filtration to meet final discharge criteria. Wastewater from the personnel camp at the Diamond Point Port site will also require treatment prior to discharge.

The mine area will have two water treatment plants: WTP #1 (the open pit WTP) and WTP #2 (the main WTP). Both will be constructed with multiple, independent treatment trains, which will enable ongoing water treatment during mechanical interruption of any one train.

Water Treatment Plant #1

WTP #1 will treat water from the open pit WMP with treatment plant processes commonly used in the mining industry around the world. Figure 4-2 shows a simplified schematic of the treatment process. Major treatment steps are outlined in sequence below.

1. Dissolved metals will be oxidized with potassium permanganate, followed by co-precipitation with ferric chloride. Hydrochloric acid or lime will be added as needed to maintain the water pH for optimal precipitation.
2. Flocculators/clarifiers will be used to separate out the co-precipitated solids. Clarifier solids will be thickened and transferred to the pyritic TSF.
3. Clarified water will then be treated with sodium hydrogen sulfide, lime, and ferrous chloride to further precipitate remaining metals under reducing conditions.
4. Water from the sulfide reaction tanks will be filtered with sand filters and Ultrafiltration (UF) membranes to remove precipitated metals. Backwash from the sand filters and UF membranes will be thickened and transferred to the pyritic TSF.
5. A portion of the UF membrane permeate water will be treated with four stages of reverse osmosis (RO) membranes to further remove TDS to a concentration that will be safely below the discharge limit. Permeate from the RO membranes will be recombined with the main effluent stream for discharge to the environment.
6. Reject brine from the RO membranes will be transferred to the pyritic TSF.

Water Treatment Plant #2

WTP #2 will treat water from the main WMP with treatment plant processes commonly used in the mining industry around the world. Figure 4-3 shows a simplified schematic of the treatment process. Key treatment steps occur in the following sequence:

1. Dissolved metals will be oxidized with potassium permanganate, followed by co-precipitation with ferric chloride. Hydrochloric acid or lime will be added as needed to maintain the water pH for optimal precipitation.

2. Flocculators/clarifiers will be used to separate out the co-precipitated solids. Most of the solids from the clarifiers will be recycled back to the oxidation reaction tanks. The balance of clarifier solids will be thickened and transferred to the pyritic TSF.

3. Clarified water will then be treated with sodium hydrogen sulfide, lime, and ferrous chloride to further precipitate remaining metals under reducing conditions.

4. Water from the sulfide reaction tanks will be filtered with sand filters and UF membranes to remove precipitated metals. Backwash from the sand filters and UF membranes will be thickened and transferred to the pyritic TSF.

5. RO membranes will provide additional metals and metalloids removal as well as removal of TDS and sulfate. Permeate from the RO membranes may require alkalinity adjustment prior to discharge.

6. Reject from the RO membranes will have a high concentration of dissolved sulfate and other divalent ions. To prevent overloading the mine water balance with dissolved sulfate, sulfate will be precipitated from the reject before transferring to the pyritic TSF. Sulfate from the RO reject will be precipitated as calcium sulfate with a lime softening process. The calcium sulfate sludge will be transferred to the pyritic TSF. Based on the expected pH in the pyritic TSF, the calcium sulfate sludge is not expected to re-dissolve.

7. Supernatant from the calcium sulfate precipitation process will contain high levels of TDS and dissolved sulfate, a portion of which will need to be removed from the WTP process to avoid continual buildup. The supernatant water will be filtered with UF membranes. UF backwash will be sent to the sludge thickener. UF permeate will be sent to brine concentration RO membranes. Brine concentration RO permeate will have alkalinity adjusted as necessary and then will be discharged.

8. Reject from the brine concentration RO membranes, which will still be a relatively high flow of water with high TDS and dissolved sulfate, will be further processed with a two more identical stages of calcium sulfate precipitation by lime softening, UF membrane filtration, and brine concentration RO membranes. All brine concentration RO permeate will have alkalinity adjusted as necessary and then will be discharged. Brine from the last stage of RO membranes will be transferred to the pyritic TSF.

