FACT SHEET

The United States Environmental Protection Agency (EPA)
Plans To Modify A
National Pollutant Discharge Elimination System (NPDES) Permit To:

Teck Cominco Alaska, Inc. (Red Dog Mine)
P.O. Box 1230
Kotzebue, Alaska 99752

Permit Number: AK-003865-2

Public Comment Period:

EPA Proposes NPDES Permit Modification.

EPA proposes to modify the requirements for total dissolved solids contained in the NPDES permit for the Red Dog Mine site. In order to ensure protection of water quality, the permit places limits on the amount of total dissolved solids (as well as numerous other pollutants) that can be discharged from the wastewater treatment plant to Middle Fork Red Dog Creek.

This Fact Sheet includes:

- information on public comment, public hearing, and appeal procedures
- a listing of proposed effluent limitations, and other conditions
- a map and description of the area where the Red Dog mine is located
- technical material supporting the proposed permit conditions

The State of Alaska Proposed Certification.

The Alaska Department of Environmental Conservation is proposing to submit to EPA a modified Certificate of Reasonable Assurance for the NPDES permit for the Red Dog Mine site, under section 401 of the Clean Water Act. The requirements from the proposed modified certification have been incorporated into the draft permit modification.

Public Comment.

Persons wishing to comment on or request a public hearing for the draft permit modification may do so in writing by the close of the public comment period. A request for a public hearing must state the nature of the issues to be raised as well as the requester's name, address and telephone number. All comments and requests for Public Hearings must be in writing and should be submitted to EPA as described in the Public Comments Section of the attached Public Notice.

After the public comment period ends, and all comments have been considered, EPA's regional

Director for the Office of Water will make a final decision regarding permit reissuance.

If no substantive comments are received, the proposed conditions in the modified permit will become final, and the permit will become effective upon issuance. If comments are received, EPA will address the comments and issue the permit. The permit will become effective 30 days after the issuance date, unless an appeal is submitted to the Environmental Appeals Board within 30 days.

Documents are Available for Review.

The draft NPDES permit modification and related documents can be reviewed or obtained by visiting or contacting EPA's Regional Offices in Seattle or Anchorage between 8:30 a.m. and 4:00 p.m., Monday through Friday (See addresses below). Draft permits, Fact Sheets, and other information can also be found by visiting the Region 10 website at www.epa.gov/r10earth/water/npdes.htm.

United States Environmental Protection Agency
Region 10
1200 Sixth Avenue, OW-130
Seattle, Washington 98101
(206) 553-2108 or
1-800-424-4372 (within Alaska, Idaho, Oregon and Washington)

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Federal Building, 222 W. 7th Avenue, #19
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I. INTRODUCTION

The Environmental Protection Agency (EPA) is proposing to modify the NPDES permit for the Red Dog mine site. The proposed modification incorporates a site-specific criterion for total dissolved solids (TDS) in Mainstem Red Dog Creek, and the preliminary determinations made in the Alaska Department of Environmental Conservation's (ADEC) modified certification of the NPDES permit (i.e., mixing zone allowances, and TDS limits for Ikalukrok Creek).

EPA regulations at 40 C.F.R. §122.62(a)(3) allow a permit to be modified when the standards on which the permit was based have been changed. In this case, ADEC has changed the state-wide TDS criteria, and is proposing to adopt a site-specific criterion for TDS for Mainstem Red Dog Creek. Additionally, EPA regulations at 40 C.F.R. §124.55(b) allow a permit to be modified when a 401 certification for the permit is modified. ADEC is proposing to modify its 401 certification for the permit.

The EPA regulations allow the permit to be modified only to the extent necessary to reflect the modified state standards for TDS, the site-specific criterion, and the modified conditions in the 401 certification. Therefore, this permit modification only modifies the TDS effluent limitations and monitoring requirements.

II. REQUEST FOR SITE-SPECIFIC CRITERION AND MODIFICATION OF THE 401 CERTIFICATION

In a letter dated January 9, 2001, Teck Cominco Alaska requested ADEC to take the following actions:

Mainstem Red Dog Creek

- Establish a site-specific criterion for TDS of 1,500 mg/L for Mainstem Red Dog Creek, except during Arctic grayling spawning (when the existing criterion of 500 mg/L would remain in effect).

- Authorize a mixing zone in Mainstem Red Dog Creek, beginning at the confluence of North Fork Red Dog Creek and Mainstem and continuing downstream for 1,930 feet. A mixing zone is an area in a waterbody downstream of the discharge, where the effluent is diluted by the receiving water. Within the mixing zone the TDS criterion does not have to be met at all locations. Outside of the mixing zone the criterion must be met.

Ikalukrok Creek

- Establish a TDS water quality criterion of 1,000 mg/L in Ikalukrok Creek from the confluence of Mainstem Red Dog Creek to the confluence of the Wulik River, except in spawning areas during spawning periods;

- In spawning habitat (about 9.5 miles below Dudd Creek), during spawning periods, establish a TDS water quality criterion of 500 mg/L;

- Authorize a mixing zone in Ikalukrok Creek, beginning at the confluence of Mainstem Red Dog Creek and Ikalukrok Creek and continuing downstream for 3,420 feet.

