PLAN OF OPERATIONS
PROJECT DESCRIPTION
Donlin Gold Project

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EXECUTIVE SUMMARY

Donlin Gold LLC[1] (Donlin Gold) is proposing the development of an open pit, hardrock gold mine located 277 miles (446 km) west of Anchorage, 145 miles (233 km) northeast of Bethel, and 10 miles (16 km) north of the village of Crooked Creek (Figure 1-1). The proposed Donlin Gold project includes land leased from Calista Corporation (Calista), an Alaska Native Claims Settlement Act (ANCSA) regional corporation that holds the subsurface (mineral) estate for ANCSA lands in the region. In addition to the subsurface estate, Calista owns some surface estate lands in the lease area. A Surface Use Agreement with The Kuskokwim Corporation, an ANCSA village corporation, grants surface use rights.

Bethel, the largest community in western Alaska, is the administrative and transportation center of the Yukon–Kuskokwim Delta. The proposed Jungjuk (Angyaruaq) Port site is about 177 river miles (285 km) upstream of Bethel and about 57 river miles (92 km) upstream of Aniak, the regional transportation center for the middle Kuskokwim Valley.

The gold resource is hosted in intrusive and sedimentary rock in two main areas, Lewis and ACMA, with 80% found in intrusive rock. The proven and probable[2] reserves total 556.5 Mst (504.8 Mt with an average grade of 0.061 Troy ounces per short ton (2.09 grams per tonne). With process plant recovery at approximately 90%, the property would produce an average of over one million Troy ounces of gold annually.

The proposed Donlin Gold project would require three to four years to construct and have an active mine life of approximately 27 years. The mine is proposed to be a year-round, conventional "truck and shovel" operation using both bulk and selective mining methods. The operation would have a projected average mining rate 422,000 stpd (383,000 t/d), or 154 Mstpy (140 Mtpy), and an average process plant production rate of 59,000 stpd (53,500 t/d). Processing plant components include a gyratory crusher, semi-autogenous grinding and ball mills, followed by flotation, concentration, pressure oxidation, and carbon-in-leach process circuits. Conventional carbon stripping and electrolytic gold recovery would produce an end product of gold doré bars, which would be shipped to a custom refinery for further processing. State-of-the-art mercury abatement controls would be installed at each of the major thermal sources, including the autoclave, carbon kiln, electrowinning cell, gold furnaces, and retort.

Tailings storage would encompass an area of 2,351 acres (951 ha) with a total capacity of approximately 335,000 acre-ft (413 Mm^3) of process plant tailings, decant water, and

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[1] Donlin Gold LLC is a limited liability company jointly owned by Barrick Gold U.S. Inc. and NovaGold Resources Alaska, Inc. on a 50/50 basis.

[2] Based on an assessment of qualitative, non-technical factors, Barrick Gold Corporation treats mineralization at Donlin Creek as measured and indicated resources, rather than proven and probable reserves for securities reporting, accounting, and other public disclosure purposes. Mineral Reserves are those parts of Mineral Resources which, after the application of all mining factors, result in an estimated tonnage and grade that is the basis of an economically viable project after taking account of all relevant processing, metallurgical, economic, marketing, legal, environment, socio-economic, and government factors. Mineral Reserves are inclusive of diluting material that will be mined in conjunction with the Mineral Reserves and delivered to the treatment plant or equivalent facility. The term 'Mineral Reserve' need not necessarily signify that extraction facilities are in place or operative or that all governmental approvals have been received. It does signify that there are reasonable expectations of such approvals.

stormwater. Total waste rock material is estimated at 3,145 Mst (2,853 Mt), with approximately 2,460 Mst (2,232 Mt) to be placed in a waste rock facility located outside the mine pit and the remaining waste rock backfilled in the pit.

The proposed project is expected to operate with an overall water surplus; therefore, an important part of the water management strategy for construction and operations is to build a number of diversion structures and actively treat water to further reduce pond storage volumes during operations and at closure. To account for the possibility of a series of successive dry years occurring early in the proposed project life, which could result in a process water shortage, the overall water management plan focuses on the provision of sufficient water storage capacity early in the construction phase of the proposed project. The diversion structures, combined with optimized water use, would limit the volume of water to be treated during operations and remaining at the end of operations.

Electric power for the proposed Donlin Gold project site will be generated on site from a dual-fueled (natural gas as primary and ultra-low sulfur diesel as backup) reciprocating engine power plant with heat recovery.

Natural gas would be transported to the Donlin Gold mine site via a 315 mile (507 km), 14 inch (35.6 cm) diameter buried steel pipeline originating from an existing 20 inch (51 cm) natural gas pipeline near Beluga, Alaska.

General cargo for operations would be transported to Bethel by marine barge from terminals in Seattle, Washington, Vancouver, BC, or Dutch Harbor, Alaska. At Bethel, cargo would be transferred to the dock for temporary storage or loaded onto river barges for transport up the Kuskokwim River to a port constructed at Jungjuk Creek. A 30 mile (48 km) all-season access road would be constructed from the proposed Jungjuk (Angyaruaq) Port to the mine site.

Fuel would be transported to Dutch Harbor by tanker, then to Bethel by marine barge. At Bethel fuel would either be transferred directly to double-hull river barges for transport to Jungjuk, or be off-loaded for temporary storage. From Jungjuk Port fuel would be delivered to the mine site fuel storage facility by tanker trucks.

The proposed Donlin Gold project would be a permanent camp operation accessible primarily by a 5,000 foot (1,524 m) gravel airstrip. The camp would be capable of housing 638 workers.

Reclamation and closure planning has been based on the concept of “design for closure,” which was initiated in the very early stages of the Donlin Gold project development to address post-closure impacts on the physical resources of the area and on local communities. In addition to reclaiming disturbances associated with mining, processing, and ancillary support facilities in a manner compatible with the designated post-mining land use, the goal of the Donlin Gold reclamation plan is to minimize the area affected by operations. During operations, concurrent reclamation would be performed whenever possible in areas no longer required for active mining.

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ACRONYMS

ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
ANCSA	Alaska Native Claims Settlement Act
ANFO	ammonium nitrate and fuel oil
APDES	Alaska Pollutant Discharge Elimination System
BATF	U.S. Department of Justice Bureau of Alcohol, Tobacco and Firearms
BLM	U.S. Department of Interior Bureau of Land Management
Calista	Calista Corporation
CCD	counter current decant
CIL	carbon-in-leach
CSIA	Closure Social Impact Assessment
CWD	contact water dam
Donlin Gold	Donlin Gold LLC
EAP	Emergency Action Plan
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FWDD	fresh water diversion dam
HDPE	high-density polyethylene
ISO	International Organization for Standards
LLDPE	linear low-density polyethylene
MSHA	U.S. Department of Labor Mine Safety and Health Administration
NAG	non-acid generating
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
ODPCP	Oil Discharge Prevention and Contingency Plan
OHSA	U.S. Department of Labor Occupational Health and Safety Administration
PAG	potentially acid generating
PDUS	Placer Dome U.S.
POX	pressure oxidation
RC	reverse circulation
RO	reverse osmosis
ROD	Record of Decision
ROW	right-of-way
SAG	semi-autogenous grinding
SRS	seepage recovery system
SUA	surface use agreement
TKC	The Kuskokwim Corporation
TSF	tailings storage facility
ULSD	ultra-low-sulfur diesel
USACE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service

WAD	weak acid dissociable
WRF	waste rock facility
WTP	water treatment plant

ELEMENTS AND COMPOUNDS

CaO	calcium oxide (quicklime)
$CuSO_4$	copper sulfate
$KMnO_4$	potassium permanganate
MIBC	methyl isobutyl carbinol
Na_2CO_3	soda ash
NaOH	sodium hydroxide
$Na_2S_2O_5$	sodium metabisulfite
PAX	potassium amyl xanthate
SO_2	sulfur dioxide
SO_2/Air	sulfur dioxide cyanide detoxification process

UNITS OF MEASURE

°	degree
cm	centimeter
ft	feet/foot
gal	U.S. gallon
ha	hectare
hp	horsepower
kg	kilogram
kg/t	kilogram per ton
km	kilometer
km^2	square kilometer
kV	kilovolt
kW	kilowatt
L	liter
lb	pound
m	meter
m^3	cubic meter
m^3/h	cubic meter per hour
mil	thousandth of an inch
mm	millimeter
Mgal	million U.S. gallons
Mm^3	million cubic meters
ML	million liters
Mst	million short tons
Mt	million tonnes
Mstpy	million short tons per year
MW	megawatt
st	short ton (2,000 pounds)
stpd	short tons per day
stph	short tons per hour
t	tonne (1,000 kg)
t/d	tonnes per day
t/h	tonnes per hour
µm	micron
yd^3	cubic yard

1.0 INTRODUCTION

This Project Description provides an overall description of the Project and a summary of information from the documents that comprise the Plan of Operations. The comprehensive Plan of Operations includes the following volumes:

- Volume I: Project Description
- Volume II: Water Resources Management Plan
- Volume III: Integrated Waste Management Plan
  - Volume IIIA Tailings Management Plan
  - Volume IIIB Waste Rock Management Plan
- Volume IV: Reclamation and Closure Plan
- Volume V: Dam Safety Program Plans
  - Volume VA: Tailings Storage Facility (TSF) Operations & Maintenance (O&M) Manual
  - Volume VB: TSF Emergency Action Plan (EAP)
  - Volume VC: Snow Gulch O&M Manual
  - Volume VD: Snow Gulch EAP
- Volume VI: Transportation Plan
  - Volume VIA: Terminal and Tank Farm Oil Discharge Prevention and Contingency Plan (ODPCP)
  - Volume VIB: Vessel Operations ODPCP
- Volume VII: Monitoring Plans
  - Volume VIIA: Integrated Waste Monitoring Plan
  - Volume VIIB: Alaska Pollutant Discharge Elimination System (APDES) Permit Monitoring Plan
  - Volume VIIC: Aquatic Resources Monitoring Plan

1.1 Plan Revisions

This Project Description may be revised periodically during construction and operations as additional data or information becomes available. Revisions may also be warranted based on technological developments, changes to the project design, or other information. Table 1-1 provides a record of these changes.

Table 1-1: Record of Changes and Amendments

Date	Section (s) Revised or Amended

1.2 Property Description

1.2.1 Location

The proposed Donlin Gold project is approximately 277 miles (446 km) west of Anchorage, 145 miles (233 km) northeast of Bethel, and 10 miles (16 km) north of the village of Crooked Creek (Figure 1-1). Bethel, 73 river miles (117 km) upstream from the mouth of the Kuskokwim River on the Bering Sea, is the regional center for the Yukon–Kuskokwim region of Alaska. Bethel is 177 river miles (285 km) southwest of the proposed Jungjuk Port site. The city of Aniak, also on the Kuskokwim River, approximately 57 river miles (92 km) southwest of the proposed Jungjuk Port site, is the regional center for the middle Kuskokwim Valley (Figure 1-1).

Currently there is no road or rail access to the site, and all personnel and supplies are transported by air. The project is completely isolated from existing power and other infrastructure.

1.2.2 Site Description and Physiographical Features

The proposed project site lies in an area of low-lying, well-rounded ridges on the western slopes of the Kuskokwim Mountains, at elevations ranging from 500 to 2,100 ft (152 to 640 m). Area vegetation is typically hard shrubs and small trees. Hillsides are forested with black spruce, alder, birch, and larch. Soft muskeg and discontinuous permafrost can be found in poorly drained areas at lower elevations. The area has a relatively dry interior continental climate with an average annual precipitation of 19.6 inches (499 mm) and potential evaporation/sublimation of 14.6 inches (370 mm). Summer temperatures are relatively warm and may exceed 83°F (28°C). Minimum temperatures may fall to -45°F (-43°C) during the winter months.

The existing exploration camp at the site is an all-season facility that can accommodate a workforce of up to 160 people engaged in exploration, environmental, geotechnical, and engineering studies. At present there is no overland access to the project site. All equipment, supplies, and personnel are transported by air to an existing 5,000 ft (1,524 m) airstrip capable of handling aircraft as large as a C-130 Hercules. The project site is currently serviced by charter air services out of Anchorage and Aniak.

- Populated Place
- Proposed Natural Gas Pipeline Alignment
- Proposed Infrastructure Layout
- Federal Administrative Boundaries
- State Administrative Boundaries

Seward Meridian, UTM Zone 5, NAD83

SCALE:

0 12.5 25 50 mi

0 20 40 80 km

DONLIN GOLD

PROJECT LOCATION MAP

DONLIN GOLD PROJECT

FIGURE:

1-1

DG: PER540.mxd, 10/05/16, R01

1.2.3 Project Land Status

The proposed Donlin Gold project includes land leased from Calista Corporation (Calista), an Alaska Native Claims Settlement Act (ANCSA) regional corporation that holds the subsurface (mineral) estate for ANCSA lands in the region. Titles to all of the sections in the lease area have been conveyed to Calista. In addition to the subsurface estate, Calista owns some surface estate lands in the lease area. A Surface Use Agreement (SUA) with The Kuskokwim Corporation (TKC), an ANCSA village corporation, grants surface use rights.

The currently identified mineral resource and the bulk of the primary infrastructure (mill and waste rock facilities) lie on the leased lands. Additional lands required for the Jungjuk Port site, road to the port site, gas pipeline, and tailings storage facility in Anaconda Creek lie on a combination of Native, State of Alaska, and U.S. Department of Interior Bureau of Land Management (BLM) lands (Figure 1-2).

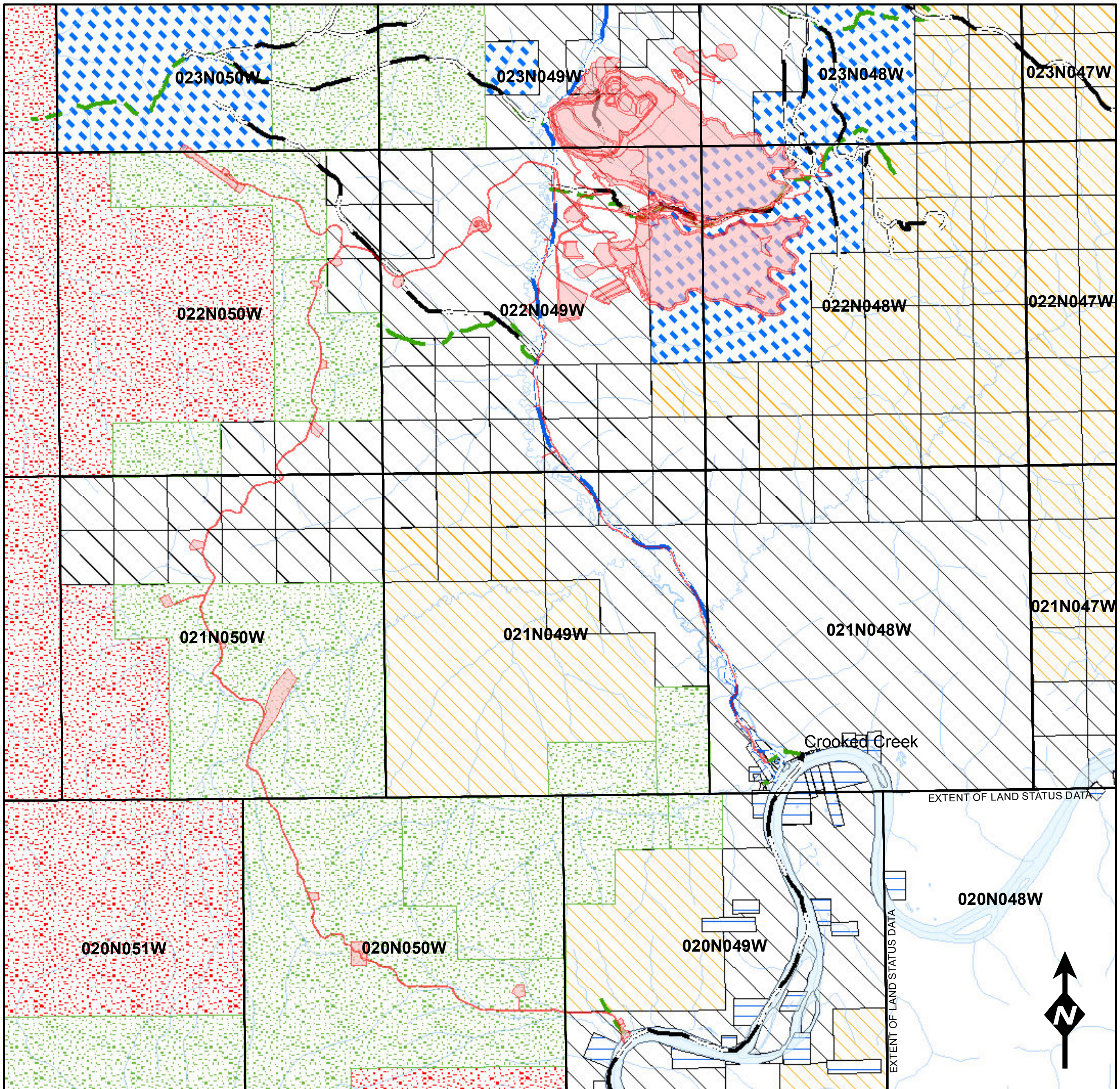
Rights-of-way would be required from the State and the BLM for the road and pipeline alignments where they cross state and federal lands, respectively.

Lyman Resources in Alaska, Inc. (“Lymans”) has title to approximately 13 acres (5.26 ha) of surface estate within the Snow Gulch area. Donlin has a lease agreement with the Lymans that provides Donlin with legal control of the land.

All exploration activities on leased lands are covered under the terms of the lease agreement with Calista and the SUA with TKC. Exploration and geotechnical drilling operations on the property are currently permitted on an “as needed” basis.

1.2.4 History

Placer gold was first discovered at Snow Gulch, a tributary of Donlin Creek, in 1909. Resource Associates of Alaska carried out a regional evaluation for Calista in 1974 to 1975, identifying mineral potential in the area. Calista prospected the area and conducted limited exploration activities in 1984. The first substantial exploration program was carried out by Westgold in 1988 to 1989. Teck operated the project briefly in 1993. Placer Dome U.S. (PDUS) explored the property from 1995 to 2000, formed the Donlin Creek Joint Venture (DCJV) with NovaGold as operator in 2001, and then reassumed management of the DCJV as operator in February 2003. Barrick Gold acquired Placer Dome in 2006 and in so doing acquired the PDUS interest in the DCJV. In December 2007, Donlin Creek LLC was formed as a limited liability company with 50/50 ownership by Barrick Gold U.S. and NovaGold Resources Alaska, Inc. In 2011, Donlin Creek LLC changed its name to Donlin Gold LLC.



Federal Land

Federal Land, ANCSA Sec. 17(d)(1) withdrawals for classification and study

Other Land

Patented Private Trade and Manufacturing Sites, Homesites and Homesteads

State Land

State-Owned. Tentatively Approved (TA) or Patented Lands

General Grant Selections

State-Leased Airport Facility at Crooked Creek. Surface owned by Kuskokwim Corp., subsurface owned by Calista.

ANCSA Selections and Conveyances

Calista Corporation Interim Conveyed [14(h)(8)] or Patented Land

Kuskokwim Corp. (surface) and Calista Corp. (subsurface) Patented or Interim Conveyed Lands

Native Allotments

Approximate locations (Certified & Applications)

ROW & Easements

Alaska Omnibus Act Right of Way — Alaska Omnibus Act Right-of-Way State-Owned FAS Route 231 Crooked Creek to Iditarod Note: ANCSA title subject to this R/W.

RST — State-Identified RS 2477 Public Rights-of-Way Note: These Rights-of-Way may or may not be legally valid.

ANCSA Sec. 17(b) Public Trail Easements (EIN) — ANCSA Sec. 17(b) Public Easements Note: Use and weight restrictions apply.

SCALE:

0 1 2 4 mi

0 1.5 3 6 km

DONLIN GOLD

REGIONAL LAND STATUS

DONLIN GOLD PROJECT

FIGURE: 1-2

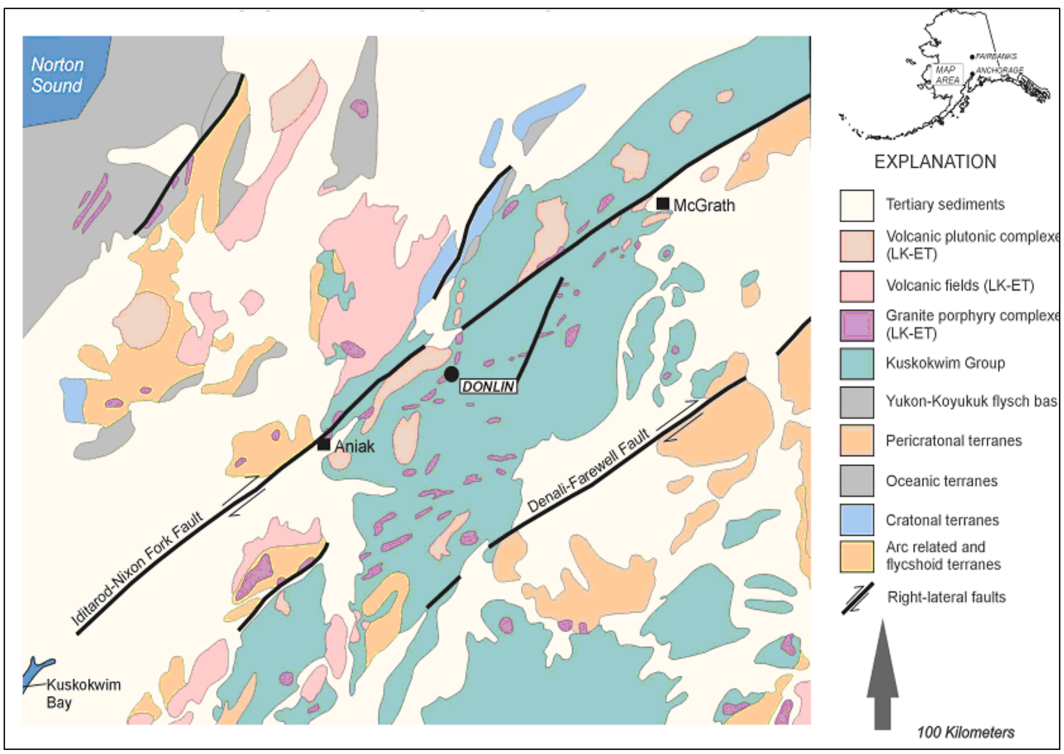
DG: PER0032_A.mxd, 07/17/12, R04

From 1988 through 2010, a total of 1,834 exploration and development diamond core and reverse circulation (RC) drill holes have been completed, for an aggregate 1,337,321 ft (407,720 m).