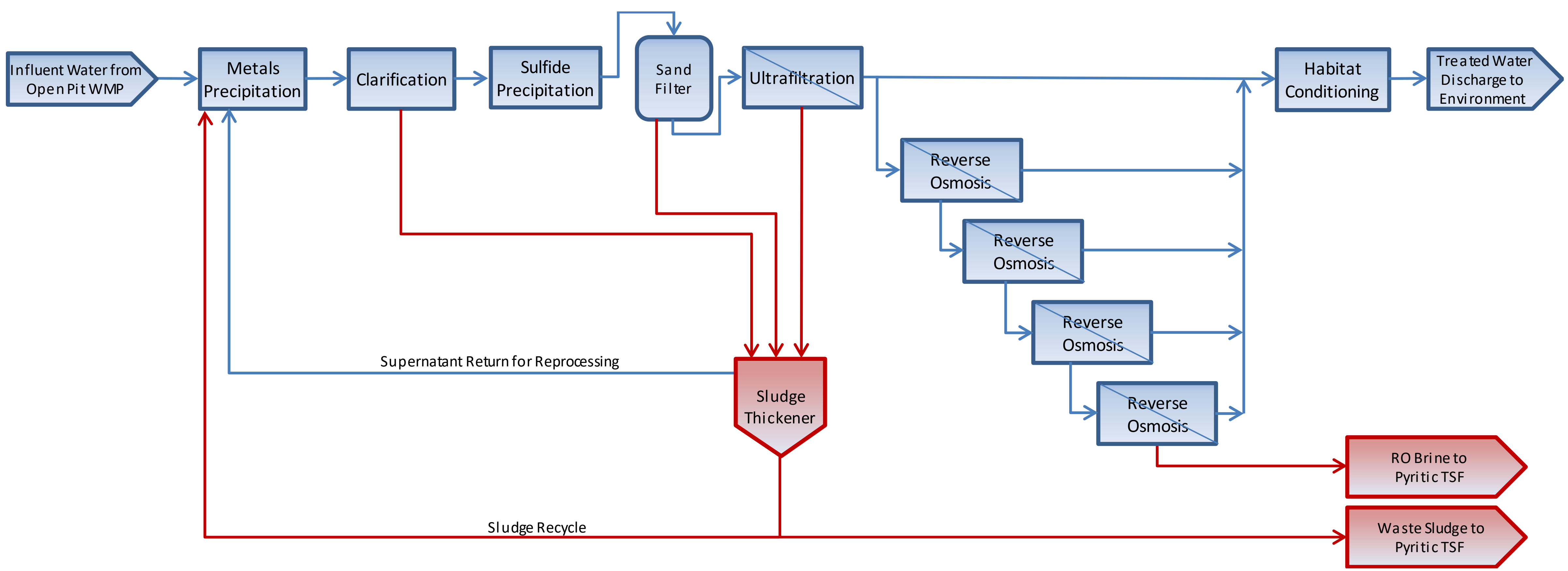

FIGURE 4-2

Water Treatment Plant #1

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Rev: 0	Author: HDR

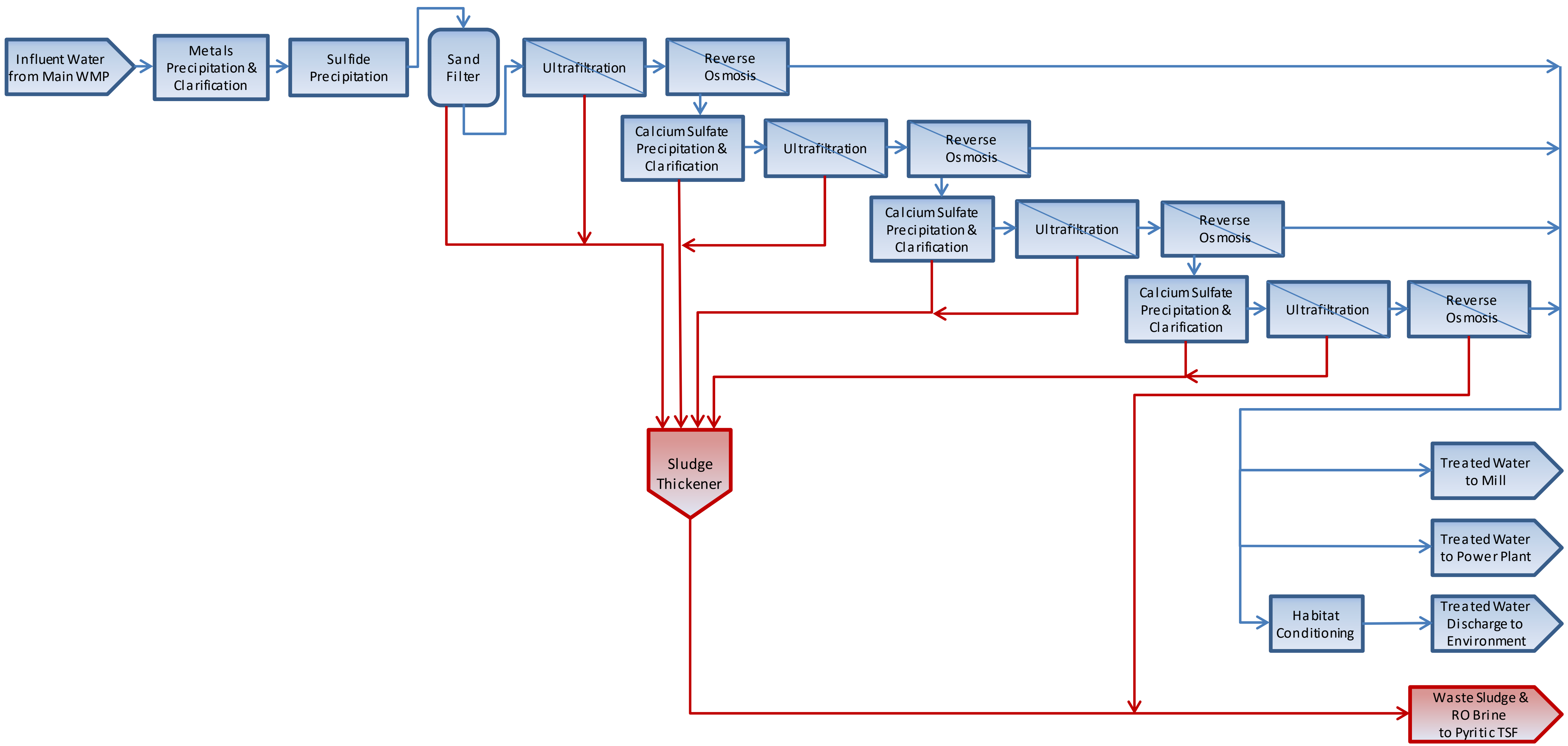

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FIGURE 4-3

Water Treatment Plant #2:
Operations Phase

File: WTPSchematics_20191212.vsd	Date: 04/07/2020
Rev: 0	Author: HDR

4.1.4. Closure/Post-Closure Phase

Closure and post-closure water management addresses both the immediate physical closure of the site and associated reclamation activities, as well as the long-term post-closure period and associated maintenance and monitoring activities. Additional details on reclamation and closure are provided in Section 6.

4.1.4.1 Water Management Plan

The water management plan during the closure and post-closure phases can be summarized as follows:

- Closure Phase 1: Years 0-15
  - WTP #3 replaces WTP #1 to treat open pit water.
  - Excess and seepage water from the bulk TSF is pumped to the main WMP.
  - Seepage water from the pyritic TSF is pumped to the main WMP.
  - Surplus water from the main WMP is treated at WTP #2 and released to the downstream environment.
  - Surplus water from the open pit is pumped to WTP #3 to maintain the placement of the PAG waste rock in the dry.
  - Treated water from WTP #3 is released to the downstream environment
  - The open pit WMP is reclaimed.
- Closure Phase 2: Year 16 until the pit is full (approximately Year 20).
  - WTP #2 is decommissioned once it is no longer required.
  - The pyritic TSF and associated seepage collection ponds are reclaimed and surface water runoff from the area is discharged to the downstream environment.
  - The main WMP is reclaimed and surface water runoff from the area is discharged to the downstream environment.
  - Bulk TSF and seepage collection pond water is pumped to the open pit.
  - The open pit fills to the maximum management level.
  - The basis for the current analysis is that no water will be treated during this phase, however an adaptive management strategy would be utilized, and water would be directed to WTP #3 for treatment and release if required to maintain downstream flows.
- Closure Phase 3: Year 20 until the bulk TSF consolidation is complete (approximately Year 50).
  - Bulk TSF seepage is directed to WTP #3.
  - Water levels in the open pit are maintained below the main management level by treating and releasing surplus water from the open pit.

- Post-Closure
  - Runoff water is directly discharged from the reclaimed bulk TSF to the NFK catchment once it has been demonstrated to meet water quality criteria.
  - Bulk TSF seepage water is directed to WTP #3.
  - Water levels in the open pit are maintained below the main management level by treating and releasing surplus water from the open pit.

4.1.4.2 Water Management Plan

Water treatment during the closure and post-closure phases will utilize the facilities as outlined below. Water quality will be closely monitored, and changes and adjustments to the treatment process will be made as needed. The reclamation and closure bond package will include provisions for periodic replacement of water treatment facilities and ongoing operating and monitoring costs over the long-term, post-closure period.

Water Treatment during Closure Phase 1

The mine area will have two water treatment plants during Closure Phase 1: WTP #2 and WTP #3. Both will have multiple, independent treatment trains, which will enable ongoing water treatment during mechanical interruption of any one train.

Water Treatment Plant #2 - Closure Phase 1

During Closure Phase 1 WTP #2 will treat water from the main WMP with treatment plant processes commonly used in the mining industry around the world. Figure 4-4 shows a simplified schematic of the treatment process. Key treatment steps occur in the following sequence:

1. Dissolved metals will be oxidized with potassium permanganate, followed by co-precipitation with ferric sulfate. Hydrochloric acid or lime will be added as needed to maintain the water pH for optimal precipitation.
2. Flocculators/clarifiers will be used to separate out the co-precipitated solids. Most of the solids from the clarifiers will be recycled back to the oxidation reaction tanks. The balance of clarifier solids will be thickened and transferred to the open pit.
3. Clarified water will then be treated with sodium hydrogen sulfide, lime, and ferrous sulfate to further precipitate remaining metals under reducing conditions.
4. Water from the sulfide reaction tanks will be filtered with sand filters and UF membranes to remove precipitated metals. Backwash from the sand filters and UF membranes will be thickened and transferred to the open pit.
5. RO membranes will provide additional metals and metalloids removal as well as removal of TDS and sulfate. Permeate from the RO membranes may require alkalinity adjustment prior to discharge.