On November 22, 2002, ADEC proposed a TDS site-specific criterion of 1,500 mg/L for the Mainstem Red Dog Creek, effective after the Arctic grayling have finished spawning in Mainstem Red Dog Creek. Additionally, ADEC is proposing to modify its certification for the Red Dog Mine permit to establish TDS criteria of 1,000 mg/L in Ikalukrok Creek, and 500 mg/L in spawning habitat during spawning periods in Ikalukrok Creek. Also, ADEC proposes to authorize mixing zones for Mainstem Red Dog Creek and Ikalukrok Creek.

If the site-specific criterion is not formally adopted by ADEC and approved by EPA, or if the conditions in the proposed modification to the 401 certification are not issued in a final 401 certification by ADEC, the TDS effluent limitations in the 1998 permit will be retained.

III. TOTAL DISSOLVED SOLIDS

TDS consists of inorganic salts and small amounts of organic matter dissolved in water. The principal constituents are: carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium. TDS is typically introduced into surface waters by geological formations underlying an area, groundwater (via seeps and springs into a freshwater system), wind-borne sea spray, and human activities (mining and other surface excavation, water treatment chemicals, road salting, residential and urban runoff, agricultural chemicals, and irrigation). An elevated TDS concentration in drinking water is not a health hazard. Additionally, the levels of TDS proposed in this permit modification are not expected to cause adverse affects on aquatic life. The effects of TDS on human health and on aquatic life are discussed in more detail in Appendix A.

IV. FACILITY INFORMATION

A. Facility Location: The Red Dog Mine began operating in 1988 and produces lead and zinc ore concentrate. It is located in northwest Alaska, approximately 82 miles northeast of Kotzebue and 50 miles inland from the Chukchi Sea. The mine site is located on Red Dog Creek in the Delong Mountains. Red Dog Creek drains the western foothills of the DeLong Mountains and flows into the Ikalukrok Creek, which is a major tributary of the Wulik River (see Appendix B). Red Dog Creek comprises two major tributaries (Middle Fork and North Fork) that combine to form the Mainstem Red Dog Creek. A third tributary, the South Fork, was impounded to form the tailings pond and no longer flows to its natural confluence with the Middle Fork. The Red Dog Mine facilities, including the mine pit and water management system (i.e., the ditch that collects the contaminated mine drainage from the mine site and routes it to the tailings impoundment) are contained within the drainage areas of Middle and South Fork Red

Dog Creek.

The mine site is connected to a port facility by a 52 mile gravel road. The port facility is located on the Chukchi Sea approximately 15 miles south of Kivalina. The mine is located within the Northwest Arctic Borough, on land owned by the Northwest Arctic Native Association. See Appendix B for a map of the area.

B. Facility Process: The mine processes ore through a series of crushing, grinding, flotation, and dewatering steps. Contaminated water from all sources is collected in the tailings impoundment. The water from the tailings impoundment is treated by using lime to precipitate zinc, lead, and iron; additionally, sodium sulfide is used to precipitate cadmium. The majority of precipitates are removed from the water by settling, the water then goes through two sand filters to remove suspended solids. The treated water is discharged to Middle Fork Red Dog Creek at rates up to 14,000 gallons per minute. The mine generally discharges from May through October.

C. Permit History: The original NPDES permit was issued for the facility in July 1985 and it expired in July 1990. The permit was administratively extended (i.e., the conditions of the permit continued to be in effect) until the permit was reissued in August 1998. The current permit expires in August 2003.

The 1998 NPDES permit included metals limits which were significantly more stringent than the original 1985 permit. The permit also included a limit for TDS based on the State's narrative water quality criterion for aquatic life use. This criterion did not allow the instream TDS concentration to increase more than one third above the natural background TDS level (after the permit was issued ADEC changed the TDS criterion). The background concentration was determined to be 132 mg/L, and the effluent limits were set at 176 mg/L (monthly average limit) and 196 mg/L (maximum daily limit).

As stated above, lime precipitation and sodium sulfide precipitation are used in the wastewater treatment process to lower the concentration of toxic metals in the mine's wastewater. This treatment process introduces TDS into the mine's effluent. In 2002 the effluent TDS concentration ranged from 1,710 mg/L to 3,640 mg/L, with a median TDS concentration of 3,430 mg/L.

D. Compliance History: Since the permit was re-issued in 1998 the mine has not been able to comply with the effluent limits for TDS. EPA issued a compliance order to the facility in 1999, and modified it 2000, 2001 and 2002. The order outlined the interim conditions the facility had to meet, and required the facility to meet the effluent limits by August 28, 2003.

