ALASKA POLLUTANT DISCHARGE ELIMINATION SYSTEM

PERMIT FACT SHEET – DRAFT

Permit Number: AK0053741

Usibelli Coal Mine, Inc.

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Wastewater Discharge Authorization Program

555 Cordova Street

Anchorage, AK 99501

Public Comment Period Start Date: insert date
Public Comment Period Expiration Date: insert date
Alaska Online Public Notice System

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Proposed issuance of an Alaska Pollutant Discharge Elimination System (APDES) permit to

USIBELLI COAL MINE, INC.

For wastewater discharges from

Jumbo Dome Mine
100 River Road
Healy, Alaska

Alaska Department of Environmental Conservation (Department or DEC) proposes to issue an APDES individual permit to Usibelli Coal Mine, Inc. 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 Usibelli Coal Mine and the development of the permit including:

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

Public Comment

Persons wishing to comment on, or request a public hearing for the draft permit for this facility, may do so in writing by the expiration date of the public comment period.

Commenters are requested to submit a concise statement on the permit condition(s) and the relevant facts upon which the comments are based. Commenters are encouraged to cite specific permit requirements or conditions in their submittals.

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. The Department will hold a public hearing whenever the Department finds, on the basis of requests, a significant degree of public interest in a draft permit. The Department may also hold a public hearing if a hearing might clarify one or more issues involved in a permit decision or for other good reason, in the Department's discretion. A public hearing will be held at the closest practicable location to the site of the operation. If the Department holds a public hearing, the Director will appoint a designee to preside at the hearing. The public may also submit written testimony in lieu of or in addition to providing oral testimony at the hearing. A hearing will be tape recorded. If there is sufficient public interest in a hearing, the comment period will be extended to allow time to public notice the hearing. Details about the time and location of the hearing will be provided in a separate notice.

All comments and requests for public hearings must be in writing and should be submitted to the Department at the technical contact address, fax, or email identified above (see also the public comments section of the attached public notice). Mailed comments and requests must be postmarked on or before the expiration date of the public comment period.

After the close of the public comment period and after a public hearing, if applicable, the Department will review the comments received on the draft permit. The Department will respond to the comments received in a Response to Comments document that will be made available to the public. If no substantive comments are received, the tentative conditions in the draft permit will become the proposed final permit.

The proposed final permit will be made publicly available for a five-day applicant review. The applicant may waive this review period. After the close of the proposed final permit review period, the Department will make a final decision regarding permit issuance. A final permit will become effective 30 days after the Department's decision, in accordance with the state's appeals process at 18 AAC 15.185.

The Department will transmit the final permit, fact sheet (amended as appropriate), and the 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
410 Willoughby Street, Suite 310
Juneau, AK 99811-1800

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, 99811-1800

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, application, and related documents can be obtained by visiting or contacting DEC between 8:00 a.m. and 4:30 p.m. Monday through Friday at the addresses below. The permit, fact sheet, application, and other information are located on the Department's Wastewater Discharge Authorization Program website: http://www.dec.state.ak.us/water/wwdp/index.htm .

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

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1.0 APPLICANT

This fact sheet provides information on the draft Alaska Pollutant Discharge Elimination System (APDES) permit for the following entity:

Name of Facility:	Jumbo Dome Mine
APDES Permit Number:	AK0053741
Facility Location:	12 miles northeast of Healy, Denali Borough, Alaska
Mailing Address:	100 River Road, Healy, AK 99743
Facility Contact:	Mr. Fred Wallis

Figures in Appendix A of this fact sheet show the location of the Jumbo Dome Mine along with discharge and monitoring locations.

2.0 FACILITY INFORMATION

2.1 Background

Usibelli Coal Mine, Inc. (Usibelli), has operated coal mines in interior Alaska since 1943. In a typical year, Usibelli mines approximately two million tons of subbituminous coal using surface mining methods. Approximately one million tons of Usibelli's annual production is used in interior Alaska to generate electricity and heat, while the balance is generally exported to overseas markets. Currently, Usibelli is the only coal producer in Alaska.