6. Reject from the RO membranes will have a high concentration of dissolved sulfate and other divalent ions. To prevent overloading the mine water balance with dissolved sulfate, sulfate will be precipitated from the reject before transferring to the open pit. Sulfate from the RO reject will be precipitated as calcium sulfate with a lime softening process. The calcium sulfate sludge will be transferred to the open pit. Based on the expected pH in the open pit, the calcium sulfate sludge is not expected to re-dissolve.
7. Supernatant from the calcium sulfate precipitation process will contain high levels of TDS and dissolved sulfate, a portion of which will need to be removed from the WTP process to avoid continual buildup. The supernatant water will be filtered with UF membranes. UF backwash will be sent to the sludge thickener. UF permeate will be sent to brine concentration RO membranes. Brine concentration RO permeate will have alkalinity adjusted as necessary and then will be discharged.
8. Reject from the brine concentration RO membranes, which will still be a relatively high flow of water with high TDS and dissolved sulfate, will be further processed with a two more identical stages of calcium sulfate precipitation by lime softening, UF membrane filtration, and brine concentration RO membranes. All brine concentration RO permeate will have alkalinity adjusted as necessary and then will be discharged. Brine from the last stage of RO membranes will be transferred to the open pit.

Water Treatment Plant #3- Closure Phase 1

During Closure Phase 1 WTP #3 will treat water from the open pit with treatment plant processes commonly used in the mining industry around the world. Figure 4-5 shows a simplified schematic of the treatment process. Key treatment steps occur in the following sequence:

1. Dissolved metals will be oxidized with potassium permanganate, followed by co-precipitation with ferric sulfate. Hydrochloric acid or lime will be added as needed to maintain the water pH for optimal precipitation.
2. Flocculators/clarifiers will be used to separate out the co-precipitated solids. Most of the solids from the clarifiers will be recycled back to the oxidation reaction tanks. The balance of clarifier solids will be thickened and transferred to the open pit.
3. Clarified water will then be treated with sodium hydrogen sulfide, lime, and ferrous sulfate to further precipitate remaining metals under reducing conditions.
4. Water from the sulfide reaction tanks will be filtered with sand filters and UF membranes to remove precipitated metals. Backwash from the sand filters and UF membranes will be thickened and transferred to the open pit.

5. Nanofiltration (NF) membranes will provide additional metals and metalloids removal as well as removal of TDS and sulfate. Permeate from the NF membranes may require alkalinity adjustment prior to discharge.
6. Reject from the NF membranes will have a high concentration of dissolved sulfate and other divalent ions. To prevent overloading the mine water balance with dissolved sulfate, sulfate will be precipitated from the reject before transferring to the open pit. Sulfate from the NF reject will be precipitated as calcium sulfate with a lime softening process. The calcium sulfate sludge will be transferred to the open pit. Based on the expected pH in the open pit, the calcium sulfate sludge is not expected to re-dissolve.
7. Supernatant from the calcium sulfate precipitation process will contain high levels of TDS and dissolved sulfate, a portion of which will need to be removed from the WTP process to avoid continual buildup. The supernatant water will be filtered with UF membranes. UF backwash will be sent to the sludge thickener. UF permeate will be sent to brine concentration RO membranes. Brine concentration RO permeate will have alkalinity adjusted as necessary and then will be discharged.
8. Reject from the brine concentration RO membranes, which will still be a relatively high flow of water with high TDS and dissolved sulfate, will be further processed with a two more identical stages of calcium sulfate precipitation by lime softening, UF membrane filtration, and brine concentration RO membranes. All brine concentration RO permeate will have alkalinity adjusted as necessary and then will be discharged.
9. Brine from the last stage of RO membranes will be evaporated. The concentrated liquid brine stream from the evaporators will be sent to crystallizers. The crystallized salt stream from the crystallizers will be sent to centrifuges to remove any excess liquid from the salt crystals and that liquid will be returned to the crystallizers for reprocessing. The crystallized salt from the centrifuge, which will be primarily sodium chloride, will be sent to an approved facility for disposal. The water vapor from the evaporators and crystallizers will be condensed and the resulting liquid water will be discharged.

Water Treatment during Closure Phase 2

Closure Phase 2 is a period of approximately 5 years during which inflow to the Open Pit will not be removed, allowing the water level to rise to the Maximum Management Level and no surplus water will be treated. WTP #3 will be maintained in standby status but not operated during Closure Phase 2.

Water Treatment during Closure Phase 3 and Post Closure

During Closure Phase 3 and Post Closure WTP #3 will treat two streams of water separately: a stream from the Bulk TSF Main Seepage Collection Pond (SCP) and a stream from the open pit.

WTP #3 will use treatment plant processes commonly used in the mining industry around the world. The treatment processes utilized for each stream are described separately below:

Water Treatment Plant #3- Closure Phase 3 and Post Closure - Bulk TSF Main SCP Stream

Figure 4-6 shows a simplified schematic of the treatment process for the Bulk TSF Main SCP Stream within WTP #3 during Closure Phase 3 and Post Closure. Key treatment steps occur in the following sequence:

1. Dissolved metals will be oxidized with potassium permanganate, followed by co-precipitation with ferric chloride. Hydrochloric acid or lime will be added as needed to maintain the water pH for optimal precipitation.
2. Flocculators/clarifiers will be used to separate out the co-precipitated solids. Most of the solids from the clarifiers will be recycled back to the oxidation reaction tanks. The balance of clarifier solids will be thickened and transferred to the open pit.
3. Clarified water will then be treated with sodium hydrogen sulfide, lime, and ferrous chloride to further precipitate remaining metals under reducing conditions.
4. Water from the sulfide reaction tanks will be filtered with sand filters and UF membranes to remove precipitated metals. Backwash from the sand filters and UF membranes will be thickened and transferred to the open pit.
5. NF membranes will provide additional metals and metalloids removal as well as removal of TDS and sulfate. Permeate from the NF membranes may require alkalinity adjustment prior to discharge.
6. Reject from the NF membranes will have a high concentration of dissolved sulfate and other divalent ions. To prevent overloading the mine water balance with dissolved sulfate, sulfate will be precipitated from the reject before transferring to the open pit. Sulfate from the NF reject will be precipitated as calcium sulfate with a lime softening process. The calcium sulfate sludge will be transferred to the open pit. Based on the expected pH in the open pit, the calcium sulfate sludge is not expected to re-dissolve.
7. Supernatant from the calcium sulfate precipitation process will contain high levels of TDS and dissolved sulfate, a portion of which will need to be removed from the WTP process to avoid continual buildup. The supernatant water will be filtered with UF membranes. UF backwash will be sent to the sludge thickener. UF permeate will be sent to brine concentration RO membranes. Brine concentration RO permeate will have alkalinity adjusted as necessary and then will be discharged.
8. Reject from the brine concentration RO membranes, which will still be a relatively high flow of water with high TDS and dissolved sulfate, will be further processed with a two more identical stages of calcium sulfate precipitation by lime softening, UF membrane filtration, and brine concentration RO membranes. All brine

concentration RO permeate will have alkalinity adjusted as necessary and then will be discharged. Brine from the last stage of RO membranes will be transferred to the open pit.