V. RECEIVING WATER INFORMATION

A. Outfall Location/Receiving Water: The Red Dog Mine discharges treated wastewater to the Middle Fork Red Dog Creek.

B. Alaska Water Quality Standards: A State's water quality standards are composed of use classifications, and numeric and narrative water quality criteria. The use classification system designates the beneficial uses (e.g., aquatic life, contact recreation, drinking water, etc.) that each water body is expected to achieve. The numeric and/or narrative water quality criteria are the criteria, for each pollutant, that are necessary to support the use classification of the water body. For example, if a waterbody is protected for drinking water use then the level of cadmium in the water must not exceed 5 μg/L.

Alaska's use classifications and criteria are established in 18 AAC 70.020(a) and (b). Additionally, Alaska's water quality standards at 18 AAC 70.235 allow ADEC to establish a site-specific water quality criterion that modifies a water quality criterion set out in 18 ACC 70.020 (b). As mentioned previously, ADEC is proposing to establish a TDS site-specific criterion of 1,500 mg/L for Mainstem Red Dog Creek which would be effective after Arctic grayling have finished spawning. Table 1 summarizes the stream segment, its use classification and the associated TDS criterion.

Table 1 - Use Classifications and TDS Criteria

Stream Reach	**Use Classification**	**TDS criterion**
Upper Middle Fork Red Dog Creek (Headwaters to terminus of the Red Dog mine water management system)	Industrial Water Supply	No amounts above natural conditions that can cause corrosion, scaling or process problems.
Lower Middle Fork Red Dog Creek (Terminus of the Red Dog mine water management system to confluence with North Fork Red Dog Creek)	Industrial Water Supply Contact Recreation (wading only) Secondary Contact Recreation (except fishing)	No amounts above natural conditions that can cause corrosion, scaling or process problems.
Mainstem Red Dog Creek (Confluence of North Fork Red Dog Creek to confluence of Ikalukrok Creek)	Aquatic Life Industrial Water Supply Contact Recreation (wading only) Secondary Contact Recreation	ADEC has proposed a site-specific criterion of 1,500 mg/L, except during fish spawning periods. In spawning areas, during spawning periods the TDS criterion cannot exceed 500 mg/L.
Ikalukrok Creek (from the confluence with the Mainstem to the confluence with the Wulik)	Aquatic Life Industrial Water Supply Contact Recreation (wading only) Secondary Contact Recreation	ADEC is proposing to set the criterion at 1,000 mg/L, and 500 mg/L during spawning periods in spawning habitat.

C. Mixing Zones: Alaska's water quality standards (18 AAC 70.240) allow ADEC to authorize mixing zones in its 401 certification of the NPDES permit. A mixing zone is an area in a waterbody surrounding, or downstream of, a discharge where the effluent plume is diluted by the receiving water. Within the mixing zone specified water quality

criterion may be exceeded. Outside of the mixing zone the water quality criterion must be met.

ADEC is proposing to authorize the following mixing zones in its 401 certification of the permit:

(1) Mainstem Red Dog Creek - Begining at the confluence of North Fork Red Dog Creek and the Mainstem and continues downstream for 1,930 feet.

(2) Ikalukrok Creek - beginning at the confluence of Mainstem Red Dog Creek and Ikalukrok Creek and continuing downstream for 3,420 feet.

VI. PROPOSED PERMIT CONDITIONS

In general, the Clean Water Act (CWA) requires that an NPDES permit's effluent 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 requires a level of treatment for a mining point source based on currently available treatment technologies. A water quality-based effluent limit is designed to ensure that the water quality standards of a waterbody are being met. Generally, water quality-based effluent limits are more stringent than technology-based effluent limits. For the ore mining facilities, EPA has not developed technology-based effluent limitations for TDS (See 40 C.F.R. Part 440), therefore the proposed effluent limits are water-quality based. For more information on water quality-based effluent limits see Appendices C and D. The following summarizes the proposed effluent limitations that are in the draft permit for the facility.

A. Effluent cannot be discharged until after the Arctic grayling have completed spawning in Mainstem Red Dog Creek (spring);

B. After the Arctic grayling spawning season, the effluent flow from the mine site must be regulated so that the in-stream TDS concentration, outside of the mixing zone in Mainstem Red Dog Creek, does not exceed 1,500 mg/L.

C. In Ikalukrok Creek, the effluent from the mine site must be regulated so that the TDS concentration outside of the mixing zone in Ikalukrok Creek does not exceed 1000 mg/L.

D. When salmon and Dolly Varden are spawning in Ikalukrok Creek (July 25 through the end of the discharge season), effluent from the mine site must be regulated so that the TDS concentration in Ikalukrok Creek where spawning occurs does not exceed 500 mg/L.

VII. PROPOSED MONITORING REQUIREMENTS

Section 308 of the Clean Water Act and federal regulation 40 C.F.R. §122.44(i) require effluent monitoring in NPDES permits in order to determine compliance with effluent limitations. Section 308 also allows additional effluent and receiving water monitoring in order to gather data to determine if additional effluent limitations are required and to monitor effluent impacts on receiving water quality. The permittee is responsible for conducting the monitoring and for reporting results on Discharge Monitoring Reports to EPA. The following summarizes the proposed monitoring stations and requirements.

