RED DOG MINE
Site Current Conditions

Waste Management Permitting Program
Tasks B-04, C-02 and D-02

Teck Cominco Alaska Incorporated
Red Dog Operations
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December 5, 2002

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1 Introduction

Teck Cominco Alaska Incorporated (TCAK), in a partnership with the NANA Regional Corporation, operates the Red Dog zinc-lead mine in the Northwest Arctic Borough (NWAB) of Alaska, 90 miles north of Kotzebue. Red Dog is the world's largest zinc mine and direct employer of approximately 450 people. Another 130 people work for contractors NANA Management Services Inc., which provides camp management, housekeeping, catering and other services; and NANA/Lynden LLC, which operates trucks carrying mineral concentrates from the mine to tidewater. Most employees are Alaskans and approximately 56 percent of the jobs created by the mine are filled by NANA shareholders.

TCAK and NANA are working closely with State of Alaska agencies, through the Large Mine Permitting Team, to develop an integrated management, reclamation and closure plan that will support approval of the reclamation plan and issuance of a solid waste permit (SWP) for Red Dog, pursuant to 18AAC60.210. The plan will address:

- pre-mining conditions,
- current mine conditions (pre-permit condition),
- future mine development,
- control and closure measures,
- impact assessment,
- monitoring and maintenance, and
- financial assurance.

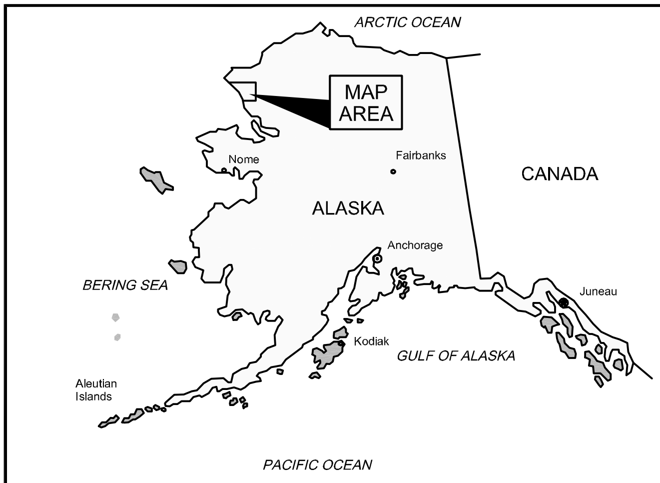
Plan development considers the facilities of the Red Dog site including the open pit, waste rock stockpiles, tailings facility, millsite, camp, water management facilities, airstrip, freshwater reservoir, material storage areas and ancillary facilities. The facilities of the DeLong Mountain Transportation System (DMTS), including a haul road and portsite on the Chukchi Sea south of Kivalina, are outside the scope of the plan and the SWP.

The permitting process is expected to continue through 2004, leading to the issuance of a Solid Waste Permit (SWP) for the period 2005–9. The process is structured according to the *Action Plan for the Waste Management Permitting Program* (AMEC 2002) which comprises 88 tasks grouped into 15 work areas. The plan was developed by 20 representatives of TCAK, NANA, Northwest Arctic Borough (NWAB) and the State of Alaska (ADNR, ADEC, ADF&G and ADL) at a planning session in Anchorage in early 2002.

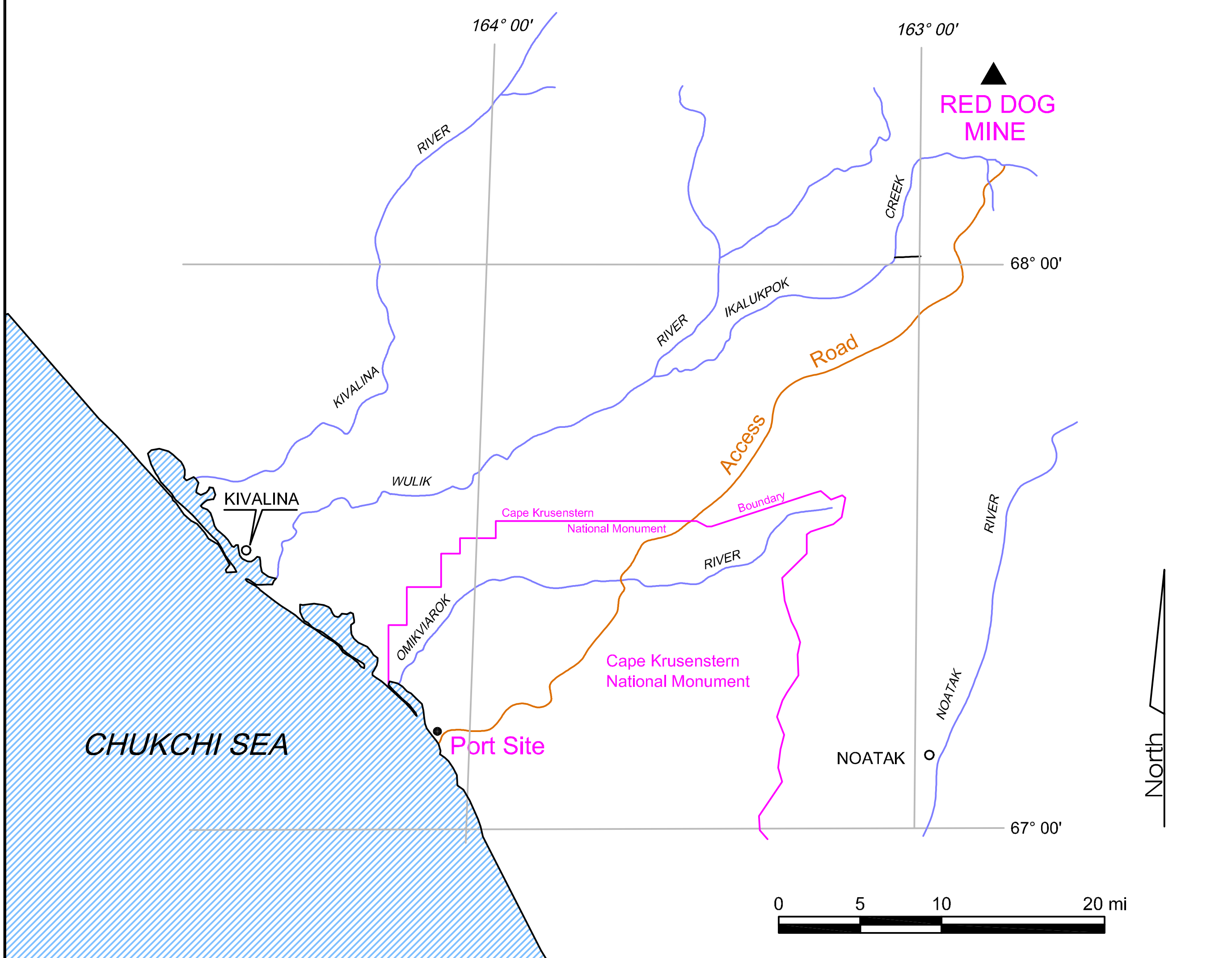
This document describes the mine site facilities and addresses the requirements of action plan tasks B-04 (Identify Current Mine Condition), C-02 (Identify Current Waste Rock Condition) and D-02 (Identify Current Tailings Conditions).

1.1 Red Dog Mine Site

The Red Dog Mine is located in northwestern Alaska, approximately 90 miles north of Kotzebue and 47 miles inland from the coast of the Chukchi Sea (Figure 1). The mine site is located on a ridge between the Middle and South Forks of Red Dog Creek, in the DeLong Mountains of the Western Brooks Range.



LOCATION MAP



Approved By:			teckcominco	Figure 1 Red Dog Mine and Port Project Vicinity Map
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The Red Dog deposit consists of metal sulfides in a Mississippian shale. The orebody lies within the drainage basin of the Middle Fork of Red Dog Creek, which cuts through the orebody. Facilities at the mine site include an open pit zinc/lead mine, concentrator, tailings impoundment, concentrate storage building, maintenance facilities, power generation plant and an accommodations complex. The open pit mine is established on both sides of the valley of the Middle Fork of Red Dog Creek. The concentrator lies to the west of the orebody, on the northwest side of the ridge between the Middle and South Fork of Red Dog Creek. The tailings impoundment is formed by a dam across the South Fork of Red Dog Creek. Figure 2 provides an plan view of the mine area.

Construction of the mill began in 1988, along with removal of overburden (pre-mine stripping) and construction of the tailings dam. The first ore was delivered to the mill in November 1989, and the first concentrate was produced late in 1989.