Usibelli is working to secure mining permits for the Jumbo Dome Mine (Jumbo Dome). Jumbo Dome is located in the Marguerite Creek drainage, 12 miles northeast of Healy, Alaska. Surface property and coal resources in the mining area are owned by the State of Alaska and the University of Alaska and are leased to Usibelli. Jumbo Dome has approximately 80 million tons of coal reserves, which will support 20 to 40 years of mining according to the current mine plan.

2.2 Facility Description

Jumbo Dome will consist of mining and reclamation areas and auxiliary facilities needed to support the mining process. These facilities include a shop, fuel storage area, powder magazine, electrical substation, haul roads, and water management and treatment systems. No coal preparation will occur within the area covered by the APDES permit.

Up to four coal seams will be mined at Jumbo Dome from the upper Suntrana geological formation. After sediment control measures have been established, the mining process will begin with the clearing of vegetation and the removal of topsoil, which will be used in the reclamation of regraded areas. Overburden and interburden will be blasted and moved by trucks, shovels, dozers, wheel loaders, and a dragline. After the mineable coal seams have been uncovered, coal will be blasted and loaded into trucks for transport to Usibelli's existing coal tipple in Hoseanna Creek. Reclamation will occur contemporaneously as the pits advance.

Water at Jumbo Dome will be managed through a network of dewatering wells, sumps, ditches, culverts, groundwater diversion systems, and ponds. Diversion structures are designed to convey the peak flow from a 10-year, 24-hour storm event. Ponds are designed to contain the peak discharge from a 100-year, 6-hour storm event. A detailed description of the water management

system for Jumbo Dome can be found in the *Drainage and Sediment Control Plan*, which is required by the permit.

Wastewater at Jumbo Dome will consist of mine drainage, pumped groundwater from dewatering wells, and seepage water that contacts the mine area. Based on local geochemistry and water chemistry the pollutants of concern, which are naturally occurring minerals, are metals, total suspended solids, settleable solids, nitrate/nitrite, and sulfate. As site conditions allow, ditches and groundwater diversion systems will be used to divert non-contact water around active mining areas. Within the active mining area, mine drainage wastewater consists of a blend of storm water, mine water, groundwater and seepage water, which will be captured in three large settling ponds, Jumbo Dome 2 (JD2), Jumbo Dome 3 (JD3), and Jumbo Dome 4 (JD4). See Figure 2. Wastewater in JD2, JD3, and JD4 will be treated with a flocculant to enhance the removal of sediments. After settling, a wastewater from each pond passes through that pond's individual treatment train consisting of passive aeration (for removal of iron), dolomite beds (for removal of manganese), and a polishing pond before being discharged according to the terms of the permit.

The permit proposes to authorize the discharge of treated wastewater to Marguerite Creek from outfalls JD2, JD3, and JD4. Each outfall's designation represents the pond and treatment train that it discharges. Discharge from each outfall is expected to be seasonal (six months per year), with a maximum annual discharge of 140 million gallons per year for each outfall. No mixing zone is authorized as part of the permit.

3.0 COMPLIANCE HISTORY

As this will be the first APDES permit for the Jumbo Dome Mine, no compliance history exists.

4.0 EFFLUENT LIMITS AND MONITORING REQUIREMENTS

4.1 Basis for Permit Effluent Limits

The Clean Water Act (CWA) requires that the limits for a particular pollutant be the more stringent of either technology-based effluent limits (TBELs) or water quality-based limits (WQBELs). TBELs are set according to the level of treatment that is achievable using available technology. WQBELs are set as the permit limit if they are more stringent than TBELs to ensure that the receiving water quality is protected.