A. Monitoring Stations

1. ADEC is proposing to authorize a mixing zone in Mainstem Red Dog Creek, starting at the confluence with North Fork Red Dog Creek and continuing downstream 1,930 feet. A water quality monitoring station, Station 10, is located 1.2 miles (about 6,300 feet) below the confluence with North Fork Red Dog Creek. Since the effluent and receiving water are fully mixed at the edge of the mixing zone and there are no other tributaries to Mainstem Red Dog Creek between Station 10 and the edge of the mixing zone, Station 10 should adequately reflect the water quality conditions outside of the mixing zone. Therefore, Station 10 will be used to collect information to ensure that criteria are being met in Mainstem Red Dog Creek outside of the mixing zone.

2. ADEC is also proposing to authorize a mixing zone in Ikalukrok Creek starting at the confluence with Mainstem Red Dog Creek and continuing downstream for 3,420 feet. Station 150 is a water quality monitoring station located within 150 feet of the edge of the mixing zone. Since the water from Mainstem Red Dog Creek and Ikalukrok Creek are fully mixed at the edge of the mixing zone and there are no other tributaries to Ikalukrok Creek between Station 150 and the edge of the mixing zone, Station 150 should accurately reflect the water quality conditions at the outside of the mixing zone. Therefore, Station 150 will be used to collect information to ensure that the in-stream criteria are being met in Ikalukrok Creek outside of the mixing zone.

   The 1998 NPDES permit required the permittee to collect water quality data at Station 73. Station 73 is located in Ikalukrok Creek approximately 1.6 miles downstream of Mainstem Red Dog Creek (approximately 1 mile further downstream than Station 150). Since the water from Mainstem Red Dog Creek and upper Ikalukrok Creek are fully mixed at Station 150, the results gathered from Station 150 should be reflective of Station 73. Therefore, the permittee will be required to gather all the water quality monitoring data at Station 150 rather than at Station 73.

3. Station 160 is a water quality monitoring station located in Ikalukrok Creek

about 3 miles below the confluence with Dudd Creek. It is located above the known spawning areas in Ikalukrok Creek. This station will be used to collect information to ensure that the in-stream criterion of 500 mg/L is being met at spawning locations in Ikalukrok Creek downstream of the confluence of Dudd Creek during spawning periods.

There is some Dolly Varden spawning habitat in Ikalukrok Creek at the mouth of Dudd Creek. Teck Cominco collected TDS samples at several transects across Ikalukrok Creek, at the mouth of Dudd Creek, as well as vertical profiles of the water. Results from the monitoring show that this spawning habitat is composed primarily of Dudd Creek water with little input from Ikalukrok Creek, therefore the TDS level will reflect the water quality in Dudd Creek without the influence of the effluent.

B. Monitoring Requirements

1. TDS must be monitored by direct laboratory testing once per week at Station 10, Station 150, Station 160, and the effluent. Additionally, the permittee must record simultaneously conductivity[1] measurements at each of the stations and of the effluent.

2. Once per month carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium must be analyzed at Station 10, Station 150, Station 160, and the effluent.

3. The permittee has installed transmitters at Stations 10 and 160 which can provide real-time data to the mill. The stations have dataloggers which can measure and record stream temperature, conductivity, TDS and stream flow. This data is then transmitted to the mine site.

   At least twice each day the permittee must download conductivity, TDS and effluent stream flow from Outfall 001, Station 10 and Station 160. This data must be used to estimate the allowable effluent flow that can be released to Middle Fork Red Dog Creek in order to ensure that the applicable in-stream criteria are met in Mainstem Red Dog Creek and Ikalukrok Creek. For additional information on estimating the allowable effluent flow volume see Appendix C.

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[1] Conductivity is the ability of a substance to conduct an electrical current. In an aqueous solution, this ability depends on the presence of ions, their concentration, activity, molecular mobility, and valence state. The principle ions in the effluent are carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium, which are also the effluent's principle TDS constituents. Therefore, conductivity measurements are closely related to TDS level.

4. At the end of each month season the permittee must update the Station 10 and 160 TDS/Conductivity correlation curves with the direct laboratory testing data for stations 10 and 160, respectively.

IX. OTHER LEGAL REQUIREMENTS

A. Endangered Species Act: The Endangered Species Act requires federal agencies to consult with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service if their actions could adversely affect any threatened or endangered species. The are no threatened or endangered species in the vicinity of this facility.

B. State Certification: Section 401 of the Clean Water Act requires state certification of the permit before EPA may issue a final permit. As a result of the certification, the state may require more stringent permit conditions or additional monitoring requirements to ensure that the permit complies with water state quality standards.