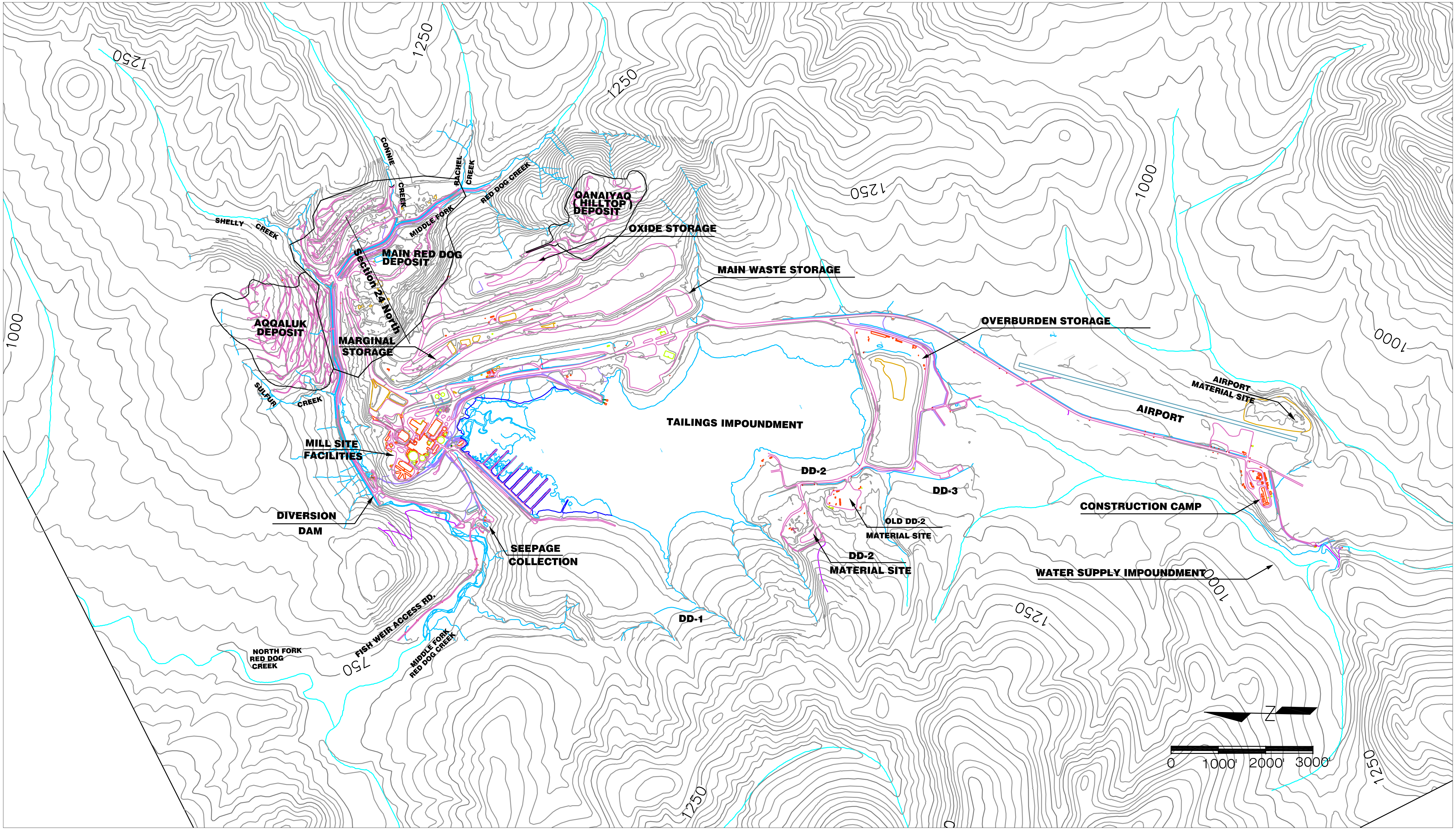
1.2 Legal Description

The Red Dog property, on private land owned by NANA, is located in the Kateel River Meridian, State of Alaska, and lies within three townships. Figure 3 shows the property boundary as defined in the legal agreement between NANA and TCAK. The legal description for this land is:

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

2 Geology

Red Dog Mine is a Mississippian to Permian aged zinc lead silver deposit. Located in the Western Brooks Range, the topography is moderately sloping, with elevations ranging from 780 feet to 1,500 feet above sea level. Permafrost has developed to a depth of several hundred feet. The Middle Fork of Red Dog Creek flows over the ore body where weathered ore is exposed along its valley and fresh sulfide veins are cut by its creek bed.



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Title: Figure 2 Red Dog Mine Aerial Site View

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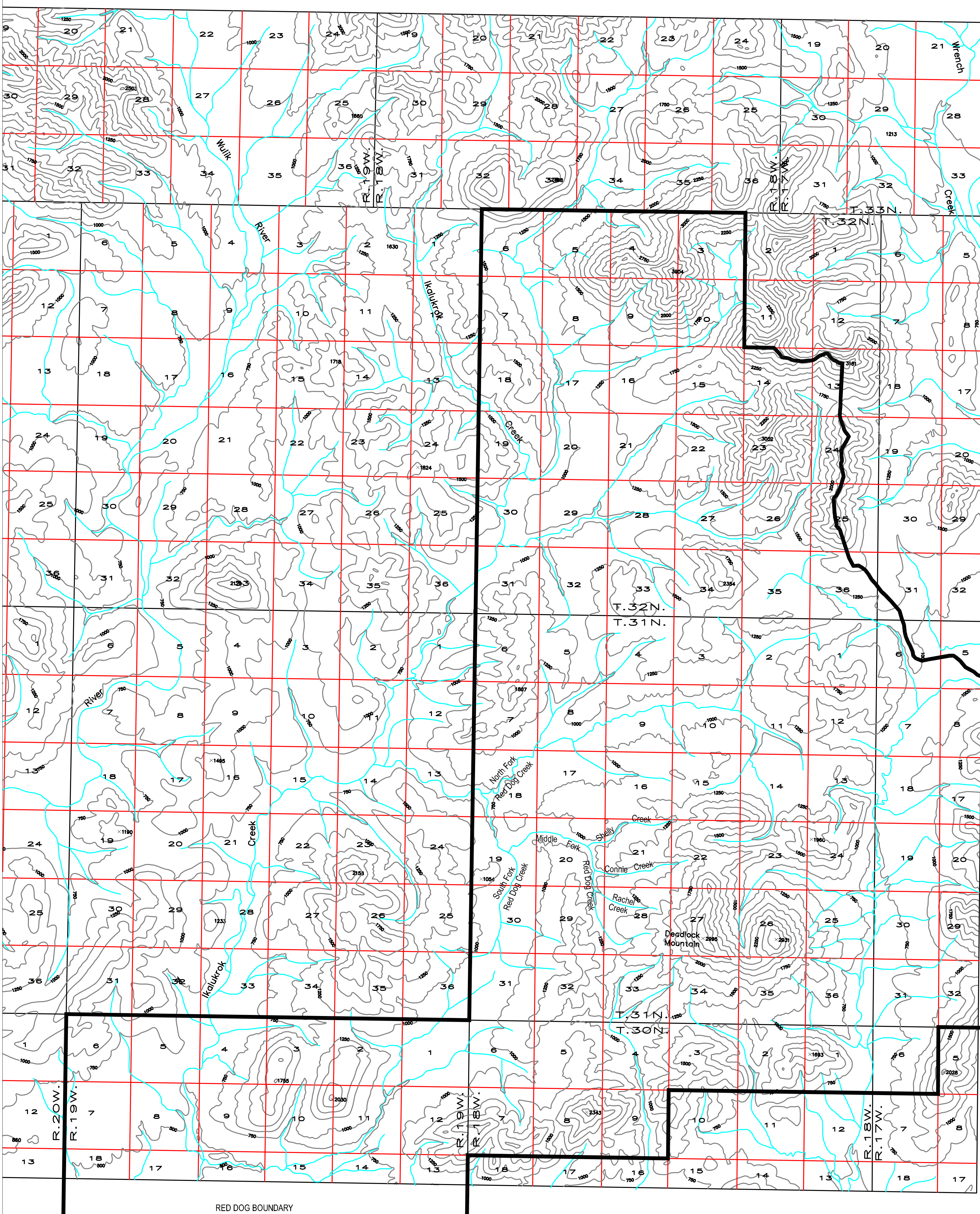

0 1 2 3 4 5 6 7

GRAPHIC SCALE IN MILES

0 9,000 18,000 27,000 36,000 45,000

GRAPHIC SCALE IN FEET 1" = 9000'

NORTH

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FIGURE 3

RED DOG MINE
BOUNDARY LINE
TOWNSHIP, RANGE & SECTIONS

DATE: 4/25/99 by SOH

Ref: USGS Map "DE LONG MOUNTAINS" (A2) 1:63,360 Series
Alaska State Plane Zone 7

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2.1 Main Deposit

The Main deposit is the area of current mining. The orebody is an elongated zone, 4,400 feet long and 1,500 feet wide, with a long axis trending about N30°W. The maximum ore thickness is 500 feet, including internal waste (rock within the orebody that does not have a recoverable value). The deposit's cross-section mimics the creek valley, producing a relatively constant ore thickness and a synformal shape.

2.2 Stratigraphy

The stratigraphic section at Red Dog consists of Mississippian to Cretaceous aged clastic sediments and exhalite rocks associated with the mineralizing event. The Kuna Formation, the oldest formation at Red Dog, is subdivided into two members, the Kivalina Member and the younger Ikalukrok Member. The Kivalina Member consists of up to 400 feet of intercalating, dark-gray, calcareous shale and light-gray limestone. Forming the footwall to the ore body, this unit contains uneconomic lead and zinc mineralization near its upper contact. The Ikalukrok Member consists of a monotonous section of carbonaceous black shale with a maximum thickness of 400 feet. It hosts the orebody and has been locally silicified by the ore-forming event.