1.2.5 Regional Geology

The Donlin Gold deposit lies in the Kuskokwim basin, which consists primarily of a thick sequence of clastic sedimentary rocks of the Upper Cretaceous Kuskokwim Group. The sedimentary rocks accumulated between a series of Proterozoic- to Mesozoic-age amalgamated terranes and are cut by the northeast-trending Iditarod-Nixon Fork and Denali-Farewell strike-slip faults (Figure 1-3). The Kuskokwim Group is intruded by Late Cretaceous to Early Tertiary granitic volcano-plutonic complexes and by "granite porphyry" dikes, sills, and stocks. The granite porphyry rocks were emplaced within or near northeast-trending fault zones and are often associated with placer and lode gold occurrences (e.g., Donlin Gold).

Figure 1-3: Regional Geology of the Proposed Project Area



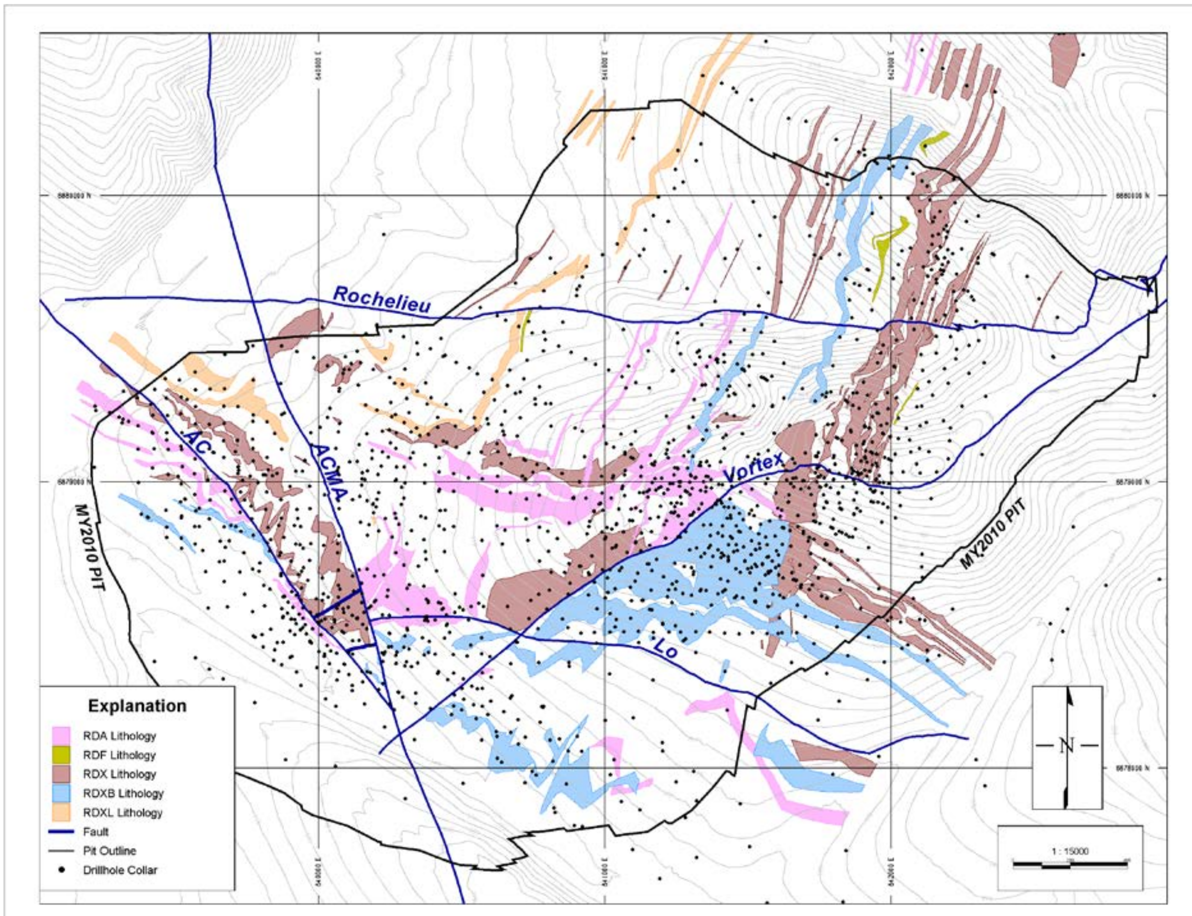
1.3 Project Geology and Resource Estimate

The current geological model and gold resource estimate are based on an aggregate of more than 15 years of exploration work. The data referenced for this report include mapping, sampling, drilling, resource modeling, and other geological studies completed through 2010.

The proposed Donlin Gold project area is underlain by Kuskokwim Group sedimentary rocks and granite porphyry. The sedimentary rocks are broadly folded and generally dip 10° to 50° southwest. Lithic sandstone is the most common sedimentary rock type, but intercalated siltstone and shale increase in the southern part of the resource area. Igneous rocks consist primarily of five textural variations of granite porphyry, locally called rhyodacite (Figure 1-3). Northerly dipping thrust faults are cut by northeast- and northwest-striking strike-slip faults. Steeply southeast dipping, north-northeast-striking fractures provided the primary fluid channels for gold-bearing hydrothermal solutions. The interpreted property geology is shown in Figure 1-4 and Figure 1-5. Cross-sections through the Lewis and ACMA deposit areas are shown in Figures 1-6 and 1-7.

The northeast elongated, roughly 5,000 ft wide x 10,000 ft long (1.5 km x 3 km), cluster of gold deposits has an aggregate vertical range that exceeds 2,800 ft (850 m). The deposits are hosted primarily in igneous rocks and are associated with an extensive Late Cretaceous gold-arsenic-antimony-mercury hydrothermal system. Gold occurs in broad, disseminated sulfide zones in rhyodacite and minor mafic intrusive rocks, and in sulfide and quartz-carbonate-sulfide vein networks in igneous and sedimentary rocks. Sub-microscopic gold is contained primarily in arsenopyrite and secondarily in pyrite and marcasite.

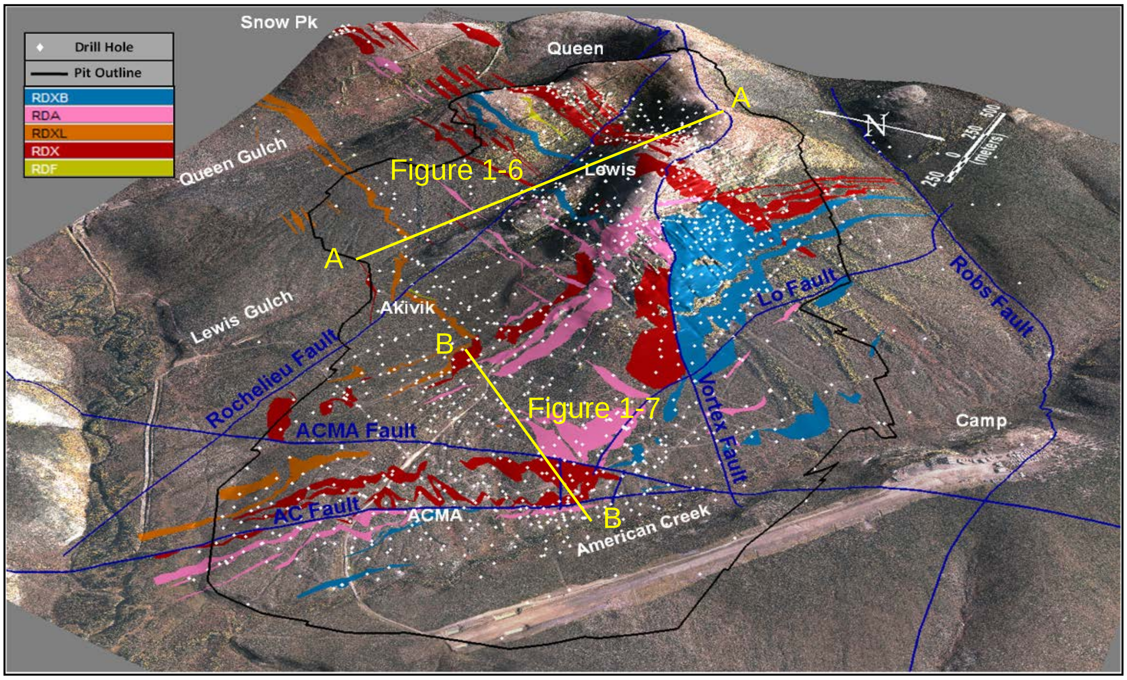
Figure 1-4: Interpreted Donlin Gold Geology



Note: Shows igneous rocks, faults, and gold prospects.

RDA – aphanitic porphyry
RDX – crowded porphyry
RDXL– lathe rich porphyry
RDXB – blue porphyry

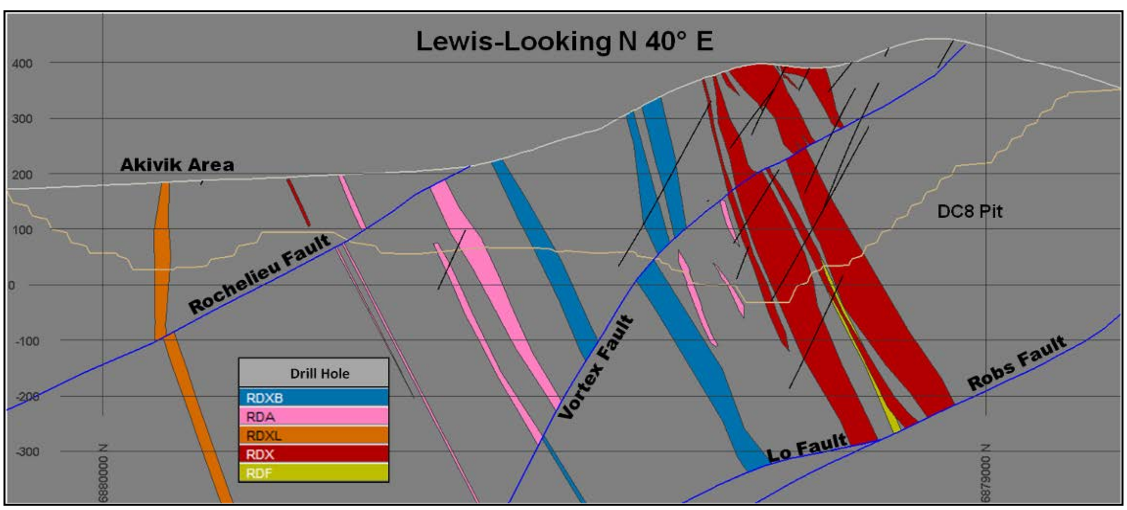
Figure 1-5: Interpreted Surface Geology of the Donlin Gold Resource Area



Note: Shows igneous rocks, faults, and gold prospects.

RDA – aphanitic porphyry
RDX – crowded porphyry
RDXL- lathe rich porphyry
RDXB – blue porphyry

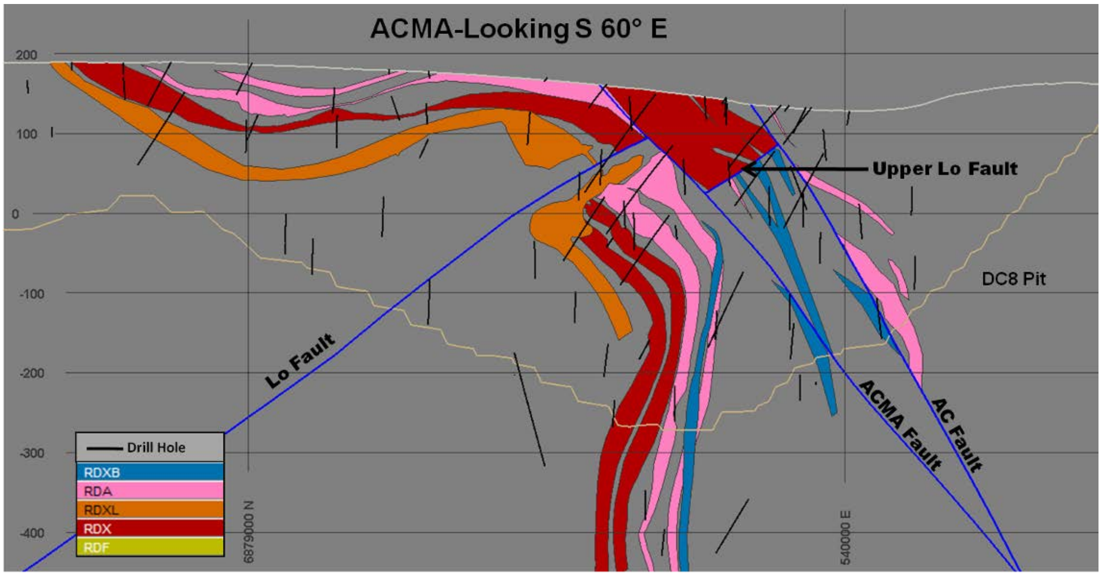
Figure 1-6: Lewis Area Section ("A" Cross Section)



Note: Shows intrusive rocks, faults, drill holes, and proposed pit, looking north-easterly.

RDA – aphanitic porphyry
RDX – crowded porphyry
RDXL- lathe rich porphyry
RDXB – blue porphyry

Figure 1-7: ACMA Area Section ("B" Cross Section)



Note: Shows intrusive rocks, faults, drill holes, and proposed pit, looking south-easterly.
Shows igneous rocks, faults, and gold prospects.
RDA – aphanitic porphyry
RDX – crowded porphyry
RDXL- lathe rich porphyry
RDXB – blue porphyry

2.0 MINE COMPONENTS

2.1 Basic Design Information

The main components and systems of the proposed Donlin Gold project are listed in Table 2-1. The table includes design values, equipment details, and brief descriptions of the process circuits.

Table 2-1: Basic Design Information for Donlin Gold Project

Item / Parameter	Value / Description
PROJECT MINE LIFE	Approximately 27 years
WORK FORCE	
Construction phase	Up to 2,560
Natural gas pipeline construction	650
Permanent	600 to 1,000
Living accommodations	On site
OPERATIONAL PERIOD	
Daily	24 hours
Annual	365 days
PRODUCTION RATE	
Nominal mill throughput	59,000 stpd (53,500 t/d)
Based on 92% availability	19.8 Mstpy (18 Mt/a)
PIT DIMENSIONS	
Pit footprint	Approximately 2.2 miles long x 1 mile wide (3,470 m x 2,543 m). Covers 1,462 acres (592 ha)
Lewis pit depth	1,653 ft (504 m) from upper highwall to final pit bottom
ACMA pit depth	1,850 ft (564 m) from upper highwall to final pit bottom
Bench height	40 ft (12 m)
Spilt bench height	20 ft (6 m)
Overall slope angle	23°to 42
ORE AND DEVELOPMENT ROCK	
Ore	556 Mst (505 Mt)
Development rock (waste)	3,145 Mst (2,853 Mt)
Average tons mined during production	422,000 stpd (383,000 t/d)
Strip ratio average	5.5:1.0 (waste to ore)
Overburden stockpiles	46.6 Mst (42.1 Mt)
Waste rock used for construction	100 Mst (91 Mt)
Waste rock stored in waste rock facility (WRF)	2,460 Mst (2,232 Mt)
Waste rock backfilled to pit	467 Mst (424 Mt)
PRIMARY MINING EQUIPMENT OVER MINE LIFE	
Electric hydraulic shovels	6 x 50 yd^3 (38 m^3)
Diesel hydraulic shovel	1 x 50 yd^3 (38 m^3)
Front-end loaders	2 x 53 yd^3 (41 m^3)
Haul trucks	69 x 400 st (360 t)
Haul trucks	10 x 150 st (136 t)
CRUSHING/CONVEYING	

Item / Parameter	Value / Description
Gyratory crusher	60 x 89 inches (152 x 226 cm)
Crush size	80% passing 5 inches (13 cm)
Conveyor	54 inches wide x 0.72 miles long (1.4 m x 1.2 km)
Covered stockpile live capacity	42,000 st (38,000 t)
Covered stockpile total capacity	192,000 st (174,200 t)
PROCESSING	
Semi-Autogenous Grinding (SAG) mill	
Size	38 ft diameter x 25 ft long (11.6 x 7.6 m)
Drive	Powered by 26,800 hp (20 MW) wrap-around variable-speed drive
Pebble crusher (cone crusher) drive	1,006 hp (750 kW)
Ball mills	One primary and one secondary regrind mill
Size	26 ft diameter x 45 ft long (7.9 x 13.7 m)
Drive	Trunnion-supported 24,140 hp (18 MW) wrap-around
Cyclone clusters	
Primary cyclones	12 x 33 inches (30 x 84 cm)
Secondary cyclones	28 x 15 inches (71 x 38 cm)
Flotation circuit	
Residence time	114 minutes
Primary rougher flotation circuit	2 trains, 11 cells each
Secondary rougher flotation circuit	2 trains, 11 cells each
Rougher flotation	
Primary acid conditioning tank	Copper sulfate ($CuSO_4$) added to promote sulfide flotation
Secondary conditioning tank	Methyl isobutyl carbinol (MIBC) frother and potassium amyl xanthate (PAX) collector added
Primary rougher concentrate	Sent to concentrate thickener
Rougher tails	Sent to secondary ball mill for regrind before secondary flotation, cleaner flotation, and final cleaner scavenger flotation
Grind	80% passing 270 mesh (50 µm)
Secondary rougher and cleaner scavenger tails	Sent to flotation tails thickener and then to the TSF
Autoclaves	2 units: parallel operation with 50-minute retention time each to convert sulfide flotation concentrate slurry to oxide concentrate slurry at high temperature and pressure, and with sulfuric acid
Solid/liquid separation	Solids report to leach; acidic overflow solution neutralized with flotation tailings and lime
Carbon-in-leach (CIL)	6 tanks in series, 24-hour retention time
Carbon stripping	Conventional
Gold recovery	Electrolytic
Overall gold recovery	Approximately 90%
CIL slurry	Sent to cyanide detoxification circuit
Tailings	Discharged to TSF at 36% solids by weight
TSF	
Capacity	568 Mst (515 Mt)
Tailings density	78.0 lb/ft^3 (1.25 t/m^3)

Item / Parameter	Value / Description
Size	2,351 acres (951 ha)
Features:	
Cross-valley dam	
Ultimate height measured from downstream toe to crest	471 ft (142 m)
Ultimate length from north abutment to south abutment	5,863 ft (1,787 m)
Linear low-density polyethylene (LLDPE) synthetic liner	60 mil (1.5 mm)
Seepage collection system	Pond, diversion ditches, collection wells
Zero-discharge facility	
Water reclaim to process plant	Reclaim barges and pipeline
Temporary freshwater reservoirs	2 reservoirs directly east of TSF back dam to control water during early construction of TSF starter dam (first three years)
NATURAL GAS PIPELINE	
Dimensions	315 miles (507 km) x 14 inch (36 cm) diameter
Origin	Cook Inlet, Alaska
Natural gas use	Fuel source for generating electricity, heating, and processing ore
POWER	
Total connected load	227 MW
Engines	12 dual fuel (natural gas or ultra-low sulfur diesel [ULSD]) combined-cycle reciprocating type with heat recovery providing steam to one heat recovery steam turbine generator
Emergency power	6 gensets (2 Powerplant black start generators, 4 camp backup generators)
Average running load	153 MW
Average natural gas consumption	10.8 ft^3 (307 Mm^3) per year
Generators at the Jungjuk Port site	2 x 600 kW, one primary, one standby
Generators at the airstrip	2 x 200 kW, one primary, one standby
WATER SUPPLY	
Water supply for processing	Contact water pond, dewatering wells, and freshwater reservoirs
If not required for process:	
Water from pit perimeter dewatering wells	To be treated to meet expected effluent limits before being discharged
Storm water collected in diversion ditches and areas not in contact with waste rock, mine pit, or process solutions	To be released
Potable water	
Temporary construction and permanent camp	8 wells
Jungjuk Port	1 well
WATER TREATMENT	
Construction Camp/Mill Area Sewage Treatment Plant	Modular conventional wastewater treatment plant
Permanent Camp Sewage Treatment Plant	Conventional wastewater treatment plant

Item / Parameter	Value / Description
Mine Site Water, Construction	Modular treatment plant
Mine Site Water, Operations	Clarification, oxidation and greensand filtration, with reverse osmosis (RO) as required
INFRASTRUCTURE	
Gravel airstrip	5,000 ft long x 150 ft wide (1,524 x 45 m)
Jungjuk Port Location	8 miles (13 km) downriver from Village of Crooked Creek on Kuskokwim River
Jungjuk Port to Mine Access Road	Approximately 30 miles (48 km) long
MAJOR CONSUMABLES (Average Annual)	
ULSD	40 Mgal (151 ML)
Borax	61 st (55 t)
Sodium Hydroxide	332 st (301 t)
Copper Sulfate	2,436 st (2,210 t)
PAX	4,306 st (3,906 t)
Activated Carbon	159 st (144 t)
Antiscalent	259 st (235 t)
Magnafloc 351 (Flocculant)	2,648 st (2,402 t)
Flocculant (AF 304)	1,014 st (920 t)
Fluorspar (Glass Grade)	11 st (10 t)
MIBC/F549 (Frothers)	2,500 st (2,268 t)
Ammonium Nitrate	39,069 st (30,000 t)
Potassium Nitrate	48 st (44 t)
Lime (CaO, Quicklime)	42,836 st (38,860 t)
Manganese Dioxide	22 st (20 t)
Microsand	7.7 st (7 t)
Nitric Acid	667 st(605 t)
Silica Sand	48 st (44 t)
Sodium Cyanide	2,618 st (2,375 t)
Sodium Nitrate	54 st (49 t)
Cytec E40 (Dispersant)	54 st (49 t)
Elemental Sulfur (Prills)	1,444 st (1,310 t)
Liquefied CO^2	376 st (333 t)
Ferric Sulfate	1,305 st (1,184 t)
UNR	169 st (153 t)
Sulfuric Acid 98%	787 st (714 t)
Potassium Permanganate	35 st (32 t)
Sodium Metabisulfite	17.6 st (16 t)
Sulfur Impregnated Carbon	46 st (42 t)

2.2 Mining

2.2.1 Mining Methods and Phases

The proposed Donlin Gold deposit would be mined by a combination of bulk and selective mining methods. RC drilling would be the primary source of ore control samples, and blasthole sampling would be done for waste characterization. The open pit mine design and production schedule were developed for a nominal process plant throughput of 59,000 st (53,500 t) of ore per day, 21.5 Mst (19.5 Mt) per year, after an approximate 2-year ramp-up period. The estimated active mine life is approximately 27 years. A combination of 20 ft (6 m) and 40 ft (12 m) bench heights would be used in mine planning to yield a relatively high mining rate while allowing for more selective mining in complex ore zones.