APPENDIX A

Effects of TDS on Human Health and Aquatic Life

TDS generally consists of inorganic salts and small amounts of organic matter dissolved in water. The principal components are carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium. TDS is introduced into surface waters by geological formations underlying an area, groundwater (via seeps and springs into a freshwater system), wind-borne sea spray, and human activities (mining and other surface excavation, water treatment chemicals, road salting, residential and urban runoff, agricultural chemicals, and irrigation). The following provides a discussion of the effects of TDS on human health and aquatic life.

I. HUMAN HEALTH

Drinking Water Standards for TDS

The National Primary Drinking Water Standards protect public health by limiting the level of contaminants in drinking water. EPA has not developed primary drinking water standards for TDS because TDS in drinking water is not a hazard to human health. The most important effect of TDS on drinking water quality is its effect on taste. The taste of drinking water with a TDS level less than or equal to 600 mg/L is generally considered good. EPA does recommend acceptable levels of TDS in drinking water in its National Secondary Drinking Water Regulations. These regulations provide non-mandatory recommendations for contaminants that can cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as changes in taste, odor, or color). EPA recommends TDS not exceed 500 mg/L in water used for drinking.

The effluent from the Red Dog Mine has a very high TDS concentration, which elevates the TDS concentrations in Mainstem Red Dog Creek and the Ikalukrok Creek above naturally occurring levels. While these creeks are not regularly used by humans as direct sources of drinking water, they eventually discharge to the Wulik River, which is used as a drinking water source for the village of Kivalina.

TDS sampling has been conducted in Mainstem Red Dog Creek, Ikalukrok Creek and the Wulik River from 1999 through 2002. During this time period the facility was discharging under a compliance order that imposed conditions similar to the proposed conditions in this permit modification. Consequently, the conditions measured in the creek while the orer was in effect will be expected to be the same if the proposed permit modification goes into effect. Table A-1 lists the locations of the sampling stations where TDS sampling occurred, and Table A-2 provides a summary of the TDS data collected at these stations during that time period.

TABLE A-1 Sampling Locations		
Station Number	Creek/River	Location
Station 10	Mainstem Red Dog Creek	about 1.5 miles below the confluence of the North Fork Red Dog Creek
Station 160	Ikalukrok Creek	about 3 miles below the confluence of the Dudd Creek
Station 1	Wulik River	about 2.5 miles upstream of Kivalina

TABLE A-2 - TDS DATA			
	Station 10 Mainstem Red Dog Creek	**Station 160 Ikalukrok Creek**	**Station 1 Wulik River**
Minimum value	50	50	51.3
Median value	1090	368	228
Maximum value	1820	876	392
Number of samples	115	97	35
Percent of Data exceeding secondary drinking water standard (500 mg/L)	80 %	10 %	0 %
NOTE: The median value is the value where half of the data is greater than the median value and half of the data is less than the median value.			

From the data in Table A-2 it can be seen that the level of TDS in Main Stem Red Dog Creek contains TDS concentrations that exceed the secondary drinking water standard (500 mg/L) most of the time. The Ikalukrok Creek TDS exceeded the standard infrequently. The Wulik River's TDS concentration was always well below the recommended standard.

Drinking Water Standards for the Principle Constituents of TDS

As stated previously, the principle constituents of TDS are carbonates, chlorides, sulfates, potassium, magnesium, calcium, and sodium. In addition to the recommended TDS standard, the National Secondary Drinking Water Standards provide non-mandatory recommendations for three of the constituents: sodium, sulfates, and chlorides.

The secondary drinking water standard for sodium is 200 mg/L. Sodium can affect the taste of drinking water. Both sulfates and chlorides have a secondary drinking water standard of 250 mg/L. Both of these constituents can affect taste and cause corrosion, and sulfates at high levels can cause laxative effects. These constituents of TDS were analyzed at Station 160 (in the Ikalukrok Creek below Dudd Creek) and Station 1 (in the Wulik River above Kivalina), during 1999 through 2002, when the mine

was operating under conditions similar to those in the proposed permit modification. The results are summarized in Table A-3:

TABLE A-3 Sodium/Sulfate/Chloride

	Sodium (standard = 200 mg/L)		Sulfate (standard = 250 mg/L)		Chloride (standard = 250 mg/L)	
	Station 160 Ikalukrok Creek	**Station 1 Wulik River**	**Station 160 Ikalukrok Creek**	**Station 1 Wulik River**	**Station 160 Ikalukrok Creek**	**Station 1 Wulik River**
Minimum	1.8	2.2	22.5	17.1	0.9	3.2
Median	5.1	12.6	168	51.6	2.5	24.1
Maximum	11.7	18.3	345	96.8	10.5	48.1
Number of samples	54	23	54	23	43	23
Percent of Data exceeding secondary drinking water standard	0%	0%	13%	0%	0%	0%

As can be seen from the data above, in the Wulik River, the sodium, sulfate and chloride are always well below the recommended levels that are based on aesthetic or cosmetic effects, and corrosion concerns.