Water Treatment Plant #3- Closure Phase 3 and Post Closure - Open Pit Stream

Figure 4-7 shows a simplified schematic of the treatment process for the Open Pit Stream within WTP #3 during Closure Phase 3 and Post Closure. Key treatment steps occur in the following sequence:

1. Dissolved metals will be oxidized with potassium permanganate, followed by co-precipitation with ferric chloride. Hydrochloric acid or lime will be added as needed to maintain the water pH for optimal precipitation.
2. Flocculators/clarifiers will be used to separate out the co-precipitated solids. Most of the solids from the clarifiers will be recycled back to the oxidation reaction tanks. The balance of clarifier solids will be thickened and transferred to the open pit.
3. Clarified water will then be treated with sodium hydrogen sulfide, lime, and ferrous chloride to further precipitate remaining metals under reducing conditions.
4. Water from the sulfide reaction tanks will be filtered with sand filters and UF membranes to remove precipitated metals. UF permeate water will be discharged to the environment. Backwash from the sand filters and UF membranes will be thickened and transferred to the open pit.

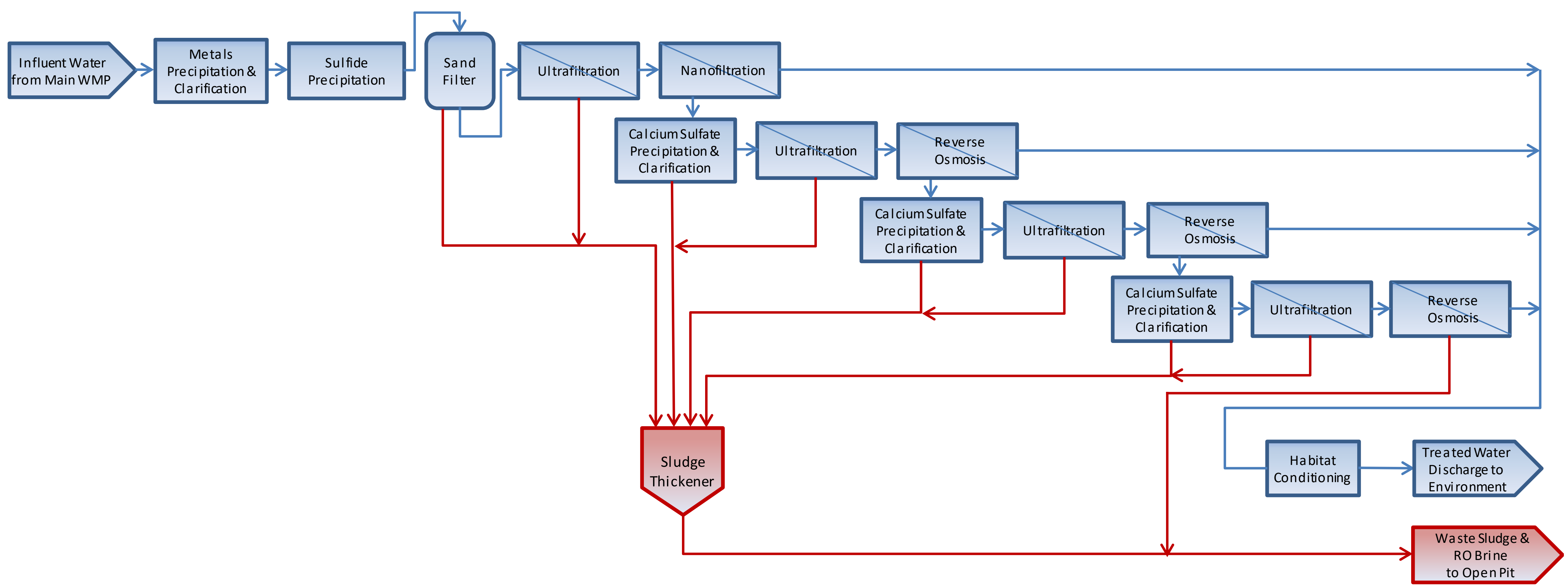

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FIGURE 4-4

Water Treatment Plant #2:
Closure Phase 1

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Rev: 0	Author: HDR

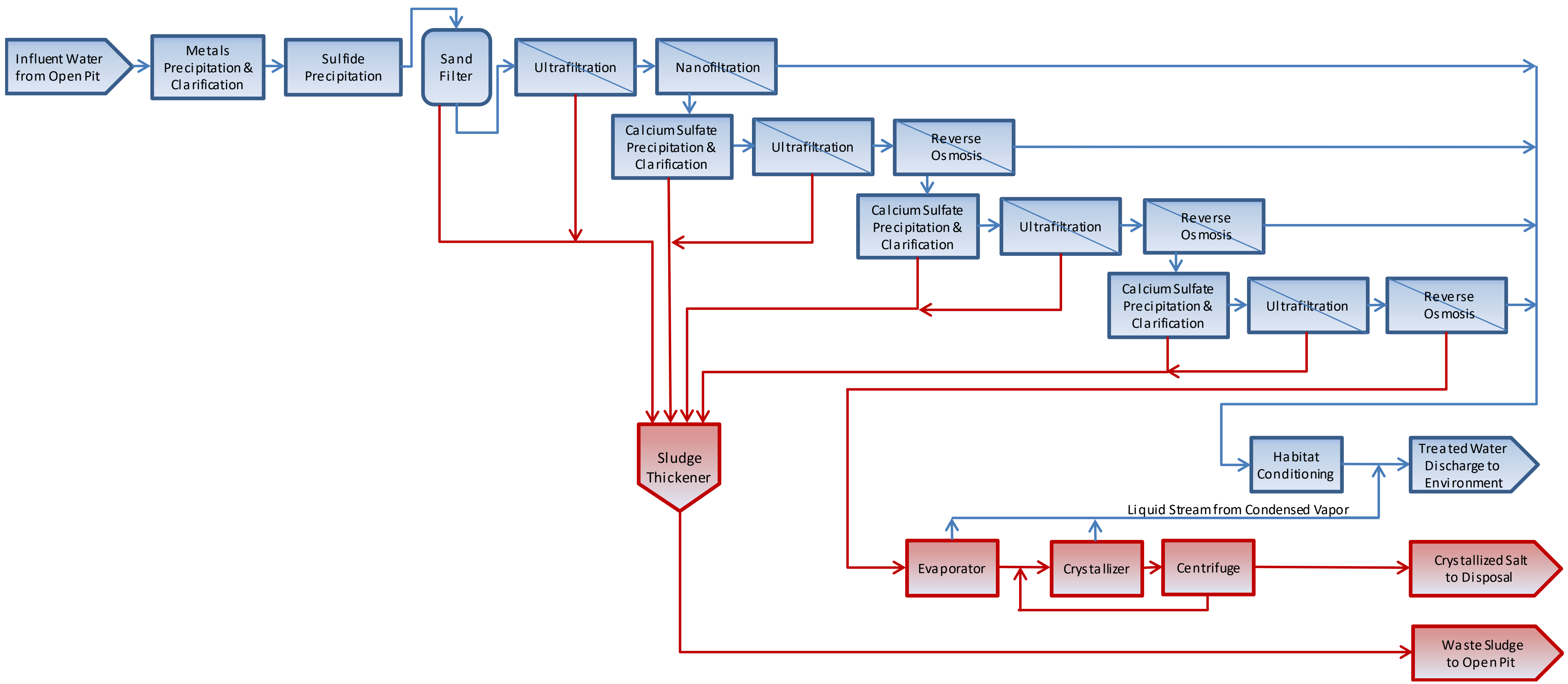

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FIGURE 4-5

Water Treatment Plant #3: Closure Phase 1

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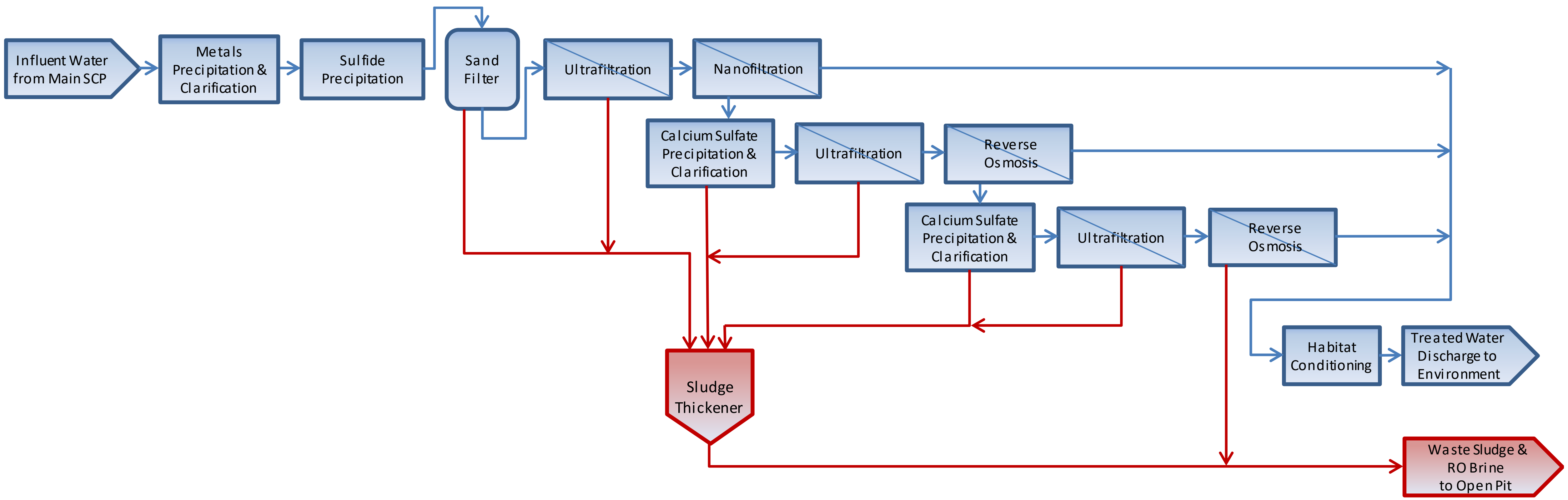

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FIGURE 4-6

Water Treatment Plant #3: Closure Phases 3 & 4 – Main SCP Stream

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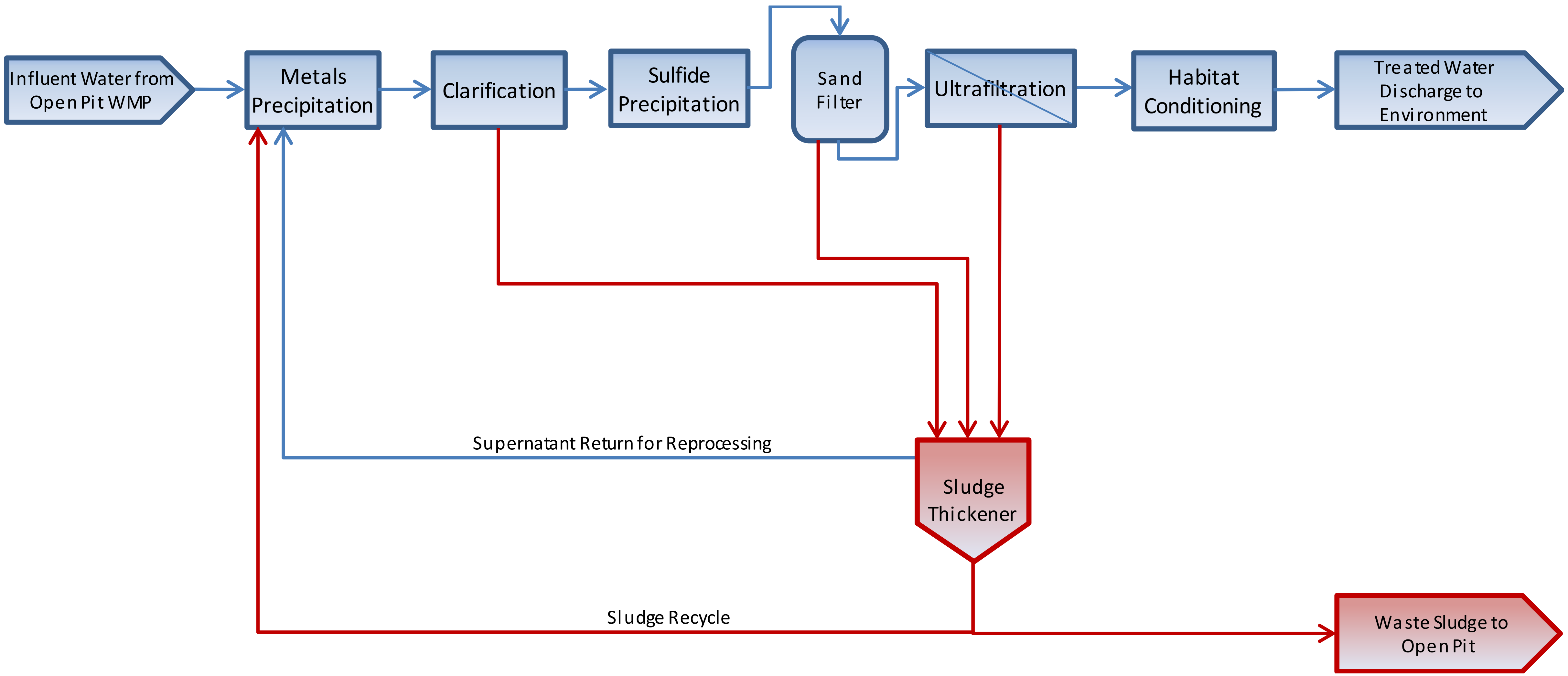

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FIGURE 4-7