The Environmental Protection Agency (EPA) promulgated effluent limitation guidelines (ELGs) for the coal mining point source category at 40 CFR Part 434. Several of the subcategories in 40 CFR Part 434 apply to the permitting action. These subcategories include: Subpart A—General Provisions, Subpart D—Alkaline Mine Drainage, Subpart F—Miscellaneous Provisions, and Subpart H—Western Alkaline Coal Mining. Among these subparts, the general provisions of Subpart A and only the New Source Performance Standards (NSPS) found in Subparts D, F, and H apply to a new source coal mine like this one, which is a source that has commenced construction after the ELGs were established on May 4, 1984.

Under 40 CFR 434 Subpart F, the TBELs for coal mining vary according to precipitation levels, chemistry of the mine drainage, and geographic location. Regarding precipitation levels, TBELs

are established for the discharge of wastewater during dry periods, medium precipitation events, and large precipitation events. A 10-year, 24-hour storm event is the threshold that separates the medium and large categories. Precipitation in excess of the 10-year, 24-hour value constitutes a large precipitation event. For Jumbo Dome, a 10-year event is two inches of rain in 24 hours. See Table 2 and Table 3 for specific citations and alternate limitations detailed in 40 CFR 434 Subpart F. Furthermore, Permits Parts 1.2.3 and 1.2.4 impose specific requirements of 40 CFR Parts 434.61 and 434.63, respectively.

Selecting the applicable TBELs for coal mines also requires knowledge of the chemistry of the mine drainage. There are two categories of coal mine drainage in 40 CFR Part 434: 1) Acid or ferruginous mine drainage, and 2) Alkaline mine drainage. Acid or ferruginous mine drainage is defined as, “drainage which, before any treatment, either has a pH less than 6.0 or a total iron concentration equal to or greater than 10 mg/L” in 40 CFR Part 434.11(a). Alkaline mine drainage has a pH greater than or equal to 6.0 and a total iron concentration less than 10 mg/L. Water chemistry data from Marguerite Creek directly above and below the mine have been gathered for the past 14 years. During that span, 70 pH measurements indicate that the pH has never been below 6.15 standard units. (s.u.) and the average pH has been 7.2 s.u. Regarding total iron concentrations in Marguerite Creek, the dataset contains 76 measurements and the 95th percentile of those data yields a concentration less than 6.0 mg/L. Since data indicate that drainage throughout the mine area is alkaline as defined by regulation, 40 CFR 434 Subpart D – Alkaline Mine Drainage applies to Jumbo Dome.

Subpart H in 40 CFR Part 434 applies exclusively to Western Alkaline Coal Mining. These TBELs are for reclamation areas, brushing and grubbing areas, topsoil stockpiling areas, and regraded areas at western coal mining operations. Western coal mining is defined as a, “coal mining operation located in the interior western United States, west of the 100th meridian west longitude, in an arid or semiarid environment with an average annual precipitation of 26.0 inches or less.” The Western Alkaline Coal Mining TBELs, which are narrative, also apply to Jumbo Dome. The NSPS effluent limitations applied to the mine are found in 40 CFR Part 434.82. Specifically, the permit requirement for a site-specific Sediment Control Plan used to acquire a Surface Mining Control and Reclamation Act permit satisfies Subpart H. Table 1 to Table 3 identify the parameters and numeric TBELs required by the permit.

Table 1: Technology-Based Effluent Limits for Alkaline Mine Drainage [40 CFR § 434.45]

Parameter	Units	Maximum for any 1 day	Average of daily values for 30 consecutive days	Range
Iron, total[a]	mg/L[b]	6.0	3.0	---
Total Suspended Solids (TSS)[a, c]	mg/L	70.0	35.0	---
pH[a]	s.u.[d]	---	---	6.0 to 9.0

a. Drainage from reclamation, brushing and grubbing, topsoil stockpiling, and regraded areas is excluded from this limit.
b. Milligrams per liter.
c. This limit applies when discharging during dry weather periods. However, this limit does not apply when discharge is caused by a precipitation or snowmelt event.
d. Standard units.