II. AQUATIC LIFE

The TDS criteria applicable to Main Stem Red Dog Creek and Ikalukrok Creek are:

Main Stem Red Dog Creek: During Arctic grayling[2] spawning discharge of effluent is not permitted. After the Arctic grayling spawning season the TDS concentrations in Main Stem Red Dog Creek cannot exceed 1,500 mg/L outside of the proposed mixing zone[3].

Ikalukrok Creek: During the discharge season the TDS concentration in Ikalukrok Creek (below Main Stem Red Dog Creek) cannot exceed 1,000 mg/L outside of the proposed mixing zone. During the salmon and Dolly Varden[4] spawning season, in spawning areas, the TDS concentration

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[2] Arctic grayling spawn only in Main Stem Red Dog Creek in the spring (Memo dated July 27, 2002 from Alvin Ott, ADF&G to Pete McGee, ADEC).

[3] This is the site-specific criterion that ADEC has proposed, but which has not yet been submitted to EPA.

[4] Salmon and Dolly Varden spawn in Ikalukrok Creek at the mouth of Dudd Creek and approximately 9.5 miles below Dudd Creek in late summer (Memo to Pete McGee, ADEC.

cannot exceed 500 mg/L.

In June 2001 the Alaska Department of Fish and Game (ADF&G) published a document entitled *Effects of Total Dissolved Solids on Aquatic Organisms, A Literature Review* to determine whether the above criteria for TDS are sufficient to protect fish spawning and rearing, and non-fish species, in Red Dog Creek and Ikalukrok Creek. The document reviewed the published literature and technical reports that addressed the toxicity of TDS to aquatic species, focusing on a TDS range of 500 mg/L to 1,500 mg/L. The document found the following with respect to the toxicity of TDS:

1. Toxicity is due primarily to ionic properties rather than osmotic effects.

2. For chum, coho, and Atlantic salmon, Rainbow and brook trout, striped bass and fathead minnow, the life stage most sensitive to TDS exposure is from fertilization through egg hardening.

3. A TDS concentration in the range of 750 mg/L significantly reduces fertilization and hatching rates in coho and chum salmon, and extends the developmental time to epiboly and the eyed-egg stage.

4. After egg hardening, fish do not appear to be affected by elevated concentrations of TDS up to 2,000 mg/L.

5. Aquatic invertebrate growth and survival is not affected by concentrations of TDS less than 1,500 mg/L. Concentrations of TDS showing adverse effects were from 1692 mg/L to 2,430 mg/L.

6. Few studies were found on effects of elevated TDS concentrations on freshwater algae. No range of concentrations causing toxic responses could be determined from published reports.

APPENDIX B
Mine Site/Creeks/Spawning Areas

APPENDIX C
Water Quality-Based Effluent Limits

The following discussion is divided into three sections. Section A discusses the statutory basis for including water quality-based effluent limits in NPDES permits, Section B discusses the procedures used to determine whether water quality-based effluent limits are needed in an NPDES permit, and Section C discusses the procedures used to develop water quality-based effluent limits.

A. Statutory Basis for Water Quality-Based Limits

Section 301(b)(1)(C) of the CWA requires the development of limitations in permits necessary to meet water quality standards. Discharges to state waters must also comply with limitations imposed by the state as part of its certification of NPDES permits under Section 401 of the CWA.

The NPDES regulation (40 C.F.R. §122.44(d)(1)) implementing Section 301(b)(1)(C) of the CWA requires that permits include limits for all pollutants or parameters which "are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality."

The regulations require that this evaluation be made using procedures which account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant in the effluent, species sensitivity (for toxicity), and where appropriate, dilution in the receiving water. The limits must be stringent enough to ensure that water quality standards are met.

B. Reasonable Potential Analysis

When evaluating the effluent to determine whether water quality-based effluent limits are needed based on a pollutant specific numeric criterion, a projection of the receiving water concentration (downstream of where the effluent enters the receiving water) for the pollutant of concern is made. The concentration of the effluent and receiving water and, if appropriate, the dilution available from the receiving water are factors used to project the receiving water concentration. If the projected concentration of the receiving water exceeds the numeric criterion for the specific pollutant, then there is a reasonable potential that the discharge may cause or contribute to an excursion above the applicable water quality standard, and a water quality-based effluent limit is required.

Sometimes it is appropriate to allow localized exceedances of water quality criteria within a defined area, called a mixing zone, in which the discharge has not yet fully mixed with the receiving water. Mixing zone allowances will increase the amount of the pollutant that may be discharged, and decrease treatment requirements. Mixing zones can be used only when there is adequate receiving water flow volume and low enough background pollutant level, that there

will be adequate dilution to protect the designated uses of the water body. Mixing zones must be authorized by the Alaska Department of Environmental Conservation in its certification of the NPDES permit.

EPA performed a reasonable potential analysis for TDS and found that a water quality-based effluent limit is necessary. See Appendix D for the reasonable potential analysis.