Water Treatment Plant #3: Closure Phases 3 & 4 – Open Pit Stream

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Rev: 0	Author: HDR

5. PROJECT CONSTRUCTION

The Project will take approximately four years to construct. Construction will occur on the four main project components – mine site, transportation corridor, Diamond Point Port, and natural gas line across Cook Inlet, with the focus shifting between these components depending on the stage of construction. Several temporary elements will be built during the Preproduction Phase to facilitate construction of the permanent facilities. These temporary facilities will be either repurposed or removed and reclaimed when construction is complete.

5.1. CONSTRUCTION OVERVIEW

5.1.1. Site Access

Key first steps will be to establish transportation infrastructure to access the site, to install those environmental protection systems that will service the Preproduction Phase, and to construct temporary facilities that enable the construction crews to live and work at the sites.

The initial construction effort will be at the Diamond Point Port. Existing beaching areas at Williamsport and Diamond Point will be used to land equipment and supplies and a temporary camp will be established to support construction. Temporary diesel generators will be used for power supply.

The existing Pile Bay/Williamsport road will be utilized to transport equipment and supplies for initial construction of the road alignment along the north shore of Iliamna Lake while the port facilities and road along Iliamna Bay's west side are being constructed. Additional equipment would be shipped by barge from Pile Bay to Iliamna/Newhalen so that work can commence on the western portions of the access road at the same time. The existing Pedro Bay runway will be used to support initial construction of the access road. No modifications of the runway will be required.

Initial access to the mine site should be complete within one year.