Table 2: Technology-Based Effluent Limits for Medium Precipitation Events [40 CFR § 434.63(a)(2)]

Parameter	Units	Maximum for any 1 day	Average of daily values for 30 consecutive days	Range
Settleable solids[a,b]	ml/L[c]	0.5	---	---
pH[a]	s.u.	---	---	6.0 to 9.0

a. Drainage from reclamation, brushing and grubbing, topsoil stockpiling, and regraded areas is excluded from this limit.
b. This limit applies when discharge is caused by rainfall totaling 2.0 inches or less in 24 hours (or snowmelt of equivalent volume) but does not apply during dry weather periods or heavy rainfall events, i.e. greater than 2.0 inches in 24 hours.
c. Milliliters per liter.

Table 3: Technology-Based Effluent Limits for Large Precipitation Events [40 CFR § 434.63(d)(2)]

Parameter	Units	Maximum for any 1 day	Average of daily values for 30 consecutive days	Range
pH[a, b]	s.u.	---	---	6.0 to 9.0

a. Drainage from brushing and grubbing, topsoil stockpiling, and regraded areas is excluded from this limit.
b. This limit applies when discharge is caused by rainfall in excess of 2.0 inches in 24 hours (or snowmelt of equivalent volume).

4.2 Basis for Effluent and Receiving Water Monitoring

In accordance with AS 46.03.110(d), the Department may specify in a permit the terms and conditions under which waste material may be disposed. Monitoring in a permit is required to determine compliance with effluent limits. 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.

4.3 Effluent Limits and Monitoring Requirements

This is a new operation and effluent data does not exist. However, Usibelli provided estimated maximum effluent concentrations based on the water balance, background water chemistry, proportions of contributing sources of water, and predicted treatment efficiencies. Central to modeling the maximum effluent concentration for each constituent of concern was a treatability study provided by the applicant. Per section 2.4.1 of the *APDES Permits Reasonable Potential Analysis and Effluent Limits Development Guide* (RPA Guidance, 2014) and based on modeling and treatability study provided by the applicant, best professional judgment determined that one datum was sufficient for performing a reasonable potential analysis on each parameter. For constituents that indicated a reasonable potential to exceed WQS, effluent limits were developed.

The permit contains effluent limits that are both TBELs and WQBELs, and a flow limit based on the treatment system design. TBELs and WQBELs have been applied to the outfall discharges. Table 4 summarizes the proposed permit limits for outfalls JD2, JD3, and JD4 (see Appendix B for more details regarding the legal and technical basis surrounding the selection of effluent limits).

Under 18 AAC 83.540, permits are required to apply mass-based limits. Mass-loading rate is equal to flow rate multiplied by concentration. Flow limits and concentration limits are provided in the permit. Consequently, mass-loading rate limits are imposed through effluent limits and flow limits.

Table 4: Effluent Limits and Monitoring Frequencies for Outfalls JD2, JD3, and JD4

Parameter[a]	Maximum Daily Limit	Average Monthly Limit	Units	Minimum Sample Frequency	Sample Type
Total Flow	0.050	0.0484	MGD[b]	Continuous[c]	Recorded
Aluminum	--	--	µg/L[d]	1/Week	Grab
Barium	4,012	2,000	µg/L	1/Week	Grab
Cadmium	0.27	0.13	µg/L	1/Week	Grab
Copper	7.4	3.7	µg/L	1/Week	Grab
Iron[e]	1,643	819	µg/L	1/Week	Grab
Lead	2.2	1.1	µg/L	1/Week	Grab
Manganese[f], option 1, effluent monitoring only	165	82	µg/L	1/Week	Grab

