ALASKA POLLUTANT DISCHARGE ELIMINATION SYSTEM

PERMIT FACT SHEET

Permit Number: AK0053643

Fort Knox Mine

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Wastewater Discharge Authorization Program

555 Cordova Street

Anchorage, AK 99501

Public Comment Period Start: July 7, 2012
Public Comment Period End: August 6, 2012
Alaska Online Public Notice System

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An Alaska Pollutant Discharge Elimination System (APDES) permit is issued to

FAIRBANKS GOLD MINING, INCORPORATED

For wastewater discharges from

Fort Knox Mine
1 Fort Knox Road
Fairbanks, Alaska 99712

The Alaska Department of Environmental Conservation (Department or DEC) issues an APDES individual permit (permit) to Fairbanks Gold Mining, Incorporated (FGMI). The permit authorizes and sets conditions on the discharge of pollutants from this facility to waters of the United States. In order to ensure protection of water quality and human health, the permit places limits on the types and amounts of pollutants that can be discharged from the facility and outlines best management practices to which the facility must adhere.

This fact sheet explains the nature of potential discharges from the Fort Knox Mine and the development of the permit including:

- information on public comment, public hearing, and appeal procedures,
- a listing of effluent limits and other conditions,
- technical material supporting the conditions in the permit, and
- monitoring requirements in the permit.

Appeals Process

The Department will transmit the final fact sheet, permit, and Response to Comments to anyone who provided comments during the public comment period or who requested to be notified of the Department's final decision.

The Department has both an informal review process and a formal administrative appeal process for final APDES permit decisions. An informal review request must be delivered within 15 days after receiving the Department's decision to the Director of the Division of Water at the following address:

Director, Division of Water
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, AK 99501

Interested persons can review 18 AAC 15.185 for the procedures and substantive requirements regarding a request for an informal Department review.

See http://www.dec.state.ak.us/commish/InformalReviews.htm for information regarding informal reviews of Department decisions.

An adjudicatory hearing request must be delivered to the Commissioner of the Department within 30 days of the permit decision or a decision issued under the informal review process. An adjudicatory hearing will be conducted by an administrative law judge in the Office of Administrative Hearings within the Department of Administration. A written request for an adjudicatory hearing shall be delivered to the Commissioner at the following address:

Commissioner
Alaska Department of Environmental Conservation
410 Willoughby Street, Suite 303
Juneau AK, 99811

Interested persons can review 18 AAC 15.200 for the procedures and substantive requirements regarding a request for an adjudicatory hearing. See http://www.dec.state.ak.us/commish/ReviewGuidance.htm for information regarding appeals of Department decisions.

Documents are Available

The permit, fact sheet, and other information are located on the Department's Wastewater Discharge Authorization Program website: http://www.dec.state.ak.us/water/wwdp/index.htm.

The permit, fact sheet, response to comments, and related documents can also be obtained by visiting or contacting DEC between 8:00 a.m. and 4:30 p.m. Monday through Friday at the addresses below.

Wastewater Discharge Authorization Program, Division of Water Alaska Department of Environmental Conservation 610 University Avenue Fairbanks, AK 99709 (907) 451-2136
Wastewater Discharge Authorization Program, Division of Water Alaska Department of Environmental Conservation 555 Cordova Street Anchorage, AK 99501 (907) 269-6285
Wastewater Discharge Authorization Program, Division of Water Alaska Department of Environmental Conservation 410 Willoughby Avenue, Suite 310 Juneau, AK 99801 (907) 465-5180

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This fact sheet provides the basis for the conditions and requirements of Alaska Pollutant Discharge Elimination System (APDES) permit AK0053643, which authorizes the discharge of extracted, non-contact, non-process, groundwater to the Old Fish Creek Channel from mine pit dewatering wells. The permit authorizes discharge of high quality groundwater to the surface in the Fish Creek drainage. The permit includes effluent limits and monitoring requirements for discharges to the Old Fish Creek Channel. All effluent limits are water quality-based as no federally promulgated technology-based effluent limits apply to the discharged wastewater. No mixing zone is authorized as water quality criteria are met prior to discharge to the receiving waterbody.

2.0 APPLICANT

This fact sheet provides information on the APDES permit for the following entity.

Applicant	Fairbanks Gold Mining, Incorporated (FGMI)
Facility Name	Fort Knox Mine (Fort Knox)
APDES Permit Number	AK0053643
Facility Location	1 Fort Knox Road Fairbanks, Alaska 99712
Mailing Address	P.O. Box 73726 Fairbanks, Alaska 99707-3726
Facility Contact	Mr. Delbert Parr, Environmental Manager (907) 490-2207

The map in Figure 2 and photo in Figure 3 to this fact sheet show the location of the discharge point to the Old Fish Creek Channel.

3.0 FACILITY INFORMATION

3.1 Background

Fort Knox is owned and operated by FGMI, a wholly-owned subsidiary of Kinross Gold Corporation. Fort Knox, originally permitted for construction and operation in 1994, is an open-pit gold mine located approximately 26 miles northeast of Fairbanks on the north flank of Gilmore Dome. The mine is located along a belt of lode and placer deposits that comprise one of the highest gold-producing areas in Alaska. The area in and around Fort Knox has a long history of gold exploration and mining activities, dating back almost 100 years; the drainages surrounding Fort Knox were first prospected in 1913 (USGS 2001). Fort Knox processes ore onsite at a carbon-in-pulp mill with a daily capacity of up to 45,000 tons and produces approximately 300,000 to 350,000 ounces of gold annually. Site facilities include the active open pit mine, mill, tailings storage facility (TSF), constructed wetlands complex, freshwater reservoir, and the Walter Creek Valley heap leach facility. See the three figures on pages 19 to 21 for Fort Knox location and site maps.

Fort Knox currently operates as a zero-discharge facility. The TSF and the mill form a closed system for process water. Water used in the mill is pumped from the TSF decant

pond and process water is returned to the decant pond in the tailings slurry.

3.2 Active Open Pit Mine

The active open pit mine is located in the southwestern portion of Fort Knox. Mining operations are conducted 24 hours a day, seven days a week. The pit is actively dewatered via a system of dewatering wells, which continuously pump groundwater from beneath the pit and its surrounding area to maintain dry conditions. The groundwater is currently piped to the TSF.

3.3 Tailings Storage Facility

The TSF consists of deposited tailings, decant pond, dam, seepage interception system, and the seepage monitoring system. The TSF decant pond is located within the tailings deposition area upstream of the TSF dam. The TSF decant pond fluctuates in size but typically ranges between 300 to 400 acres depending on mine operations and climatic influences.

The TSF dam is an earth-filled structure approximately 4,390 feet long and 352 feet high at its crest. It impounds all tailings generated by the mill, as well as surface runoff and process water. The dam is designed and maintained to contain the 100-year, 24-hour storm event in addition to the average 30-day spring breakup. Impoundment water is not discharged but is recycled to the mill for reuse in the gold ore beneficiation process.

Currently, the TSF dam is undergoing construction modifications to increase its elevation by 52 feet, from 1,488 feet to 1,540 feet above sea level. The increased height is necessary to accommodate planned production through the end of the known mine life. Increases in planned production will exceed the current capacity of the TSF. Construction is anticipated to be completed in 2013.

The TSF dam is designed to allow seepage to pass beneath the dam into fractured bedrock. All seepage is then captured by pump-back and interceptor systems. The pump-back system includes a pump-back sump together with a pumping and piping system designed to return the seepage to the TSF. Most seepage passing beneath the dam feeds into a large lined sump from which the seepage is pumped back to the decant pond at a rate of approximately 2,200 gallons per minute (gpm). Any seepage not captured directly by the pump-back system is captured by interceptor wells, which create a hydraulic barrier preventing seepage from migrating further downgradient and assuring the TSF operates as a zero discharge facility.

3.4 Constructed Wetlands Complex

The Old Fish Creek Channel originated in the area currently occupied by the TSF. Consequently, remnants of the Old Fish Creek Channel are first evident downgradient from the toe of the TSF dam, and it flows east through a series of constructed wetlands and ponds, Ponds A through F, moving east toward the reservoir. Ponds A and B are adjacent to one another, with a north-south bifurcation in their center. Pond A is fed from the west and Pond B is fed from the north through a culvert. Water outflows from Ponds A and B through a low-flow channel draining to the east and under the road. Flow continues downstream, into the freshwater reservoir.