The Siksikpuk formation overlies the Kuna Formation. It is estimated to be approximately 225 feet thick and comprised of green gray and maroon shales and cherts. Bedded, unmineralized barite of the exhalite event is hosted in the Siksikpuk Formation. This formation is utilized as an important source of high quality construction material. Conformable with, and overlying, the Siksikpuk formation is the Otuk Formation. It consists of up to 150 feet of interbedded chert, shale, and carbonate.

The Okpikruak Formation is the youngest stratigraphic unit and is unconformable with underlying formations. Estimated to be over 1,230 feet thick, it is comprised of micaceous mudstones, shales, and fine-grained graywacke.

2.3 Exhalite Rock Suite

All rocks associated with the mineralizing event, including the silicified Ikalukrok Member shale and unmineralized barite rock in the Siksikpuk Formation, are included in the exhalite rock suite. Three rock types dominate and form a gradational continuum in this suite. They are silica rock, barite rock and sulfide rock. The exhalite mineralogy is simple and primarily limited to quartz, barite, sphalerite, galena, pyrite, and marcasite.

Silica Rock: Extremely fine to medium crystalline, massive, milky-white quartz is a common rock type of the exhalite suite. Silica rock is frequently sulfide bearing, making it an important ore type. Included in the silica rock category are the silicified Ikalukrok Member shales, which often resemble primary chert. Trace amounts of pyrobitiminous vug fillings frequently occur in this silica rock.

Barite Rock: Two types of barite rock exist in the Red Dog orebody: mineralized and unmineralized. The mineralized barite rock is hosted by the Ikalukrok Member and is the more prevalent of the two types. It commonly consists of dark-gray, fine to medium crystalline, non orientated aggregates of prismatic barite crystals, with variable amounts of interstitial sulfides. This rock is often ore grade, and has a higher lead to zinc ratio than the rest of the orebody. A cap of unmineralized barite rock, up to 100 feet thick, occurs at the base of the Siksikpuk Formation. Steep, coarse, witherite (barium carbonate) veins cut both barite rock types and the Siksikpuk Formation. In addition, irregular, ghost like witherite zones have also been noted within the barite rock itself.

Sulfide Rock: Exhalite rock with greater than forty percent total sulfides is classified as sulfide rock. Silica is the main gangue mineral, but lesser amounts of barite are also common. Sphalerite (zinc sulfide) is the dominant sulfide, and at least two distinct varieties occur. The subordinate variety is honey colored, amorphous to very finely crystalline, and commonly occurs as disseminations and fragmental massive intergrowths. A coarser, medium crystalline, reddish brown variety occurs as disseminations, massive intergrowths, and cross cutting wispy irregular stringers to massive veins. Cadmium and silver also occur in this reddish-brown sphalerite.

Galena (lead sulfide) is another major ore mineral in the sulfide rock. It commonly occurs as smeared, thin, elongated blebs, fine disseminations, and wispy irregular veins. The bulk of the silver occurs within the crystalline structure of the galena.

Zones of massive iron sulfide, up to ten feet thick, occur within the exhalite package, which has a total iron value of 6.6%. This zone of iron sulfide is composed of two minerals, pyrite and marcasite. Pyrite dominates marcasite at an estimated ratio of 2:1. It commonly occurs as fragmented massive clasts, disseminations and wispy irregular veins. Marcasite replaces pyrite throughout the orebody.

2.4 Structure

The Red Dog stratigraphic section and orebody is structurally repeated by thrust faults. A cross-section showing the structure of the deposit is presented on Figure 4.

Three thrust plates are recognized: the upper plate, a thin non ore bearing plate; the median plate, a thick plate containing the highest ore grades and the majority of the reserve; and the lower plate, also a thick plate and an important ore host. A series of low-angle thrust faults and internal waste sections separate the plates. Plate thickness is extremely variable, ranging up to 550 feet in some areas, and locally pinching out in others.

A melange/fault zone lies at the base of the lowest plate and separates Red Dog's geologic section from similar stacked sections, which form the Brooks Range. It is up to 260 feet thick and comprised of sheared, cataclastic rocks. Normal, strike/slip and reverse faults are common. Most of the contacts currently exposed in the pit are structural in nature. A moderately well developed, open-joint system occurs. The dominant set strikes N60°E and dips steeply to the south. A subordinate near-vertical N20°W to N45°W set has also been noted. Drag folds related to thrusting are common. A broad recumbent fold has been identified by drilling in the southern part of the deposit.

2.5 Weathering

The upper portion of the Red Dog orebody has been weathered by physical (freeze/thaw) and chemical (oxidizing) conditions. The contact between weathered and-unweathered rock is irregular, and can be abrupt or gradual, occurring over thicknesses of up to ten feet. The weathered zone ranges from a few to 70 feet thick, with an aver age thickness of 20 feet. Increased porosity due to fracturing appears to be an important factor controlling the localization of weathering.

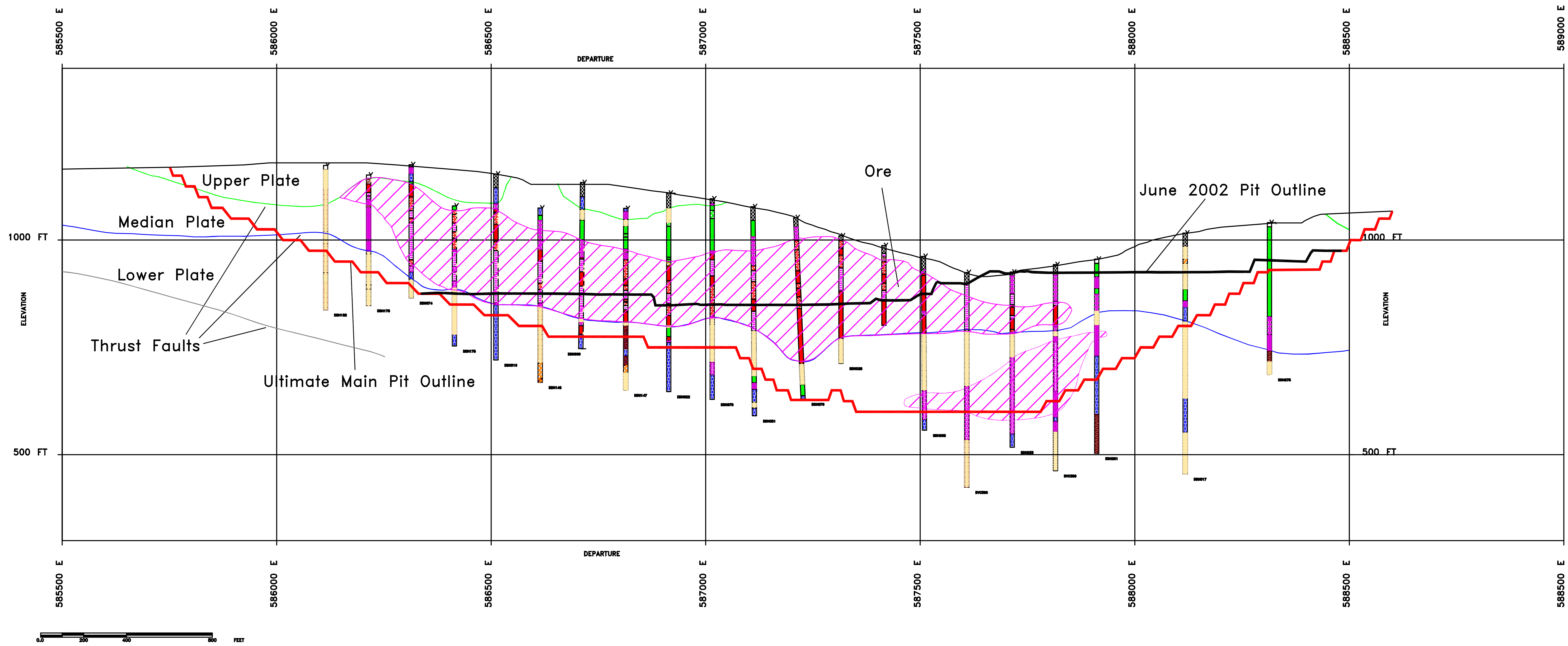

Figure 4
Section 24 North
Looking North

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Department	Reviewed By	Date
Mine Engineering		
Mine Operations		
Survey		
Geology		
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Physically, the weathered material ranges from competent rock to soft, poorly cohesive rock, to desegregated sand and clay. Weathered ore may contain sulfides and/or sulfates. Oxidation alters sphalerite to goslarite, and pyrite to melanterite. Galena alters to an earthy anglesite and, to a lesser extent, plumbojarosite. Zones of intense weathering display zinc and iron depletion, and an enrichment of lead and silver due to the relative solubility of the sulfates. Elemental sulfur is formed by this process and values measured as high as 8.2% by weight have been measured.

Oxidation of sulfides to sulfates has liberated zinc, lead, iron, and cadmium from the orebody. Acidic groundwater, emanating from the orebody, can have pH values less than 2.3 and a zinc content in excess of 10,000 part per million (ppm). Low pH values and elevated metal values have been common to the Middle Fork of Red Dog Creek since sampling started in the early 1980's (Dames & Moore, 1983a, b). Zinc values as high as 2,300 ppm and pH values below 4.0 have been measured in the creek. Prior to mining, a well-developed geochemical halo existed downstream from the orebody; the precipitation of iron hydroxide in the stream-bed produced a striking color anomaly.