5.1.2. Mine Site

Construction activities will commence at the mine site with completion of the initial access and the construction of temporary accommodation and service facilities. Earthworks will be the primary initial activity. The level of this activity will expand over the next year, with structure construction commencing as the associated earthworks are complete. The focus will be on establishing the process and power plant sites, the open pit WMP, the main WMP, the pyritic TSF, and the bulk TSF. Support facilities, such as accommodations, fuel storage, and power generation, will expand as the site activity increases. Laydown areas and access roads for construction will be placed within the future footprint of the facilities to minimize impacts.

Following on from this, process plant and power plant foundations will be well advanced and equipment deliveries commenced. The accommodations facility will be completed for construction and access roads built. The initial bulk TSF main embankment construction will be well advanced, with the goal of ensuring that at least one year's worth of water is stored to facilitate process plant startup.

The later construction years will entail significant activity at the site. During this period, the bulk TSF main embankment will be completed, the process plant building erected, and pyritic TSF foundation and liner installed. The WTPs will be ready for initial use and the power plant construction advanced. The initial open pit development will commence with mine service facilities constructed and initial pit dewatering systems installed and operating. Production mining equipment will be delivered and commissioned as required.

A major activity during the final year of construction will be the open pit Preproduction Phase mining. The remaining process and power plant construction will be completed, as will the remaining embankments in the TSF.

5.1.3. Gas, Concentrate, and Water Return Pipelines

The natural gas line installation will be the other major activity occurring during the second and third construction years. Four separate centers will comprise the gas pipeline: the compressor station and transition section on the Kenai Peninsula, the marine section between the Kenai Peninsula and Ursus Cove, the section crossing Ursus Head and the head of Cottonwood Bay, and the overland section along the road. These activities can generally proceed independently of each other, with a target of having natural gas to the mine site by the end of the third construction year.

The concentrate and water return pipelines between the mine site and the port would be constructed at the same time as the road segment of the gas pipeline. Pumping facilities at the mid-point pumping station would also be constructed during this time period.

5.2. Commissioning Overview

Following construction, the process plant undergoes the following activities to transfer the project from a construction site to a fully operational process plant.

5.2.1. Construction Completion

In the lead up to the completion of the construction phases, pipelines will be pressure tested and all mechanical, civil, structural and electrical installations will be checked to ensure that they are installed according to design and can operate safely. The completions process includes structured and rigorous Quality Assessment and Quality Control procedures to resolve any remaining construction issues prior to pre-commissioning.

5.2.2. Pre-commissioning

This phase involves the testing and inspection of individual plant sub-systems, and associated equipment and facilities to confirm that they are safe and ready for the wet commissioning stage. This includes things such as motor rotations, testing and energisation of power and control systems, field instrument calibrations and adjustments, verification of safety devices and alarms, and first fills of lubricants. Testing of safety systems may involve unit process emergency procedures and live testing.

5.2.3. Wet Commissioning

During wet commissioning, plant operations are simulated, using water where applicable, to test equipment, piping, instrumentation and control systems, and interlocking to the maximum extent possible prior to the introduction of mineralized material. The water testing will check that fluid systems perform to their design intent and meet their design specifications prior to the introduction of mineralized material during process commissioning.

5.2.4. Process Commissioning

This phase comprises the initial operation of the plant facilities using mineralized material and process reagents. The objective is to have the process plant operating in a steady and consistent manner prior to the ramp-up phase. During this phase, differing results or any unforeseen issues with the scale up from test work to full-scale operation of the process plant will be identified. During this phase, plant or infrastructure modifications, or process reconfiguration, may be required to improve the process or enhance efficiency.

5.2.5. Ramp Up

The ramp-up phase may last several months, during which the process plant will be ramped up to its full design capacity and performance levels. This phase may also entail infrastructure modifications or process reconfiguration as identified by the commissioning and operations teams.

5.3. TEMPORARY FACILITIES

Many of the facilities installed during initial construction activities will be converted to permanent use. However, a number of these will be decommissioned and removed during or following construction.

The initial construction camps at the Diamond Point Port and mine site will likely be fabric-covered or transportable facilities. The construction camp at the mine will be located near the mill laydown area. The construction camp at the port will be located in an area that will be used for port operations and will not require a separate footprint. Temporary camps will be established to support road construction and will remain in place until pipeline construction is complete. Existing facilities in Iliamna and Newhalen will also be utilized. During the exploration phase, PLP employed more than 200 staff in Iliamna/Newhalen in these existing accommodations. Until the access road crossing the Newhalen River is complete, the crews will either be bused on existing roads to their workplaces or shuttled to their workplaces by helicopter.

The temporary construction camp at the mine site will be expanded during the initial phase of construction at this location. Construction crews will utilize this camp and the permanent accommodations complex when it is complete. As construction is completed and crew sizes reduce, they will transition to the temporary camp only. This will enable the accommodations complex to be refurbished to single-room occupancy for the mine operations staff.

All temporary construction facilities will be removed after construction, and the sites, unless being used for permanent facilities, will be reclaimed.

5.4. Environmental Protections During Construction

5.4.1. Wastewater and Stormwater

Appropriate ADEC discharge permits or authorizations under general permits will be obtained for all wastewater discharges prior to construction. Stormwater runoff will be properly controlled at all construction sites using structural and non-structural BMPs. No construction will begin without coverage under applicable ADEC general stormwater permits and an approved stormwater pollution prevention plan. Routine inspections and monitoring will ensure the proper functioning of all stormwater BMPs throughout the construction period.

5.4.2. Fuel Management

Fuel management will include appropriate containment and practices, in accordance with ADEC and EPA regulations and approved spill prevention and response plans. Construction equipment and construction-camp power generation will use diesel fuel. Diesel storage will include a variety of tank types and sizes ranging from approximately 10,000 to 50,000 gallons. Aviation fuel for helicopters will be stored at the mine site, Diamond Point Port, and other satellite locations as necessary. Fuel will be distributed to the smaller camps and individual work sites from the main storage locations by fuel truck.

5.4.3. Wildlife Management

PLP will develop a Wildlife Interaction Plan management plans to minimize human-wildlife interactions and resolve conflicts. All employees and contractors will receive wildlife education and training as part of their orientation. The U.S. Fish and Wildlife's national bald eagle management guidelines will be followed to the extent practicable to minimize any potential for disturbance or impacts. A nest relocation or non-purposeful take permit will be requested only when work cannot be limited in the vicinity of a protected nest.

Protection of marine mammals will be addressed through the Marine Mammal Protection Act (MMPA) and PLP will follow the requirements of any authorizations issued under the MMPA.

5.4.3.1 Environmental Construction Windows

Work in anadromous fish streams will comply with Anadromous Fish Act regulations, ADF&G guidance, and ADNR lease requirements. Resident fish will require site-specific protections under the Alaska Fish Passage Act. Stream surveys conducted as part of the environmental baseline studies will inform the establishment of permit conditions. Mitigation measures will be determined during the permitting process.

Ground-clearing activities will be conducted prior to construction work and will be timed to avoid bird-nesting periods in accordance with the U.S. Fish and Wildlife Service's Migratory Bird Treaty

Act guidance. Nesting periods are generally spring and summer but vary according to habitats and species.

5.4.3.2 Helicopter Protocols

PLP protocols to ensure that helicopters and fixed-wing planes do not harass wildlife have been well established during the exploration phase of the project. These protocols, listed below, will remain in place throughout construction and the life of the mine.