Ponds C, D, E, and F are hydraulically separated from Ponds A and B and the Old Fish Creek Channel. Ponds C, D, E, and F receive much of their water volume from an unnamed creek to the south that flows eastward from Pond C through D, E, and F before entering the Old Fish Creek Channel which then flows into the freshwater reservoir.

The constructed wetlands complex, upstream to Pond D, provides favorable spawning and overwintering habitat for resident fish species.

3.5 Freshwater Reservoir
The freshwater reservoir is located on Fish Creek three miles below the TSF dam. The reservoir receives inflows through precipitation and runoff from surrounding drainages (i.e., Last Chance Creek and Solo Creek), as well as the Old Fish Creek Channel, upstream of the reservoir. A spillway on the downstream end of the freshwater reservoir releases water into a lower reach of Fish Creek. The reservoir supports self-sustaining populations of Arctic grayling and burbot. Water from the reservoir is supplied to the mill for mixing reagents, gland water, and makeup water for the milling process when necessary.

3.6 Existing Wastewater Management
In summary, Fort Knox currently operates as a zero-discharge facility. Water from mining, processing, mill operations, and pit dewatering is routed to the TSF for reuse in mine operations. Seepage beneath the TSF dam is captured by seepage pump back and interceptor systems and directed back into the TSF. The freshwater reservoir receives inflows through precipitation and runoff from surrounding drainages (i.e. Last Chance Creek and Solo Creek), as well as the Old Fish Creek Channel, upstream of the reservoir. No water or wastewater from mine activities is currently routed to the reservoir.

4.0 COMPLIANCE HISTORY

This APDES Permit issuance regulates a new wastewater discharge to surface water. Accordingly, no compliance history is available for this first-time APDES permitting action.

5.0 EFFLUENT LIMITS AND MONITORING REQUIREMENTS

FGMI will discharge non-contact, non-process, groundwater extracted from pit dewatering wells into the Old Fish Creek Channel via a newly constructed outfall. The discharge would flow at a maximum rate of 2,000 gallons per minute (gpm).

High quality wastewater from select dewatering wells will be combined and discharged through outfall 001. Since the discharge is confined to what has been sampled and determined to be only high quality groundwater, water treatment is not necessary to meet Alaska Water Quality Standards (WQS) prior to discharge. Once the extracted dewatered groundwater has been combined, the overall water quality has been shown to meet or exceed WQS. With time, dewatering wells will fail or be abandoned for various reasons, and new dewatering wells will be installed to properly control groundwater. Initially, the discharge rate is expected to be around 400 gpm but may reach a maximum of 2,000 gpm when the mine pit expands.

Water quality data collected from 2007 through 2011 from active pit dewatering wells were reviewed to provide a baseline water quality assessment for the discharge. These data indicate that pollutants of concern are inorganic in nature with regulatory surface water criteria prescribed under the *Alaska Water Quality Manual for Toxic and other Deleterious Organic and Inorganic Substances* (DEC, 2008). The potential of WQS exceedances will be mitigated by selecting individual wells for discharge based on water quality and maintaining discharges that collectively meet WQS. See Appendix B for additional water quality analyses information.

5.1 Basis For Permit Effluent Limits

The CWA requires that the limits for a particular pollutant be the more stringent of either technology-based effluent limits or water quality-based effluent limits. A technology-based effluent limit is set according to the level of treatment that is achievable using available technology. A water quality-based effluent limit is designed to ensure that the applicable WQS of a waterbody are met. The discharge is composed of non-process, non-contact, groundwater; therefore, technology-based effluent limits were determined not to be applicable. In the water quality data assessment, the most stringent WQS were used to determine the potential for discharge exceedances of those WQS. The basis for the permit's effluent limits is provided in Appendix B.

5.2 Effluent Limits and Monitoring Requirements

Under AS 46.03.110(d), the Department may specify in a permit the terms and conditions under which waste material may be disposed. APDES regulations require that permits include monitoring to determine compliance with permit requirements (18 AAC 83.455). Monitoring may also be required to gather effluent and receiving water data to determine if additional effluent limits are required and/or to monitor effluent impact on the receiving waterbody quality. The permittee is responsible for conducting the monitoring and for reporting results to DEC.

Effluent limits and monitoring apply at the end-of-pipe for outfall 001, which is located in the Old Fish Creek Channel. No mixing zone is being authorized as part of this permitting action. Monitor only parameters include total chromium and whole effluent toxicity (WET). Effluent limits are imposed for flow and pollutants of concern, which include pH, nitrite and nitrate, weak acid dissociable (WAD) cyanide, and inorganic constituents with a reasonable potential to exceed WQS (Table 1).

Table 1: Outfall 001 Effluent Limits and Monitoring Frequencies

Parameter[a]	Maximum Daily Limit (MDL)	Average Monthly Limit (AML)	Units	Minimum Sample Frequency	Sample Type
Antimony	12	6.0	Micrograms per liter (µg/L)	1/Week	Grab (total recoverable)
Arsenic	20	10	µg/L	1/Week	Grab (total recoverable)
Chromium, Total[b]	Monitor only	Monitor only	µg/L	1/Week	Grab (total recoverable)
Chromium VI[b]	16	8.1	µg/L	See note b	Grab (dissolved)
Copper	8.9	4.4	µg/L	1/Week	Grab (total recoverable)
Cyanide, Weak-Acid Dissociable (WAD)	8.5	4.3	µg/L	1/Week	Grab (total recoverable)
Fluoride	2.0	1.0	Milligrams per liter (mg/L)	1/Week	Grab (total recoverable)
Lead	2.8	1.4	µg/L	1/Week	Grab (total recoverable)
Manganese	100	50	µg/L	1/Week	Grab (total recoverable)
Nickel	57	29	µg/L	1/Week	Grab (total recoverable)
Nitrate + Nitrite	20	10	mg/L	1/Week	Grab (total recoverable)
Sulfate	500	250	mg/L	1/Week	Grab (total recoverable)
TDS	1,000	500	mg/L	1/Week	Grab (total recoverable)
Zinc	80	40	µg/L	1/Week	Grab (total recoverable)
pH	6.5 to 8.5		Standard units (s.u.)	1/Week	Grab
Total Flow	2,000	N/A	gpm	Continuous	Meter
Whole Effluent Toxicity (WET)	Monitor only	Monitor only	Chronic toxic units (TUc)	Annually	Grab

a. Use the following test methods: EPA Method 200.8 for metals, Standard Method 4500 CN-I for WAD cyanide, EPA Method 300.0 for anions, and EPA Method 218.4 for chromium VI.

b. When results show a total chromium measurement exceeding 11 µg/L, dissolved chromium VI must be analyzed during the next sampling event. The sample holding time for chromium VI is 24 hours.

5.3 WET Monitoring

Under 18 AAC 83.435, it requires that a permit contain limits on WET when a discharge has

reasonable potential to cause or contribute to an exceedance of a WQS.

WET tests are laboratory tests that measure total toxic effect of an effluent on living organisms. WET tests use small vertebrate and invertebrate species and/or plants to measure the aggregate toxicity of an effluent. The two different durations of toxicity tests are acute and chronic. Acute toxicity tests measure survival over a 96-hour exposure. Chronic toxicity tests measure reductions in survival, growth, and reproduction over a 7-day exposure.

Since this is a new discharge, no WET data has been generated. The permit requires annual WET monitoring to evaluate the potential aggregate toxicity of the effluent and to produce data on which to base future WET requirements. Additionally, WET sampling has been designated as grab because of the stable aqueous chemistry of groundwater, which in this case constitutes the effluent.

5.4 Annual Water Quality Monitoring Summary
Under 18 AAC 83.455(b), the Department establishes requirements to report monitoring results, including the frequency of required reports, on a case-by-case basis depending on the nature and effect of the discharge. The Department requires a monitoring report from a permittee under this subsection at least once a year. An annual summary of water quality monitoring, as required in Permit Part 1.5, allows a comprehensive evaluation of water quality trends each year.

6.0 RECEIVING WATERBODY

6.1 Outfall Location
FGMI will install a new outfall, outfall 001, in the Old Fish Creek Channel. Outfall 001 will be located at 65.004738 degrees (°) latitude and -147.262755° longitude, approximately 8,578 feet upstream from the freshwater reservoir pump house. The outfall location was selected in response to Alaska Department of Fish and Game (ADF&G) input, as the increased volume of high-quality flow would likely promote development of new fish-rearing areas.