Parameter[a]	Maximum Daily Limit	Average Monthly Limit	Units	Minimum Sample Frequency	Sample Type
Manganese[f], option 2, effluent with concurrent monitoring	Receiving water sample not to exceed 300	Average of receiving water samples	µg/L	1/Week	1/Week
Manganese[f], receiving water	Report	Report	µg/L	1/Week	1/Week
Nitrate + Nitrite as N	--	--	mg/L[g]	1/Week	Grab
Selenium	8.2	4.1	µg/L	1/Week	Grab
Sulfate	502	250	mg/L	1/Week	Grab
Settleable Solids[h, i]	0.5		ml/L[j]	1/Week	Grab
Total Dissolved Solids (TDS)	1,003	500	mg/L	1/Week	Grab
Total Suspended Solids (TSS)[e]	70	35	mg/L	1/Week	Grab
pH[k]	6.5 to 8.5[l]		s.u.[m]	1/Day	Grab
Whole Effluent Toxicity (WET)	Report	NA	TU_c[n]	1/Year	Grab

a. All metals shall be measured as total recoverable, and drainage from reclamation (with the exception of pH), brushing and grubbing, topsoil stockpiling, and regraded areas is excluded from these limits (see 40 CFR Part 434 Subpart H).
b. Million gallons per day
c. In the event that continuous monitoring is interrupted due to forces outside the permittee's control (e.g. power outage), best professional judgement shall be used to estimate daily discharge.
d. Micrograms per liter
e. This limit applies when discharging during dry weather periods. However, this limit does not apply when discharge is caused by a precipitation or snowmelt event.
f. See 18 AAC 70.235(b) (2003).
g. Milligrams per liter
h. This limit applies when discharge is caused by rainfall totaling 2.0 inches or less in 24 hours (or snowmelt of equivalent volume) but does not apply during dry weather periods or heavy rainfall events, i.e. greater than 2.0 inches in 24 hours.
i. Use the following procedure to determine settleable solids. Fill an Imhoff cone to the one-liter mark with a thoroughly mixed sample. Allow to settle undisturbed for 45 minutes. Gently stir along the inside surface of the cone with a stirring rod. Allow to settle undisturbed for 15 minutes longer. Record the volume of settled material in the cone as milliliters per liter. Where a separation of settleable and floating materials occurs, do not include the floating material in the reading.
j. Milliliters per liter
k. These limits apply regardless of precipitation. Additionally, when discharge is caused by greater than 2.0 inches in 24 hours, this limit applies to reclamation areas as well as mining areas.
l. Cannot be outside this range
m. Standard units
n. Chronic toxic units

The effluent limit for manganese is based on a natural condition based site-specific water quality criterion (see Section 5.1). The permit provides two monitoring options for manganese: 1) monitor only the effluent, or 2) monitor the effluent and the receiving water concurrently. For the first option, effluent only monitoring, the effluent limit for manganese defaults to 82 µg/L, which is the prevailing highest quality natural condition for manganese in Marguerite Creek. For the second option, concurrent samples are taken from the effluent stream and from Middle Marguerite Creek monitoring station, and the measured manganese concentration in Middle Marguerite Creek monitoring station is the effluent limit. The sample from the Middle Marguerite Creek monitoring station, which is upgradient of the disturbed area, must be collected within one hour of effluent sampling.

4.4 Effluent Monitoring

The permit requires monitoring of the effluent to determine compliance with TBELs and WQBELs. Effluent samples will be collected from the effluent stream after the last treatment process and prior to discharge into Marguerite Creek. Drainage and sediment control structures at Jumbo Dome were not in place as this permit was developed. Field conditions—such as topography, changes in the mine plan, etc.—could dictate that outfall locations be moved. The permit allows outfalls to be moved up to 1,000 feet to accommodate conditions in the field but does not allow for new outfalls to be added with modification to the permit.

Whole effluent toxicity (WET) tests are required to measure the aggregate toxic effect of the effluent.

Monitoring data produced will be used to evaluate the effluent for pollutants of concern and to conduct future reasonable potential analysis as needed, which will determine if the discharge of these pollutants might cause an exceedance of the water quality criteria in the receiving waterbody.

The permittee shall also consult and review APDES Application Form 2D, which contains specific effluent monitoring requirements due to be submitted in the application for permit reissuance (180 days prior to the permit expiration date). A copy of Form 2D can be found at http://dec.alaska.gov/water/wwdp/index.htm.