3 Pit Reserves

Mineable reserves have been calculated using a 3-D computerized block model made up of 25'×25'×25' blocks. Assay and geologic data are obtained from five foot interval diamond drill core samples. A series of kriging and inverse distance weighting routines estimate the metal grades by matching similar geologic codes in the block with surrounding drillhole composites. Estimated grade and material type provide the basic information for assigning pit slope criteria, metallurgical recovery and material density to the blocks. These are the basic requirements for calculating an economic reserve.

As of January 1, 2002, remaining reserves in the Main Pit are estimated at 38.4 million ore tonnes and 37.6 million waste tonnes. The current pit configuration is approximately 3,285 feet wide (east-west) and 3,550 feet long (north-south). The benches are 25 feet high and extend from the 1225 to 475 foot elevations. Reserves are re-evaluated routinely to incorporate new drilling, geotechnical, metallurgical and cost information.

4 Mine and Mill Operations

Mine production at Red Dog Mine involves the stripping and stockpiling of ore, waste (i.e., rock with sub-economic value) and overburden/topsoil. Mill production involves crushing, grinding and processing to produce mineral concentrates. Based on the current economic pit design, the Red Dog Mine is expected to remain in production until 2012. Teck Cominco is exploring options that will potentially extend the life of the mine, including mining the Aqqaluk and Qanaiyaq (formerly Hilltop) deposits (additional mine life will be determined after delineation of these deposits). Processing the oxide ore, marginal ore, and mill tailings may also extend the mine life, depending on their economic feasibility. A description of the mine facilities and their operations is provided on the following pages. The layout of the facilities is shown on Figure 2.

4.1 Current Production Mining

The current five-year forecast shows an ore production rate of 3.5 million tonnes per year, with a stripping ratio (waste:ore) of approximately 1:1. Mining is done by open-pit methods and has averaged 8,900 ore tonnes per day in 2002. The mill requires a consistent feed of homogeneous ore material to optimize recovery. To accommodate this requirement, layered stockpiles are built to combine the various types and grades of ore. A typical stockpile size is 280,000 tonnes.

Because the grade and type of Red Dog ore varies, several benches are open for production at one time to maintain ore stockpile criteria and waste material handling. Production drilling is conducted with down-the-hole hammer systems. Varying material densities within the orebody require different blast hole patterns and blasting agents. Blasts range in size from a few to 350 holes. Benches are constructed 25 feet high and final pit slopes are dependent upon localized material type and groundwater conditions. Special drill-blast attention is done on final pit wall shots to promote competent slopes.

Caterpillar 992C Front-end loaders load broken ore and waste with 12 yard buckets into 85 (777B) & 100 (777D) ton haul trucks. Ore is hauled to the crusher stockpile pad. Stockpiles are built in lifts 5' high. A total of 5 lifts make up a stockpile. Lifts 1, 3 and 5 are free dumped, while lifts 2 and 4 are dozed with a track dozer to provide a smooth floor for the trucks to drive on.

4.2 Waste Stockpile Areas

Mine waste is stored in four separate stockpile areas to segregate material types. These are the Main Waste, Oxide, Marginal and Overburden stockpile areas.

Main Waste Stockpile Area: The Main Waste stockpile area is located on the hillside, southwest of the Main Pit (Figure 2). The hill has gentle slopes averaging approximately 10 to 12 percent, with a maximum slope of 20 percent. Waste is hauled from the pit where the trucks free dump over the edge. The stockpile contains the marginal stockpile (3–6% zinc grade), barite, construction grade waste and competent mineralized overburden.

The Main Waste stockpile area is being constructed in phases (Figure 5). The first phase of the design is to develop a series of stages, based on a stair-step concept, along the entire length of the stockpile area. Each stage is anticipated to be 40 feet high, vertically overlapping one another. The stages are left undisturbed for at least one season following placement, to allow for settlement and to promote stability. The second phase will encompass the entire stockpile area at a higher elevation, utilizing a single lift. As new reserves become proven, additional lifts are possible. At final closure, the stockpile will be resloped to a final configuration that will be documented in the final Closure and Reclamation Plan and approved by regulatory authorities.

The stability of the Main Waste stockpile area was evaluated during the design phase of the mine under seismic and static loading conditions (Dames & Moore, 1987b). After a few years of construction, it was evident the stability of the waste material exceeded initial estimates and was re-evaluated in 1996. While it is not fully understood why the first study showed such a discrepancy, it was noted that no account was made for strength gains due to freeze-back. The study also recognized the use of shear keys did not increase stability as previously believed. The construction of shear keys was abandoned and the stockpile has advanced south with no apparent detrimental effects.

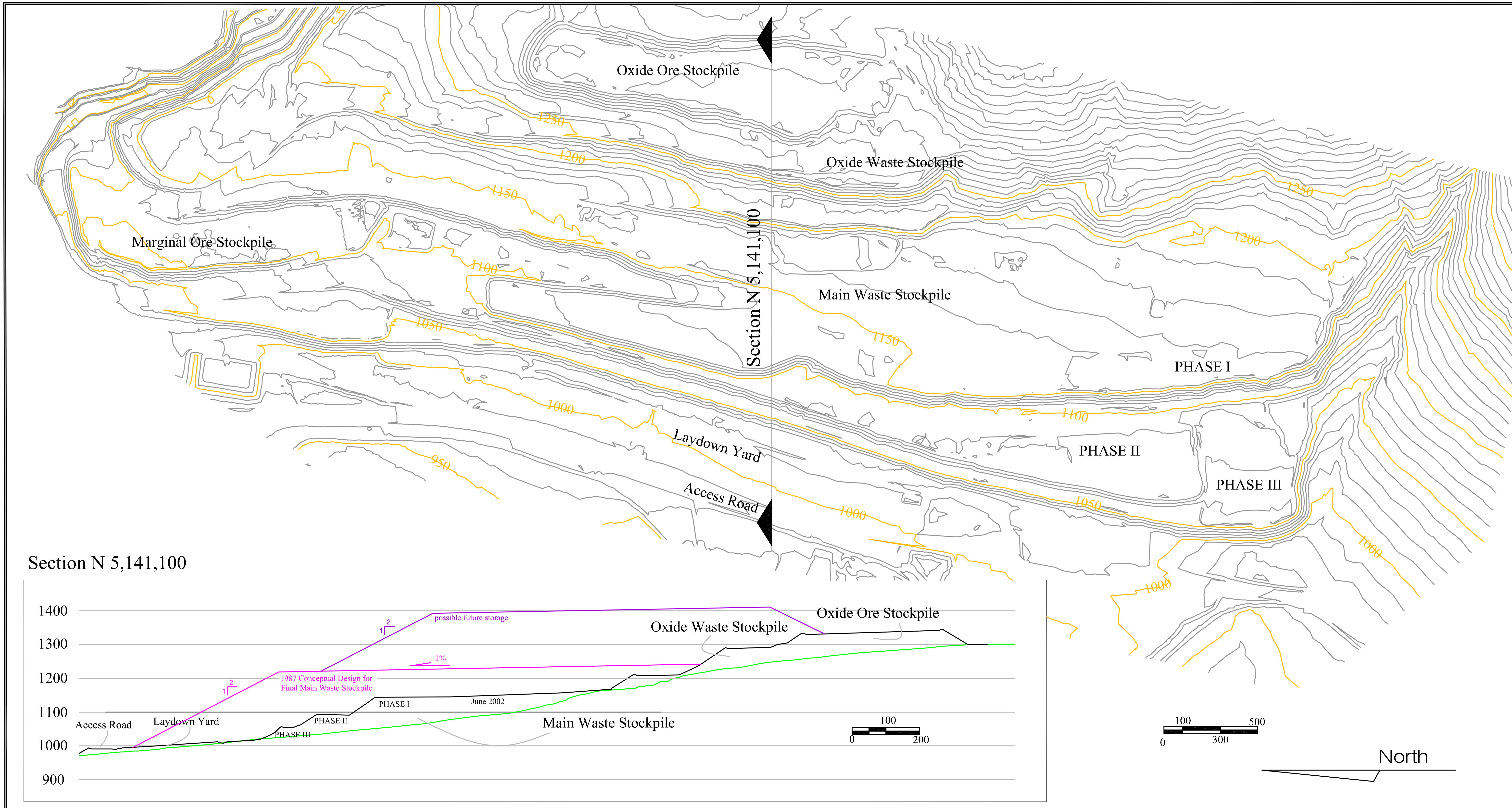

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Figure 5
Current
Main Waste & Oxide Stockpile Areas
as of June 2002

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Scale: As shown
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The total volume of material in storage in the Main Waste stockpile and the Marginal stockpile was approximately 11.9 million bank cubic yards (bcy) as of July, 2002.

Marginal Stockpile Area: The north end of the Main Waste stockpile is dedicated for the marginal stockpile. This material consists of rock with a zinc grade too low to be processed under current economic conditions. This rock may in the future be processed through the mill; if not, the area will be reclaimed in conjunction with the Main Waste stockpile.

Oxide Stockpile Area: The Oxide stockpile area, located east of the Main Waste stockpile area, is used to store both oxide ore and oxide waste. Oxide ore is high in non-sulfide lead and cannot presently be processed through the mill. Future processing will depend on the availability of appropriate processing technology. Oxide waste is material where lead is present in non-sulfide form, but the concentration is not high enough to consider recovering it. Oxide waste is considered to be less competent material and therefore stored separately from the Main Waste stockpile area.