6.2 Water Quality Standards
In 18 AAC 70, it requires that permit conditions ensure compliance with the WQS. The state's WQS are composed of use classifications, numeric and/or narrative water quality criteria, and an antidegradation policy. The use classification system designates the beneficial uses that each waterbody is expected to achieve. The numeric and/or narrative water quality criteria are the criteria deemed necessary by the state to support the beneficial use classification of each waterbody. See Section 8.0 for additional information on antidegradation.

Waterbodies in Alaska are designated for all uses unless the waterbody has been reclassified under 18 AAC 70.230, as listed under 18 AAC 70.230(e). Some waterbodies in Alaska can also have site-specific criterion per 18 AAC 70.235, such as those listed under 18 AAC 70.236(b). Old Fish Creek Channel has not been reclassified and all applicable freshwater uses classified under 18 AAC 70.020 are applicable. Accordingly, the reservoir is currently

classified under 18 AAC 70.020 for protection of all freshwater uses: water supply for drinking, agriculture, aquaculture, and industrial uses; contact and secondary recreation; and growth and propagation of fish, shellfish, other aquatic life, and wildlife.

6.3 Water Quality Status of Receiving Waterbody

Any part of a waterbody for which the water quality does not or is not expected to meet applicable WQS is defined as a "water quality limited segment" and placed on the state's impaired waterbody list. The Old Fish Creek Channel is not listed as impaired in the *Alaska Final 2010 Integrated Water Quality Monitoring and Assessment Report* (2010). Accordingly, no Total Maximum Daily Load has been prepared and implemented per Section 303(d) of the Clean Water Act for this receiving waterbody.

6.4 Receiving Water Monitoring

There is one receiving water monitoring station located at the Freshwater Reservoir Pump House. Monitored parameters must be sampled at least every calendar quarter. See Table 2 for Receiving Water Monitoring Requirements.

Table 2: Receiving Water Monitoring Requirements

Parameter[a]	Units	Minimum Level of Quantification (ML)
Antimony	µg/L	6.0
Arsenic	µg/L	10
Chromium, Total[b]	µg/L	11
Chromium VI[b]	µg/L	10
Copper	µg/L	6.2
Cyanide, WAD	µg/L	5.2
Fluoride	mg/L	1.0
Lead	µg/L	1.7
Manganese	µg/L	50
Nickel	µg/L	35
Nitrate + Nitrite	mg/L	10
Sulfate	mg/L	250
TDS	mg/L	500
Zinc	µg/L	80
Hardness[c]	mg/L	Calculated
pH	s.u.	4.0 to 11.0

a. Use the following test methods: EPA Method 200.8 for metals, Standard Method 4500 CN-I for WAD cyanide, EPA Method 300.0 for anions, and EPA Method 218.4 for chromium VI.

b. When results show a total chromium measurement exceeding 11 µg/L, dissolved chromium VI must be analyzed during the next sampling event. The sample holding time for chromium VI is 24 hours.

c. Hardness is calculated as follows: $(2.497 \times [Ca]) + (4.118 \times [Mg])$.

7.0 ANTIBACKSLIDING

Under 18 AAC 83.480, it requires that "effluent limitations, standards, or conditions must be at least as stringent as the final effluent limitations, standards, or conditions in the previous permit." In 18 AAC 83.480(c), it also states that a permit may not be reissued "to contain an effluent limitation that is less stringent than required by effluent guidelines in effect at the time the permit is renewed or reissued." This permit is the first issuance of an APDES permit for Fort Knox; therefore, effluent limits are newly established, and antibacksliding requirements are not applicable.

8.0 ANTIDEGRADATION

The antidegradation policy of the WQS requires that the existing water uses and the level of water quality necessary to protect existing uses must be maintained and protected (18 AAC 70.015). The following analysis provides rationale for Department decisions with respect to the antidegradation policy.

The Department's approach to implementing the antidegradation policy is based on the requirements in 18 AAC 70 and the *Interim Antidegradation Implementation Methods* Policy and Procedure document (DEC, July 2010). Using these requirements and policy, the Department determines whether a waterbody or portion of a waterbody is classified as Tier 1, Tier 2, or Tier 3, where a larger number indicates a greater level of water quality protection. To qualify as Tier 3, or "outstanding national resource" water, one of two criteria must be met. The waterbody must either be 1) in a national or state park or wildlife refuge, or 2) possess exceptional recreational or ecological significance. At this time, the Department has not designated any Tier 3 waters in Alaska, and based on available information, Old Fish Creek Channel has not been classified as Tier 3.

Since the Department determined that the Old Fish Creek Channel is not a Tier 3 waterbody and it waterbody is not listed as impaired (i.e. Tier 1 designation isn't applicable), the following analysis is based on a Tier 2 waterbody classification. Under 18 AAC 70.015(a)(2), antidegradation analysis was applied on a parameter-by-parameter basis to permit limits associated with reduction of water quality.

The state's antidegradation policy requires that the existing water uses and the level of water quality necessary to protect existing and designated uses must be maintained and protected. The Department may allow reduction of water quality only after finding that the following five specific criteria of the antidegradation policy at 18 AAC 70.015(a)(2)(A)-(E) are met. The Department's findings follow.

1) 18 AAC 70.015(a)(2)(A). Allowing the discharge is necessary to accommodate important economic or social development in the area where the water is located.

   Rationale: Fort Knox has a significant impact on the socioeconomics of the Fairbanks North Star Borough (FNSB), as well as the state as a whole. Fort Knox employed more than 500 employees in 2010, all residing in the FNSB, making it the fifth largest private sector employer in the FNSB and the tenth largest employer overall. Payroll in 2010 was $45.3

million, averaging $90,280 per employee (compensation package of wages and benefits). Fort Knox employee wages are approximately 2.1 times higher than the average income of private sector workers in FNSB.

Fort Knox spent $171.4 million with approximately 400 private sector vendors in Alaska in 2010; 32 percent went to wholesale and retail business, 21 percent went to utility companies, 21 percent went to fuel suppliers, and 16 percent went to construction firms.

Fort Knox is the largest taxpayer in FNSB, and contributed $4.7 million in real and business property taxes in 2010. The State of Alaska received $11.1 million in taxes and fees from Fort Knox, including $5.7 million in mining license tax.

Dozens of Alaska nonprofit organizations received more than $145,000 in charitable contributions from FGMI. These organizations represented membership groups, charitable programs, youth sports, public safety support, social assistance, and civic organizations.

The operation of Fort Knox is important to the FNSB and Alaska, and contributes significantly to the socioeconomic health of many communities. The Department finds that the discharge is necessary to accommodate important economic and social development in the area where the water is located, and the requirement is met.

2) 18 AAC 70.015(a)(2)(B). Reducing water quality will not violate the applicable criteria of 18 AAC 70.020 or 18 AAC 70.235 or the WET limit in 18 AAC 70.030.

Rationale: Discharge authorized by the permit at outfall 001 conforms to the requirements of 18 AAC 70.020, 18 AAC 70.235, and 18 AAC 70.030. No mixing zone is authorized, and WQS are met at the end of pipe before the discharge enters the Old Fish Creek Channel. More specifically, the permit's outfall 001 effluent limits are based on the applicable WQS (18 AAC 70.020) and converted to maximum daily and average monthly values using established calculations and a default coefficient of variation for new dischargers with very little data.

The Department finds that the reduced water quality will not violate applicable water quality criteria, and the requirement is met.

3) 18 AAC 70.015(a)(2)(C). Resulting water quality will be adequate to fully protect existing uses of the water.

Rationale: On April 5, 2012, ADF&G stated, "…it (the permitted discharge) will almost certainly create fish habitat in the North Historic Fish Creek Channel and improve fish habitat in the WSR (water supply reservoir), and possibly in Fish Creek downstream...(Bill Morris, Regional Supervisor, Fairbanks, personal communication)." The resulting water quality will not only protect existing uses, but enhancement of the existing fishery is expected. In addition, no mixing zone or other water quality variance is being authorized.

The Department finds that the resulting water quality will be adequate to fully protect

existing and designated uses, and this requirement is met.

4) 18 AAC 70.015(a)(2)(D). The most effective and reasonable methods of pollution prevention control and treatment will be applied to all wastes and other substances to be discharged.

Rationale: The effluent is a blend of many mine dewatering wells. The final effluent must meet water quality-based effluent limits before discharge. Consequently, only the high quality water is permitted to be discharged. No treatment of the effluent is required prior to discharge to meet WQS. Instead, source control prevents pollution and maintains high quality effluent.