The resource is divided into two main areas, ACMA and Lewis. The pits have similar mineralization characteristics, with ore-grade gold hosted in both intrusive and sedimentary rock units. The grade of the gold mineralization in ACMA is higher than in the Lewis area. ACMA would be mined in nine phases and Lewis in six. The initial phases of the two pits are independent, but they partially merge later in the mine life (Figure 2-1).

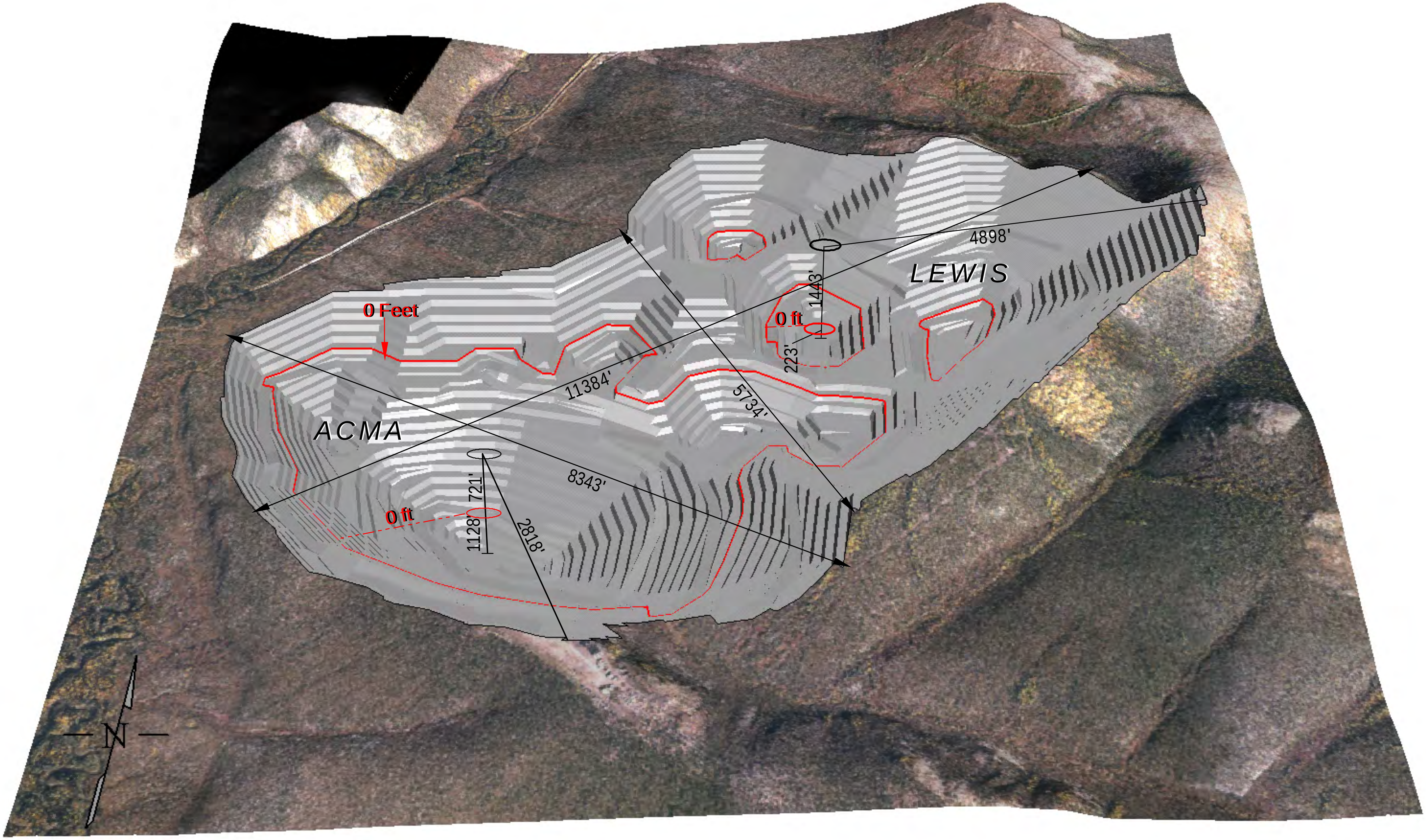
Water management plans include surface ditches, a contact water pond immediately upstream of the pit, plus diversion systems further upstream to control surface waters in the pit and WRF. Dewatering systems consisting of vertical dewatering wells, horizontal drains, and in-pit sump pumps would be needed to manage groundwater within the ACMA and Lewis pits.

Water from pit dewatering wells would be used as process plant make-up water when needed. When none is used as make-up water, the pit well water would be pumped to a water treatment plant (WTP), then treated, and released to Crooked Creek.

2.2.2 Loading and Hauling Equipment

The predicted primary mining fleet over the life of mine includes:

- six 50 yd^3 (38 m^3) electric hydraulic shovels
- one 50 yd^3 (38 m^3) diesel hydraulic shovel
- two 53 yd^3 (41 m^3) front end loaders
- sixty-nine 400 st (360 t) haul trucks
- ten 150 st (136 t) haul trucks.



Note:
- Pit Design - MY2010 Ultimate Pit
- Measurements are approximated
- Contour lines = 12 meters

SCALE:

NOT TO SCALE

DONLIN GOLD

PIT DESIGN CONCEPT

DONLIN GOLD PROJECT

FIGURE:

2-1

DG: PER0004.mxd, 10/25/11, R03

Initial pioneering and pit development during the preproduction period would be accomplished with wheel loaders, dozers, a drill, and 150 st (136 t) haul trucks. The preproduction objective would be to remove the overburden, develop mine access roads suitable for large mining equipment, and prepare the initial pit for large hydraulic shovels and mining equipment. During operations, hydraulic shovels would be the primary loading equipment, supported by front-end loaders. Haul roads would be required between the pit phases and the ore crusher, WRF, overburden stockpiles, construction areas, and truck shop.

Auxiliary mine equipment includes blast hole drills, blasting emulsion trucks, track dozers, rubber-tired dozers, lube and service trucks, transport vehicles, and small trailer-mounted light plants. The auxiliary fleet would be used for road and bench development and maintenance, constructing the WRF, landfill trench maintenance, and miscellaneous projects. A fleet of graders would maintain the roads. Water trucks would be used to spray roads and working areas for dust control.

2.2.3 Blasting

It is anticipated that blasting agents would consist of 70% emulsion and 30% ammonium nitrate and fuel oil (ANFO), based on projected moisture conditions. There would be seven different blasthole patterns based on bench height, hardness of material, and type of material (i.e., ore, waste, or overburden). Table 2-2 provides an example of specifics on blasting criteria.

An explosives contractor may be engaged to provide blasting services and supply the explosives, emulsion plant, blasting accessories, explosives magazines, mixing equipment, and delivery trucks. The contractor could also provide a “down-the-hole” blasting service.

Table 2-2: Blasting Criteria

Bench Height		Blasting Condition	Blasthole Size		Pattern		Explosives Weight per Hole*	
(ft)	(m)		(inches)	(mm)	(ft x ft)	(m x m)	(lb)	(kg)
40	12	Hard	6.5	165	16 X 18	4.8 x 5.5	551	250
40	12	Soft	6.5	165	17 x 19	5.1 x 5.9	551	250
40	12	Hard	7.8	200	19 x 22	5.7 x 6.6	798	362
40	12	Soft	7.8	200	20 x 23	6.1 x 7.0	798	362
20	6	Hard	5.5	140	13 x 15	4.1 x 4.7	168	76
20	6	Soft	5.5	140	14 x 19	4.4 x 5.1	168	76
40	12	Bulk	9.8	251	23 x 26	7.0 x 8.0	1,179	535

*70% emulsion/30% ANFO blend explosive

2.2.4 Waste Rock Facility and Overburden Stockpile

This section summarizes waste rock management. More detailed information can be found in the *Waste Rock Management Plan, Volume IIIB,* SRK 2016a. Waste rock from the pit would be placed in the WRF east of the pit area (Figure 2-2). The waste rock would also be used as construction material for haul roads, and as backfill in the ACMA pit. Sufficient overburden would be stored separately for use in final site reclamation; the remainder would be placed into the WRF or used for construction.

Overburden stockpiles would be located on the north and south sides of the open pit (Figure 2-2). The North Overburden Stockpile will primarily contain “fine grained” material consisting of organic material (i.e., woody debris, and peat), loess, and alluvium. The perimeter of the stockpile would be bermed to channel storm water runoff to a settling pond prior to release. This material would be used for the final reclamation growth media cover to revegetate the reclaimed areas. The South Overburden Stockpile would be located immediately south of Omega Gulch and contain “coarse grained” consisting of colluvium and terrace gravels. The South Overburden Stockpile would be bermed and storm water and seepage collected would be pumped to the Lower contact water dam (CWD).

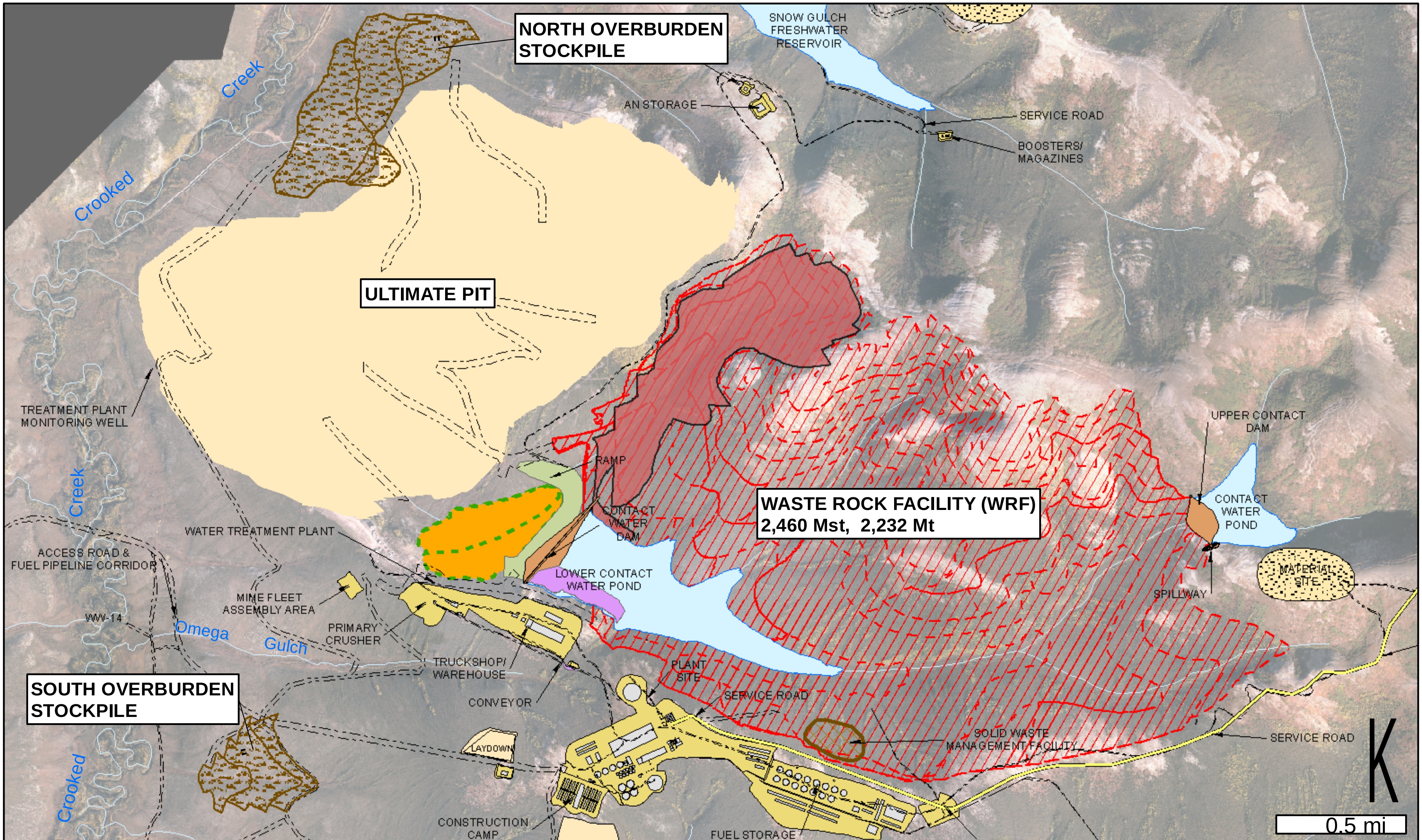
The WRF would be constructed in the American Creek valley, immediately east of the open pit. The ultimate footprint of the facility would cover an area of approximately 3.5 square miles (9 km^2) to contain approximately 2,460 Mst (2,232 Mt) of waste rock. The materials placed in the WRF would consist primarily of a mixture of siltstones, shales, and greywackes, with lesser amounts of intrusive rock. Up to 8% of the materials placed in the WRF, by volume on an annual basis, would be overburden. This would include approximately 46 Mst (41 Mt) of overburden not required for reclamation purposes.

The WRF would be developed entirely from the bottom up. Construction of the first lift would begin at the start of the preproduction period. Most of the WRF would be constructed in 100 ft (30 m) lifts. The toe of each subsequent lift would be set back 155 ft (47 m) from the crest of the previous lift, resulting in an overall dump angle of 3H:1V. The elevation of the top lift of the WRF would be approximately 1,705 ft (520 m) above mean sea level, resulting in a maximum dump height of about 1,115 ft (340 m) and maximum thickness of about 985 ft (300 m).

The waste rock has been characterized by its potential for acid generation, as determined by acid base accounting (ABA)[3], and has been assigned reactivity categories (Table 2-3). Categories 1 to 4 are non-acid generating (NAG), and 5 to 7 are potentially acid generating (PAG). PAG-7 rock could potentially start producing acid in less than a few years, PAG-6 in less than a decade, and PAG-5 after several decades. The NAG and PAG-5 rock would be blended together for disposal in the WRF because the NAG rock has enough neutralization ability to balance the PAG-5 reactivity (SRK 2011). PAG-6 rock would be managed in isolated cells constructed in the WRF, primarily in an area called Rob’s Gulch.

[3] Acid-Base Accounting (ABA) is the balance between acid production and acid consumption (neutralization) properties of mine waste material.

An engineered, compacted cover of terrace gravels would be placed over the PAG-6 waste to minimize the amount of water that contacts the PAG material. Once mining has progressed and areas of the pit are available to be backfilled, any PAG-6 rock mined subsequently would be placed in these backfill dumps. PAG-7 rock would be temporarily stored in the low-grade stockpile area until the pit backfill dumps become available or the material is classified as ore. At closure, the pit would be inundated, submerging all backfilled waste rock.



Natural Gas Pipeline
Streams
Ultimate Pit
Waste Rock Facility
Ore Stockpile
Material Site
Solid Waste
Berm
Building
Facility
Laydown Area
Overburden Stockpile
Pond
Ramp
Potentially Acid Generating Rock (PAG) #6

DONLIN GOLD

WASTE ROCK FACILITY AND OVERBURDEN STOCKPILES

DONLIN GOLD PROJECT

FIGURE:

2-2

DG: PER0033.mxd, 07/17/12, R07

Table 2-3: Waste Rock Classifications and Tonnage Estimates

Waste Rock Classification	Tonnage		Percent of Total
	tons (thousands)	tonnes (thousands)	
NAG 1-4 and Overburden	2,920,000	2,649,000	93
PAG 5	87,200	79,100	2.7
PAG 6	135,300	122,700	4.3
PAG 7	2,600	2,360	0.08
Total Waste Rock	**3,145,000**	**2,853,100**	**100.00**

For both concurrent and final reclamation, two layers of material would be spread over the WRF. The first layer would be 12 inches (30 cm) of colluvium or terrace gravel to minimize infiltration of surface runoff and the second would be 14 inches (35 cm) of peat and loess to provide an organic layer to support plant growth. To keep them viable and available for reclamation, these materials would be stockpiled separately during preproduction and development stripping operations *Reclamation and Closure Plan, Volume IV,* SRK 2016b*.*

2.3 Processing

2.3.1 Overview

Processing is the breaking down the ore into a fine material to allow the gold to be separated from the host rock. Mineral processing involves several steps that take place sequentially after the ore has been mined and transported to the crushing facilities. The processing steps include crushing, grinding, flotation, pressure oxidation, cyanide leaching, gold refining, cyanide detoxification, and discharge of tailings to the TSF.

The process plant would have an average throughput of 59,000 st (53,500 t) per day of ore on a 24 hour per day, 365 day per year basis. Ore would be crushed to 80% passing 5 inches (13 cm) in a primary gyratory crusher installed near the ACMA pit and conveyed to the coarse ore stockpile near the process plant. From the coarse ore stockpile, the ore would be conveyed to a SAG mill that operates in closed circuit with a ball mill and a bank of cyclones to prepare material to 80% passing 100 mesh or 150 µm for primary flotation. Primary flotation tails would be further ground in a ball mill closed circuit system with cyclones to prepare material (80% passing 270 mesh, or 50 µm) for secondary flotation.

In the flotation circuits, the gold-bearing, sulfidic mineral particles would be separated from the non-economic rock (gangue) using frother (methyl isobutyl carbinol) and collectors (potassium amyl xanthate). The flotation concentrate, representing approximately 17% of the process plant throughput, would be then be sent through an acidulation circuit for partial acidulation and then to the pressure oxidation (POX) circuit. The POX circuit would consist of two autoclaves, which are metal vessels lined with refractory brick designed to withstand high temperatures and pressures. Autoclaves use heat, pressure, and high-pressure oxygen gas to oxidize the sulfides in the flotation concentrate so that the gold is amenable to extraction in the next steps of the process.

The concentrate slurry from the POX circuit would be thickened and washed in a counter-current decantation stage (CCD) to reduce acid content. A portion of the decant solution from the CCD would return to the acidulation circuit, and excess solution would be combined with the flotation tails for neutralization of the acidic solution. After raising its pH to approximately 10.5 to 11, the thickened slurry product from the CCD would be sent to the carbon-in-leach (CIL) circuit. In CIL, the cyanide solution would dissolve the microscopic gold contained in the slurry. The dissolved gold would be adsorbed onto granular, activated carbon particles in the CIL circuit. Periodically, the gold-loaded carbon particles would be screened out of the slurry to enter a gold recovery circuit. At this stage, the gold would be stripped from the carbon, plated onto a cathode by electrowinning, and melted into doré bars for shipment to a refiner. Gold recovery is estimated to be approximately 90%.

The resulting tailings slurry from the CIL circuit would flow by gravity through a Inco SO_2/air cyanide detoxification process before being combined with flotation tails (approximately 83% of the initial ore feed) and sent to the TSF at a pH range of 6 to 9.

Figure 2-3 shows the general flow sheet for processing, and Figure 2-4 is a plan view of the preliminary plant site layout. The process plant is described in more detail below.