While a very minor amount of oxide material is currently generated from the Main pit, dumping is possible year-round. The high elevation of the site was a criterion for site selection due to the lower potential for snow accumulation and surface water, reducing the leaching potential. The material is placed by end dumping and spreading of the piles. As of July, 2002, the volume of the Oxide stockpile was about 2.2 million bcy.

Overburden Stockpile Area: The Overburden stockpile area is located at the south end of the tailings impoundment, within the Red Dog Creek watershed and lies on top of the divide of the Red Dog Creek and Bons Creek watersheds (Figure 6). It contains highly weathered, non-mineralized material (lead/zinc concentration less than 1%), such as Kivalina shale, stripped organic materials and materials excavated from the tailings and mill site areas during construction. The only future material that will be sent to this area will be topsoil, stored for future reclamation projects.

The stability of the Overburden stockpile area was evaluated during the design phase of the mine under static and long-term seismic loading conditions (Dames & Moore, 1987). The design called for the staged construction of structural berms to retain the overburden (Figure 6). The berms were constructed in phases in the upstream direction, towards the tailings impoundment, with a layer of riprap on the lower slope for erosion protection. The stability of the overburden material has proven to be much greater than originally estimated. The current stored material exceeds the berm heights, and no structural stability problems have occurred. Thermistor data has shown the permafrost layer below to be migrating into the stockpile.

The volume of the Overburden stockpile, including containment berms, was about 6.6 bcy in July of this year. The side slopes of this stockpile area were re-sloped at 2:1 in 1998-99 and seeded with a mixture of native grasses in the summers of 1999, 2000 and 2001.

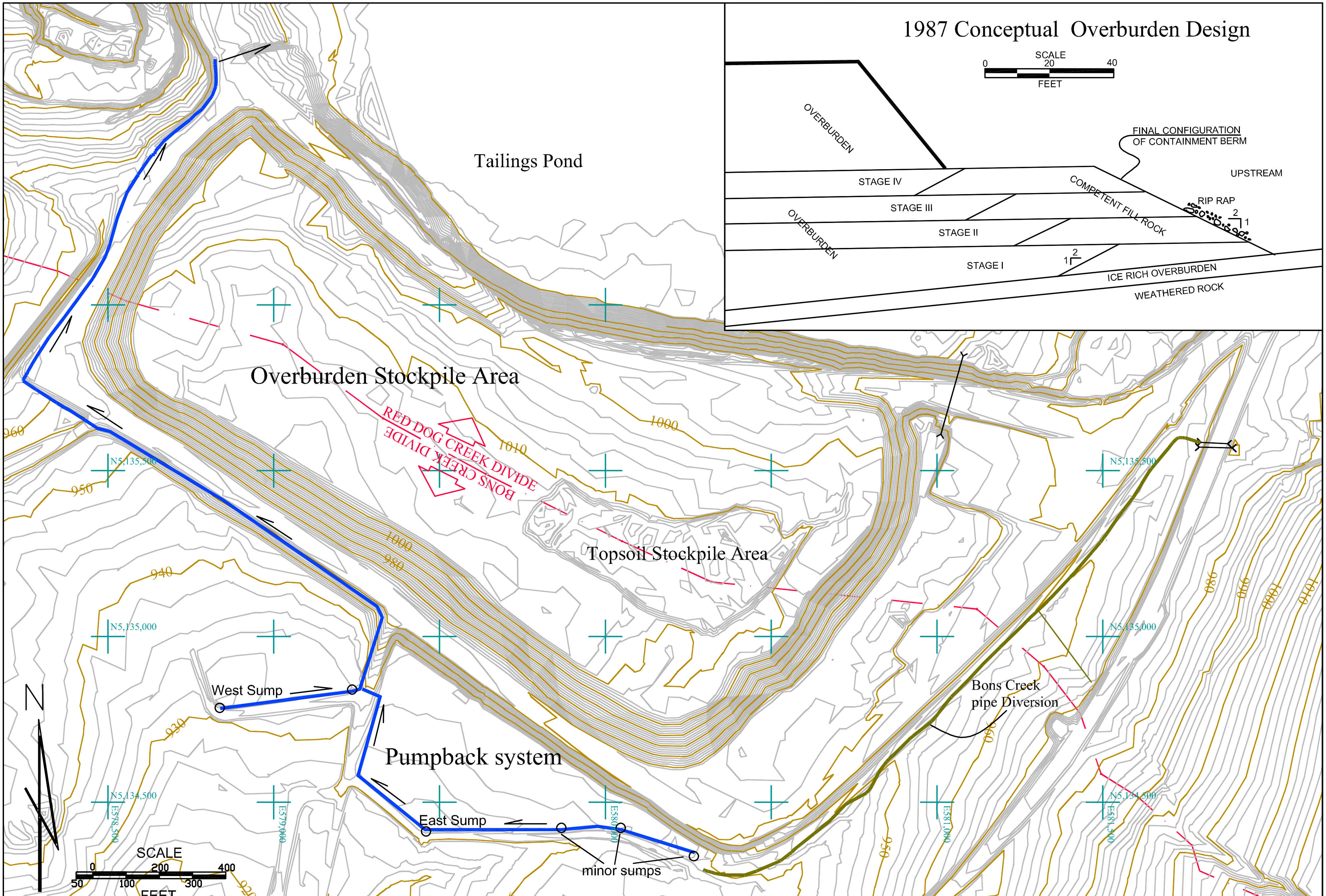

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Figure 6
Current Overburden Stockpile Area and Pumpback System

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4.3 Mill Production

The mill is located on a graded pad adjacent to, and northeast of, the tailings dam (Figure 2). The operation includes two crushing plants and grinding, flotation, reagent and dewatering facilities. The mill operates continuously except for maintenance shut-downs. Operational availability generally exceeds 90%.

A schematic of the mill process is presented on Figure 7. Stockpiled ore is rehandled to a gyratory crusher where it is reduced to a size of less than six inches in one pass. The crusher product is conveyed to an enclosed, coarse ore stockpile. The building is capable of holding about 15,000 tonnes of mill feed in one large pile. Coarse ore is withdrawn from underneath the stockpile by six variable speed apron feeders, which in turn feed three Semi-Autogenous Grinding (SAG) mills.

The grinding circuit can be run in two main configurations ("open" or "closed") depending on equipment availability. In both configurations, SAG's 1 and 2 discharge passes over a trommel screen with 7/16"x3/4" openings. The oversize material is recycled to the head of the mill, and the undersize flows to a common discharge box. SAG 3 utilizes a 1.5"x1.5" trommel opening, and the oversize is recycled to the mill by an internal water jet recovery system.

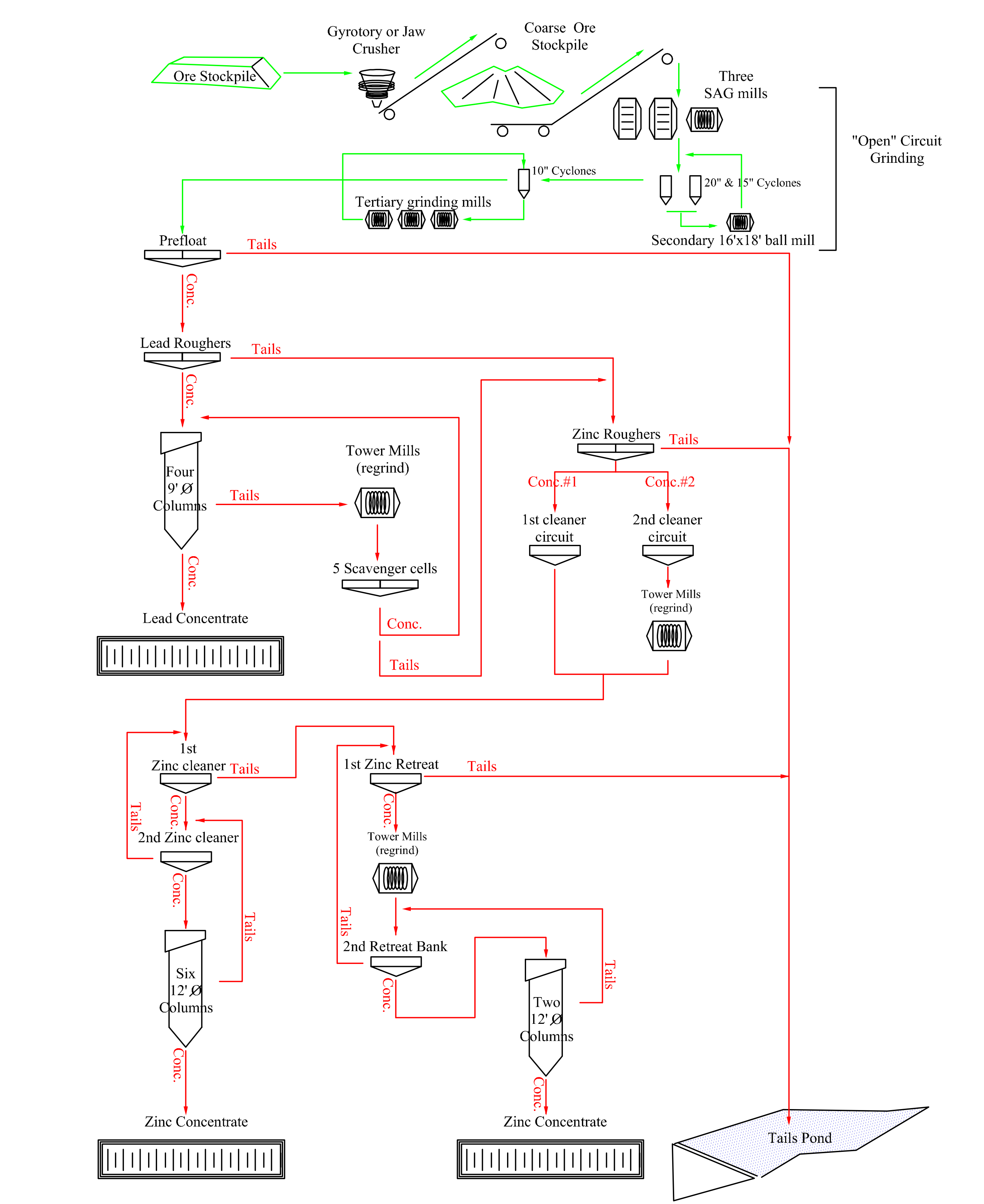
Grinding is typically run in an "open circuit" configuration. All three SAG mill discharge streams feed a set of 20" cyclones. The overflow from these cyclones reports to another set of cyclones (10") and to a final grinding stage (tertiary). The underflow from the 20" cyclones feeds a 16x18 foot ball mill for secondary grinding. The ball mill discharge is directed to a set of 15" cyclones, with its overflow reporting to the 10" cyclones and tertiary grinding and the underflow reporting back to the 16x18 foot ball mill.