- Do not harass or pursue wildlife.
- Fly 500 feet above ground level or higher when possible and safe to do so.
- When wildlife (especially bears, caribou, moose, wolves, raptor nests, flocks of waterfowl, seabirds, or marine mammals) are observed, avoid flying directly overhead and maximize lateral distance as quickly as possible.

5.4.3.3 Hunting and Fishing Restrictions

PLP employees and contractors will not be allowed to fish, hunt, or gather while on their work rotation during the construction and operation of the Pebble Project facilities.

6. CLOSURE AND RECLAMATION

PLP's core operating principles are governed by a commitment to conduct all mining operations, including reclamation and closure, in a manner that adheres to socially and environmentally responsible stewardship while maximizing benefits to state and local stakeholders. PLP has adopted a philosophy of "design for closure" in the development of the Project that incorporates closure and long-term post-closure water management considerations into all aspects of the project design to ensure that all regulatory requirements, as well as private landowner obligations, are met at closure.

Considerations incorporated into the project design include:

- A separate pyritic TSF allows potentially acid generating tailings and PAG/ML waste rock to be relocated into the open pit and stored sub-aqueously during closure, preventing acid mine generation from this material and allowing reclamation of the pyritic TSF footprint.
- Quarried and waste rock will be geochemically tested prior to being used in construction to avoid the potential for contaminated drainage during operations and post-closure.
- Growth media and overburden will be salvaged during construction for use as growth medium during reclamation.
- TSF embankment slopes will be 2.6H:1V to provide long-term stability and facilitate the placement of growth medium.
- The overall project footprint will be minimized to facilitate physical closure and post-closure water management.

Reclamation and closure of the Project falls under the jurisdiction of the ADNR Division of Mining, Land, and Water, and the ADEC. The Alaska Reclamation Act (Alaska Statute 27.19) is administered by the ADNR; it applies to state, federal, municipal, and private land and water subject to mining operations. Except as provided in an exemption for small operations, a miner may not engage in a mining operation until the ADNR has approved a reclamation plan for the operation. The landowner participates in the planning process with regard to determining and concurring with the designated post-mining land use.

6.1. PHYSICAL RECLAMATION AND CLOSURE

The physical site closure work will commence as operations end.

- Active mining stops. Pit dewatering rates will be adjusted to maintain water levels in the pit at levels that provide safe access for placement of pyritic tailings and PAG waste rock.
- Pyritic tailings and PAG waste rock will be placed into the pit for long term storage below water. Once the material has been transferred to the open pit, pit dewatering

will cease and the water will be allowed to rise to the maximum management level. The mill, pyritic TSF, main WMP, and other infrastructure not required for post-closure will be removed and/or reclaimed.

- The bulk tailings will have a dry closure and be allowed to fully consolidate. Once runoff is demonstrated to meet water quality criteria it will be directly discharged to the NFK catchment area. Bulk TSF seepage water will be pumped to the WTP.
- Once the open pit water level reaches the maximum management level, dewatering will recommence to maintain the water level, ensuring inward flow of surrounding groundwater and prevent contact water from getting into the groundwater.
- Once physical closure activities are completed, site access infrastructure will be reconfigured to support long-term post closure activities.

All mill and support facilities not required for post-closure, including the pyritic TSF, main WMP, and open pit WMP embankments and liners, will be dismantled and removed. Concrete pads and foundations will be broken up so that they do not act as an impermeable impediment to water flows. Inert materials will be disposed of in an on-site monofill that will be sited within the disturbed footprint, while others will be shipped off site for disposal as appropriate. Disturbed areas will be recontoured, graded, ripped, and scarified. Topsoil and growth media will be placed as needed, and sites will be seeded for revegetation. Surface runoff from the disturbed areas will be collected and either treated in the WTPs or directed to the pit lake until it is found to be suitable for direct discharge to the downstream drainages.

A spillway will be constructed from the bulk TSF. Late in the operating phase, tailings in the bulk TSF will be spigoted to allow for surface drainage toward the closure spillway. As milling operations cease, free water will be pumped from the surface of the bulk tails, and they will be allowed to consolidate until the surface is suitable for equipment traffic on the surface. The tails will be re-graded as needed to facilitate drainage. A capillary break and growth media will be placed over the surface of the tails prior to seeding for revegetation. Growth media will also be placed on the bulk TSF embankments prior to seeding for revegetation.

Seepage water from the bulk TSF embankment seepage collection systems will be collected and directed to the pit lake.

The road system will be retained as long as required for the transport of bulk supplies needed for long-term post-closure water treatment and monitoring. The concentrate and return water pipelines will be pigged and cleaned before being abandoned in place. Surface facilities associated with the pipelines will be removed and reclaimed. The Diamond Point Port facilities will be removed, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies. The natural gas pipeline will be maintained until such time as it is no longer required to provide energy to the project site. If no longer required, the pipeline will be pigged and cleaned before being abandoned in place or removed, subject to the regulatory review and approval at the decommissioning stage of the project. Surface facilities associated with the pipeline will be removed and reclaimed.

6.2. Post-Closure Management

The pit lake will fill during the closure period. Surface runoff from the walls will result in leaching of accumulated metals from the walls. The pit lake is expected to stratify during the closure period with surface waters retaining a neutral to slightly basic pH over time. Water quality parameters showing predictions that exceed discharge limits include hardness and several trace elements (Al, As, Cd, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, and Zn). Pit lake water quality will be monitored, and appropriate precautions will be taken to manage wildlife activity on the lake. Once the level of the pit lake has risen to about 890 feet elevation, water will be pumped from the pit, treated as required, and discharged to the environment. By maintaining the water level at this elevation, which is at least 50 feet below the elevation at which groundwater flow would be directed outward from the open pit, upset conditions resulting in an unplanned discharge can be avoided, as there is time to address any problems with the WTP before flows reverse.

Long-term discharge from the bulk TSF seepage collection systems will be pumped to the WTP.

6.3. Financial Assurance

Prior to commencing construction, the Project Reclamation and Closure Plan approval and associated financial assurance mechanisms will need to be in place. The Reclamation and Closure Plan and financial assurance obligations will be updated on a 5-year cycle in accordance with regulatory requirements to address any changes in closure and post-closure requirements and cost obligations.

A detailed reclamation and closure cost model will be developed to address all costs required for both the physical closure of the Project and the funding of long-term post closure monitoring, water treatment, and site maintenance. The estimate will include the costs of closure planning and design, and mobilization of third-party equipment to site; detailed estimates of equipment and labor requirements for physical closure; capital, sustaining capital, and operating costs for water treatment and other long-term post-closure operations; and appropriate indirect costs and contingencies developed following ADNR guidance.

7. ENVIRONMENTAL PERMITTING

Numerous environmental permits and plans will be required by federal, state, and local agencies. PLP will work with applicable permitting agencies and the State of Alaska large mine permitting team to provide complete permit applications in an orderly manner.

Because the Pebble Project involves a federal permit—U.S. Army Corps of Engineers Section 404/10 permit for the filling of wetlands and placement of structures in navigable waters—the provisions of NEPA will apply to this Project. There are provisions within NEPA, as well as within the permitting processes for many of the individual permits, that will provide for public review and comment on the Project.

Table 7-1 lists the types of permits that are expected to be required for the Pebble Project. Multiple permits of certain types may have to be applied for to accommodate the full scope of facilities.