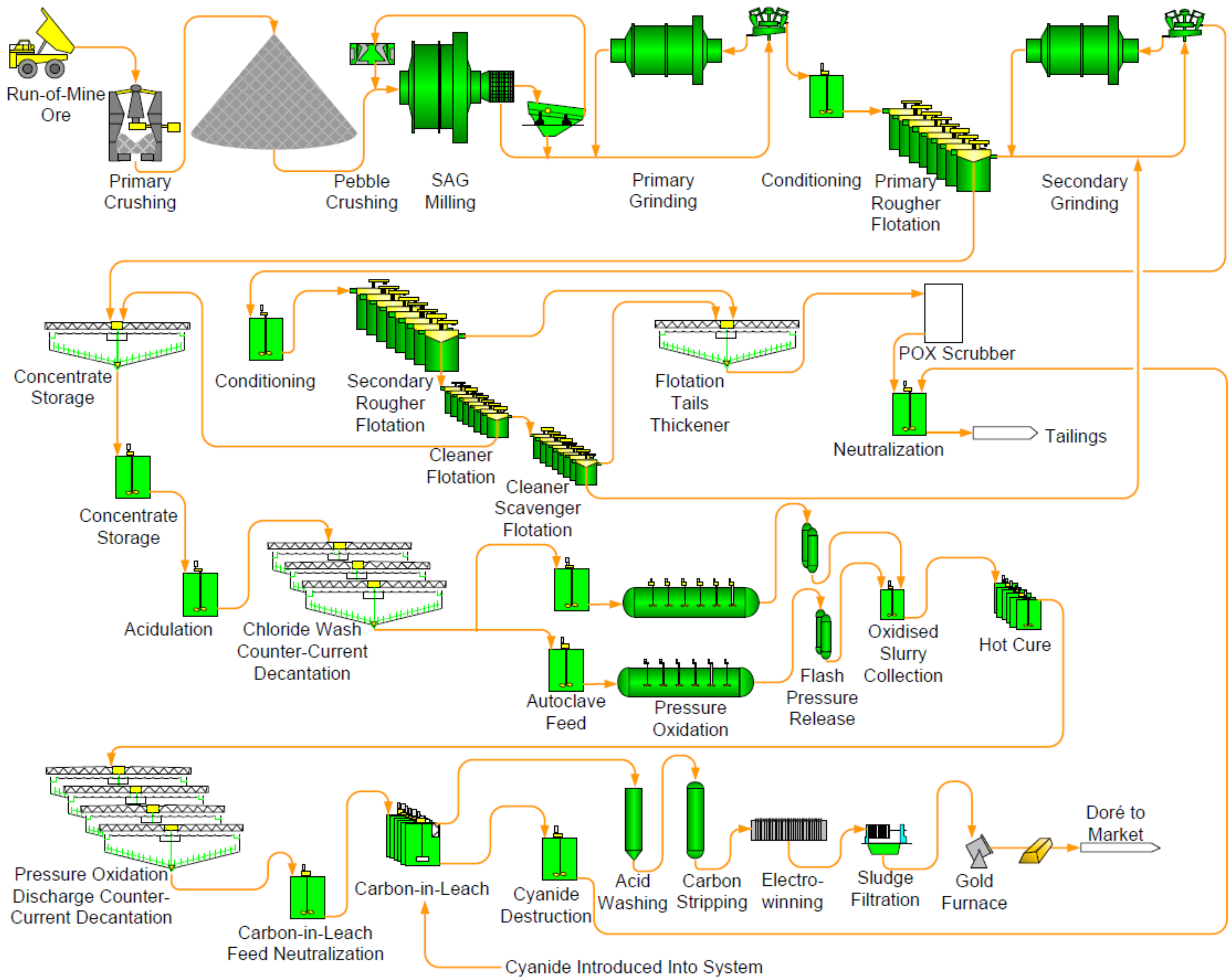
2.3.2 Crushing

Run-of-mine ore would be delivered by mine haul trucks to the feed hopper of a 60 x 89 inch (152 x 226 cm) direct-dump gyratory crusher. The crusher would be driven by an 800 hp (600 kW) motor, be set at 6 inches (15 cm), and have a nominal throughput capacity of approximately 3,780 stph (3,430 t/h). When the hopper is full, ore would be dumped on a bypass stockpile for rehandle to the crusher at a later time.

The crusher would discharge through a surge bin to a variable-speed drive apron feeder, which in turn would discharge to a 54 inch (1.4 m) wide conveyor that would transport the ore to a coarse ore stockpile near the process plant. Baghouses would control potential fugitive dust emissions at all transfer points.

2.3.3 Coarse Ore Reclaim

The coarse ore stockpile would be enclosed within an insulated, conical-shaped, steel-framed and steel-clad structure that would control dusting and minimize exposure of the ore to precipitation. The stockpile would have a live capacity of 42,000 st (38,000 t) of ore, representing 16 hours of process plant operation, and a total capacity of 196,000 st (174,000 t). A bulldozer would be required to access dead storage.



SCALE:

N/A

DONLIN GOLD

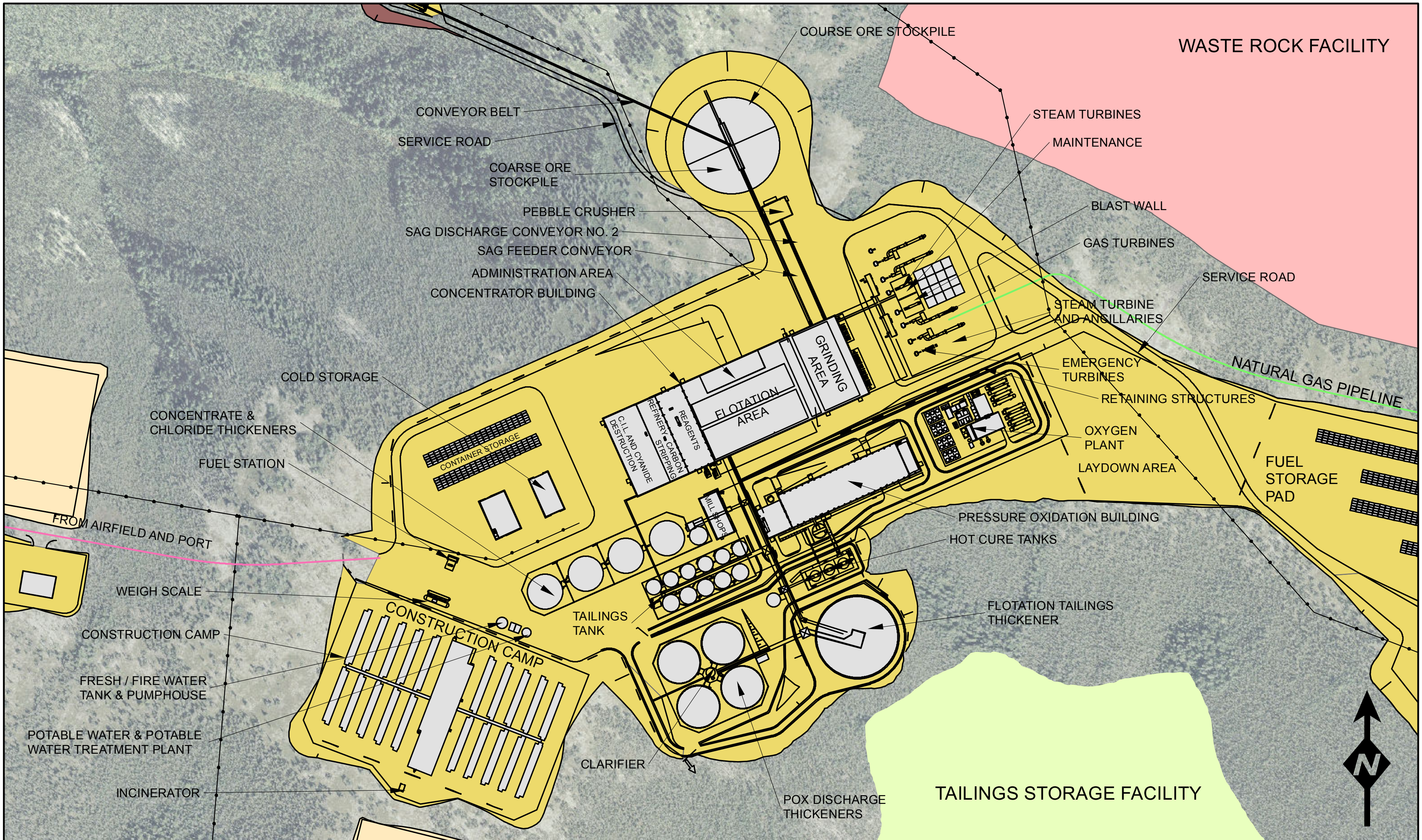
SIMPLIFIED PROCESS FLOWSHEET

DONLIN GOLD PROJECT

FIGURE:

2-3

DG: PER0144.mxd, 08/25/11, R01



Building
Facility
Laydown Area
Waste Rock Facility
Tailings Storage Facility
Berm

SCALE:

0 250 500 ft

0 50 100 200 m

DONLIN GOLD

PRELIMINARY PLANT SITE LAYOUT

DONLIN GOLD PROJECT

FIGURE:

2-4

DG: PER0056.mxd, 07/17/12, R04

A reclaim tunnel and reclaim feeder chamber containing four feeders (two apron-type and two belt-type) would be installed underneath the coarse ore stockpile to deliver the coarse ore to the SAG mill feed conveyor. The nominal feed rate to the SAG mill would be achieved with three feeders operating.

2.3.4 Grinding

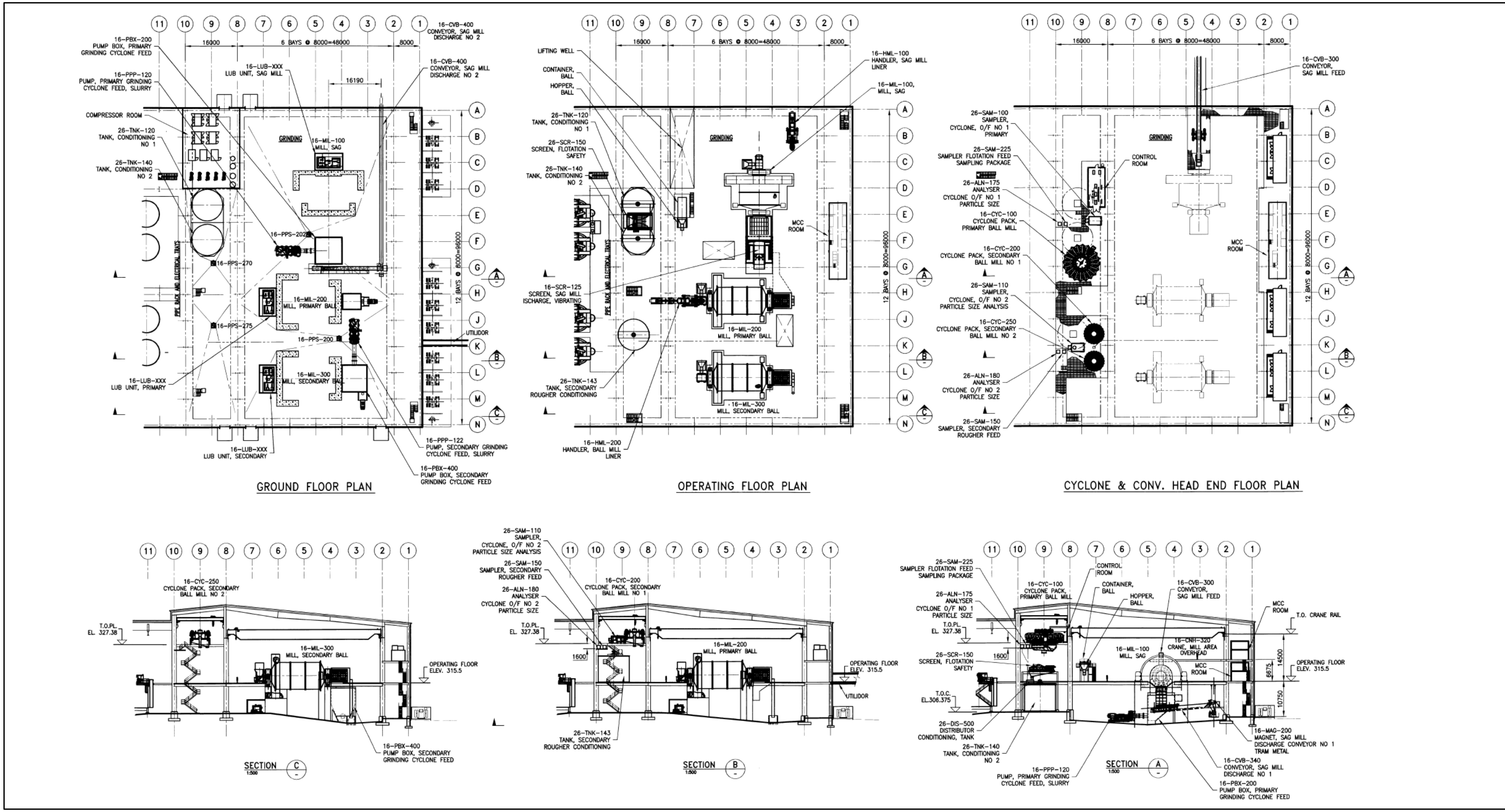
The grinding equipment includes a SAG mill, a pebble crusher, hydrocyclones, and a primary ball mill for slurry that is recirculated as required to reduce feed to the flotation circuit to the correct size. Figure 2-5 depicts the grinding area and sectional views of the SAG mill and ball mill.

The SAG mill feed conveyor would feed ore to the SAG mill at an average rate of about 2,642 stph (2,397 t/h). The mill would be 38 ft diameter x 26.5 ft long (11.6 x 8.1 m), powered by a 26,800 hp (20 MW) electric motor sufficient to accommodate fluctuations in ore type and to maintain tonnage. Recycled solution water from within the process or from the TSF, along with copper sulfate, would be added to the feed end for slurry density control and to activate the sulfide minerals prior to flotation. Discharge from the mill would pass to vibrating screens from which oversize would be conveyed to the pebble crusher and then back to the SAG mill; the undersize would report to the SAG/ball mill discharge pump box.

The oversized material (pebbles) conveyed to the pebble crusher building would be further reduced in size by two cone crushers before the material was conveyed back to the SAG mill. Two surge bins and a bypass bin would be provided. Slurry from the SAG/ball mill discharge pump box would be pumped through a bank of hydrocyclones for sizing. Cyclone underflow (oversized material) would pass to a 24,000 hp (18 MW) ball mill measuring 26 ft diameter x 45.5 ft long (7.9 x 13.9 m) for further size reduction. Ball mill discharge would flow back into the SAG/ball mill discharge sump where it would be combined with the SAG mill product and be resized. Cyclone overflow would advance to the flotation circuit at 35% solids with an average particle size of 80% passing 300 mesh (50 µm).

2.3.5 Flotation Circuit

Flotation is used to separate the gold-bearing, sulfidic mineral particles from the non-economic rock (gangue) using frothers (MIBC and F-549), promoter (copper sulfate), collector (PAX), dispersant (Cytec E-40), and acidic solution (available from the POX and CCD circuits) for pH control.



Source: (AMEC)A1-159984-16-16-100.dwg

REV:	NOTES:

DONLIN GOLD

GRINDING BAYS AND SECTIONALS

DONLIN GOLD PROJECT

SCALE: NA

FIGURE: 2-5

DG: PER0055.mxd, 08/17/11, R02

As shown in Figure 2-6, the primary rougher flotation circuit would include two banks of 11 flotation cells. Concentrate from the primary flotation cells would be sent to the concentrate thickener, while the tails would be sent to a second 26 ft diameter x 45.5 ft long (7.9 x 13.9 m) ball mill for secondary grinding. Slurry exiting the ball mill would be pumped to a second bank of cyclones for size separation. The coarser particles would be returned to the regrind mill, and the finer particles would be pumped to the secondary rougher flotation circuit, which would also consist of two banks of 11 flotation cells.

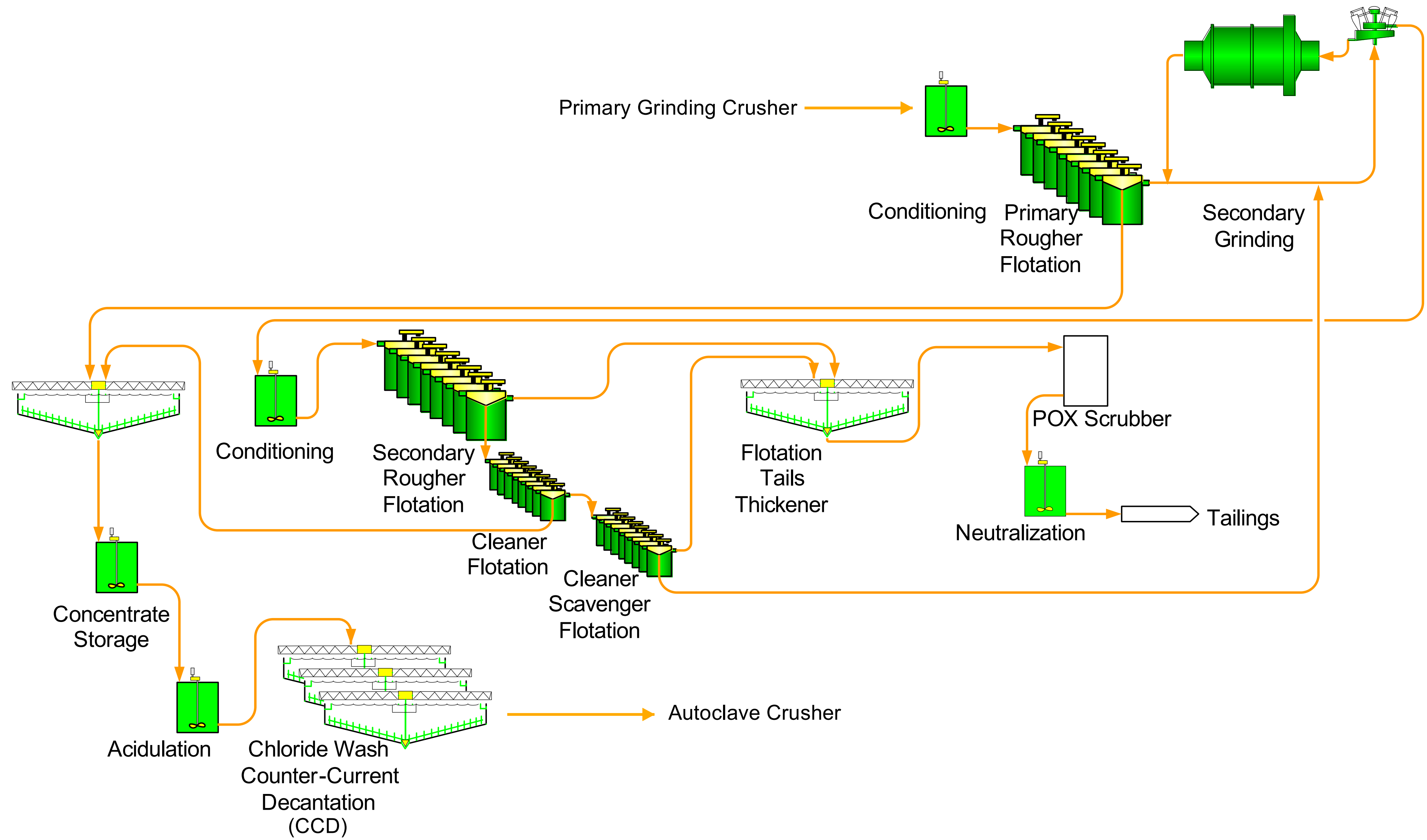
The concentrate from the secondary rougher flotation would be upgraded further in the cleaner flotation circuit, consisting of six flotation tank cells. The discharge from the cleaner would be scavenged in the cleaner scavenger circuit, which would consist of four flotation tank cells. The cleaner concentrate would be sent to the concentrate thickener, while the cleaner scavenger concentrate would be returned to the secondary ball mill for further size reduction. The cleaner scavenger tails would be sent to the tailings thickener.

The concentrate storage circuit would incorporate 36 hours of concentrate storage time to maintain continuity of feed to the POX circuit during extended periods of downtime of the grinding and flotation circuits.

2.3.6 Flotation Tailings Neutralization

Flotation tailings would be heated to 131°F (55°C) through an autoclave quench vessel and then combined with the excess diluted acidic wash solution from the chloride CCD wash (Section 2.3.7). The flotation tails would be thickened using flocculent, the overflow water would be pumped to the flotation process makeup water tank, and the thickened flotation tails underflow would be used as neutralizing material (source of natural carbonates) for excess acidic solution collected from the POX CCD wash.

The flotation neutralization circuit would consist of a 315 ft diameter (96 m) thickener and five mechanically agitated and aerated tanks in series. Each tank would be 64 ft diameter x 77 ft high (19.5 x 23.3 m); the combined tankage would provide enough reaction time to bring the pH of the solution up to 5. Discharge from the neutralization circuit would pass into the final tailings pump box and be combined with tailings from the neutralized CIL circuit. Provision would be made for the addition of lime slurry, reclaim water, and flotation process water to adjust the pH of the final tailings before discharge to the TSF.



	SCALE:			FIGURE:
	N/A	DONLIN GOLD	**FLOTATION CIRCUIT** DONLIN GOLD PROJECT	**2-6**

DG: PER0145.mxd, 08/25/11, R01

2.3.7 Pressure Oxidation (POX)

Combined flotation concentrates would be dewatered in a thickener before acidulation and subsequent CCD washing to remove solubilized chlorides. Autoclave feed slurry would be stored in the flotation concentrate storage tanks and pass from there into two agitated autoclave feed storage tanks where the slurry would be heated before entering the autoclaves. The autoclave circuit (Figure 2-7) includes two autoclaves 16 x 108 ft (5 x 33 m) in size operating in parallel. The autoclaves would be designed to operate at 437°F (225°C) and with a retention time of approximately 50 minutes. The autoclave would use high-pressure oxygen gas to convert the sulfide mineralization in the slurry to oxides. The oxygen would be produced at an on-site air separation plant. Cooling water and steam would be used to control the operating temperature within the autoclaves.

Vent gas from the autoclaves would be cooled in a quench vessel before being sent to the mercury abatement system. The vent gas from the quench vessel would be piped to a secondary spray-tree condenser vessel where water would further cool the gas and condense the steam. The gas would then pass through a venturi scrubber to remove particulates before entering a refrigerated wet-gas condenser where the gases would be cooled to condense mercury.