Monitoring frequencies are based on the nature and effect of the pollutant, as well as a determination of the minimum sampling necessary to adequately monitor the facility's performance. Monitoring frequencies are based on recommendations in the *RPA Guidance*, 2014, Appendix 2. The permittee has the option of taking more frequent samples than required under the permit. These additional samples can be used for averaging if they are conducted using Department-approved test methods (generally found in 18 AAC 70 and 40 CFR § 136 [adopted by reference in 18 AAC 83.010]), and if the Method Detection Limits (MDLs) are less than the effluent limits.

4.5 Whole Effluent Toxicity Monitoring

18 AAC 83.435 requires that a permit contain limitations on WET when a discharge has reasonable potential to cause or contribute to exceedances of Alaska Water Quality Standards (WQS). The permit does not establish WET limits because no effluent monitoring data for WET are currently available for a determination of reasonable potential to cause or contribute to an exceedance of the chronic WET numeric water quality criterion. The permit requires annual

WET testing. The data from these tests will be used to determine whether there is a reasonable potential to exceed WET water quality criterion and could be used to establish WET limits in future permitting actions.

WET tests are laboratory tests that measure total toxic effect of an effluent on living organisms. The tests use small vertebrate and invertebrate species and/or plants to measure the aggregate toxicity of an effluent. Chronic toxicity tests measure reductions in survival, growth, and reproduction over a 7-day or 48 hour exposure. Chronic toxicity monitoring shall be conducted by the permittee according to the methods and species approved by the EPA in *Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition*, (EPA/821-R-02-013, October 2002).

5.0 RECEIVING WATERBODY

5.1 Water Quality Standards

Regulations in 18 AAC 70 require that the conditions in permits ensure compliance with the WQS. The state's WQS are composed of use classifications, numeric and 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. The antidegradation policy ensures that the beneficial uses and existing water quality are maintained.

Waterbodies in Alaska are designated for all uses unless the water 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 water quality criteria per 18 AAC 70.235 (June 26, 2003), such as those listed under 18 AAC 70.236(b). The protected classes of fresh water use at Marguerite Creek include water supply, water recreation, and growth and propagation of fish, shellfish, other aquatic life, and wildlife.

A natural condition based site-specific water quality criterion for manganese, in conformance with 18 AAC 70.235(b), is authorized in the permit. The most stringent state water quality standard for manganese is 50 µg/L. Manganese concentrations in Middle Marguerite Creek monitoring station, above the outfalls, are naturally high and variable with time. Over the past 14 years, 41 samples have been taken in Middle Marguerite Creek monitoring station. The prevailing highest quality natural condition (15th percentile of the data) for manganese is 82 µg/L (see Appendix C for more details regarding the natural condition-based site-specific criterion for manganese). The permit adopts 82 µg/L as the default natural conditions water quality criterion for manganese. Consistent with 18 AAC 70.235(b)(2) and for the purpose of compliance monitoring, if a sample taken from Middle Marguerite Creek monitoring station exceeds 82 µg/L, then the sample value constitutes the water quality criterion for manganese. The sample in Middle Marguerite Creek monitoring station, which is upgradient of the disturbed area, must be collected within one hour of effluent sampling in order to qualify.

To assure protection of receiving water quality, the following table contains parameters that must be monitored in Marguerite Creek above and below the area of impact. Receiving water monitoring is required to verify that the designated uses in Marguerite Creek have been protected from the pollutants of concern. The frequency of receiving monitoring may be reduced or

eliminated at permit reissuance (with the exception of manganese and hardness) if the data compiled during the permit cycle verifies that designated uses are being maintained and protected under the terms of the permit.