When necessary, SAG mills 1 and 2 can run in a "closed circuit", while SAG mill 3 is operated "open." Discharge material from SAG mills 1 and 2 is pumped to the 20" cyclone circuit as before. The cyclone underflow reports to an 11x15 foot ball mill, while the oversize returns to SAG 1 and 2 for further grinding. The cyclone overflow (O/F) feeds two additional 11x15 foot ball mills.

SAG mill 3 discharge reports to the discharge box of the 16x18 foot ball mill. The combined SAG discharge and ball mill discharge is classified with the 15" cyclones, and the underflow (coarse fraction) feeds the 16x18 foot ball mill. The cyclone overflow can either be directed to two smaller mills for a final step of grinding, or directed to the flotation feed, depending on equipment availability.

The grinding circuit produces an overflow, of which 80% is smaller than 65 microns. This material is delivered to the prefloation circuit. Froth flotation processes separate materials into floating (particles attached to bubbles) and sinking components, which produce concentrate and tailings, respectively. The prefloat is designed to remove the bulk of the floatable elemental sulfur and organic (carbonaceous) material that occurs in sections of the orebody. This material is discarded to the tailings impoundment. Tailings from the prefloat section are directed to the lead flotation circuit.

Reagents are added to the prefloat circuit tails to modify lead minerals (Galena) so they will readily attach to air bubbles, and float in the lead roughers. Zinc minerals



		teckcominco	Figure 7 Red Dog Operations Mill Process Flowsheet
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(Sphalerite) are depressed during this stage. Lead rougher flotation concentrate is fed to four 9' diameter columns operating in parallel. The column cells produce final lead concentrate. The column tailings are reground by tower mills and cleaned in five scavenger cells. Concentrate from the scavenger cells is recycled back to the lead columns, while the tails are sent to the lead roughers, creating a continuous recirculation through the lead circuit.

The lead rougher tailings, devoid of most floatable galena, are conditioned with reagents to activate the sphalerite and are sent to the zinc roughers. They include six flotation cells in two banks (12 cells total). As higher grade particles float faster, the concentrate from the first two cells in each bank feed the 1st cleaner circuit directly (bypassing regrinding). The rougher cells produce a second concentrate feed that is reground to further liberate the zinc minerals. Zinc rougher tailings report to the tailings pond as a portion of the final tails stream.

Both rougher concentrate streams are combined and fed to a circuit comprised of nine conventional zinc cells (1st cleaners). The 1st cleaner concentrate feeds the head of the second cleaner bank, which consists of two banks of four cells each in parallel. The concentrate from the 2nd cleaner bank feeds six 12' diameter columns in parallel. These columns produce 70-80% of the zinc final concentrate. The tailings are recycled through the system (backwards) from the columns, to the 2nd cleaner circuit, to the 1st cleaner circuit, finally reporting to the zinc retreat circuit.

The zinc retreat circuit is similar in design, but has greater flotation capacity (per tonne of feed) than the zinc cleaner circuit described above. The retreat circuit receives the zinc minerals that are very difficult to process. These include particles that have not been liberated from the other sulfide minerals and/or fine particles that float very slowly. The 1st retreat bank is fed to the tails from the 1st zinc cleaner tails to further liberate the zinc minerals. The 1st retreat concentrate is reground and fed to the 2nd retreat cleaner bank. The concentrate from this bank feeds two 12' diameter columns. These columns produce the remaining 20-30% of the final zinc concentrate. The tails are recycled through the system (backwards) from the columns to the 2nd retreat bank, to the 1st retreat bank where it eventually reaches the tailings pond as final tails.

Final lead and zinc concentrates are thickened to 60% solids by weight and dewatered in five "Lasta" filters (four 84 plate, one 88 plate) to a final cake moisture of 8.5 to 9.5%. These filtered concentrates are stored in an intermediate storage shed, located at the mill site, holding approximately 27,000 tonnes of concentrate. From the mill site concentrate storage building, the concentrate is transferred by truck to the port site for shipment.

The concentrator tailings are pumped to the tailings impoundment, where the solids settle out, and the supernatant water is recycled to two water treatment plants (WTP) capable of treating up to 22,000 gpm (Section 5).

Reagents are mixed daily from stock into solutions, generally of 10-15% strength. The main reagents used in the mill process are listed below.

- Sodium metabisulfite to counteract the ore's oxidation.
- Zinc sulfate to depress zinc through the lead circuit.

- Sodium cyanide to depress iron throughout the circuit.
- Potassium ethyl and amyl xanthate as the main mineral collectors.
- Copper sulfate to activate zinc prior to flotation.
- Methyl isobutyl carbinol is used as a froth stabilizer.
- Sodium sulphide is used in the water treatment plant for metals removal.

Daily ore throughput is approximately 10,000 tonnes at 20.0% zinc and 5.0% lead. This produces zinc concentrate containing 55-56% zinc with 3.5 ounces/ton of silver, and lead concentrate at 59% lead with approximately 12 ounces/ton of silver.

5 Tailings Management

Red Dog Mine operates a tailings storage facility in conjunction with the Red Dog mine and mill. Slurried tailings are pumped from the mill to the tailings facility and deposited either sub-aqueously or sub-aerially. The facility includes a rock fill dam and impoundment, a seepage collection and pumping system, a tailings discharge system (pumps and pipeline), and a water reclamation system. Figure 8 shows the tailings facility.

The tailings dam, which spans the South Fork of Red Dog Creek, is approximately 160 ft. high and is built with the downstream construction method. An impervious 100 mil HDPE geomembrane covers the upstream face of the dam structure. The liner is keyed into a concrete lined ditch along the upstream toe. The dam is underlain by a gravel drain that follows the former stream channel. The gravel drain interconnects to a toe drain which runs along the upstream toe of the dam below the geomembrane. Any water that gets past the geomembrane is collected in the gravel drain. The drain also maintains a low phreatic surface in the dam structure.

The tailings dam is instrumented with fourteen piezometers and nine thermister strings. Piezometers and, to a lesser extent, thermisters are used to monitor dam stability. The crest is monumented to allow annual alignment surveys used in checking for movement of the crest. The dam is inspected daily, weekly, quarterly, annually, and every five years with each increasing period requiring a more rigorous inspection.

The dam structure is regulated by the State of Alaska and is a Class III facility. The Class III designation indicates a low risk to life and property in the event of dam failure. State regulations require submission of a Periodic Safety Inspection by a qualified person every five years. The Red Dog tailings dam is inspected by a qualified person every year in addition to the required inspection.

The impoundment is designed to store tailings from the milling process, tailings water, domestic wastewater, and drainage from the mine and mill areas. Design freeboard allows for the 100-year, 24-hour precipitation event. The crest will not be overtopped by wind-caused waves on the pond surface.