Table 7-1. Environmental Permits Required for the Pebble Project

Agency	Approval Type	Project-related Examples
Federal		
BATF	License to Transport Explosives	Construction explosives acquisition and use
	Permit and License for Use of Explosives	Construction explosives acquisition and use
BSEE	Right-of-Way Authorization for Natural Gas Pipeline	Subsea natural gas pipeline in OCS waters
DHS	Airport Security Operations Plan	Iliamna Airport
	Port Facility Security Coordinator Certification	Port site
	Port Security Operations Plan	Port site
EPA	Facility Response Plan (required to be submitted to EPA, however EPA does not provide plan approvals)	Fuel storage facilities, fuel transport on the mine roadway
	RCRA Registration for Identification Number	Storage and disposal of hazardous wastes
	Spill Prevention, Control, and Countermeasure (SPCC) Plan (SPCC plans are not required to be submitted or approved by EPA. The plan will be reviewed and certified by a Professional Engineer licensed in Alaska)	Fuel storage facilities

Agency	Approval Type	Project-related Examples
FAA	Notice of Controlled Firing Area for Blasting	Construction and mining blasting activity
FCC	Radio License	Radios
MSHA	Mine Identification Number	Mine site
	Notification of Legal Identity	Mine site
NMFS	Magnuson-Stevens Fishery Conservation and Management Act Consultation documentation	Necessary in areas where mine, road, or port site activity affect essential fish habitat
USACE	Clean Water Act Section 404 permit for Discharge of Dredge or Fill Material into Waters of the U.S.	Fill into wetlands for a variety of facilities at the mine, road, pipelines, port site
	Rivers and Harbors Act Section 10 Construction of any structure in or over any Navigable Waters of the U.S.	Road bridges and causeway; port site docking and ship-loading facilities and maintenance dredging.
USCG	Facility Response Plan	Fuel storage facilities
	Fuel Offloading Plan; Person in Charge Certification	Offloading fuel from barges at the port
	Hazardous Cargo Offloading Plan; Port Operations Manual Approval	Offloading hazardous cargo from ships
	Navigation Lighting and Marking Aids Permit	Port facilities
	Rivers and Harbors Act Section 9 Construction Permit for a Bridge or Causeway across Navigable Waters	Bridge along road
USDOT	Registration for Identification Number to Transport Hazardous Wastes	Transport of hazardous wastes to approved disposal site
USFWS	Bald and Golden Eagle Protection Act Programmatic Take Permit	May be necessary in areas where mine, road, or port site activity may disturb eagles
	Migratory Bird Treaty Act Consultation documentation	May be necessary in areas where mine, road, or port site activity may disturb migratory birds

Agency	Approval Type	Project-related Examples
USFWS/NMFS	Endangered Species Act Incidental Take Authorization	May be necessary at the port site and for sub-sea pipeline construction where activities could disturb northern sea otter, Beluga whale, Steller sea lion, Steller's eider
	Marine Mammal Protection Act Incidental Take Authorization; Letter of Authorization	May be necessary at port site where activities could disturb northern sea otter, Beluga whale, Steller sea lion, harbor seal, Dall's porpoise
State		
ADEC	Alaska Solid Waste Program Integrated Waste Management Permit/Plan Approval	Tailings disposal, waste rock disposal, landfills
	Reclamation Plan Approval and Bonding	Required prior to construction.
	Alaska Solid Waste Program Solid Waste Disposal Permit; Open Burn Permit	Construction waste material disposal
	Clean Water Act Section 402 Alaska Pollutant Discharge Elimination System Water Discharge Permit	Water discharges from water treatment plans at the mine site.
	Approval to Construct and Operate a Public Water Supply System	Mine and port, and construction camps
	Clean Air Act Air Quality Control Permit to Construct and Operate – Prevention of Significant Deterioration	Power plant and other non-mobile air emissions; fugitive dust; applicable to mine, road, and port
	Clean Air Act Title V Operating Permit	Power plant and other non-mobile air emissions; fugitive dust; applicable to mine and road
	Clean Air Act Title I Operating Permit	Non-mobile air emissions; stationary sources, fugitive dust; applicable to port and Kenai compressor station
	Clean Water Act Section 401 Certification	Certification of the Section 404 Permit.
	Clean Water Act Section 402 Stormwater Construction and Multi-Sector General Permit; Stormwater Discharge Pollution Prevention Plan	Surface water runoff discharges at mine, road, and port site
	Food Sanitation Permit	Mine and port, and construction camps

Agency	Approval Type	Project-related Examples
	Oil Discharge Prevention and Contingency Plan (ODPCP or "C" Plan)	Fuel storage and transfer facilities, port and mine
ADF&G	Fish collection permits for monitoring	Required for construction and monitoring
	Fish Habitat Permit	Required for most work in anadromous streams and for most work in resident fish streams that might affect fish passage.
ADNR	Alaska Dam Safety Program Certificate of Approval to Construct a Dam	Tailings dam, seepage control dams
	Alaska Dam Safety Program Certificate of Approval to Operate a Dam	Tailings dam, seepage control dams
	Reclamation Plan Approval and Bonding	Required prior to construction.
	Lease of other State Lands	Any miscellaneous other state lands to be used by the Pebble Project – none identified at this time
	Material Sale on State Land	Materials removed from quarry sites for construction
	Mill Site Permit	All facilities on state lands
	Mining license	All facilities on state lands
	Miscellaneous Land Use Permit	All facilities on state lands
	National Historic Preservation Act Section 106 Review	Area of Potential Effect
	Pipeline Rights-of-Way Lease	Natural gas, concentrate, and water return pipelines on State lands and natural gas pipeline in State waters
	Fiber Optic Cable Right-of-Way Lease	Fiber Optic Cable on State lands and in State waters
	Powerline Right-of-Way Lease	Powerlines to support electric power distribution
	Road Right-of-Way Lease	Road between mine and port site
	Temporary Water Use Permit; Permit to Appropriate Water	Surface and groundwater flow reductions
	Tidelands Lease	Port structures below high tide line
	Upland Mining Lease	All facilities on state lands

Agency	Approval Type	Project-related Examples
ADOL	Certificate of Inspection for Fired and Unfired Pressure Vessels	
ADOT&PF	Driveway Permit	Road
	Utility Permit on Right-of-Way	Natural gas pipeline on the Kenai Peninsula
ADPS	Approval to Transport Hazardous Materials	Transport of hazardous materials along the road
	Life and Fire Safety Plan Check	Mine and port
	State Fire Marshall Plan Review Certificate of Approval	For each individual building
Local		
KPB	Conditional Use Permit	
	Floodplain Development Permit	
	Multi-Agency Permit Application	
L&PB	Lake and Peninsula Borough Development Permit	Mine and road area within the Lake and Peninsula Borough

ADEC = Alaska Department of Environmental Conservation
ADF&G = Alaska Department of Fish and Game
ADOT/PF = Alaska Department of Transportation and Public Facilities
ADPS = Alaska Department of Public Safety
BATF = U.S. Bureau of Alcohol, Tobacco, and Firearms
BSEE = Bureau of Safety and Environmental Enforcement
DHS = U.S. Department of Homeland Security
EPA = U.S. Environmental Protection Agency
FAA = Federal Aviation Administration
FCC = Federal Communications Commission
FERC = Federal Energy Regulatory Commission
L&PB = Lake and Peninsula Borough
MSHA = U.S. Mine Safety and Health Administration
NMFS = National Marine Fisheries Service
RCRA = Resource Conservation and Recovery Act
SHPO = State Historic Preservation Officer
USACE = U.S. Army Corps of Engineers
USCG = U.S. Coast Guard
USDOT = U.S. Department of Transportation
USFWS = U.S. Fish and Wildlife Service