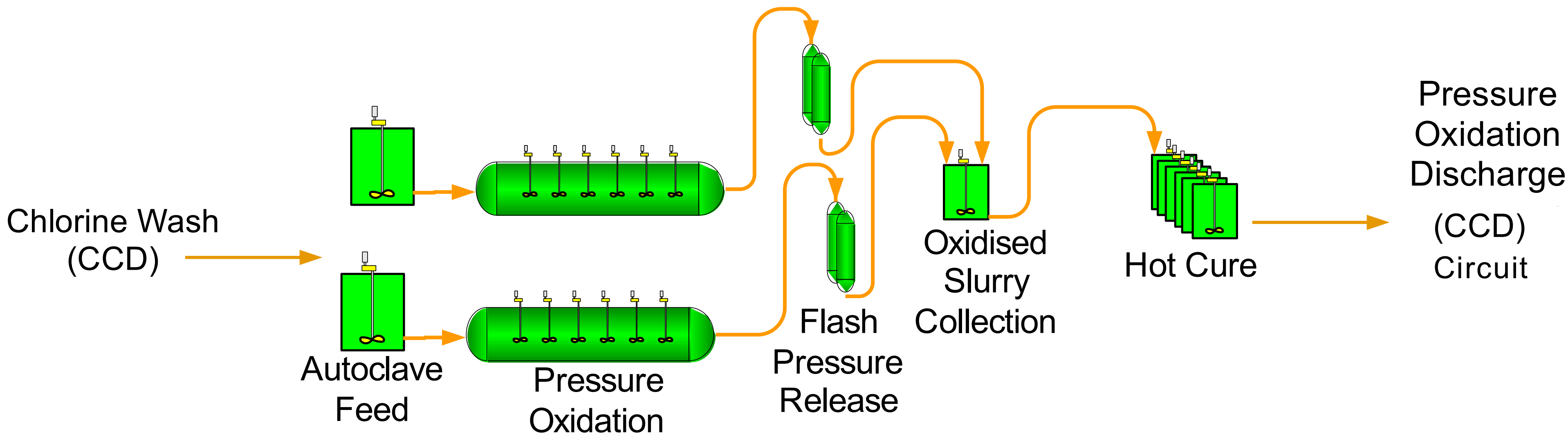
Cooled gases would enter a pre-cleaning carbon bed to remove volatile organic compounds and then through the mercury removal carbon bed containing sulfur-impregnated carbon specifically designed to adsorb mercury. The mercury-loaded carbon would be removed periodically and shipped off site for disposal. Treated exhaust would then be released from the scrubber stack.

2.3.8 POX CCD – CIL Feed Neutralization

Oxidized slurry from the POX circuit would be directed to hot cure tanks and from there to the feed tank of the first of four thickeners in the discharge CCD wash circuit. Process water with a pH of 7 or greater would be added to the last thickener in a flow direction counter to the solids to decrease the acidity of the solids.

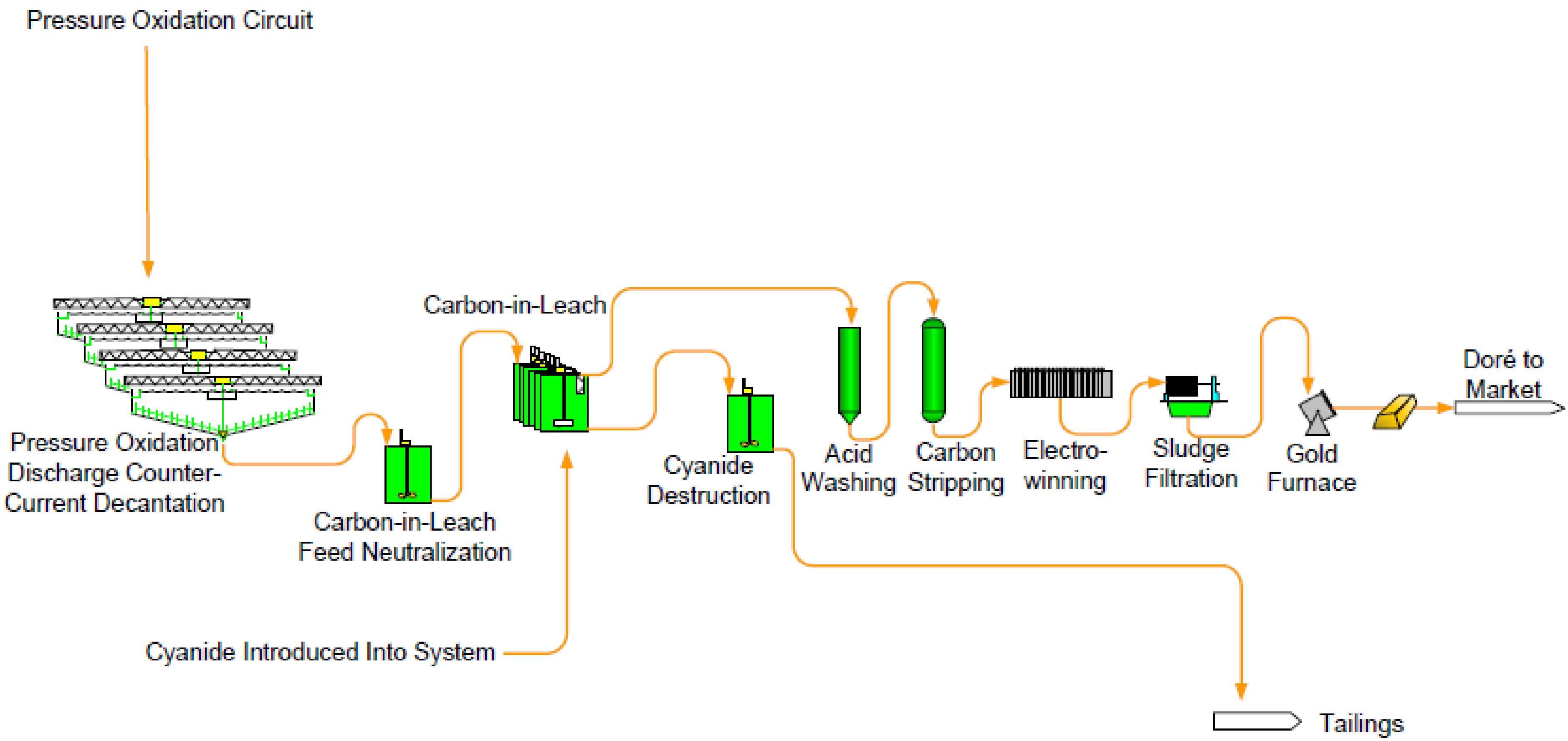
2.3.9 Carbon-In-Leach (CIL)

After washing, the oxidized slurry would be further neutralized with lime and then be sent to the first of six CIL tanks piped in a series (Figure 2-8). Lime slurry to control pH and cyanide solution would be added as required to dissolve the gold. The CIL circuit would have a retention time of 24 hours.



SCALE: N/A	DONLIN GOLD	**AUTOCLAVE CIRCUIT** DONLIN GOLD PROJECT	FIGURE: **2-7**

DG: PER0147.mxd, 06/19/12, R02



	SCALE: N/A	DONLIN GOLD	**CYANIDE LEACH CIRCUIT** DONLIN GOLD PROJECT	FIGURE: **2-8**

DG: PER0146.mxd, 08/25/11, R01

Fresh and regenerated activated carbon would be added to the last CIL tank. Gold would adsorb onto the surfaces of activated carbon particles in the CIL tanks. Carbon would be advanced in batches counter-current to the gravity flow of slurry between the tanks. This allows the slurry to flow counter-current to the activated carbon so that the most active carbon contacts the leanest gold solution stream. As loaded activated carbon is removed from the first CIL tank, using screens that separate out the large carbon particles, it would be pumped to the elution circuit for processing. The final slurry, now depleted in gold, would be pumped to the cyanide detoxification system.

2.3.10 Cyanide Detoxification

The screened CIL tailings discharge would be treated by the SO_2/air process. A sulfur burner would provide the SO_2 to detoxify residual cyanide from the CIL process. Two tanks operating in series would provide two hours' retention for cyanide detoxification. SO_2 would be added at a rate sufficient to reduce the weak acid dissociable (WAD) cyanide levels to ≤10 ppm. Lime slurry would be added as needed to provide pH control, and copper sulfate solution would be added as a reaction catalyst.

2.3.11 Carbon Stripping

Loaded carbon from the first CIL tank would be pumped to a holding tank where it would be acid washed with a weak nitric acid solution to remove any inorganic scale buildup. The washed, loaded carbon would then be transferred to one of the batch strip vessels, where a hot strip solution of caustic soda and cyanide from the barren tank would be introduced under pressure. This solution would strip the gold from the carbon, creating a high-grade pregnant solution. The pregnant solution would be cooled in heat exchangers, passed through electrowinning cells, and recycled to the barren tank. Caustic soda, cyanide, and water would be added to the barren tank to maintain proper strip solution concentrations.

2.3.12 Electrowinning and Refining

The pregnant strip solution would pass into electrowinning cells in the refinery where the gold would be recovered on cathodes. Sludge from the cathodes would be filtered, dried, and then heated in a retort to volatize and remove mercury, which would be shipped off site in flasks or pigs for management and storage.

The retorted gold sludge would be refined on site by fluxing and melting in an induction furnace to produce doré bars. Since the slag from this refining process could contain small amounts of gold in the form of small gold beads, the slag would be returned to the grinding circuit for reprocessing.

2.3.13 Carbon Regeneration

The stripped carbon would be thermally regenerated at high temperatures (1,000-1,600°F [500-900°C]) in a horizontal rotating kiln to remove organic contaminants and capture mercury in the emission controls. Coarse carbon would be recycled to the carbon storage tank for reuse in the CIL circuit. New carbon would be conditioned in a carbon attrition tank, screened, and pumped to the carbon storage tank.

2.3.14 Mercury Abatement Systems

The mercury abatement and emission control systems would be “state-of-art” technology designed to comply with Federal Maximum Achievable Control Technology and state air quality regulations. The design and operation of the systems would be based on actual operating performance achieved at other sites.

Mercury abatement systems would be necessary at the following locations in the process facility:

- Carbon regeneration kiln
- POX vent gas
- electrowinning cell
- Retort
- Refinery furnace.

Mercury would be removed from the gas streams using specialized control equipment, as described in the Mercury Emissions Control Summary Report (Hatch 2014). The mercury air emissions control equipment is specialized based on the concentration and type of mercury present in the different gas streams. But all the control systems remove mercury from vent gases in essentially the following steps:

1. Particulate removal – Filters and scrubbers remove dust that may contain particulate mercury, from the vent gas stream. This increases the performance of the condensation and final polishing steps.

2. Gas cooling and mercury condensation – Vent gases are cooled which transforms (condenses) gaseous mercury into liquid elemental mercury. The liquid mercury is collected in flasks and removed from the gas stream.

3. Final Polishing – Most of the mercury is removed from the vent gases via condensation. Additional mercury is removed as the vent gases travel through carbon beds containing sulfur-impregnated carbon specifically designed to adsorb mercury. The mercury-loaded carbon would be removed periodically and replaced with fresh carbon to maintain removal efficiency.

The mercury controls and expected removal efficiency for each location are summarized in Table 2-6. Mercury would be collected and disposed of in two forms: condensed liquid, which would be collected in specialized flasks or pigs, and mercury-loaded carbon. Both would be shipped off site.

In addition to the mercury abatement system, mercury suppressant in the form of UNR products would be introduced at the TSF reclaim water header to precipitate residual mercury remaining in solution as an insoluble organic sulfide-mercury particle.

Table 2-4: Mercury Emission Control Equipment

Process Unit	Mercury Emission Control Equipment	Expected Removal Efficiency
POX autoclave vent gas	Cyclone, condenser, scrubber, sulfur-impregnated activated carbon filter	99.9%
Carbon generation kiln vent gas	Carbon knock-off box, cooler/condenser, mercury collection tank, sulfur-impregnated activated carbon filter	99%
Electrowinning vent gas	Demister, sulfur-impregnated activated carbon	99%
Retort vent gas	Condenser, sulfur impregnated activated carbon	99%
Refinery furnace gas	Bag house, HEPA filter, sulfur-impregnated activated carbon	99%

2.3.15 Reagents

The process would require several types of reagents. Flotation reagents (nitric acid, PAX, copper sulfate, and MIBC/F549) would be used for concentrating the gold tied up in sulfide mineralization, and lime, sodium cyanide, and activated carbon would be the primary chemical reagents for gold recovery. The POX circuit would utilize oxygen gas and steam to convert the sulfidic slurry to oxide slurry. The carbon stripping and regeneration circuit would require sodium hydroxide, sodium cyanide, and nitric acid; the thickeners would require flocculant, and sulfur dioxide gas from burnt sulfur and copper sulfate would be needed for cyanide detoxification. Small quantities of fluxes would be used in the assay lab and refinery. Water softening and anti-scalant agents would be added to the process plant water.

The quantities and containers listed below are typical for transporting and handling the various reagents, but actual quantities and containers would vary depending on the vendor.

Potassium Amyl Xanthate (PAX)

PAX would be the primary collector for sulfide minerals. PAX would be received in 1,870 lb (848 kg) bulk bags and mixed in an agitated tank. Once the PAX is completely dissolved, the solution would be pumped to a storage tank for distribution to the flotation circuit.

Methyl Isobutyl Carbinol (MIBC/F549)

MIBC/F549 are frothers that would be received in reagent totes as concentrated solutions. The solutions would be pumped into separate storage tanks and transferred to day tanks as required to allow for distribution within the flotation circuit.

Nitric Acid

Nitric acid would be received in reagent totes as a concentrated solution and be used for acid-washing loaded carbon. The acid would be pumped directly from the International Organization for Standards (ISO) container to the acid wash solution tanks as required to make up a 3% acid solution, which would be distributed to the acid wash column by pumps.

Nitric acid would be received in 27 st (25 t) bulk ISO containers as a high-strength solution. All of the nitric acid would be stored inside the heated reagent area because of its relatively low freezing point of -7.6°F (-22°C). Nitric acid ISO containers will be vented and any fumes exhausted to the outside.

Lime

Lime would be used to control slurry pH for CIL leaching, cyanide detoxification, and in the tailings neutralization circuit as required. Lime would be received in bulk as calcium oxide (quicklime) and be transferred to a 200 st (181 t) lime bin.

Sodium Cyanide

Sodium cyanide would be used to dissolve gold. It would be received as solid briquettes in 24 st (22 t) ISO steel shipping containers and stored in an area that provides secondary containment. Stock cyanide solution would be prepared by circulating process water with sufficient sodium hydroxide content to maintain a pH of around 10 in the enclosed ISO container. The dissolving briquettes would form a 30% sodium cyanide solution. Once the briquettes were completely dissolved, the solution would be transferred to a storage tank. Field titrations determine the free cyanide concentrations required in the leach train; adjustments would then be made to the cyanide solution addition rate to maintain the required operating concentrations at the CIL and carbon stripping circuits.

Activated Carbon

Activated carbon would be used to capture dissolved gold from the slurry. It would be received in 1,000 lb (454 kg) supersacks. To prepare carbon for addition to the circuit, the contents of one bag would be discharged into the carbon conditioning tank, where it would be agitated as high-solids slurry to round off sharp corners and remove soft carbon. The conditioned carbon would be added to the CIL circuit.

Sodium Hydroxide (Caustic Soda)

Sodium hydroxide would be used to raise the pH in the strip circuit, for mixing cyanide, and to neutralize spent acid solution used in acid-washing the carbon. It would be received as pellets packaged in supersacks containing 2,000 lb (907 kg). The pellets would be mixed with water in batches to make a 20% solution for use.

Mercury Suppressant (UNR Products)

UNR Products are a proprietary reagent that would be used to reduce the soluble mercury levels leached into solution from the autoclave process (mercury containing cyanide solution that does not adsorb onto carbon) to low levels within the reclaim water stream recycled from the TSF.

Flocculants

Flocculants would be used to accelerate settling in the thickening process prior to CCD wash thickening, POX CCD thickening, and the flotation tails/concentrate thickeners. Dry flocculant would be delivered to the site in 1,000 to 2,000 lb (454 to 907 kg) supersacks. The materials would be stored in a reagent building and mixed in a mixing system near the thickener.

Sulfur

Supersacks (2,000 lb [907 kg]) of sulfur would be delivered to site and stored in a covered area with contained drainage. The sulfur would be reclaimed by a feeder and conveyed to the molten sulfur tank, where it would be melted using heat from the waste heat recovery system in the plant. The molten sulfur would be pumped to a furnace where it would be mixed with air and combusts to yield a discharge gas containing 16 to 17% SO_2 by volume. The discharged SO_2 gas would be diluted with air to 2 to 3% SO_2 and be pressurized to feed the cyanide detoxification tanks.

Copper Sulfate

Copper sulfate ($CuS0_4$) would be used as a promoter in flotation and a catalyst in cyanide detoxification. It would be received in 2,000 lb (907 kg) supersacks and be dissolved in tanks to form a 5 to 20% solution. Solution from the tanks would be metered to the SAG mill and the cyanide detoxification circuit.

Fluxes

Fluxes would be used in the gold refining process. Sodium borate (borax), sodium nitrate, and silica sand would be received in 50 to 400 lb (23 to 181 kg) bags or drums. These chemicals would be used directly from their containers in the preparation of furnace charges for assaying or refining.

Water Softening and Anti-Scalant Agents

Water-softening and anti-scalant agents would be added to the process plant water to reduce levels of dissolved calcium, magnesium, manganese, and ferrous iron and to prevent scaling in pipes. The chemicals would be received in 1.1 st (1 t) tote tanks and in 2,000 lb (907 kg) supersacks. Dry chemicals would be stored in cold storage. Wet chemicals would be kept from freezing.

2.4 Tailings Storage Facility

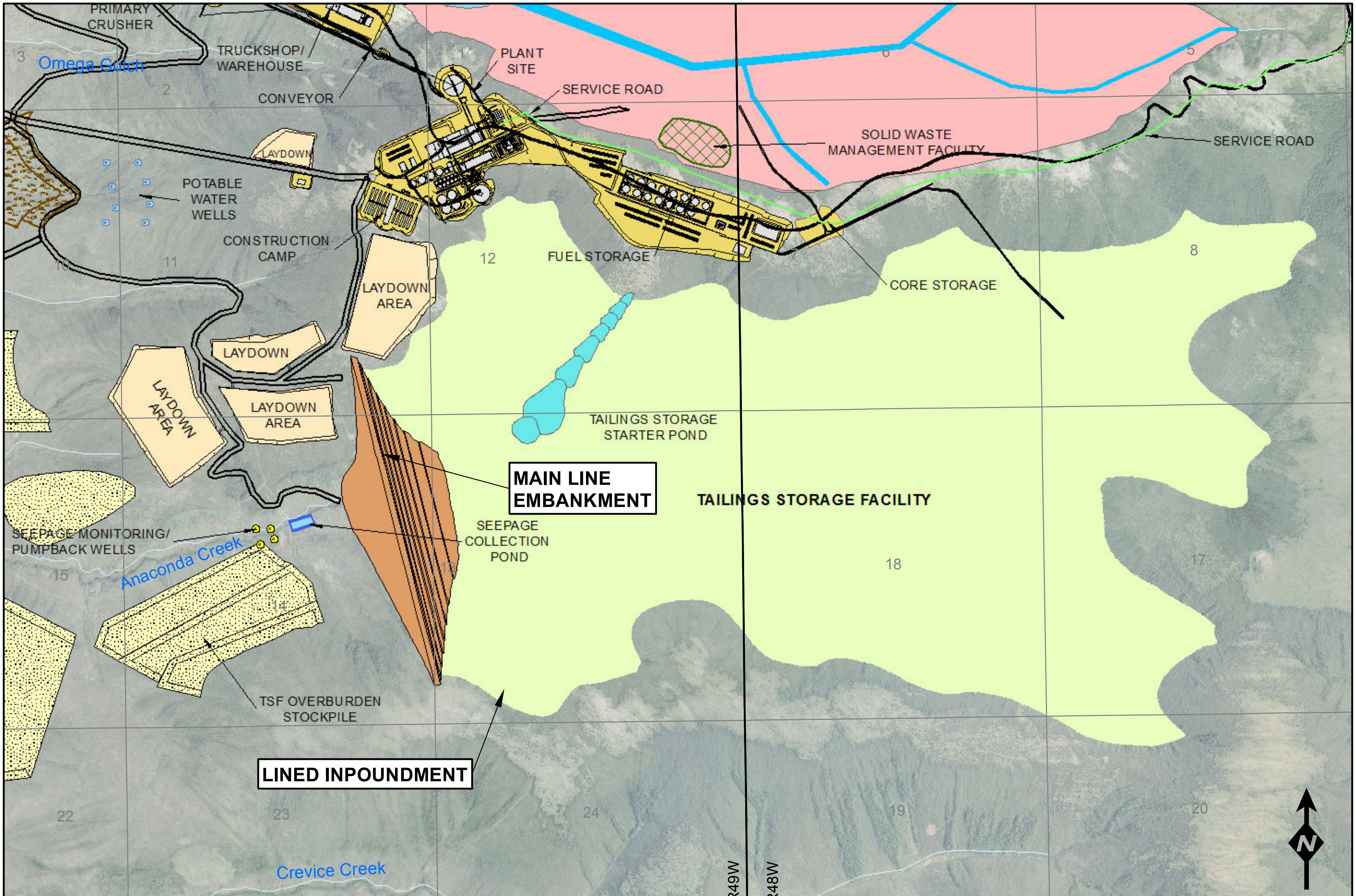
Tailings consist of combined streams from flotation tailings, wash thickener overflow, and the detoxified cyanide slurry from the CIL circuit. The 36% solids by weight tailings material would flow by gravity through a 48 inch (1.2 m) diameter high-density polyethylene (HDPE) pipe to the TSF, an impoundment that would be designed and constructed in Anaconda Creek valley. The TSF would consist of a main lined dam embankment, two temporary lined cross-valley dams, a lined impoundment, a reclaim water system, and a seepage collection system (Figure 2-9). Information on the tailings management and the TSF are found in the *Tailings Management Plan, Volume IIIA,* SRK 2016c and summarized below.