Table 5: Receiving Water Monitoring Requirements

Parameter[a]	Units	Minimum Level of Quantification (ML)
Aluminum	µg/L	87
Barium	µg/L	2,000
Cadmium	µg/L	0.1
Calcium	mg/L	5
Copper	µg/L	3.7
Iron	mg/L	819
Lead	µg/L	1.0
Magnesium	mg/L	5
Manganese	µg/L	50
Nitrate + Nitrite as N	mg/L	10
Selenium	µg/L	6
Sulfate	mg/L	250
TDS	mg/L	500
Hardness[b] as $CaCO_3$	mg/L	calculated
pH	s.u.	4.0 to 11.0

a. Acceptable test methods include EPA Method 200.8 for metals and EPA Method 300.0 for anions.
b. Hardness is calculated as follows: (2.497 x [Ca]) + (4.118 x [Mg]).

5.2 Water Quality Status of Receiving Water

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. Marguerite Creek is not included on the *Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report*, July 15, 2010 and a Total Maximum Daily Load has accordingly not been prepared for the waterbody.

6.0 ANTIBACKSLIDING

This is the first APDES permit for the facility; therefore, analysis of antibacksliding legal provisions are not warranted because those provisions focus exclusively on permit reissuance.

7.0 ANTIDEGRADATION

The Antidegradation Policy of the WQS (18 AAC 70.015) states that the existing water uses and the level of water quality necessary to protect existing uses must be maintained and protected. This section analyzes and provides rationale for the Department's decisions in the permit issuance with respect to the Antidegradation Policy.

The Department's approach to implementing the Antidegradation Policy, found in 18 AAC 70.015, is based on the requirements in 18 AAC 70 and the Department's *Policy and Procedure Guidance for Interim Antidegradation Implementation Methods*, dated July 14, 2010. Using these requirements and policies, the Department determines whether a waterbody, or portion of a waterbody, is classified as Tier 1, Tier 2, or Tier 3, where a higher numbered tier indicates a greater level of water quality protection. At this time, no Tier 3 waters have been designated in Alaska. Accordingly, this antidegradation analysis conservatively assumes that the discharge is to a Tier 2 water, which is the next highest level of protection and is more rigorous than a Tier 1 analysis.

The State's Antidegradation Policy in 18 AAC 70.015(a)(2) states that if the quality of water exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water (i.e. Tier 2 waters), that quality must be maintained and protected. The Department may allow a reduction of water quality only after finding that five specific requirements 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 lower water quality is necessary to accommodate important economic or social development in the area where the water is located.

   Based on the evaluation required per 18 AAC 70.015(a)(2)(D) below, the Department has determined that the most reasonable and effective pollution prevention, control, and treatment methods are being used and that the localized lowering of water quality is necessary.

   Usibelli's contributions to economic and social development in interior Alaska are significant. These contributions include jobs, spending on goods and services, and reduced energy costs for residents and businesses in interior Alaska. Issuance of the permit will allow Usibelli to develop Jumbo Dome, which will extend mining operations for at least 20 years.

   According to a study published by the McDowell Group in 2013, Usibelli's mining operations accounted for 577 interior Alaska jobs and 692 jobs statewide. These jobs accounted for a total of $52 million dollars in payroll, averaging over $75,000 annually per employee. These wages are among the highest in interior Alaska.

   Usibelli's mining operations are particularly important to the economy of the Denali Borough. Seasonal fluctuations in employment in the Borough are extreme. Employment levels in 2012 ranged from a high of over 3,600 in July to a low of 832 in January. From November through March, Usibelli employs one out of every six workers in the Denali Borough. Annually, Usibelli accounts for 30 percent of all employment in the nearby town of Healy.

In addition to direct employment, the Usibelli mining operations have important "downstream" effects on the economy. These effects include $72 million in annual spending with 400 different businesses and organizations in Alaska. Additionally, coal from Usibelli is used in power generation for the University of Alaska Fairbanks campus and the military facilities at Clear Air Force Station, Fort Wainwright, and Eielson Air Force Base.

Finally, coal from Usibelli is interior Alaska's most affordable energy source. Absent interior Alaska's six coal-fired power plants, electricity costs in interior Alaska would rise by an estimated 25 percent, which would cost residents an extra $200 million annually.