When making waste management and pollution prevention decisions, the Department's first priority is to consider source reduction as imposed by this permit. Consequently, the Department finds the most effective methods of pollution prevention, control, and treatment are the practices and requirements imposed by this permit, and this requirement is met.

5) 18 AAC 70.015(a)(2)(E). Wastes and other substances discharged will be treated or controlled to achieve the highest statutory and regulatory requirements.

Rationale: The "highest statutory and regulatory requirements" defined in 18 AAC 70.990(30) (as amended June 26, 2003) have been applied to outfall 001. There are three parts to the definition.

The first part of the definition under 18 AAC 70.990(30)(A) considers all federal technology-based effluent limitation guidelines (ELGs). For outfall 001 and its effluent, which is not mine contact water, there are no applicable ELGs.

Under 18 AAC 70.990(30)(B), the second part of the definition refers to the "highest statutory and regulatory requirements." It refers to 18 AAC 72.040, which considers discharge of sewage to sewers and does not apply to this facility. However, it appears that reference to 18 AAC 70.040 is an error and that the proper reference should be 18 AAC 70.050. Nonetheless, 18 AAC 72.050, Minimum Treatment, establishes minimum treatment requirements for domestic wastewater, and there are no domestic waste streams associated with this discharge.

The third part of "highest statutory and regulatory requirements" considers any more stringent treatment required by state law including 18 AAC 70 and 18 AAC 72. Since there are no ELGs applicable to the effluent, all the permit limits are the most stringent water quality-based limits required by state law.

The Department finds that waste control required in this permit achieves the highest statutory and regulatory requirements, and this requirement is met.

9.0 OTHER PERMIT CONDITIONS

9.1 Quality Assurance Project Plan

The permittee is required to develop procedures in a Quality Assurance Project Plan (QAPP) to ensure that the monitoring data submitted are accurate and to explain data anomalies if they occur. The permittee is required to update the QAPP and submit written notification of any updates to the Department within 60 days of the effective date of the final permit. The QAPP shall consist of standard operating procedures the permittee must follow for collecting, handling, storing and shipping samples; laboratory analysis; and data reporting. The QAPP shall be retained on site and made available to the Department upon request.

9.2 Best Management Practices Plan

According to AS 46.03.110(d), as previously cited, the Department may specify in a permit the terms and conditions under which waste material may be disposed. This permit requires the permittee to develop a Best Management Practices (BMP) Plan in order to prevent or minimize the potential for the release of pollutants to waters and lands of the State of Alaska through facility runoff, spillage or leaks, or erosion. The permit contains conditions that must be included in the BMP Plan. The permit requires the permittee to develop and implement a BMP Plan within 90 days of the effective date of the permit, the BMP Plan must be kept on site and made available to the Department upon request, the BMP Plan must be reviewed annually for compliance with permit requirements, and a statement must be submitted to the Department certifying each annual review.

9.3 Standard Conditions

Appendix A of the permit contains standard regulatory language that must be included in all APDES permits. These requirements are based on the regulations and cannot be challenged in the context of an individual APDES permit action. The standard regulatory language covers requirements such as monitoring, recording, reporting requirements, compliance responsibilities, general requirements, and other legal obligations.

10.0   OTHER CONSIDERATIONS

10.1 Endangered Species Act

The Endangered Species Act (ESA) requires federal agencies to consult with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) if their actions could beneficially or adversely affect any threatened or endangered species. As a state agency, DEC is not required to consult with USFWS or NMFS regarding permitting actions. However, DEC values input from the Services on ESA concerns, and on April 5, 2012, DEC solicited USFWS and NMFS for feedback about ESA impacts associated with this permit. That same day, USFWS indicated lack of concern about this permit because there are no threatened or endangered or species in the area of Fort Knox Mine (Bob Henszey, Fish & Wildlife Biologist, Fairbanks, personal communication). To date, NMFS has not yet responded to inquiries about ESA impacts.

10.2 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (January 21, 1999) requires federal agencies to consult with NMFS when any activity proposed to be permitted, funded, or undertaken by a federal agency has the potential to adversely affect (reduce quality and/or quantity of) Essential Fish Habitat (EFH). EFH includes the waters and substrate (sediments, etc.) necessary for fish from commercially-fished species to spawn, breed, feed, or grow to maturity. As a state agency, DEC is not required to consult with NMFS regarding permitting actions. However, DEC is concerned with protecting EFH, and on April 5, 2012, DEC solicited NMFS and ADF&G for feedback on EFH impacts associated with this permit. Later that day, ADF&G replied that only positive impacts to EFH are associated with the permitted activities (Bill Morris, Regional Supervisor, Fairbanks, personal communication). To date, NMFS has not yet responded to inquiries about EFH impacts.

11.0   PERMIT EXPIRATION

The permit will expire five years from its effective date. Should the permit expire prior to the Department reissuing in a timely manner, the permit may be administratively extended under 18 AAC 83.155 if all requirements of this regulation are met.

12.0   REFERENCES

Fairbanks Gold Mining, Incorporated (FGMI). 2008. Fort Knox Mine Monitoring Plan. June 2008.

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Figure 1: Vicinity Project Map
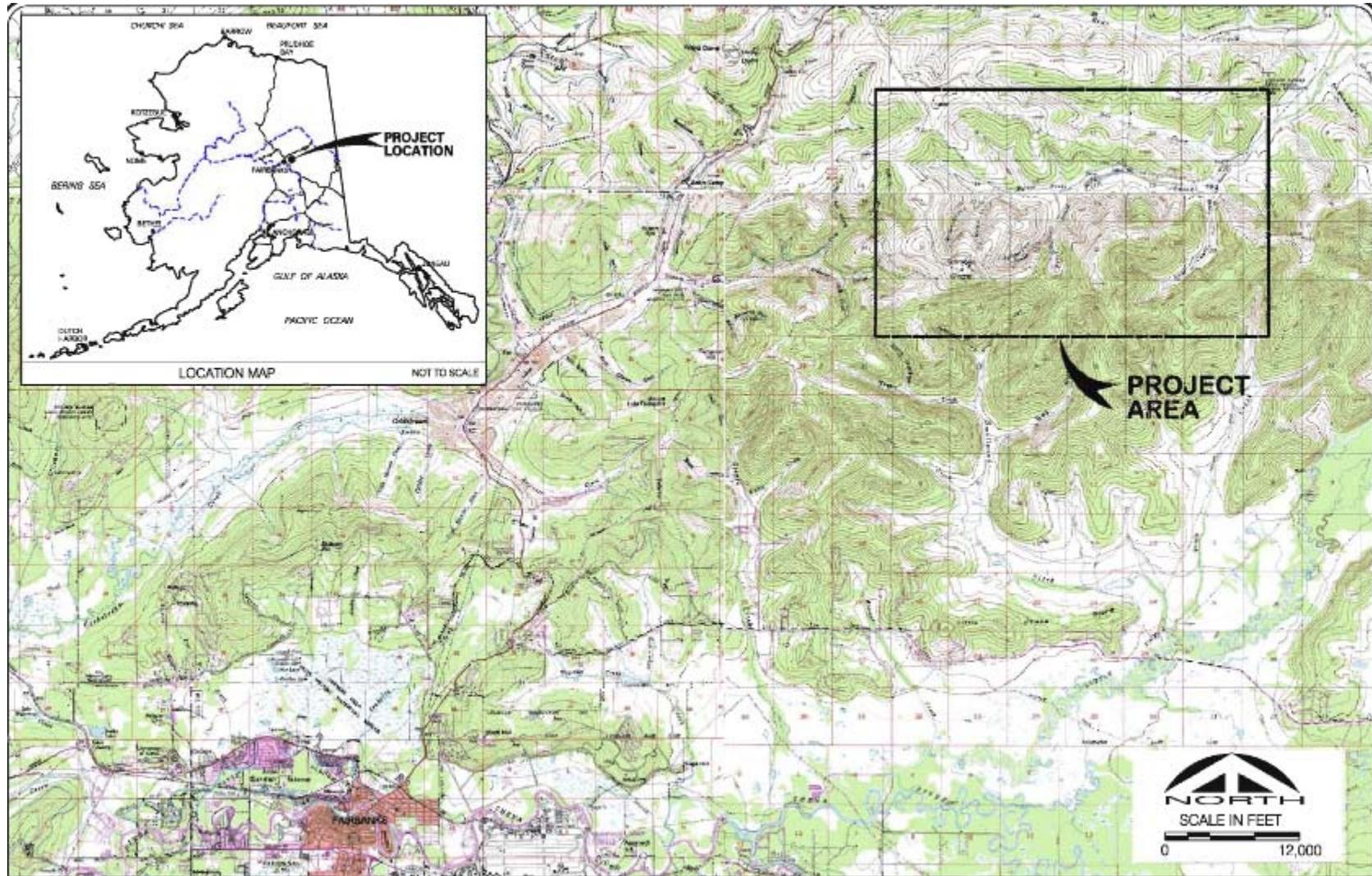
Figure 2: Facility Plan View Map