The tailings dam would be constructed of compacted rockfill using the downstream method with a 60 mil (1.5 mm) linear low-density polyethylene (LLDPE) composite liner on the upstream face. The tailings impoundment footprint would be lined with a 60 mil (1.5 mm) textured LLDPE liner over a 3.3 ft (1 m) thick layer of broadly graded silty sand and gravel acting as low-permeability bedding material and providing secondary containment.

Based on the design flood event and tailings storage requirements, the starter dam would be 177 ft (54 m) high to store one year of tailings production, plus the regulated design flood event and adequate freeboard. The ultimate height of the dam would be 471 ft (143.6 m) as measured from the downstream toe to the crest. The TSF would have an ultimate capacity of approximately 335,000 acre-ft (413 Mm^3), corresponding to an ultimate impoundment surface area of approximately 2,351 acres (951 ha). The total catchment area of the TSF would be approximately 3,755 acres (1,520 ha).

The TSF would be constructed in six stages over the mine life. Organics and some growth media would be stripped prior to dam and liner construction. The material would be stockpiled in the lower portions of the Anaconda drainage below the TSF footprint.

The TSF would be designed to provide storage for a combination of the 200-year return period snowmelt, 24-hour probable maximum precipitation rainfall event, excess water accumulation under average conditions in the site water balance, and emergency freeboard.



Potable Water Wells
Seepage Monitoring Wells
Streams
Natural Gas Pipeline
Facility, Toe Accents, Laydown Areas
Seepage Collection Pond
Growth Media Stockpile
Overburden Stockpile
Building
Dam
Drainage
Facility
Laydown Area
Ultimate Pit
Reclaim Causeway
Road
Solid Waste
Waste Rock Facility
Tailings Storage Facility

SCALE:

0 500 1,000 2,000 ft

0 150 300 600 m

DONLIN GOLD

LOCATION OF TAILINGS STORAGE FACILITY

DONLIN GOLD PROJECT

FIGURE:

2-9

DG: PER0035.mxd, 07/18/12, R08

Two freshwater diversion dams (FWDDs) would be maintained during the first three years of operations. At the end of the third year, the dams would be decommissioned, the liners removed, and the area regraded. During construction, these diversion dams would minimize runoff to the impoundment and facilitate construction of the TSF starter dam and liner placement. The dams would limit the amount of fresh water entering the TSF during operations and provide a significant control on the volume of water in the impoundment during the first three years of operations. The FWDDs would be sized to hold the 100-year return period snowmelt runoff and with spillways designed to pass the 100-year peak instantaneous flow. Based on storage requirements, the north FWDD will be 74 ft (22.5 m) high and the south FWDD 66 ft (20 m) high.

Runoff to the TSF impoundment in Anaconda Creek would be minimized by staged diversion channels constructed on either side of the facility and two temporary upstream FWDDs. The diversion channels are initially constructed with the starter dam and raised upslope during the first and second dam raises. Channel diversions have not been included beyond the second raise as the diverted catchment area at these elevations is minimal; the potential volume of water that could be diverted does not have a significant effect on the water balance.

A seepage recovery system (SRS) consisting of a pond, and a line of four monitoring/seepage collection wells would be built immediately downstream of the footprint of the main tailings dam. The seepage rate from the lined TSF facility would be de minimis, and most water reporting to the seepage collection system would be groundwater. During operations, water from the seepage collection system would be used as process water or pumped to the WTP prior to being discharged into Crooked Creek.

Reclaim water from the tailings pond would be pumped from a floating pump barge through a pipeline back to the process facility or during periods of excess water the net precipitation volume would be sent to the WTP. Treated water would be discharged into Crooked Creek.

2.5 Off-site Infrastructure

2.5.1 General

The main off-site infrastructure facilities for the proposed project would be barge ports at Bethel and Jungjuk Creek, an access road from Jungjuk to the mine site, an airstrip, a natural gas pipeline, and associated borrow sites for construction materials. Other access roads would connect the port road to the airfield, material borrow sites, and permanent camp. Dutch Harbor may be used for the receipt and storage of ultra-low-sulfur diesel (ULSD) before transshipment to Bethel. The facilities would all be arranged, designed, and constructed using proven methods for functionality, durability, and safety in the remote locations and cold environment.

Bethel is 73 river miles (117 km) upstream from the Bering Sea on the Kuskokwim River, and the Jungjuk Port site is another 177 river miles (285 km) upstream, about 8 nautical miles (13 km) downstream of the village of Crooked Creek. The mine site is 30 land miles (48 km) northeast of Jungjuk Port.

General cargo bound for the mine would be consolidated at terminals in Vancouver, BC, and in Seattle to be trucked to marine terminals for ocean-barging to Bethel. The consolidation terminals would operate year-round to store containers and handle cargo from suppliers. The ice-free barging season on the Kuskokwim River is restricted to approximately 110 days per year.

All cargoes classified as hazardous would be properly packaged and identified in accordance with applicable state and federal statutes and regulations. Processes and practices for handling and marking all hazardous materials would be developed. Staff who provide logistics and transport services would be certified to handle, store, and transport these materials.

Spill response equipment would be provided at the Bethel and Jungjuk Port sites, and all crews would be trained in the appropriate spill response and cleanup strategies.

The *Transportation Plan, Volume VI,* SRK 2016d provides a description of the transportation plan for the Project. Summary information is provided below.

2.5.2 Bethel Cargo Terminal

The City of Bethel is the main port in the Yukon–Kuskokwim Delta. A cargo terminal, with berth and mooring facilities, would be constructed in Bethel to receive the ocean barges, to unload the cargo, and to either place the loads into storage or transfer them to river barges for seasonal shipment to the Jungjuk Port. Bethel would also receive shipments from river barges originating from the Jungjuk Port (SRK 2016d).

The navigation channel through Kuskokwim Bay and up the Kuskokwim River to Bethel is marked by seasonal buoys. The usual procedure is for a small pilot boat from Goodnews Bay to precede the tug pulling the barge and verify water depth. This protects the barge from running aground in case a buoy has moved or the channel has shifted; the channel is known to shift from time to time from the effects of river currents on the sandy river bottom. The deepest draft available for vessels to Bethel is 14 ft (4.27 m); ocean barges do not travel farther upriver. However, it may be possible for vessels with greater draft to reach Bethel during seasonally high water levels or by synchronizing the sailing with high tide.

Donlin is working with a third party vendor to provide dock and yard facilities in Bethel to support the project through construction and operations. The proposed yard is located at an existing industrial facility accessible by road and a new dock on the Kuskokwim River would be constructed.

2.5.3 Jungjuk (Angyaruaq) Port

The Jungjuk Port site would serve as a terminus between barge transport from Bethel and road transport to the mine. Proposed facilities include barge berths, a barge ramp, container-handling equipment, seasonal storage for containers, break-bulk cargo, and fuel, and barge-season office/lunchroom facilities. Electricity would be provided by two 600 kW diesel engine-powered generators (one primary and one standby). Fire protection water would be provided from a heated and insulated above-ground 240,000 USgal (900 m^3) dedicated water storage tank.

Containers, fuel, and other cargo would be off-loaded at the port terminal and trucked to the mine throughout the barging season. For protection against ice loading, a sheet pile bulkhead earth-retaining system would be constructed for the dock. The dock area would be 3.5 acres (1.4 ha) in size, sited at an elevation above the high water line. A 17.5 acre (7 ha) container storage area behind the dock area would have sufficient space for trucks to drop off empty trailers and pick up loaded containers for delivery to the proposed mine site.

Considerations in the selection and design of the Jungjuk Port facility included the remote location of the site, the seasonal ice environment, availability of required vacant land area, private land ownership, water depth, proximity to the mine, the road route to the mine, and river navigation issues such as the location of shallows.

2.5.4 Ultra-Low-Sulfur Diesel Fuel Delivery

ULSD would be delivered to the Jungjuk Port facilities in barges at a maximum rate of 5 Mgal (19 ML) every four days and unloaded into one temporary vertical storage tank. Fuel would be pumped from the temporary storage tank to tanker trucks and transported to the main fuel storage facility at the mine site (SRK 2016d). Fuel purchased from refineries would be shipped directly to Bethel or through Dutch Harbor on the Aleutian Islands, where additional fuel storage at existing facilities may be required for the proposed project.

The fuel would be transported by ocean barge to Bethel for storage before being shipped upriver to Jungjuk Port in double-hulled river barges. A 6 Mgal (23 ML) fuel storage facility would be provided at Bethel, and a single 2.8 Mgal (10.6 ML) capacity tank would be provided at Jungjuk Port for temporary storage. The tanks at both Bethel and Jungjuk Port would be installed in lined containment areas. Less storage would be needed at Jungjuk Port because it is intended to move fuel and other cargoes to the mine site as soon as possible in the shipping season, particularly during the construction period. The fuel stored at Jungjuk Port would be transferred to tanker trucks for transport along the access road to the mine site.

2.5.5 Mine Access Road

The proposed 30 mile (48 km) long access road (Figure 2-10) between Jungjuk Port and the mine site would be all new construction in an untracked region, with no passage through or near any settlements or communities, and no junctions with any existing road system. At present there is no road connection between the two locations. The primary purpose of the road would be to transport cargo and fuel.

The road would be two-lane, gravel-surfaced, and designed with consideration of seasonal drainage and spring runoff along the route. Two-lane roads have significant operational and safety benefits. The road would be used only for mine support traffic, which would be controlled and managed by mine operations. Near the mine site, short spur roads off the main access road would run to the airstrip and the mine camp facilities.

The road would traverse varied, mostly upland terrain. Some 50 stream or drainage crossings have been identified along the route, with six requiring bridging. Culverts would be provided for all other crossings.

Road and facility construction materials would be excavated from approximately 20 material sites located along the mine access road from Jungjuk Port to the mine site and within the foot print of the mine facilities. Material from these sites will be used for initial construction, phased construction (i.e., TSF dam and impoundment), and maintenance of the access road and mine roads.

Appropriate best management practices and safety procedures would be followed for road maintenance during construction and operations.

2.5.6 Natural Gas Pipeline

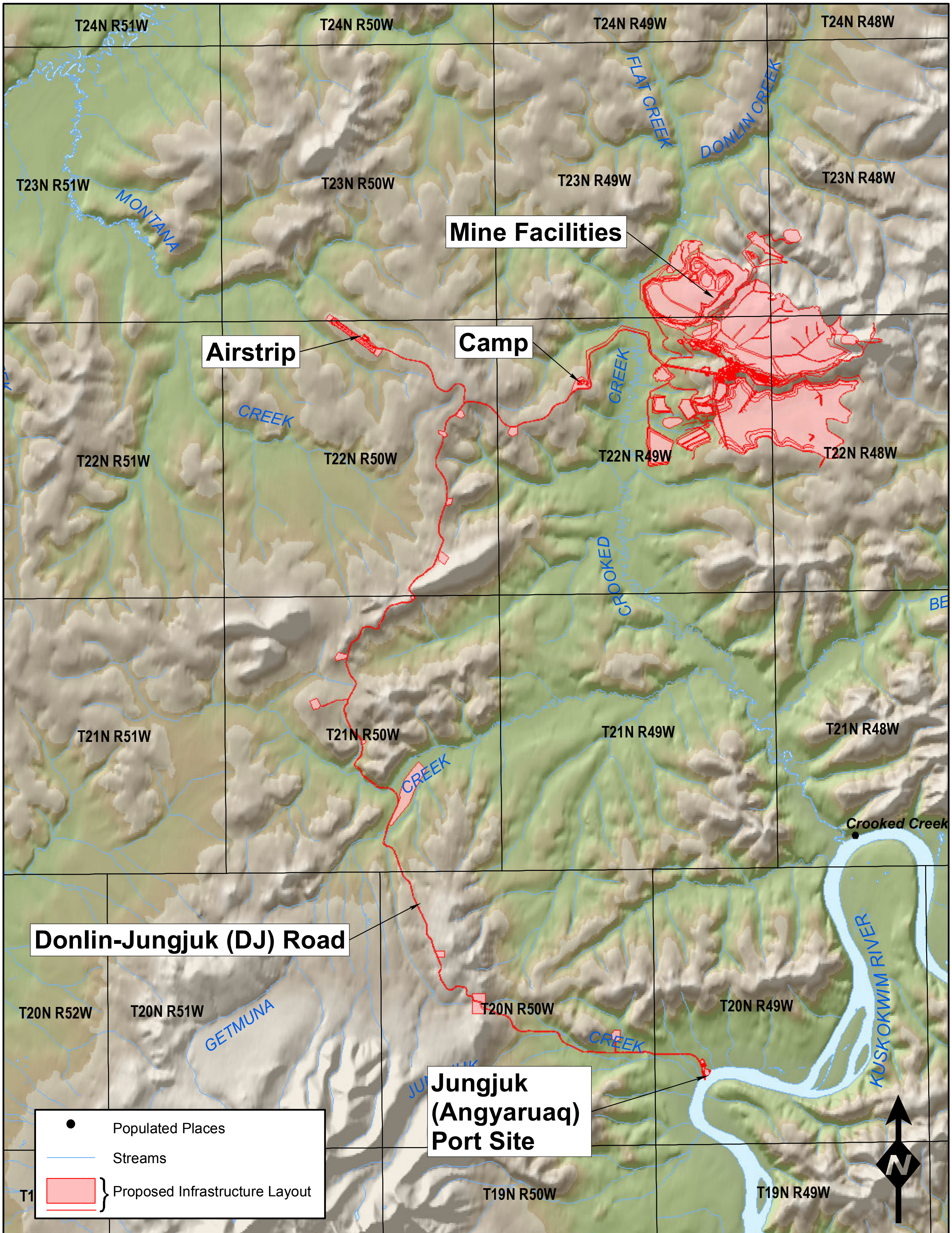
A 14 inch (356 mm) diameter steel pipeline would be constructed to transport natural gas approximately 315 miles (507 km) from the ENSTAR Natural Gas Company's existing 20 inch (508 mm) Beluga gas pipeline near Beluga to the proposed mine site (Figure 2-11). The pipeline would require one compressor station to compress the gas to the necessary pressure for transportation. At the mine site, natural gas would be used as a fuel source for heating, generating electricity, and processing ore.

Except for two above-ground fault crossings, each approximately 1,300 ft (400 m) long, the pipeline would be buried entirely within a permanent, 50 foot (15 m) wide right-of-way. To mitigate impacts to aquatic resources, construction techniques such as horizontal directional drilling and winter trenching would be used to bury the pipeline beneath stream and river crossings when fish are not present. Small surface check-valve stations would be installed every 20 miles (32 km) along the route, and a pigging station would be provided at approximately the halfway mark. Details of the natural gas pipeline can be found in the *Natural Gas Pipeline, Plan of Development, Donlin Gold,* SRK 2013.

2.5.7 Airstrip

Mine development would include the construction of a 5,000 ft long x 150 ft wide (1,524 m x 45 m) gravel airstrip on a ridge top approximately 9 road miles (14.5 km) west of the mine site.

Two approximately 9,900 gal (37,400 L) fuel storage tanks, one containing Jet "A" fuel and the other 100 LL (low lead) aviation gasoline, would be provided at the airstrip site. A small 5,000 gal (18,900 L) ULSD tank would store fuel for two 200 kW generators (one primary, one standby) to provide power to the airstrip facilities.



SCALE:

0 1 2 4 mi

0 2 4 8 km

DONLIN GOLD

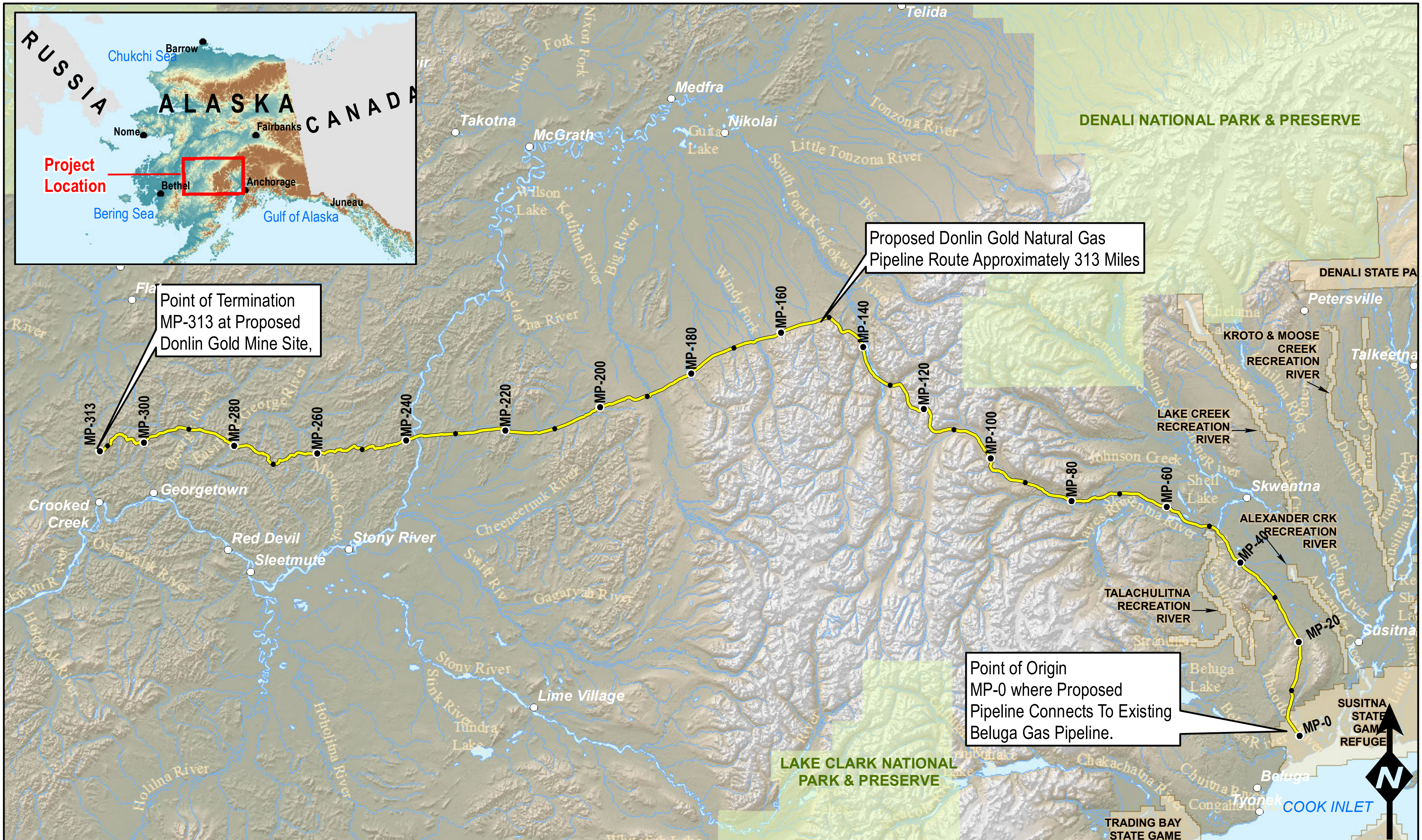
BASIC ROUTE OF MINE ACCESS ROADS

DONLIN GOLD PROJECT

FIGURE:

2-10

DG: PER0034.mxd, 07/17/12, R07



- ○ Populated Places
- • Milepost (MP)
- Proposed Gasline Route
- Federal Admnistrative Boundaries
- State Administrative Boundaries

Seward Meridian, UTM Zone 5, NAD83

SCALE:

0 5 10 20 Mi

0 12.5 25 50 Km

DONLIN GOLD

LOCATION OF PROPOSED NATURAL GAS PIPELINE ROUTE

DONLIN GOLD PROJECT

FIGURE:

2-11

DG: PER0278.mxd, 07/17/12, R03

The airstrip design is based on U.S. Department of Transportation (USDOT), Federal Aviation Administration (FAA) standards. The specified aircrafts are a Bombardier Dash 8 and a Lockheed C-130.

The airstrip would be accessed from a 3 mile (4.8 km) long spur road beginning at mile 5.4 (8.7 km) of the Donlin-Jungjuk road.

2.5.8 Permanent Accommodation Camp

The permanent accommodation camp would be located along the access road approximately 2.4 miles (3.9 km) from the project site. It would initially house 434 people and ultimately be expanded to house a maximum of 638 people.

The camp would include six stand-alone, three-story dormitory wings and a stand-alone, single-story core services facility housing a dining room, kitchen, food preparation and food storage areas, recreation and movie rooms, exercise and weight rooms, a first-aid station, and airstrip terminal functions such as a departure waiting area and arrival check-in. All the above units would be of pre-fabricated modular construction, transported to site and placed on steel beam grillage and concrete pedestal foundations.