The current dam crest is at elevation 950 ft. The pond elevation is at 936 ft elevation. Upstream (south) from the dam the impoundment is 8,000 ft long and 2,600 ft wide at its widest point. It is bounded on the south end by the Kivalina Overburden dump built on

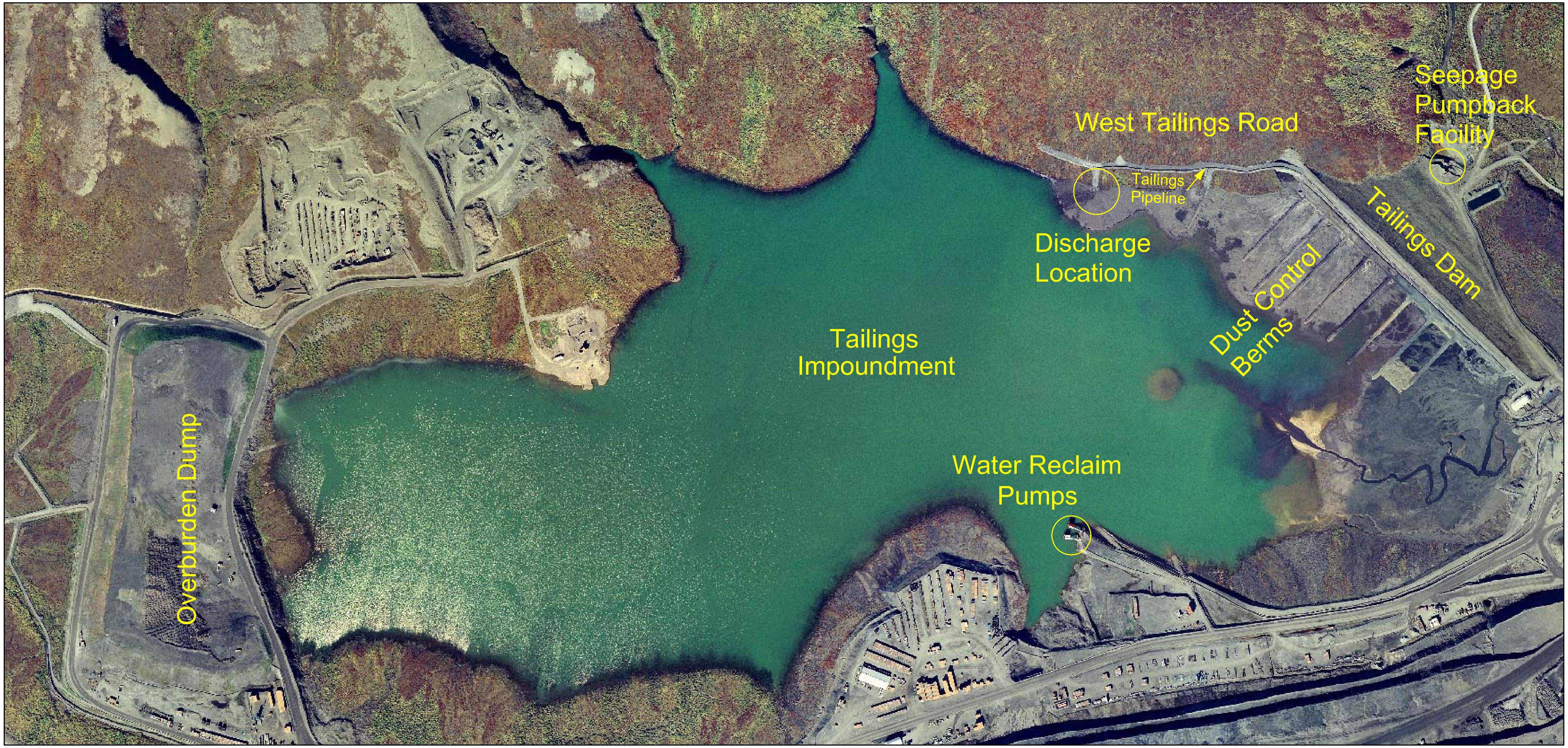

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Figure 8
Red Dog Mine
Tailings Facility

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Computer File No. Y:\Minetech\Intra\Diversions\Tailings\NOTES\Solid Waste Permit\Figure1 TD Photo.dwg the divide between the South Fork of Red Dog Creek and Bon's Creek. Original topography within the impoundment ranges from 800 ft to 950 ft elevation. The impoundment has an ultimate capacity of approximately 39.3 million cubic yards (cy) of tailings, assuming that the tailings remain covered by water (i.e., that they are not deposited subaerially, forming beaches that would extend above the elevation of the dam crest). Bathymetric surveys are carried out periodically, most recently in October 2001. From this survey, the impoundment contains 14.2 million cy of tailings. Approximately 1.98 million cy of tailings are deposited each year.

The seepage collection and pump-back system includes a lined dam less than 20 ft high, and three pumps connected in parallel to a pipeline that discharges to the tailings pond. Water from the tailings-dam underdrain as well as precipitation that falls in the small drainage area below the crest of the dam is collected in the seepage impoundment and pumped back to the tailings pond. A small well and pump are installed below the seepage dam to collect groundwater. Water from this well is directed to the seepage pond. The quantity pumped back from the seepage dam during mid-February to the end of April (when the ground is frozen) averages less than 300 gpm. June through September pump back quantity averages 570 gpm and includes snowmelt and rain water. Seepage quantities compare well with what was predicted in the original dam design.

The tailings discharge system includes slurry pumps located in the mill and a 6,500 ft. long pipeline with diameters that vary from 18" to 26" leading to the tailings impoundment. The pipeline exits the mill via an underground utility corridor leading to the east abutment of the tailings dam. A pipe bench on the upstream face of the dam supports the pipe where it crosses the dam from the east side to the west. On leaving the dam, the pipeline follows a road on the west side of the impoundment. From the road along the west side, access roads to the pond have been constructed. The pipe is routed to the access roads and tailings are discharged to the pond from the end of the access roads. Tailings are deposited both sub-aerially and sub-aqueously. The choice of method is dependent on operational and environmental considerations.

The initial design called for depositing tailings along the upstream face of the dam. This provides a better seal between the dam structure and the original ground. Sealing was completed on the dam during 2000. Road building along the west side of the tailings pond is done as required under the short term tailings deposition plan. The road allows access to planned discharge locations as well as providing support and maintenance access for the tailings pipe.

A reclaim pumping facility is located on the east side of the pond at about the halfway point of the ponds length. Water is pumped from the tailings pond to two water treatment plants (WTPs). The first WTP operates year-round and is used to treat reclaim water that is used in the mill. The second WTP operates seasonally, usually from late May to early October, and is used to treat excess water from the tailings pond prior to discharging it to Red Dog Creek under authority of NPDES Permit AK-003865-2. Total reclaim flow varies from 7,000 gpm during the winter to 16,000 gpm or more during the summer, depending on the rate of treated water discharge.

In the areas around the pond where tailings have been deposited sub-aerially, beaches have formed and windblown dust is an issue. In the winter of 2001 a dust control program was initiated. Near the dam an access road was constructed parallel to the dam crest along with eight berms running from the access road to the south spaced 200 feet apart. The berms behave as snow fences and collect windblown tailings on the lee side. Other tailings beaches are treated with a chemical spray (Soil Sement) that binds the surface particles together inhibiting dust formation.

6 Water Management

6.1 Mine Water Diversion System

The main drainage route through the current mine area and two exploration sites is the Middle Fork of Red Dog Creek. The tributaries entering Red Dog Creek are conveyed through the pit operation in the lined Red Dog Creek (RDC) diversion ditch and re-enters the original creek drainage below the Red Dog Creek Diversion dam (RDC dam). Mine water, containing elevated levels of suspended solids and trace metals, is diverted into a collection system by a number of drainage ditches, trenches, french drains and pit pumps. This water is confined in a retaining basin behind the RDC dam and pumped to the tailings pond. Figure 9 shows the routes of both diversions. Figure 10 is a detail of the dam and pumpback facility.

All stormwater within this drainage flows either into the RDC diversion ditch or to the mine water collection system. The RDC ditch is higher than the mine water collection system, so that ditch leakage will not result in contamination of the clean water diverted through the mine and into the Middle Fork Red Dog Creek.

Two major tributaries that enter the pit area are collected by pipeline and discharged into the lined RDC diversion. Connie Creek is currently transported by 700 feet of underground pipeline, while Shelly Creek is diverted by 3,100 feet of above-ground pipeline. Stormwater from the surrounding areas downstream of these collection points is diverted to the mine water collection system.

Winter operation for the mine water pumpback facility runs from October through May and averages 310,000 gallons per day (gpd). This flow is handled by two pumps capable of pumping 1,200 to 1,600 gpm. Flows are much higher and extremely variable during the summer months of June to September, averaging 1.9 million gpd. Up to eight pumps with a total capacity of 10,000 gpm are utilized. The two winter pumps are staged within a corrugated metal pipe can, while the remaining six are hung outside over the cribbed retaining wall where they can be lowered into the sump when needed.

By 2003, continuing pit development will necessitate the re-routing of the RDC ditch and the mine water collection system. The new channels will be designed to operate for at least 35 years, the intent being to replace them following mine closure with permanent structures designed for long term performance.

6.2 Waste Stockpile Drainage

Current operating procedures ensure that all material delivered to the mineralized waste stockpile areas is placed within the catchment area of the tailings impoundment. Runoff from the existing Main Waste and Marginal stockpiles flows in a westerly direction into the tailings impoundment. While most of the runoff from the Oxide stockpile also runs in the westerly direction, a small portion first runs east into the Main Pit, enters the mine water collection system and is finally pumped to the tailings impoundment.