Figure 2
Fairbanks Gold Mining, Inc
APDES Permit
TOPOGRAPHIC MAP
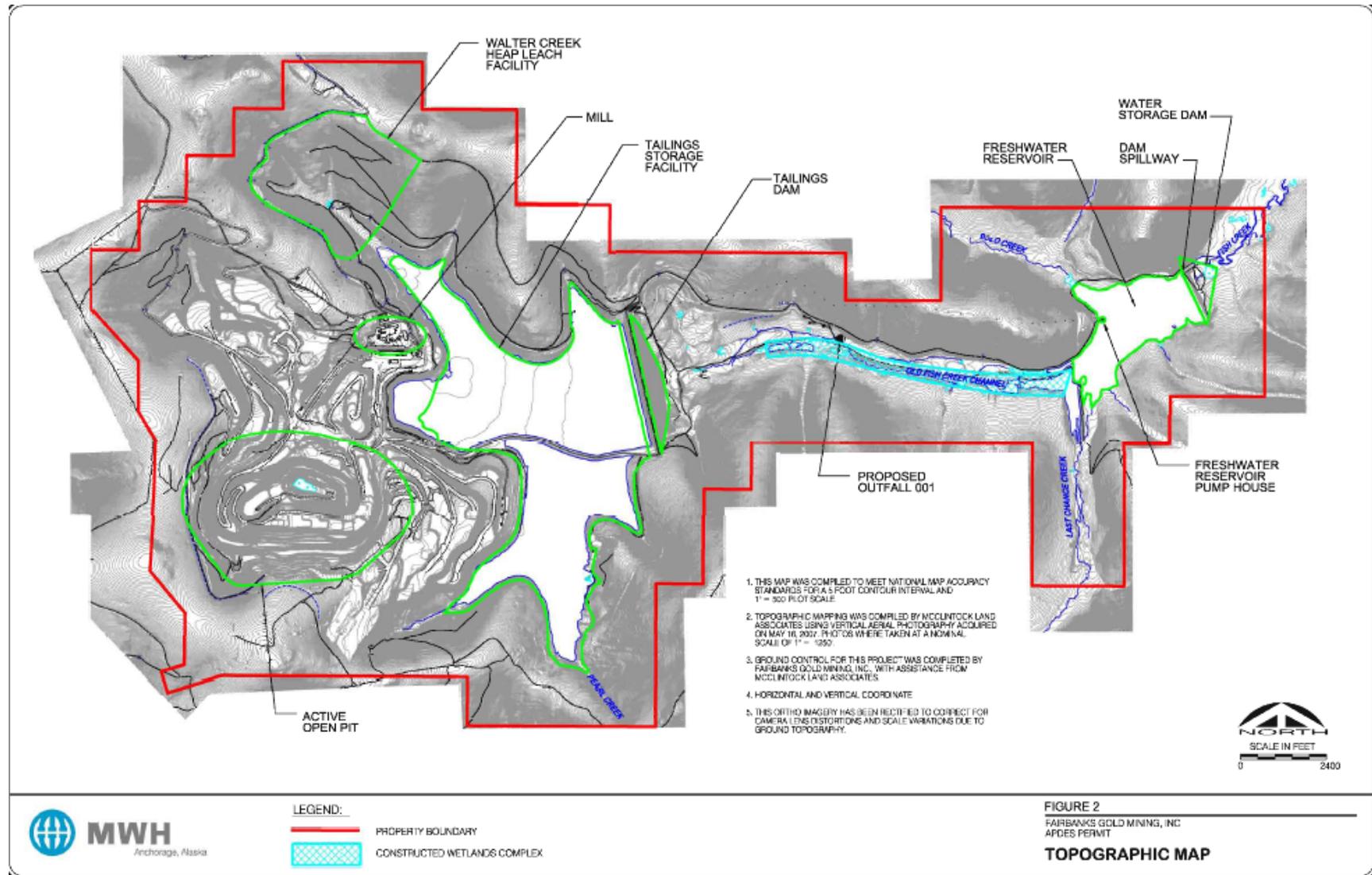
Figure 3: Enhanced Aerial Photo of the Outfall Location
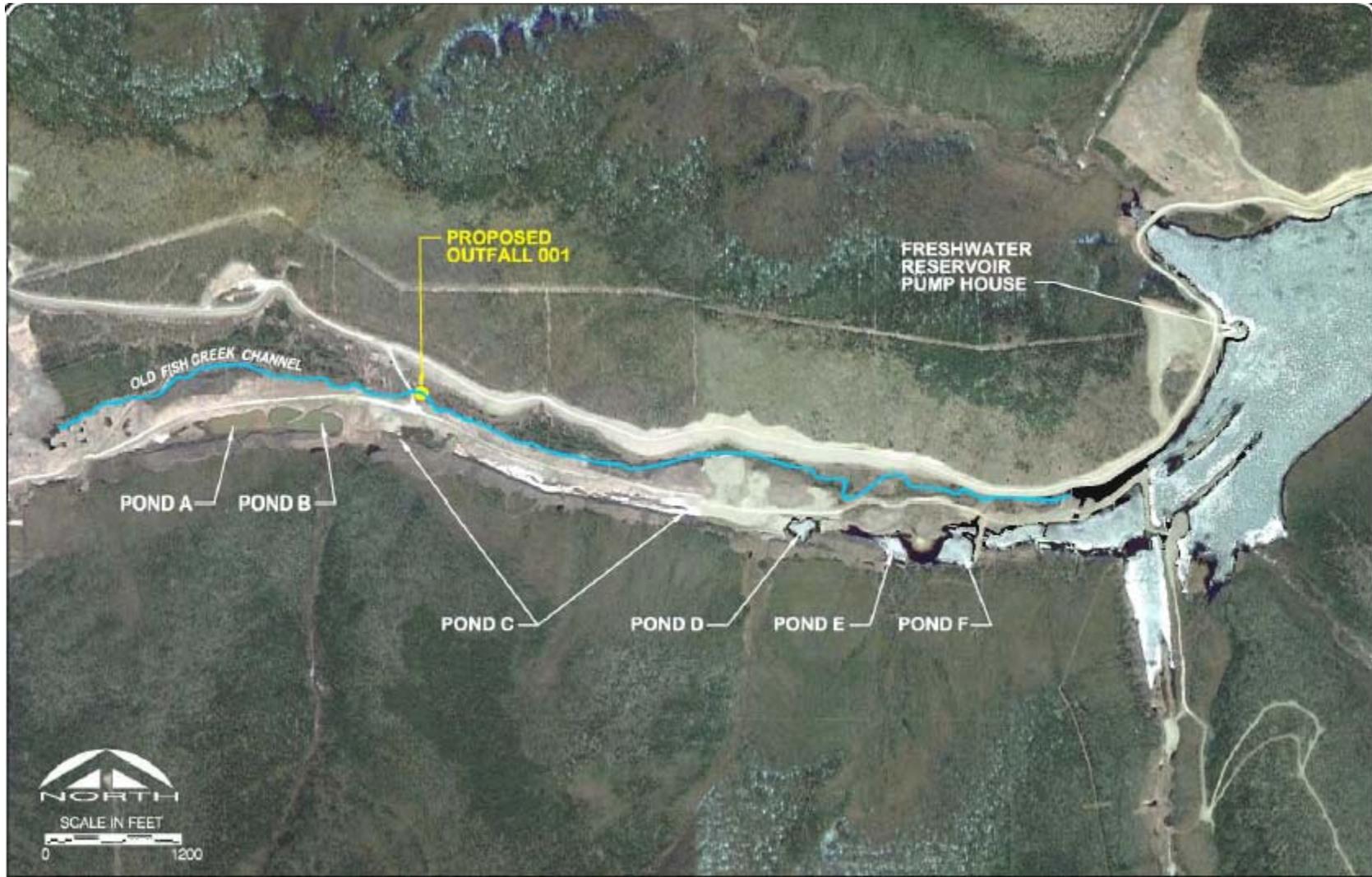
APPENDIX A   BASIS FOR EFFLUENT LIMITS

The following discussion explains in more detail the statutory and regulatory basis for the technology and water quality-based effluent limits contained in the permit. Part 1 discusses technology-based effluent limits (TBELs), Part 2 discusses water quality-based effluent limits (WQBELs) in general, and Part 3 discusses facility-specific WQBELs

A.1 Technology Based Effluent Limits

Effluent Limitation Guidelines

EPA promulgated effluent limitation guidelines (ELGs) for the ore mining and dressing point source category at 40 CFR Part 440, which include technology-based limits for this point source category. Subpart J is applicable to the concentration of pollutants discharged in mine drainage from mines that produce Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategories.