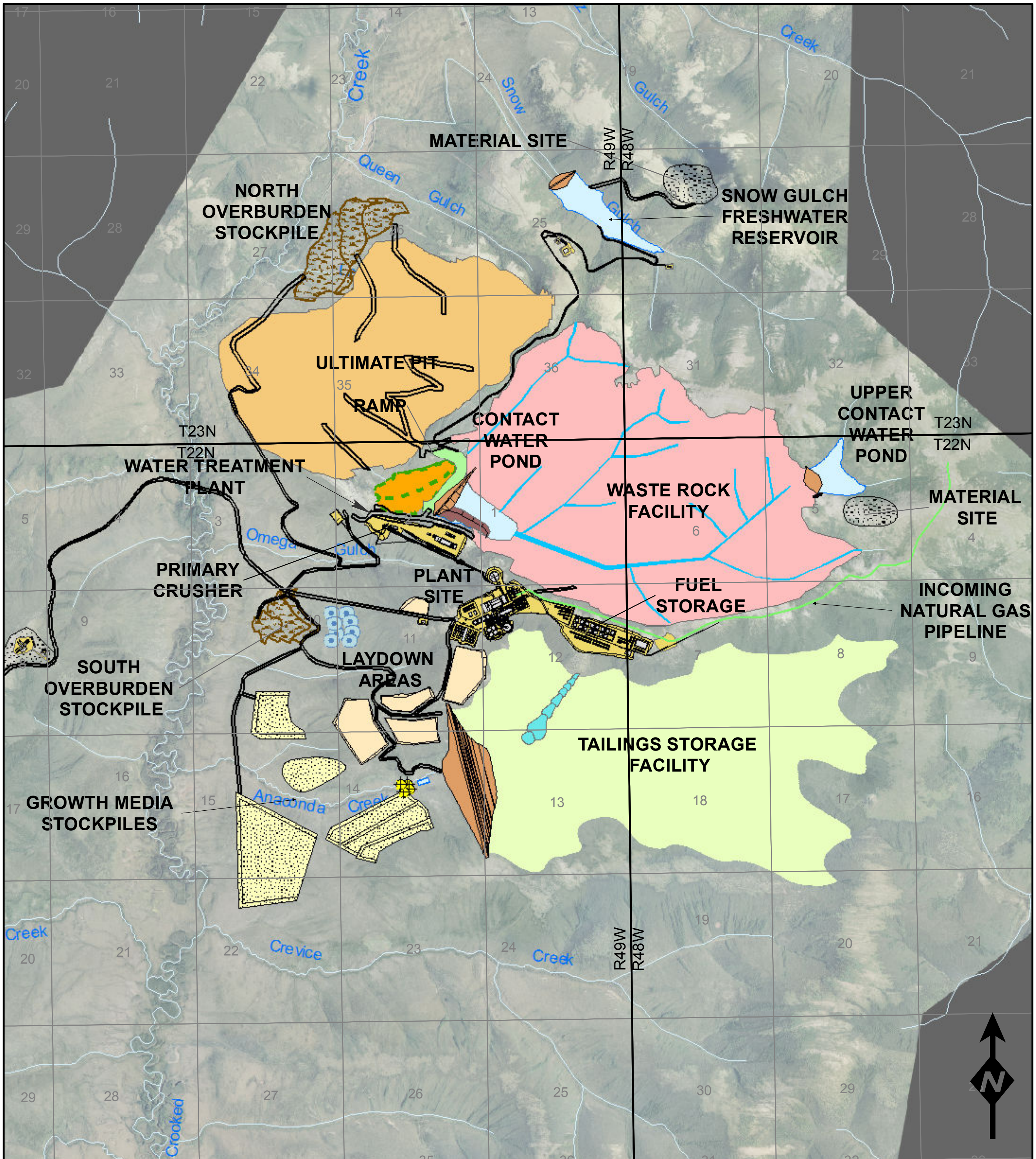
Each dormitory would be designed with bedrooms to accommodate two single-occupancy employees, one on site and one off site, with every two rooms sharing a toilet-shower room. The bedrooms would contain two lockable storage cabinets so that outgoing personnel can store their belongings. Personnel laundry, additional personal storage, housekeeping, and mechanical/electrical rooms would be provided on every floor of each wing.

The dormitory wings would be attached to the core services with heated linked corridors called utilidors. All crawl space plumbing would be designed and installed with heat-tracing and/or sufficient insulation to prevent the pipes from freezing. The accommodation complex would be heated by natural gas furnaces with a forced-air system and supplemental baseboard heaters. Potable water and sewage systems would be provided at the site. The kitchen would use natural gas for cooking.

2.6 Mine Site Infrastructure

2.6.1 Summary

The proposed plant site area is on American Ridge between the WRF and the TSF (Figure 2-12). The site would be graded to take advantage of the natural slope down to the southeast, providing gravity flow of materials between the circuits within the process plant.



Potable Water Wells	Material Site	Dam	Ramp
Seepage Monitoring Wells	Growth Media Stockpile	Drainage	Reclaim Causeway
Facility, Toe Accents, Laydown Areas	Ore Stockpile	Facility	Road
Natural Gas Pipeline	Overburden Stockpile	Laydown Area	Waste Rock Facility
Streams	Berm	Ultimate Pit	Tailings Storage Facility
	Building	Pond	

SCALE:

0 0.25 0.5 1 mi

0 0.375 0.75 1.5 km

DONLIN GOLD

GENERAL ARRANGEMENT

DONLIN GOLD PROJECT

FIGURE:

2-12

DG: PER0129.mxd, 07/17/12, R07

The primary crusher structure would be approximately 600 ft (183 m) from the southeast edge of the open pit. The coarse ore conveyor from the crusher to the plant would be approximately 0.7 miles (1.13 km) long and the conveyor will be enclosed within a 5.5 ft (1.68 m) diameter hinged cover. The other exterior conveyor galleries would be similar. The concentrator building would be steel-framed with insulated steel cladding.

The truck shop would be close to the crusher, approximately 1 mile (1.6 km) northwest of the plant site. The truck shop would house 10 heavy vehicle repair bays, various specialty service bays, a warehouse, change-rooms, and offices.

Facilities at the general plant site would include the process plant building (houses administration/change-room/maintenance shops, and assay lab), a cold storage building, and a warehouse building.

A secure storage area with secondary containment would be constructed at the process plant site. An extensive area would be provided for container storage, including an enclosed structure for the storage of cyanide and other reagents.

Two modular sanitary waste water treatment plants would be provided for the project: one for the permanent camp facility and one for the 2,560-person construction camp immediately to the west of the plant site. The sewage treatment plant for the construction camp would be reduced in size to accommodate up to 620 people in the plant site area during operations.

2.6.2 Truck Shop

The truck shop would be a pre-engineered structure 707 ft long x 161 ft wide (185 m long x 49 m wide). The height at the eaves would be approximately 72 ft (22 m) over the heavy repair bays and 40 ft (12 m) over the shops, change-rooms, and warehouse. The primary function of this complex is to maintain mine vehicles. The building would house 10 heavy vehicle repair bays, a tire bay, a lube bay, two welding-fabrication bays, two light vehicle repair bays, and machine and electrical shops. The mine rescue truck, fire truck, and first aid facility would also be housed within this building.

2.6.3 Truck Wash

The truck wash building would be 72 ft wide x 82 ft long x 59 ft high (22 m x 25 m x 18 m). A wash bay, sump room, and area for the water tanks would be provided, together with a mezzanine floor to support the heating and ventilating equipment.

2.6.4 Utilidors

All buildings on site would be interconnected with enclosed 12 ft (3.5 m) high utilidors to access and service the plant and shop areas as needed.

2.6.5 Cold Storage and Warehouse Facilities

The cold storage building would be a pre-engineered structure built with primary and secondary steel framing approximately 78 ft wide x 158 ft long (24 m wide x 48 long m), with eaves approximately 26 ft (8 m) high. The building would provide a clear-span, open, unheated space for storage. Coiling steel service doors 12 ft wide x 12 ft high (3.7 m wide x 3.7 m high) would be installed at each end of the building.

The warehouse would be a pre-engineered structure constructed with primary and secondary steel framing approximately 103 ft wide x 158 ft long (31 m wide x 48 m long), with eaves approximately 26 ft (8 m) high. The building would include a heated open area for racks and shelving, two warehouse personnel offices, and a washroom. It would also have 12 ft wide x 12 ft high (5 m wide x 5 m high) coiling steel service doors at each end of the building.

2.6.6 Administration Offices / Change-Rooms / Assay Lab Facility

The administration office area would be on the second floor of the process plant building and provide closed offices for engineering, geology, survey, and senior administration staff, plus open work areas for engineering personnel, surveyors, and technicians. Storage space would be provided for accounting records, drawings, and other engineering data. Other general areas would include a reception area, administration assistant station, conference room, lunch/training room, washrooms, communications room, computer station, and miscellaneous storage.

Change-rooms for process plant staff would be provided in the flotation area on the first floor of the process plant building. The lab facility would also be on the first floor in the flotation area, would house a metallurgical laboratory, preparation area, fire assay lab, fluxing and weighing area, and two analytical services areas.

2.6.7 Explosives Storage Area

A dedicated area for the emulsion plant, explosives magazines, and storage would be located at the north end of the pit near the Snow Gulch freshwater reservoir. Separate storage bins or silos would be constructed for emulsion and ANFO. All detonators would be stored in an explosives magazine meeting all applicable federal and state safety and security requirements.

2.6.8 Construction Camp Facilities

The construction camp would be built on a bench near the proposed plant. The camp would include 14 stand-alone, three-story dormitories designed to accommodate up to 2,560 people, and a stand-alone, single-story administrative office facility.

All units would be pre-fabricated complete with all services, furnishings, appliances, and recreation and kitchen equipment, as appropriate, to permit modular construction. The modules would be transported by barge to Jungjuk Port and then trucked to the site.

Each of the 14 dormitories would be designed as three-story wings with double-occupancy bedrooms and a common wash module on each floor containing toilets, showers, and personnel laundry facilities. Housekeeping and mechanical/electrical rooms would be provided on every floor in each wing. The dormitory wings would be attached to the core and dining services area by heated linked corridors.

The construction camp modules would be disassembled and demobilized after construction is complete.

2.7 Electrical Power, Utilities, and Services

2.7.1 Electrical Power and Distribution

The total connected electric load at the proposed Donlin Gold project site is estimated to be 227 MW, the average running load approximately 153 MW, and the peak load 184 MW. The average running load was estimated from requirements for the major motors and other electrical equipment per the Mechanical Equipment List, factored by process utilization time. Motors constitute most of the electrical loading. The largest are the grinding mill motors, which would be a gearless (wrap-around) type that uses cyclo-converter variable-speed drives with soft-start features. The oxygen plant would have three large synchronous motors that use load commutated inverter controllers that also have soft-start features.

Electric power for the proposed Donlin Gold project site will be generated from dual-fueled (natural gas and ULSD) reciprocating engine power. The power plant would consists of two equal halves, each consisting of six reciprocating engines, and a single separate steam turbine utilizing waste heat from the reciprocating engines, for a combined generating capacity of 219 MW. The two parts of the plant would be separated by a blast wall such that either half could assume control or power the emergency system in the event of a catastrophic failure. The conceptual design of the power plant does not provide thermal energy for building or process heating; the waste heat is used to generate electricity.

Power would be distributed to the main process areas by metal-clad cable feeders in trays mounted on racks routed to the local electrical rooms through utilidors, process buildings, and conveyor galleries. The main process plant loads would be serviced by a 34.5 kV radial distribution system with local transformation down to utilization voltages. This would include the grinding, oxidation, leach, refinery, and coarse ore reclaim areas. Overhead 34.5 kV power lines would be run to the more remote areas such as the primary crusher, the water system, pumping, tailings, and pit dewatering sites.

Power would be provided to the permanent camp from the mine/process plant site via a 34.5 kV pole line. In addition, an emergency diesel engine-powered generator would be installed at the camp to provide power in the event of a failure of the pole line.

The Jungjuk Port site would have a stand-alone power generation facility with two 600 kW generators (one primary, one standby) fueled with ULSD.

The airstrip would rely on two 200 kW generators (one primary, one standby) to run pumps and lights as required. These generators would also be fueled with ULSD.

2.7.2 Heating

Heating for the plant site buildings and modules would be provided by natural gas furnaces with a forced-air system augmented by electric baseboard heaters. Other remote buildings with lower heat demand, such as the WTP, pump houses, and primary crusher, would be heated with electric heaters.

For freeze protection during plant shutdown, the heating system would maintain a minimum indoor air temperature of 40°F (5°C) in all process and industrial buildings and modules. The indoor temperature in the administration building and laboratory building would remain unchanged during plant shutdown.

2.7.3 Ventilation

Continuous ventilation would be provided for all human-occupied and selected unoccupied spaces. Ventilation rates would vary depending upon the level of occupancy and the intended use of the space as per American Society of Heating, Refrigeration and Air Conditioning Engineers, U.S. Department of Labor Occupational Safety and Health Administration, and any State requirements. Ventilation systems would include makeup air units for continuous supply of tempered air, summer supply fans to provide extra cooling during the warmer months, and general exhaust fans.

For freeze protection during winter, transfer fans and distribution ductwork would circulate warm ceiling air down to floor levels for temperature control in the process areas. Additional exhaust and supply fans would be operated during the summer to cool down process areas and in some cases to minimize moisture and condensation generated by the process.

2.7.4 Air Conditioning

Offices, electrical control rooms, the administration building, and other select areas would be provided with air-cooled air conditioning systems.

2.7.5 Point-Source Dust and Fume Control

Dust control systems would include hoods, ductwork, dust collectors, and enclosures designed to prevent dust or fume emissions at their source. Dust collectors would be designed and selected to reduce particulate emissions from the discharged air to meet the applicable air pollution control regulations. All contaminated fume discharges would be treated as required to mitigate and reduce the concentration levels of the constituents present to below the criteria specified in applicable air pollution control regulations. Water would be sprayed from trucks and surfactants would be applied for dust control on haul roads and mine access roads.

2.7.6 Fuel Storage and Distribution

The maximum ULSD storage capacity at the plant site would be approximately 37.5 Mgal (142 ML). The plant site fuel storage was sized for a 10-month supply plus one month of contingency for the mine fleet and site mobile equipment. Fifteen fuel tanks (Figure 2-13), each having a capacity of 2.5 Mgal (9.5 ML), would be installed within an HDPE-lined and bunded facility. The fuel storage facility would be approximately 2,000 ft (600 m) east of the plant site at an elevation of approximately 980 ft (300 m) to allow gravity flow to the plant site and to the truck shop.

Lined and bunded storage for 2.8 Mgal (10.6 ML) of fuel would be provided at the Jungjuk Port site, but this is only intended for short-term use while the fuel barges are being unloaded during the summer.

Figure 2-13: Typical Fuel Storage Facility

From the fuel storage facility, the fuel would be distributed to various day tanks around the site. Distribution piping is 4 inches (100 mm) diameter installed in HDPE-lined pipeline corridor with the other utilities. The HDPE-lined pipeline corridor would be 33 ft (10 m) wide with safety berms and pipeline spill containment ditches.

2.7.7 Natural Gas / Propane

Natural gas for heating would be supplied to the various buildings at the plant site through an underground network of pipes. The main distribution line would extend 4.5 miles (7.2 km) along the main access road to the permanent accommodation complex and supply fuel for the forced-air heating system and for the cooking appliances in the camp kitchen. In the event that the natural gas supply is disrupted, supplemental baseboard heaters would provide heating only, while electricity would be supplied by the main power lines or from backup generators. The kitchen would use propane as a backup fuel supply, which would be stored in two 10,000 gal (38,000 L) mobile tanks relocated from the construction camp facility. A fixed pump/vaporizer assembly would be provided to ensure sufficient vapor flow regardless of outside temperature.

For the construction camp, liquid propane would be used for the cooking appliances, and ULSD fuel would be used for the heating furnaces and makeup air units. The fuel would be stored in day tanks filled by fuel tankers, as required, from the construction fuel storage depot. As with the operations ULSD supply, the supply of construction ULSD and propane would be delivered during the summer shipping season. The ULSD would be stored in temporary 132,000 gal (500,000 L) tanks until the first two 2.5 Mgal (9.6 ML) storage tanks were completed and could be filled with fuel. The propane would be stored in fourteen 10,000 gal (38 kL) mobile tanks. A fixed pump/vaporizer assembly would be provided to ensure sufficient vapor flow regardless of outside temperature.

2.7.8 Waste Management

Donlin Gold would follow a waste minimization strategy of recycling all materials where possible and promoting innovative approaches to waste management. Waste management is described in detail in the *Integrated Waste Management Plan, Volume III,* SRK 2016f.

2.7.9 Construction and Operations Water Treatment Plant Systems

The construction WTP will be modular in design and would be commissioned to coincide with the pre-stripping schedule that would expose material (mineralized overburden) that may produce runoff that would require treatment to meet discharge limits. The construction WTP would be operational prior to construction, commissioning, and operation of the Operations WTP. Treated water from the construction WTP would be discharged to Crooked Creek.

The Operations WTP will utilize clarification, oxidation and greensand filtration treatment units, and reverse osmosis [RO] final treatment as required. Ferric sulfate, sulfuric acid, potassium permanganate, antiscalent, sodium hydroxide, sulfuric acid, and sodium metabisulfite are used as reagents in the WTP. The operations WTP would have a design capacity of approximately 4,750 gpm (1,080 m^3/h) and an estimated maximum treatment rate of 4,400 gpm (1,009 m^3/h) (SRK 2016d). Treated water from the operations WTP would be discharged to Crooked Creek.

2.7.10 Sanitary Treatment Plant (STP) Systems

Two modular wastewater treatment plants would be provided: one for the permanent accommodation facility, and one for the construction camp immediately west of the plant site. The construction camp STP would later be reduced in size to accommodate the operations work force.

Sewage from the various sources would be pumped to the STPs via insulated and heat-traced overland pipelines or in pipelines running through heated utilidors. The STPs would process the sewage and produce treated effluent, which would be discharged into the TSF, and a filtered sludge, which would be burned in the on-site incinerator. Treated effluent from both plants would be discharged through separate insulated and heat traced HDPE overland pipelines to the TSF.

A septic tank and leach field sized for the maximum anticipated crew (approximately 20 persons) would be installed at the Jungjuk Port. The leach field would be placed in an appropriate location, considering soil conditions and traffic. The tank would be pumped out as necessary.

2.8 Water Requirements and Management

Project water requirements for process, potable, and firewater are summarized below. These include process water for the process plant and drinking and sanitation water for personnel at the site facilities. The proposed project is expected to operate with an overall water surplus; therefore, an important part of the water management strategy for construction and operations is to build a number of diversion structures and actively treat water to minimize the TSF pond volume during operations and at closure. To mitigate for the possibility of a series of successive dry years occurring early in the proposed project life, the Snow Gulch Freshwater Reservoir will be constructed to provide additional storage. The *Water Resources Management Plan, Volume II,* SRK 2016e describes the site water management in detail.

2.8.1 Process Water Requirements

The minimum "freshwater" requirements for the process plant would range between 2,570 and 2,770 gpm (584 and 629 m^3/h). This water requirement will be met by pit dewatering water, SRS water pumped to the raw water tank, water collected in the contact water ponds, and RO reject water from the WTP. The remainder of the process water requirement would be met by reclaim water from the TSF pond.

2.8.2 Potable Water

The source of water supply for the construction camp, and later the permanent accommodation complex and plant site potable water systems, would be an array of wells south of Omega Gulch, near Crooked Creek. Potable water for the permanent accommodation complex would be supplied from another array of wells. Water would initially be pumped from the wells to a freshwater storage tank at the construction camp. Later, as construction progresses, a line would be run to a freshwater tank at the plant site. The well pumps would be sized to meet the average daily potable water demand for the construction camp. The freshwater tank at the construction camp would include a reserve water supply for the camp fire protection systems. Piping from the wells to the storage tanks would be HDPE, insulated and heat traced, installed overland following a service road.

At both the camp and plant site, the well water from the freshwater tanks would pass through a potable WTP, followed by storage tanks and distribution piping. The potable water systems would supply a volume of 55 gal (208 L) per person per day. The distribution piping to remote buildings would be HDPE, insulated and heat-traced, installed overland. Distribution piping to other areas would be run through utilidors to buildings where possible.

A similar freshwater storage tank, potable WTP, storage tank, and distribution system would be provided for the permanent camp. The freshwater storage tank would also have a reserve supply for fire protection.

2.8.3 Firewater

Supply system requirements for fire protection water are based on National Fire Protection Association (NFPA) and FM Global standards.

Fire protection water supplies for the construction and permanent camps would be provided from the respective freshwater storage tanks. In accordance with NFPA requirements for ordinary hazard occupancies, the tanks would have a reserve supply for fire protection capable of providing 500 gpm (1,900 L/min) for one hour.

Firewater supply for the plant site would be pumped to a 475,500 gal (1,800 m^3) combined freshwater/firewater storage tank. Of this reserve, 264,000 gal (1,000 m^3) would be dedicated firewater storage. The tank would be insulated and heated and sized to meet the firewater demand of the fuel storage facility for two hours. Firewater would be pumped to the process buildings, fuel storage facility, and truck shop through an insulated and heat-traced HDPE pipeline installed overland along a piping corridor. Firewater would be distributed to various plant buildings via fire mains running through the process buildings, process plant building, and utilidors. Exterior wall hydrants would be provided on plant site buildings.

The freshwater tanks at the construction and permanent camps would be sized at 80,000 gal (300 m^3) and 53,000 gal (200 m^3), respectively. Of these reserves, 30,000 gal (114 m^3) in each tank would be dedicated fire water storage. The tanks would be insulated and heated.

Fire pumps drawing water from the plant site firewater tank would provide the water supply for the fuel storage facility. Two pumps would be provided, an electric as primary and a diesel engine-powered backup, each rated at 2,000 gpm (454 m^3/h). The fuel storage facility would be protected with a looped, above-ground, insulated, and heat-traced carbon steel piping system with monitor nozzles and hydrants located such that exposed tanks can be wetted on all sides in case of fire. A circulation pump and piping would assist with freeze prevention. In addition, aqueous film forming foam firefighting systems would be included to flood the interior of any tank.

3.0 SAFETY AND OCCUPATIONAL HEALTH

3.1 Occupational Health & Safety (OH&S) Approach

OH&S at Donlin Gold would be regulated by the U.S. Department of Labor, Mine Safety and Health Administration (MSHA). MSHA was created in 1978 following the passage of the Federal Mine Safety and Health Act of 1977. The agency develops and enforces safety and health rules that apply to all U.S. mines, and the Mine Act mandates that the agency complete at least two inspections of surface mines annually.