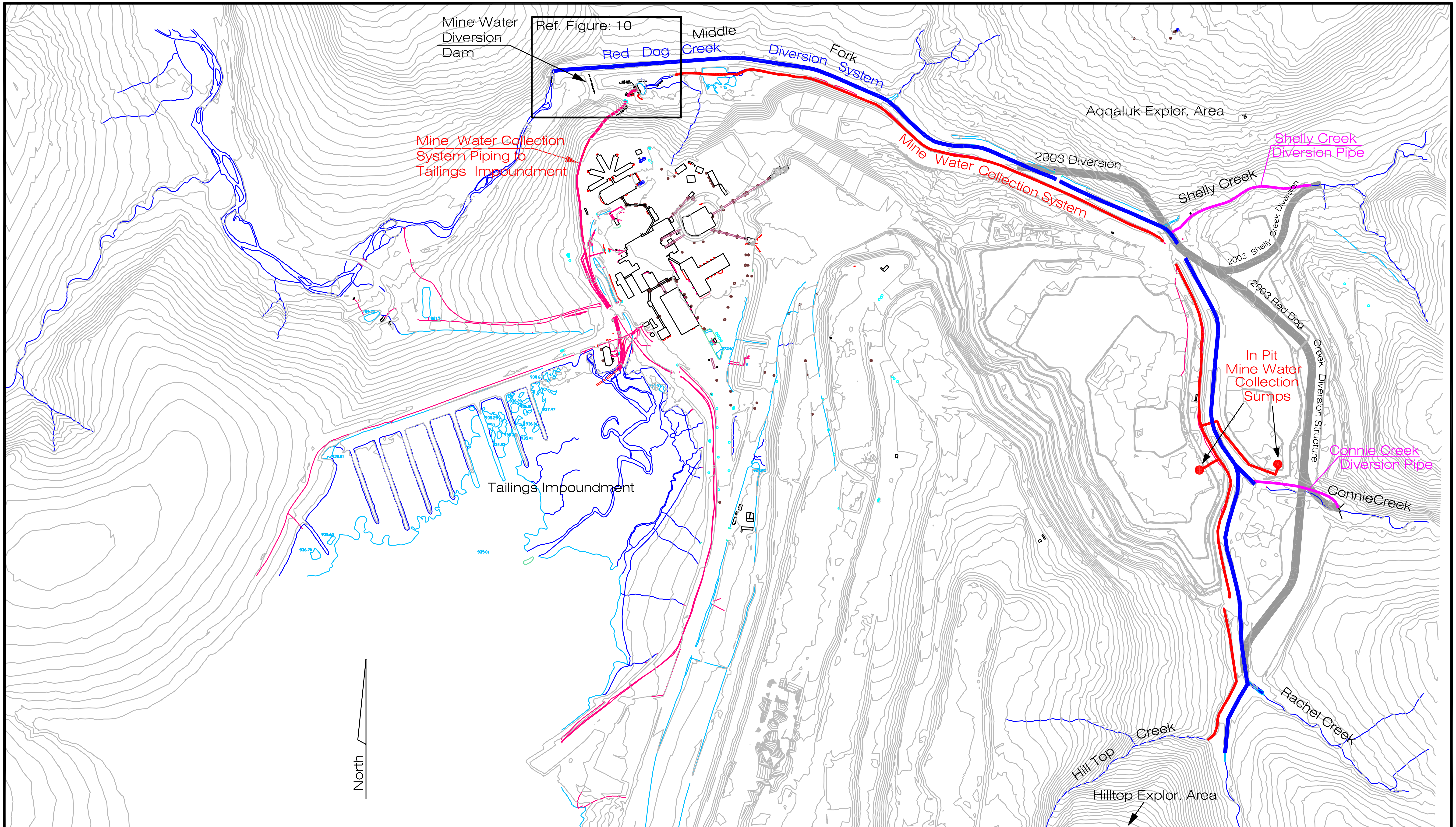

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Figure 9
Red Dog Mine
Mine Area
Water Management System

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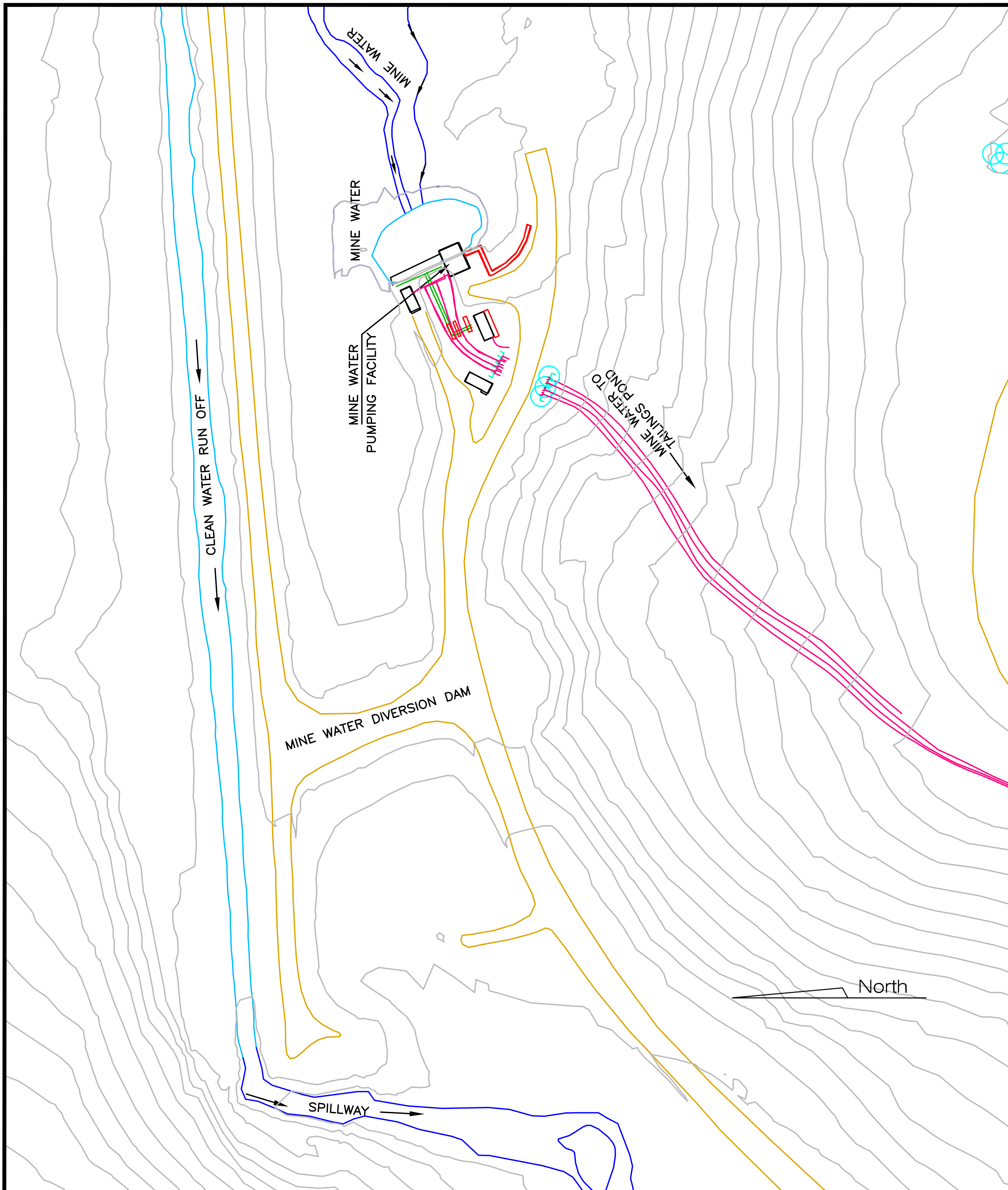

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Figure 10
Red Dog Mine Water Management System

May 2002 | 1" = 100' | 0

6.3 Overburden Stockpile Pumpback System

Much of the Overburden stockpile drains north to the tailings impoundment. However, since the stockpile lies on top of the divide, the south end drains into the Bons drainage (Figure 6). In 1996, a collection system was put in place to capture and pump the water to the tailings impoundment. Clean water flowing outside the Overburden stockpile area from the east is directed under the mine access road into pipes and is carried around the facility. The piped flow is returned to Bons Creek downstream.

7 Material Sites

7.1 DD-2 Material Sites

The DD-2 material sites are located to the west of diversion ditch #2 and northwest of the Overburden storage area (Figure 2). There are two sites approximately 1,200 feet apart and are connected by a road that runs along the western side of the tailings impoundment.

Both sites were initially used as non-mineralized, construction rock borrow pits. The northern site is an active material site. Suitable material was exhausted in the southern site and is currently used for storage of surplus equipment. The Materials Management group manages this site.

Activity in the northern site is during the summer when drilling, blasting, loading, hauling and crushing occur. A portable crusher system is utilized here as well as at several other material sites, both at the mine and along the DeLong Mountain Transportation System. The crusher operation consists of a Kue-Ken jaw crusher, a screen, a cone crusher and several conveyors. A dust suppression system utilizing water is operated when the crusher is running. As the crusher must be mobile, a portable generator, fuel tank and control room are provided.

7.2 Airport Material Site

Another material site occasionally used by the mine is located to the southeast of the airport runway (Figure 2). Drilling, blasting, loading and hauling can occur during the summers. It is unlikely crushing would ever occur here.

References

AMEC, 2002. *Action Plan for the Waste Management Permitting Program*. Consultant's report prepared to Teck Cominco Alaska Incorporated, by AMEC E&C Services Limited. Vancouver, B.C., Canada. March, 2002.