The ELGs applicable to a new source, which is a source that has commenced construction after the ELGs were established on December 3, 1982, are applicable to discharges of process wastewater from active mines. However, since the discharge permitted under this Alaska Pollutant Discharge Elimination System (APDES) permit is for non-contact, non-process, groundwater from mine dewatering wells, these ELGs are not applicable.

A.2 Water Quality-Based Effluent Limits

Statutory and Regulatory Basis

Regulations at 18 AAC 70.010 prohibit conduct that causes or contributes to a violation of the State Water Quality Standards (WQS). Under 18 AAC 15.090, it requires that permits include terms and conditions to ensure criteria are met, including operating, monitoring, and reporting requirements.

The regulations require the permitting authority to make this evaluation using procedures that account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant concentration in the effluent, species sensitivity (for toxicity), and where appropriate, dilution in the receiving water. WQBELs in the permit must be stringent enough to ensure that WQS are met and must be consistent with any available waste load allocation (WLA).

Reasonable Potential Analysis

When evaluating the effluent to determine if WQBELs based on numeric criteria are needed, the Department projects the receiving water concentration downstream of where the effluent enters the receiving water for each pollutant of concern. The Department uses the concentration of the pollutant in the effluent and receiving waterbody and, if appropriate, the dilution available from the receiving waterbody, to project the receiving water concentration. If the projected pollutant concentration in the receiving waterbody exceeds the numeric criterion for that substance, then the discharge has the reasonable potential to cause or contribute to an exceedance of the applicable WQS, and a WQBEL is required. In

this case, the discharge is to the Old Fish Creek Channel, a streambed with little to no flow. Therefore, reasonable potential is calculated based on the most stringent water quality standard with no available dilution.

Procedure for Deriving WQBELs

The *Technical Support Document for Water Quality-Based Toxics Control* (TSD) (EPA, 1991) and the WQS recommend the flow conditions for use in calculating water quality-based effluent limits (WQBEL) using steady-state modeling. The TSD and the Alaska Water Quality Standards state the WQBELs intended to protect aquatic life uses should be based on the lowest seven-day average flow rate expected to occur once every ten years (7Q10) for chronic criteria and the lowest one-day average flow rate expected to occur once every ten years (1Q10) for acute criteria.

The first step in developing a WQBEL is to develop a WLA for the pollutant. A WLA is the concentration or loading of a pollutant that the permittee may discharge without causing or contributing to an exceedance of WQS in the receiving water.
In this case, where a mixing zone is not authorized, because receiving water flow is too low to provide dilution, the criterion becomes the WLA. Establishing the criterion as the WLA ensures that the permittee will not cause or contribute to an exceedance of the criterion. The following discussion details the development of WQBELs.

Once a WLA is developed, the Department calculates effluent limits which are protective of the WLA using statistical procedures described in APPENDIX C – Effluent Limit Calculations.

A.3 Specific WQBELs

Hardness-Dependent Metals

The toxicity of some metals varies with the hardness of the water, and the aquatic life water quality criteria for these metals also vary with hardness. The receiving water hardness is used to determine the water quality criteria for such metals. For discharges from Fort Knox Mine, the receiving water is the Old Fish Creek Channel, a tributary to the Freshwater Reservoir. Since flow in the Old Fish Creek Channel is restricted to spring breakup and storm events, there is no receiving water in the area of outfall 001. The Freshwater Reservoir Pump House sampling station provides background receiving water quality data nearest to the location where the discharge enters the Freshwater Reservoir. Data used were collected between 2007 and 2011 before any discharge from this outfall. The 15th percentile of the observed hardness value is 62 mg/L as $CaCO_3$, which was used to determine the hardness-based metal criteria.

The hardness-dependent aquatic life criteria for the metals of concern may be expressed as dissolved metal. The dissolved fraction of a metal is the fraction that will pass through a 0.45-micron filter. Total recoverable metal is the concentration of the metal in an unfiltered sample. Regulations at 18 AAC 83.525 state that any permit limits for a metal must be expressed in terms of total recoverable metal. Translators are used to translate the dissolved criteria into total recoverable criteria for comparison to effluent data and for development of

WQBELs, when applicable. Translators can either be site-specific numbers or default numbers. The Environmental Protection Agency (EPA) has published guidance related to the use of translators in permits in The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion (EPA 82313-96-007, June 1996). In the absence of site-specific translators, this guidance recommends the use of water quality criteria conversion factors as the default translators. Site-specific translators were not available; therefore, the conversion factors in the Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances (DEC, 2008) were used in the reasonable potential analysis and effluent limit calculations.

Table A- 1: Conversion Factors for Total Recoverable and Dissolved Criteria (µg/L^2)

Parameter	Acute Criterion Total Recoverable[1]	Conversion Factor	Acute Criterion Dissolved	Chronic Criterion Total Recoverable[1]	Conversion Factor	Chronic Criterion Dissolved
Cadmium	1.31	0.964	1.26	0.19	0.929	0.18
Chromium VI	16.02	0.982	15.73	10.98	0.962	10.56
Copper	8.92	0.960	8.57	6.20	0.960	5.95
Lead	44.43	0.861	38.24	1.73	0.861	1.49
Nickel	313.11	0.998	312.48	34.81	0.997	34.71
Selenium	20	0.922	18.44	5	0.922	4.61
Silver	1.66	0.850	1.41	---	---	---
Zinc	79.91	0.978	78.15	79.91	0.986	78.79

[1] Calculated using a hardness value of 62 mg/L as $CaCO_3$
[2] Microgram per liter.

pH

The most stringent water quality criterion for pH is for the protection of aquatic life and aquaculture water supply. The pH criteria for these uses state that the pH must be no less than 6.5 and no greater than 8.5 standard units and may not vary more than 0.5 pH units from natural conditions.

APPENDIX B   REASONABLE POTENTIAL DETERMINATION

The following describes the process the Department used to determine if the discharge authorized in the permit has the reasonable potential to cause or contribute to a violation of Alaska Water Quality Standards (WQS). The Department used the process described in the *Technical Support Document for Water Quality-Based Toxics Control* (TSD) (EPA, 1991) and the Alaska Department of Environmental Conservation's (DEC or the Department) guidance, Reasonable Potential Procedure for Water Quality-Based Effluent Limits, APDES Permits (January 2009) ("RPA Guidance") to determine the reasonable potential for any pollutant to exceed a water quality criterion.

To determine if there is reasonable potential for the discharge to cause or contribute to an exceedance of water quality criteria for a given pollutant, the Department compares the maximum projected receiving waterbody concentration to the criteria for that pollutant. Reasonable potential to exceed exists if the projected receiving waterbody concentration exceeds the criteria, and a water quality-based effluent limitation must be included in the permit (18 AAC 83.435). This section discusses how the maximum projected receiving waterbody concentration is determined.

B.1 Mass Balance

For a discharge to a flowing waterbody, the maximum projected receiving waterbody concentration is determined using a steady state model represented by the following mass balance equation:

$$C_d Q_d = C_e Q_e + C_u Q_u \qquad \text{(Equation C-1)}$$

where,

C_d = Receiving waterbody concentration downstream of the effluent discharge

C_e = Maximum projected effluent concentration

C_u = 95th percentile measured receiving waterbody upstream concentration

Q_d = Receiving waterbody flow rate downstream of the effluent discharge = $Q_e + Q_u$

Q_e = Effluent flow rate (set equal to the design flow of the discharge)

Q_u = Receiving waterbody low flow rate upstream of the discharge (1Q10, 7Q10 or 30B3).