C. Water Quality-Based Effluent Limit

The water quality-based permit limit is developed by determining the loading of TDS that may be discharged without causing or contributing to an exceedance of water quality standards in the receiving water. The loading is calculated by using a simple mass balance equation. The equation takes into account the available dilution provided by the mixing zone and the background concentration of the pollutant.

The tailings impoundment contains water with metals levels that are acutely toxic to aquatic life and at levels that could adversely impact human health. Currently, the water in the tailings impoundment is near capacity. It is critical to maintain the water in the tailings impoundment at a level that will ensure that the structural integrity of the tailings impoundment is not jeopardized. To maintain the structural integrity of the tailings impoundment it is important that the mine discharge all of the mine drainage (i.e., the rainfall and snowmelt that comes into contact with ore) that is collected each year. This will be accomplished by allowing the permittee to use the mass balance equation on a daily basis to determine the allowable TDS load that can be discharged. By doing this the permittee will be able to take advantage of the available dilution, and increase its discharge when more dilution is available.

The following provides the general mass balance equation that will be used to determine the appropriate effluent limit.

1. Mass Balance Equation

The basic formula for the mass balance equation is:

$C_d \text{ X } Q_d = (C_e \text{ X } Q_e) + (C_u \text{ X } Q_u)$

where,
C_d = receiving water concentration downstream of the effluent discharge
Q_d = receiving water flow downstream of the effluent discharge, (it is equal to $Q_u + Q_e$)
C_e = effluent concentration
Q_e = effluent flow
C_u = upstream concentration of pollutant
Q_u = upstream flow

The above equation can rearranged, as follows, to determine the amount of flow that the facility can discharge. $Q_e = \frac{Q_u (C_d - C_u)}{(C_e - C_d)}$

In order to ensure that 1,500 mg/L will not be exceeded at the edge of the mixing zone in Mainstem Red Dog Creek, C_d (i.e., the concentration at the edge of the mixing zone) is set equal

to 1,500 mg/L and the equation for allowable effluent flow becomes: $Q_e = \frac{Q_u (1{,}500 - C_u)}{(C_e - 1{,}500)}$

In order to ensure that 500 mg/L will not be exceeded during spawning periods in Ikalukrok Creek, C_d is set equal to 500 mg/L, and the equation for allowable effluent flow is:

$$Q_e = \frac{Q_u (500 - C_u)}{(C_e - 500)}$$

The permittee will be required to use these equations twice per day, and adjust its effluent discharge rate to whichever flow rate is more restrictive.

2. Implementing the Mass Balance Equation

The permittee has installed transmitters at Stations 10 and 160 which provide in-stream data to the mill. The stations have dataloggers which can measure/calculate stream temperature, conductivity, TDS and stream flow. TDS is determined by using conductivity correlation curves (plotting TDS and specific conductance paired data and applying a linear regression). The correlation curves are updated each year and will continue to be updated each year as more information is gathered. This data is then transmitted to the mine site.

At least twice each day the permittee must download conductivity, TDS, and stream flow measurements from Stations 10 and 160. This data must be used to estimate the allowable effluent flow (using the equations above) that can be released to Middle Fork Red Dog Creek in order to ensure that the applicable in-stream criteria are met in Mainstem Red Dog Creek and Ikalukrok Creek.

Station 10 (Mainstem Red Dog Creek)

For Station 10 (Mainstem Red Dog Creek) the following information must be collected or calculated to determine the allowable effluent flow ($Q_{allowable}$) expected to result in 1,500 mg/L TDS at station 10:

Effluent

- measure conductivity of effluent
- calculate the TDS concentration of the effluent (C_e) based on the measured conductivity
- measure the flow of the effluent (Q_e)

Station 10

- measure the conductivity at Station 10
- calculate the total TDS concentration at Station 10 ($C_{10(total)}$) using the measured conductivity
- measure the total flow at Sation 10 ($Q_{10(total)}$)
- calculate the flow at Station 10 (Q_{10}) minus the effluent flow using the equation: $Q_{10} = Q_{10(total)} - Q_e$
- calculate the TDS concentration at Station 10 (C_{10}) minus the TDS contribution from the effluent using the following equation: $C_{10} = \frac{(C_{10(total)} Q_{10(total)}) - (C_e Q_e)}{(Q_{10(total)} - Q_e)}$
- calculate the allowable effluent flow ($Q_{allowable}$) expected to result in 1,500 mg/L TDS at Station 10 using the following equation: $Q_{allowable} = \frac{Q_{10} (1500 - C_{10})}{(C_e - 1500)}$

Station 160 (Ikalukrok Creek, below Dudd Creek)

For Station 160 (Ikalukrok Creek below Dudd Creek) the following information must be collected or calculated from July 25th to the end of the discharge season to determine the allowable effluent flow ($Q_{allowable}$) expected to result in 500 mg/L TDS at Station 160 during the spawning season:

Effluent

- measure conductivity of effluent
- calculate the TDS concentration of the effluent (C_e) based on the measured conductivity
- measure the flow of the effluent (Q_e)