The project would implement the following steps during construction, operations, and closure:

- provide the expertise and resources need to maintain safe and healthy working environments
- establish clearly defined, MSHA-approved safety and occupational health programs, measuring safety and health performance and making improvements as warranted
- provide a mandatory 40-hour new miner training and annual 8-hour refresher course
- require task training certification for all equipment operators and maintenance personnel
- conduct regular department-specific safety training sessions
- investigate the causes of accidents and develop effective and immediate preventative and remedial actions
- train employees to carry out their jobs safely and productively
- operate in accordance with recognized industry standards, while complying with all applicable regulations
- require that vendors and contractors comply with all applicable safety and health standards.

3.2 Communications

The external communications system would consist of one or more of the following:

- A microwave/satellite connection
- A microwave tower at Anaconda Mountain to provide a link the existing microwave network in the area
- A fiber optic link along the gas pipeline to Anchorage
- Mine operations would utilize cell phones, 2-way radios, and similar equipment for communications.

3.3 Medical Emergency Response

On-site mine rescue and medical emergencies would be handled by a Mine Rescue Team. The team would include advanced first aid and emergency medical technician (EMT) trained personnel. Team members would, to the extent possible, be distributed throughout all shifts.

Medevac would be available by fixed wing aircraft or helicopter to fly seriously injured workers to the most appropriate medical facility.

3.4 Fire Control and Suppression

All structures would be designed in compliance with State of Alaska Building Codes and approved by the State Fire Marshall's office. Fire control and suppression would be coordinated by an on-site fire brigade. In addition, all personnel would receive instruction in fire and emergency procedures during their MSHA training.

In addition to an on-site fire truck, heavy mine equipment would be available for fire control and suppression. This equipment would include a 20,000 gal (76 m^3) water truck with pumps, water cannons, and hoses, a rubber-tired dozer, tracked dozers, graders, and loaders.

All heavy equipment would be equipped with automatic and/or manually activated fire suppression systems, and handheld extinguishers would be installed in all heavy equipment and small vehicles. Automatic sprinklers would be installed in buildings, and where appropriate, fire extinguishers would be mounted on the walls of all buildings. Fire hydrants would be located near process plant/administration building complex, and conveyor drive tower.

4.0 RECLAMATION AND CLOSURE PLANNING

4.1 Purpose and Approach

Donlin Gold recognizes that its responsibility to the communities of the Yukon–Kuskokwim Delta extends beyond exploration, development, and operations to the important stage of mine closure. This will also provide a basis to calculate financial assurance. Since the very inception of the exploration program, there has been a conscious effort to “design for closure” so that the potential post-closure impacts on the environment, the subsistence resources of the area, and the local communities can be minimized. Realizing that the proposed Donlin Gold project clearly has a role to play in contributing to the long-term sustainability of the communities surrounding the project, planning for closure in collaboration with state and local authorities is essential. Reclamation and closure is described SRK 2016b and summarized below.

In addition to the basic goal of reclaiming disturbances associated with mining, processing, and ancillary support facilities in a manner compatible with the designated post-mining land use, careful planning would minimize the area affected by the operations. During operations, concurrent reclamation would be performed whenever possible in areas that are no longer required for active mining. Donlin Gold would also update and complete a Closure Social Impact Assessment (CSIA), targeted for three years prior to closure of any operation. While appropriate planning of community projects would support the long term sustainability of nearby communities, the CSIA would assess the negative and net positive benefits from the operation and identify alternative uses for the skills and infrastructure developed during operations.

Reclamation and closure of the proposed Donlin Gold project falls under the jurisdiction of the Alaska Department of Natural Resources (ADNR) Division of Mining, Land, and Water, and the Alaska Department of Environmental Conservation (ADEC). The Alaska Reclamation Act (Alaska Statute [AS] 27.19) is administered by the ADNR. The Act 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.

The U.S. Army Corps of Engineers (USACE) under the Clean Water Act Section 404 Dredge and Fill permit incorporates the reclamation plan since it is required by other statutes applicable to the Donlin Gold project.

A general overview of reclamation and closure for the major process components is provided in the following subsections. Buildings, foundations, pipelines, and other infrastructure facilities would be reclaimed to industry and regulatory standards at the cessation of mining and processing activities.

4.2 Tailings Storage Facility

Several years before the end of operations, tailings deposition would be modified to direct the operating pond toward the southeast corner of the TSF. This would be done in anticipation of closure when the tailings runoff would be directed to the closure spillway into Crevice Creek. Once process plant operations cease, water from the TSF will be pumped to the ACMA pit.

The TSF area would be reclaimed over a period of four years after cessation of processing operations. The tailings surface would be progressively reclaimed with an engineered cover consisting of a 3.3 ft (1 m) coarse rock capillary break, 1.0 ft (0.3 m) of colluvium/terrace gravel, and an overlying 1.15 ft (0.35 m) layer of peat/mineral mix to support revegetation. Pumping to ACMA pit would continue to prevent a large pond from redeveloping in the TSF.

Runoff from the cover in Years 5 to 43 of closure would be collected in a LLPDE-lined pond at the southeast corner of the reclaimed TSF. Runoff water would be held and tested to evaluate if it is suitable water quality for discharge. It is anticipated that runoff from the pond would meet the applicable water quality standards in Year 5 of closure and it would then be permitted to flow over a constructed spillway between the southeast corner of TSF in upper Anaconda drainage and Crevice Creek.

The TSF SRS would continue to operate during closure operations. Seepage and tailings consolidation water not suitable for discharge without treatment would be pumped to the ACMA Pit.

4.3 Waste Rock Facility

The ultimate WRF configuration would cover an area of approximately 3.5 square miles (9 km^2) and contain approximately 2,460 Mst (2,232 Mt) of waste rock and overburden stripped from the pit area. After active dumping ceases on each lift, the slopes would be regraded to less than or equal to 3H:1V. The WRF would be progressively reclaimed during operations by placing a cover to minimize infiltration over the waste rock dump. The soil cover would consist of a minimum of 14 inches (0.35 cm) of growth medium (peat mineral mix) over a minimum of 12 inches (0.30 cm) of terrace gravel and/or colluvium. The growth medium cover would be vegetated. Before the cover layers were added, the underlying waste rock would be contoured to provide natural drainage toward the south margin of the WRF. Seepage of meteoric infiltration from the WRF would be collected and piped to the bottom of the ACMA pit lake after closure.

4.4 Open Pit/Pit Lake

After closure, the pit would fill over a period of time. At some point, the pit lake elevation will reach a point that pumping and discharge will be necessary. It is currently anticipated that the water on the surface of the pit lake would not meet water quality criteria for several parameters and thus would be treated before discharge into Crooked Creek. Water discharged from the pit would be managed by passing it through a post-closure High Density Sludge Process WTP, where chemical precipitation technology would be applied to remove elements such as aluminum, antimony, arsenic, manganese, mercury, and selenium. The sludge from the WTP would be a chemically stable material that would be sent to the bottom of the pit lake for final storage.

To ensure adequate funding for potential perpetual water treatment, a Post-Reclamation and Closure Maintenance Trust Fund would be established during construction and operations to cover the costs of the WTP, operation/maintenance, and post-closure monitoring.

4.5 Jungjuk Port, Roads, and Airstrip

The Jungjuk Port facilities also would be reclaimed. The sheet piles and fill would be removed, and the area recontoured. The 30-mile (48 km) Jungjuk Port access road to the mine site would be required for long-term monitoring of the project site, and seasonal operation of the WTP would remain into the foreseeable future following mine closure. The airstrip would also remain to support mine long term monitoring and closure.

5.0 ENVIRONMENTAL PERMITTING PROCESS AND AUTHORIZATIONS

The proposed Donlin Gold project will require the full participation of numerous state and federal agencies to review the proposed project under applicable laws and regulations.

Certain federal decisions require compliance with the National Environmental Policy Act (NEPA). For the Donlin Gold Project, NEPA compliance is required for three federal decisions:

- USACE Section 404 permit application (wetlands dredge and fill)
- BLM Right-of-Way for portions of the natural gas pipeline that are on BLM-managed land
- U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) pipeline special use permit

The USACE is the lead federal agency and is developing an Environmental Impact Statement (EIS) for the Donlin Gold Project. BLM, PHMSA, and other agencies and several tribal governments are cooperating agencies.

Upon completion of the NEPA process, agency Records of Decision (RODs) would be prepared that identifies the preferred alternative for the project, explains the basis for the decision, and identifies any additional changes or stipulations needed in project plans under the federal agency's jurisdiction. The state permitting process typically is not finalized until the NEPA process is completed. Upon completion of the NEPA review, and the final issuance of permits and authorizations, an Environmental Management System, consisting of a number of management and maintenance plans for the proposed Donlin Gold project, would be fully implemented. The comprehensive permit review process would determine the precise number of management plans required to address all aspects of the project to ensure compliance with environmental design and permit criteria. Each plan would describe the regulatory requirement (e.g., secondary containment for petroleum products, process solutions, and reagents) and the applicable operations procedures, maintenance protocols, and response actions.

With the end goal of minimizing impacts to the environment, the project is designed to comply with all regulatory requirements through construction, operations, closure, and post-closure. Donlin Gold is committed to incorporating the strictest safeguards in its proposed design, logistics, and processing operations.

The anticipated federal and state agency permits and authorizations expected to be required for the project are listed in Table 5-1 and Table 5-2, respectively.

Table 5-1: Potential Federal Agency Permits and Authorizations

Federal Agency	Permit or Approval
BLM	• Surface Estate Lease (facilities on managed lands) • Land Use Permit (borrow pit activities on BLM managed lands) • Access Right-of-Way (BLM managed lands) • 17(b) Easement decisions
EPA	• Facility Emergency Response Plan • Emergency Planning and Community Right-to-Know Act (Hazardous Substances) • Hazardous Waste Generator Identification Number • Used Oil Generator Notification and Identification Number • SPCC Plan (required to be prepared, in place at the facility, and implemented; no associated submittal, permit or approval)
USACE	• Nationwide Permit 6 – Survey Activities (wetlands) • CWA Section 404 Permit (wetlands dredge and fill) • River and Harbors Act (RHA) Section 10 (structures in navigable waters) • Section 106 Historical and Cultural Resources Protection Act Clearance • RHA Sections 9 & 10 (dams and dikes in navigable waters – interstate commerce)
U.S. Coast Guard	• Rivers and Harbors Act (RHA) Section 9 Construction Permit (bridge across navigable waters) • Marine Protection, Research, and Sanctuaries Act compliance [ocean dumping (mooring blocks) requires a permit] • Anchorage Permit • Application for Cargo Transfer Operations • Port Operations Manual Approval • Facility Response Plans • Private Aids to Navigation Authorization • Tug and Barge Vessel Inspections • Notice to Mariners
U.S. Department of Justice Bureau of Alcohol, Tobacco, and Firearms	• License to Transport Explosives • Permit and License for Use of Explosives
Federal Communications Commission	• Radio License
FAA	• Notice of Landing Area Proposal (existing airstrip) • Notice of Controlled Firing Area for Blasting • Notice of construction, activation and de-activation of airports
Homeland Security	• TSA Inspection Program at Airport • Chemical Facility Anti -Terrorism Standards
USDOT	• Hazardous Materials Registration • Pipeline and Hazardous Materials Safety Administration approvals

Federal Agency	Permit or Approval
MSHA	• Mine Identification Number • Notification of Legal Identity • Training and Retraining of Miners Plan
National Marine Fisheries Service	• Marine Mammal Protection Act • Essential Fish Habitat • Critical Habitat Management Plan
USFWS	• Section 7 of the Endangered Species Act, Consultation

Table 5-2: Potential State Agency Permits and Authorizations

State of Alaska Agency	Permit or Approval
Alaska Department of Natural Resources	
Division of Mining, Land, and Water	• Plan of Operations review • Reclamation Plan Approval • Mining License (required regardless of land tenure; for tax revenue) • Land Use Permits and Leases (activities on state land) • Right-of-Ways, Easements, Material Sales, etc. • Right-of-Ways (natural gas pipeline) • Certificate of Approval to Construct a Dam • Certificate of Approval to Operate a Dam • Water Dam Operation & Maintenance Manual approvals • Temporary Water Use Permit • Water well logs (submittal only)Appropriation of Water Permit/Certificate to Appropriate Water (water rights) • Tidelands/Submerged Lands Permit • Shoreland Permit
Office of History and Archaeology/ State Historic Preservation Office (SHPO)	• Section 106 Historical and Cultural Resources Protection Act Clearance • Archaeology Collection Permit • Field Archaeology Permit
Division of Forestry	• Burning Permits
Alaska Department of Fish and Game	
Habitat Division	• Fish Habitat Permits • Fish Passage Permits (Culverts and Bridges • Permit to take, relocate, haze, or destroy birds or their eggs or nests, mammals for public safety purposes • Special area permits for designated area (refuges, sanctuaries, and critical habitats
Alaska Department of Environmental Conservation (DEC)	
Division of Water	• CWA Section 402 NPDES (APDES) Permit (discharges to waters of the U.S.) • Storm Water Pollution Prevention Plan • Storm Water Discharge Permit (submittal of Notice of Intent)

State of Alaska Agency	Permit or Approval
	• Section 401 Water Quality Certification (CWA 404 permit) • Wastewater Disposal Permits • Non-Domestic Wastewater Disposal Permit • Domestic Wastewater Disposal Permit
Division of Environmental Health	• Solid Waste/Wastewater Permits (Waste Rock Dumps and TSF) • Solid Waste Permit (Construction and Demolition Debris) • Food Establishment Permit • Approval to Construct and Operate a Public Water Supply System • Public Water System Identification Number
Division of Air Quality	• Air Quality Construction Permit • Air Quality PSD Title V Operating Permit • Air Quality Permit to Open Burn
Division of Spill Prevention and Response	• Oil Discharge Prevention and Contingency Plans (fuel storage facilities >420,000 gallons and oil barges)
Alaska Department of Public Safety	
Office of the State Fire Marshal	• Approval to Transport Hazardous Materials • Life and Fire Safety Plan Checks • Plan Review Certificate of Approval for each building
Alaska Department of Labor, Standards and Safety	
Division of Labor Standards and Safety	• Certificates of Inspection for Fired and Unfired Pressure Vessels • Occupational Safety and Health (inspections and certificates) • Employer Identification Number
Alaska Department of Commerce, Community, and Economic Development	
Regulatory Commission of Alaska	• Certificate of Public Convenience and Necessity for Natural Gas Pipeline
Alaska Department of Health and Social Services	
Health Impact Assessment Program	• Health Impact Assessment (HIA)
Matanuska–Susitna Borough	
Planning Department and Public Works	• Zoning • Plan review and construction permits • Solid Waste
Kenai Peninsula Borough	
Land Management Division	• Easements for utilities, pipelines, barge landings, and travel ways

6.0 REFERENCES

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7.0 GLOSSARY OF TERMS

Acid generation potential (or net acid generation potential) – A measure of the sulfide minerals in mine dumps and process plant tailing and their capability, under oxidizing conditions, to form acid.

Acid wash – Use of a weak acid solution, typically hydrochloric acid, to remove calcium type scales from the carbon.

Acidulation – The addition of sulfuric acid to remove excess carbonates in the ore before it enters the autoclave circuit. This pre-treatment improves the efficiency of the autoclave from both operations and maintenance aspects. After acidulation, the slurry moves forward to autoclaving.

Activated carbon (or granular activated carbon) – Carbon particles, approximately ⅛ inch in size, typically made by roasting coconut shells.

Apron feeder – A large, variable-speed, steel track (similar to wide bull dozer tracks) with attached pans to carry material. Used to control the rate of material fed into or out of a process.

Autoclave – A pressurized container used at mines that are producing refractory gold ore with very high sulfide content. Within the autoclave vessel, the sulfide ore is subjected to oxygen at high temperature and pressure to convert it into an oxide ore, which is then amenable to conventional cyanidation to recover the gold.

Ball mill – A large rotating cylinder partially filled with steel balls. The cascading balls grind the ore into fine particles.

Barren solution – Solution from which most of the dissolved gold has been removed.

Bench – Step- or terrace-like areas on the sides of a pit. Benches improve pit wall stability and worker safety in working areas.

Carbon safety screens – Vibrating screens that ensure coarse carbon loaded with gold remains in the circuit and is not lost to the tailings system.

Carbon Stripping – A high temperature and pressure process in which gold is removed from loaded carbon and placed back into solution.

CIP (carbon-in-pulp) – A method of recovering gold and other precious metals from pregnant cyanide solutions by adsorbing the precious metals onto activated carbon.

Closed circuit – A loop in the process wherein a selected portion of the product of a machine is returned to the head of the machine for finishing to required specification. In a closed circuit, only material meeting specification is allowed to exit the loop. A common example would be a grinding mill in closed circuit with hydrocyclones.

Crusher (including gyratory and short head cone) – A material size reducing machine that reduces or (crushes) material by compression. The machine consists of a moveable conical member (head) gyrating within an inverted concave cone (bowl). Material is crushed between the moveable head and the bowl. The material is gravity-fed through the crusher. Gyratory crushers reduce rock from the size of a small vehicle to 10 inches. Short head cone crushers reduce rock from two inches to ⅜-inch.

Cyanide – A chemical compound of carbon and nitrogen (CN-) used to dissolve gold and other precious metals. Typically, cyanide is delivered dry in the form of sodium cyanide (NaCN) briquettes and is dissolved in water and caustic to make a solution for use.

Cyanide process – That part of the process where ore in the form of a slurry is exposed to a weak cyanide solution, which dissolves gold and other precious metals.

Cyclone (hydrocyclone) – A particle sizing device that uses circular motion to generate centrifugal forces greater than the force of gravity. These high forces are used to separate particles by size and specific gravity.

Doré – A metal alloy composed of gold and other precious metals. Typically the final product from a precious metals mine.

Electrowinning – The electrolytic process of capturing dissolved gold onto a negatively charged cathode. Materials commonly used as cathodes include steel wool and stainless steel sheets.

Flux – Substances, such as silica, borax, soda ash, etc., used in the refinery to upgrade the gold by reacting at high temperatures with undesirable materials to form slag. Fluxes are liquid at furnace temperatures and are light enough in density to float on top of the molten metal.

Gravity circuit (or gravity gold recovery circuit, or gravity concentration circuit) – A circuit that uses any of several types of devices to separate gold from the other materials based on specific gravity.

Milling - A piece of milling equipment consisting of a revolving cylinder for the fine grinding of ores as a preparation for leaching. See “SAG mill” and “ball mill.”

Mining – The process of removing the ore from the ground and transporting it to the process plant. At Donlin this includes drilling, blasting, loading into trucks, and hauling to a primary crusher.

Non-putrescible – Material that would not rot.

Overburden – The material that lies above an area of economic or scientific interest. Overburden is also described as the soil and other material that lies above a specific geologic feature.

Overflow – That portion of a slurry that exits a hydrocyclone through the top and contains the smaller, less dense particles in the slurry.

Oversize – Particles that are too large to pass through a particular screen.

Pregnant solution – Water containing dissolved precious metals resulting from the leaching process.

Process Plant/Processing – (1) A processing facility in which ore is treated for the recovery of valuable metals (gold). (2) – The process of separating the valuable constituents (gold) from the non-economic constituents (which after processing are called tailings). Processing typically consists of crushing and grinding to liberate or free the gold, which is then recovered through a leach or gravity circuit.

Pulp – A suspension of pulverized or ground ore in water. The ore is kept in suspension by agitation and flow of the water.

Raft-type foundation – A foundation (usually on soft ground) consisting of an extended layer of reinforced concrete

Refinery – That part of the process plant in which gold is purified by being melted with fluxes in a furnace and is then poured into doré bars for shipment.

Reject circuit (or pebble reject) – That part of the process plant that allows screen oversize to be rejected from the grinding circuit if the gold content of this harder material is non-economic.

Rock – Uneconomic rock with no mineral value that must be removed to allow access to the ore. Some rock is used as fill in construction of roads, dams, and other mine facilities.

SAG mill (semi-autogenous grinding mill) – A large rotating cylinder that uses the ore itself as a grinding medium and supplements this with steel balls, as required, to obtain the proper size grind.

Slurry – Same as "pulp."

SO_2/Air cyanide detoxification process – A patented process that, after adjustment of pH and addition of a copper catalyst, uses sulfur dioxide and air to chemically change cyanide to cyanate. The cyanate is not stable and changes into carbonate and ammonium ions. The carbonate ion, which is essentially dissolved carbon dioxide, precipitates as calcium carbonate. The ammonium ion is converted to ammonia and nitrates.

Strip vessel (or stripping vessel) – An enclosed tank capable of holding solutions under elevated temperatures and pressures in which gold is removed from loaded carbon.

Sub-aerial deposition – Discharge of tailings slurry onto land as opposed to under water. A beach deposit is formed, allowing water to drain from the tailings and the tailings to densify more than when they are deposited sub-aqueously. Water is collected in a pool and reused in the process plant. Typically used during summer.

Sub-aqueous deposition – Discharge of tailings under water in the tailings impoundment. Solids in the tailings slurry settle in the impoundment, and the water is reused in the process plant. Typically used during winter to minimize ice formation.

Tailings – A slurry of ground ore in water that is discharged from the process plant after the gold has been extracted from it, the cyanide has been detoxified, and the pH has been neutralized.

Thickening – The partial separation of solids from liquid in a slurry by means of settling in a large tank. Typically, flocculants are added as a settling aid. Clarified water overflows from the top of the tank, and the thicker slurry exits from the bottom of the tank.

Toe – The bottom of a fill, such as a road embankment or dam.

Topsoil – The upper, outermost layer of soil, usually the top 2 inches (5.1 cm) to 8 inches (20 cm). It has the highest concentration of organic matter and microorganisms

Trash screen – A screen used to remove trash (such as plastic, wood, steel, etc.) from the slurry prior to leaching.

Underflow – That portion of a slurry that exits a hydrocyclone through the bottom and contains the larger, denser particles in the slurry.

Undersize – Particles that pass through a particular screen.

Work index – A measure of ore hardness used in sizing crushers, SAG mills, and ball mills.