When the mass balance equation is solved for C_d, it becomes:

$$C_d = \frac{C_e Q_e + C_u Q_u}{Q_e + Q_u} \qquad \text{(Equation C-2)}$$

The above form of the equation is based on the assumption that the discharge is rapidly and completely mixed with the receiving stream. If a mixing zone (MZ) based on a percentage of the critical flow in the receiving stream is allowed based on the assumption of incomplete mixing with the receiving waterbody, the equation becomes:

$$C_d = \frac{C_e Q_e + C_u(Q_U \times MZ)}{Q_e + (Q_u \times MZ)}$$
(Equation C-3)

where MZ is the fraction of the receiving waterbody flow available for dilution. Where mixing is rapid and complete, MZ is equal to 1 and equation C-2 is equal to equation C-3 (i.e., all of the critical low flow volume is available for mixing).

If a MZ is not allowed, dilution is not considered when projecting the receiving waterbody concentration, and

$$C_d = C_e$$
(Equation C-4)

There is no flow in Old Fish Creek Channel at the point of discharge, therefore, the receiving water concentration for each pollutant was determined without dilution or a MZ, and is set equal to the pollutant concentration in the effluent.

B.2 Maximum Projected Effluent Concentration

The maximum projected effluent concentration was calculated according to section 3.3 of the TSD, "Determining the Need for Permit Limits with Effluent Monitoring Data", and the APDES Program Description (October 2008), page 29, which states that the maximum projected effluent concentration will be established at the 95th percentile confidence level.

Analytical data collected from January 2007 through October 2011 from dewatering wells in and around the active mine pit, as well as for the freshwater reservoir were reviewed. Pump rate data from the dewatering wells from January through December 2011 were also reviewed. Pump rate data prior to this period were considered not applicable in calculating projected discharge flow rates, as many wells have either been mined out or are no longer functional due to changes in hydrology as a result of pit expansion.

After reviewing the available analytical and flow data from the dewatering wells, the following procedures were used.

Groundwater flow data from active dewatering wells located in and around the active mining pit for the period between January and December 2011 were reviewed. The average pump rate for each well (by percent of total combined flow rate) for all wells are summarized below.

- North Sector – 5.19%, three online wells

- East Sector – 3.24%, two online wells

- West Sector – 21.20%, 10 wells; six online, four offline

- South Sector – 11.29%, one online well

- Pit Sector – 59.08%, nine wells; five online, four offline

These calculated flow rate contributions were based on the average measured flows and did

not include periods when the wells were offline due to access or maintenance issues, or when the accuracy of measured flow was in question due to flow meter malfunction.

Inorganic analyses were performed on the dewatering wells. Results were compared against 18 Alaska Administrative Code (AAC) 70; *Water Quality Criteria for Toxics and Other Deleterious Substances in the Alaska Water Quality Criteria Manual* (DEC, 2008). Analytes were limited to inorganic parameters based on the fact the water is raw untreated/uncontaminated groundwater. The most stringent WQS for each analyte (Drinking Water; Acute or Chronic [Aquatic Life for Fresh Water]; Human Health Criteria for Noncarcinogens) was used.

The composition of a combined discharge from the dewatering wells was calculated using the average detected concentration for inorganic analytes during the sampling period from January 2007 to October 2011, to provide a typical discharge scenario. Based on the estimated flow rates (January 2011 to December 2011) and the average analytical values from each of the dewatering wells (January 2007 to October 2011), the combined potential discharge is below the most stringent WQS for all inorganic constituents using the required source control.

Without required source control, the calculated weighted average for arsenic from a combined discharge is 0.025 milligram per liter (mg/L), which exceeds the WQS of 0.010 mg/L. If discharge from well DW10-264 is eliminated, the average projected value falls to 0.012 mg/L. If both wells DW10-264 and DW09-220 are eliminated, the average calculated value falls below the WQS to (0.0096 mg/L). Both of these wells were eliminated from coverage in this permit.

Table B- 1: WQS and Water Quality Data Used in Reasonable Potential Analysis

Analyte[1]	Most Stringent Applicable WQS (Total Recoverable)	Units	16 Wells (excludes wells 264 & 220)
Aluminum[2]	750	Milligram per Liter (mg/L)	0.012
Ammonia[3] as N	2.10	mg/L	0.0057
Antimony	0.006	mg/L	0.0020
Arsenic	0.010	mg/L	0.00957
Barium	2.00	mg/L	0.003
Cadmium	0.00019	mg/L	0.00000010
Calcium, Total	none	mg/L	47.9551257
Chloride	230	mg/L	0.460
Chromium III	0.05826	mg/L	0.00017
Chromium VI	0.01143	mg/L	0.0043
Copper	0.0062	mg/L	0.00080
Cyanide, Weak-Acid Dissociable (WAD)	0.0052	mg/L	0.00094
Fluoride	1.0	mg/L	0.338
Iron	1.0	mg/L	0.102
Lead	0.00173	mg/L	0.00143
Magnesium, Total	none	mg/L	8.48422722
Manganese	0.050	mg/L	0.02158
Mercury	0.000010	mg/L	0.000000064
Nickel	0.03481	mg/L	0.0069
Nitrite + Nitrate as N	10	mg/L	2.599
Selenium	0.005	mg/L	0.00038
Silver	0.00166	mg/L	0.000014
Sulfate	230	mg/L	73.6508278
Total Dissolved Solids	500	mg/L	219
Zinc	0.07815	mg/L	0.0125

Notes:

[1] A values are in total recoverable unless otherwise indicated.

[2] Based on hardness of 62 mg/L and pH of greater than 7.9 at the *Freshwater Reservoir Pump House* sampling station from 2007 through 2011, the chronic aluminum standard is 750 μg/L[6].

[3] Based on the 90th percentile of pH data equal to 8.1, the 90th percentile of water temperature data equal to 10.4°C, and early life stages of fish at the *Freshwater Reservoir Pump House* sampling station from 2007 through 2011, the chronic ammonia standard is 2.10 mg/L.

The Department's RPA Guidance requires a distribution determination for each parameter's dataset based on non-detects and the number of samples (*n*). The spreadsheet developed under the RPA Guidance ("RPA Tool") uses the following criteria:

- $n < 10 \rightarrow$ Default (Coefficient of Variation (CV) = 0.6)
- $10 \leq n$ (all detected) $\leq 30 \rightarrow$ Lognormal
- n (all detected) $> 30 \rightarrow$ Normal
- Mixed (detected & non-detected) $\rightarrow$ Delta lognormal

Since there are a limited number of data points available, the maximum projected effluent concentration is calculated by multiplying the maximum reported effluent concentration by a reasonable potential multiplier (RPM). The RPM is the ratio of the 95th percentile concentration to the maximum reported effluent concentration and accounts for the statistical uncertainty in the effluent data. The RPM is calculated from the CV)of the data and the number of data points. The CV is defined as the ratio of the standard deviation to the mean of the data set. When fewer than ten data points are available, the TSD recommends making the assumption that the CV is set equal to 0.6. A CV value of 0.6 is a conservative estimate that assumes a relatively high variability.

Using the equations in section 3.3.2 of the TSD, the RPM is calculated based on the CV as follows. The following discussion presents the equations used to calculate the RPM.