Station 160

- measure the conductivity at station 160
- calculate the total TDS concentration at Station 160 ($C_{160(total)}$) using the measured conductivity
- measure the total flow at Station 160 ($Q_{160(total)}$)
- calculate the flow at Station 160 (Q_{160}) minus the effluent flow using the equation: $Q_{160} = Q_{160(total)} - Q_e$
- calculate the TDS concentration at Station 160 (C_{160}) minus the TDS contribution from the

effluent using the following equation: $C_{160} = \frac{(C_{160(total)} Q_{160(total)}) - (C_e Q_e)}{(Q_{160(total)} - Q_e)}$

- calculate the allowable effluent flow ($Q_{allowable}$) expected to result in 500 mg/L TDS at Station 160 using the following equation: $Q_{allowable} = Q_{160} \frac{(500 - C_{160})}{(C_e - 500)}$

- The $Q_{allowable}$ calculated above must be compared to the $Q_{allowable}$ calculated for Station 10. The permittee must discharge at the more restrictive $Q_{allowable}$

Ikalukrok Creek (above Dudd Creek)

The permittee has collected TDS data at Station 150 (located in Ikalukrok Creek about 50 yards below the edge of the proposed mixing zone) since 2001. The data collected over the last two years shows that the TDS criterion of 1,000 mg/L, which applies to Ikalukrok Creek, will be met when the TDS criterion in Mainstem Red Dog Creek is at or below 1,600 mg/L. Therefore, the proposed permit does not require the permittee to install a transmitter in Ikalukrok Creek, at the edge of the authorized mixing zone, or to collect daily in-stream data.

APPENDIX D
Reasonable Potential Analysis

To determine whether a water quality-based effluent limitation is required, the receiving water concentration of TDS is calculated downstream of where the effluent enters the receiving water. If the projected receiving water concentration is greater than the applicable numeric criterion for TDS, this implies a reasonable potential that the discharge may cause or contribute to an excursion above the applicable water quality standard, in which case an effluent limit must be incorporated into the NPDES permit. EPA conducted a reasonable potential analysis for Mainstem Red Dog Creek as follows.

The receiving water concentration is determined using the following mass balance equation: $C_d Q_d = (C_e Q_e) + (C_u Q_u)$, this equation can be rearranged as follows:

$$C_d = \frac{(C_e Q_e) + (C_u Q_u)}{(Q_e + Q_u)}$$

where,
C_d = receiving water concentration downstream of the effluent discharge
C_e = maximum effluent concentration
Q_e = maximum effluent flow
C_u = upstream concentration of pollutant
Q_u = upstream low flow

Reasonable Potential Calculation

I. Mixing Zone/Low Flow Conditions/Effluent Flow

A. Mixing Zones: The Alaska Water Quality Standards allow ADEC to authorize mixing zones. ADEC proposes to authorize a mixing zone for Mainstem Red Dog Creek starting at the confluence of North Fork Red Dog Creek and continuing downstream for 1,930 feet. At this location the effluent will be fully mixed with the water from North Fork Red Dog Creek (see Appendix B for a map of the area). If the State does not authorize the mixing zone in its final 401 certification, the permit limits will be re-calculated to ensure compliance with the standards at the point of discharge. If a mixing zone (%MZ) is allowed, the mass balance equation, above, becomes:

$$C_d = \frac{(C_e \text{ X } Q_e) + (C_u \text{ X } (Q_u \text{ X } \%MZ))}{Q_e + (Q_u \text{ X } \%MZ)}$$

B. Low Flow Conditions: A low flow value of 1 cfs for North Fork Red Dog Creek was recorded from data collected from 1999 - 2002.

C. Effluent flow : The maximum effluent flow discharged by the facility since 1999 was 29.3 cfs.

II. Data Set for TDS

The maximum TDS effluent value collected from 1996 through the 2002 discharge season was 3,640 mg/L. The maximum TDS effluent value for North Fork Red Dog Creek from 1999 through 2002 was 860 mg/L.

III. Numeric Criteria for TDS

The proposed site-specific water quality criterion for TDS in the Mainstem Red Dog Creek is 1,500 mg/L.

IV. Reasonable Potential Calculation

The upstream flow (Q_u) used to make the determination is the flow from North Fork Red Dog Creek. At the edge of the mixing zone the effluent will be fully mixed with water from North Fork Red Dog Creek (i.e., % MZ is equal to 1). The upstream concentration of TDS (C_u) is 860 mg/L, and the effluent concentration (C_e) is 3,640 mg/L. Using these values, C_d is:

$$C_d = \frac{(C_e \times Q_e) + (C_u \times (Q_u \times \%MZ))}{Q_e + (Q_u \times \%MZ)}$$

$$C_d = \frac{(3640 \times 29.3) + (1 \times (860 \times 1)}{29.3 + (1 \times 1)} = 3{,}548.3 \text{ mg/L}$$

Since 3,548.3 mg/L is greater than the proposed site-specific criterion of 1,500 mg/L a water quality-based effluent limit is needed in the permit.