First, the percentile represented by the highest reported concentration is calculated.

$$p_n = (1 - \text{confidence level})^{1/n}$$

Where,

p_n = the percentile represented by the highest reported concentration

n = the number of samples

confidence level = 95% = 0.95

The RPM is the ratio of the 95th percentile concentration (at the 95% confidence level) to the maximum reported effluent concentration. This is calculated as follows:

$$\text{RPM} = \frac{C95}{Cp}$$

Where,

$C = \exp(z\sigma - 0.5\sigma^2)$,

$\sigma^2 = \ln(CV^2 + 1)$,

CV = coefficient of variation = (standard deviation) ÷ (mean), and

z = the inverse of the normal cumulative distribution function at a given percentile

The maximum projected effluent concentration (Ce) is determined by simply multiplying the maximum reported effluent concentration by the RPM:

$C_e = (RPM)*(MEC)$

Where,

MEC = Maximum Effluent Concentration

B.3 Maximum Projected Receiving Water Concentration

The discharge has reasonable potential to cause or contribute to an exceedance of water quality criteria if the maximum projected concentration of the pollutant at the boundary of the mixing zone exceeds the most stringent criterion for that pollutant. In this case, the maximum projected receiving water concentration (C_d) is calculated without a mixing zone or credit for dilution and so is set equal to the projected maximum effluent concentration (C_e), as follows.

$$C_d = C_e$$

Table B- 2: Projected Maximum Effluent Concentration Calculations from the RPA Tool

Parameter[1]	Units	Maximum Observed Effluent Max Concentration	No. of samples (n)	Coefficient of Variation (CV)	Reasonable Potential Multiplier (RPM)	Maximum Expected Concentration (MEC)	Basis for Exceedance	Reasonable Potential[2]
Aluminum	µg/L	11.50	1	0.60	13.19	152	Acute	No
Ammonia	mg/L	0.0057	1	0.60	13.19	0.075	Chronic	No
Antimony	µg/L	1.98	1	0.60	13.19	26	HH	Yes
Arsenic	µg/L	9.57	1	0.60	13.19	126	HH	Yes
Cadmium	µg/L	0.0010	1	0.60	13.19	0.013	Chronic	No
Chloride	µg/L	460	1	0.60	13.19	6,075	HH	No
Chromium III	µg/L	0.17	1	0.60	13.19	2.3	Chronic	No
Chromium VI	µg/L	4.3	1	0.60	13.19	57	Acute	Yes
Copper	µg/L	0.80	1	0.60	13.19	11	Acute	Yes
Cyanide, WAD	µg/L	0.94	1	0.60	13.19	12	Chronic	Yes
Fluoride	µg/L	338	1	0.60	13.19	4,460	HH	Yes
Iron	µg/L	102	1	0.60	13.19	1,350	Chronic	Yes
Lead	µg/L	1.4	1	0.60	13.19	19	Chronic	Yes
Manganese	µg/L	22	1	0.60	13.19	285	HH	Yes
Mercury	µg/L	0.000064	1	0.60	13.19	0.00084	Chronic	No
Nickel	µg/L	6.9	1	0.60	13.19	91	Chronic	Yes
Nitrate + Nitrite	µg/L	2.6	1	0.60	13.19	34	HH	Yes
Selenium	µg/L	0.38	1	0.60	13.19	5.0	Chronic	Yes
Silver	µg/L	0.015	1	0.60	13.19	0.19	Acute	No
Sulfate	mg/L	74	1	0.60	13.19	972	HH	Yes
TDS	mg/L	219	1	0.60	13.19	2,890	HH	Yes
Zinc	µg/L	12	1	0.60	13.19	165	Acute	Yes

[1] All concentrations are in total recoverable.
[2] Reasonable Potential determined based on well samples and not the total combined effluent, which meets WQS prior to discharge.

APPENDIX C   EFFLUENT LIMIT CALCULATION

The following calculations demonstrate how water quality based effluent limits (WQBELs) were calculated for those pollutants that demonstrate reasonable potential.

C.1 Calculate the Wasteload Allocations (WLAs)

Wasteload allocations (WLAs) are calculated using the same mass balance equations used to calculate the concentration of the pollutant at the boundary of the mixing zone in the reasonable potential analysis, as follows.

$Q_dC_d = Q_eC_e + Q_uC_u$

Where,

Q_d = downstream flow = $Q_u + Q_e$

C_d = aquatic life criteria that cannot be exceeded

Q_e = effluent flow

C_e = effluent concentration

Q_u = upstream flow

C_u = upstream background pollutant concentration

The mass balance equation can be rearranged to determine the effluent concentration, which is the WLA, as follows.

$$C_e = WLA = \frac{Cd(Qu + Qe) - QuCu}{Qe}$$

When the upstream flow is zero, then the WLA is set equal to the effluent concentration (*Ce*).

The next step is to compute the long term average (LTA) concentrations which will be protective of the WLAs. This is done using the following equations from the *Technical Support Document for Water Quality-based Toxics Control* (TSD) (EPA, 1991):

$LTA_{acute} = WLA_{acute} * \exp(0.5\sigma^2 - z\sigma)$

Where,

$\sigma^2 = \ln(CV^2 + 1)$, and

$z = 2.326$ for the 99th percentile probability basis

$LTA_{chronic} = WLA_{chronic}{}^* \exp(0.5\sigma^2 - z\sigma)$

Where,

$\sigma^2 = \ln[(CV^2/4)+1]$, and

z =2.326 for 99**th** percentile probability basis

The LTAs are compared and the more limiting LTA is used to develop the daily maximum and monthly average permit limits as shown below.

C.2 Derive the Maximum Daily and Average Monthly Effluent Limits

The maximum daily limit (MDL) and the average monthly limit (AML) are calculated according to the TSD as follows.

$MDL = LTA_{(limiting)} * \exp(z\sigma - 0.5\sigma^2)$

Where,

$\sigma^2 = \ln(CV^2 + 1)$

$z = 2.326$ for the 99th percentile probability basis

CV = coefficient of variation

$AML = LTA_{(limiting)} * \exp(z\sigma - 0.5\sigma^2)$

Where,

$\sigma^2 = \ln[(CV^2/n) + 1]$

$z = 1.645$ for the 95th percentile probability basis

n = number of sampling events required per month (minimum of 4)

Table C- 1: Maximum Daily and Average Monthly Effluent Limits

Parameter	Units	Acute Criterion	Chronic Criterion	Human Health Criterion[1]	Technology Based Limits	Mixing Zone Dilution Factor	Maximum Daily Limit[2] (MDL)	Average Monthly Limit[2] (AML)
Antimony	µg/L	No criterion	No criterion	6.00	None	No dilution	12	6.0
Arsenic	µg/L	340.00	150.00	10.00	None	No dilution	20	10
Chromium VI	µg/L	16.29	11.43	No criteria	None	No dilution	16	8.1
Copper	µg/L	8.92	6.20	200.00	None	No dilution	8.9	4.4
Cyanide, WAD	µg/L	22.00	5.20	200.00	None	No dilution	8.5	4.3
Fluoride	mg/L	No criterion	No criterion	1.0	None	No dilution	2.0	1.0
Iron	mg/L	No criterion	1.00	5.00	None	No dilution	1.6	0.82
Lead	µg/L	44.43	1.73	50.00	None	No dilution	2.8	1.4
Manganese	µg/L	No criterion	No criterion	50.00	None	No dilution	100	50
Nickel	µg/L	313.11	34.81	100.00	None	No dilution	57	29
Nitrate	mg/L	No criterion	No criterion	10.00	None	No dilution	20	10
Nitrate + Nitrite	mg/L	No criterion	No criterion	10.00	None	No dilution	20	10
Nitrite	mg/L	No criterion	No criterion	1.00	None	No dilution	2.0	1.0
Selenium	µg/L	20.00	5.00	10.00	None	No dilution	8.2	4.1
Sulfate	mg/L	No criterion	No criterion	250.00	None	No Dilution	500	250
TDS	mg/L	No criterion	No criterion	500.00	None	No dilution	1,000	500
Zinc	µg/L	79.91	79.91	2,000.00	None	No dilution	80	40

[1] Lists the most restrictive water quality criterion when choosing from among Drinking Water, Stockwater, Irrigation Water, and Human Health for Consumption of Water and Aquatic Organisms
[2] Rounded to two significant figures

For WQBELs set for protection of human health, the TSD states that the AML should be set at the WLA, and the MDL should be calculated using the effluent variability and the multipliers provided in Table 5.3 of the TSD. The multiplier may be calculated according the following equation.

$$MDL/AML = \frac{\exp[z_m\sigma - 0.5\sigma^2]}{\exp[z_a\sigma_n - 0.5\sigma^2{}_n]}$$

Where,

$\sigma_n{}^2 = \ln(CV^2/n+1)$

$\sigma^2 = \ln(CV^2 +1)$

CV = coefficient of variation

n = number of samples per month (minimum of 4)

z_m = percentile exceedance probability for the MDL

z_a = percentile exceedance probability for the AML

Table C- 2: Human Health-Based Maximum Daily and Average Monthly Effluent Limits

Pollutant	Units	WLA	MDL/AML Multiplier	MDL	AML
Antimony	µg/L	6.0	2.0	12	6.0
Arsenic	µg/L	10	2.0	100	50
Fluoride	mg/L	1.0	2.0	2.0	1.0
Manganese	µg/L	50	2.0	100	50
Nitrate + Nitrite	mg/L	10	2.0	20	10
Sulfate	mg/L	250	2.0	500	250
TDS	mg/L	500	2.0	1,000	500