The Department concludes that the authorization of the discharge accommodates important economic and social development in interior Alaska and that the finding is met.

2. **18 AAC 70.015 (a)(2)(B).** Except as allowed under this subsection, 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.

   The permit prohibits violation of the water quality criteria in 18 AAC 70.020. No mixing zone is authorized under the permit.

   A natural condition-based site specific water quality criterion is adopted in the permit, as allowed under 18 AAC 70.235. Under 18 AAC 70.235, the Department may establish site-specific water quality criteria that modifies the water quality criteria set for a waterbody. A site-specific water quality criterion for manganese in Marguerite Creek is adopted via the permitting action.

   WET testing is required annually. WET tests reveal if the discharge has toxicity, and the permittee is required to submit these results to DEC within 14 days of receipt of test results. WET results from this permit cycle will be used when the permittee applies for reissuance of the permit to verify the applicable criteria of 18 AAC 70.030 are met.

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

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

   Analysis of the predicted effluent quality shows that discharges will protect existing waterbody uses. In addition, the effluent limits required by the permit will ensure that all uses are fully protected.

   The Department concludes that the resulting water quality will be adequate to fully protect existing uses and that the finding is met.

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

   Usibelli has designed an effective system for the prevention, control, and treatment of pollution at Jumbo Dome. Pollution will be prevented by reclaiming mined areas contemporaneously as mining advances and by diverting non-contact surface and groundwater around disturbed areas. Wastewater will be controlled through a series of engineered dewatering wells, sumps, ditches, and culverts.

Pollution will be treated through a multi-step treatment process. First, wastewater will be captured in three large treatment ponds and treated with a flocculant to enhance the removal of sediments. The treatment ponds have been designed so that, under typical conditions, wastewater will not be discharged to the environment. Next, all wastewater will pass through a treatment train consisting of passive aeration (for removal of iron), dolomite beds (for removal of manganese), and a polishing pond before being discharged. A pilot study of this treatment system has been conducted using wastewater from Jumbo Dome. The study predicts that the treatment system will be capable of meeting all effluent limits in the permit.

The treatment system at Jumbo Dome is reasonable. Coal mines throughout the United States use similar systems for the treatment of wastewater. When properly operated and maintained, these systems have proven effective for the removal of sediment and other contaminants.

The Department finds the most effective and reasonable methods of prevention, control, and treatment are the practices and requirements set out in the APDES permit.

5. **18 AAC 70.015(a)(2)(E).** All wastes and other substances discharged will be treated and controlled to achieve (i) for new and existing point sources, the highest statutory and regulatory requirements; and (ii) for nonpoint sources, all cost-effective and reasonable best management practices.

   Applicable "highest statutory and regulatory treatment requirements" are defined in 18 AAC 70.990(30) (as amended June 26, 2003) and in the July 14, 2010 DEC guidance titled "*Policy and Procedure Guidance for Interim Antidegradation Implementation Methods.*" Accordingly, there are three parts to the definition, which are:

   > (A) Any federal technology-based effluent limitation identified in 40 CFR §125.3 and 40 CFR §122.29, as amended through August 15, 1997, adopted by reference;
   >
   > (B) Minimum treatment standards in 18 AAC 72.040; and
   >
   > (C) Any treatment requirements imposed under another state law that is more stringent than a requirement of this chapter.

   The first part of the definition includes all federal technology-based ELGs, which would include those that apply to Jumbo Dome. EPA promulgated ELGs for the coal mining point source category at 40 CFR Part 434. The ELGs applicable to a new source, which is a source that has commenced construction after the ELGs were established on May 4, 1984, are applicable to discharges from active mines. All applicable federal technology-based ELGs are incorporated into the permit. Therefore, the Department concludes that this requirement is met.

   The second part of the definition 18 AAC 70.990(B) (2003) appears to be in error, as 18 AAC 72.040 describes discharges to sewers and not minimum treatment. The correct reference appears to be the minimum treatment standards found at 18 AAC 72.050, which refers to domestic wastewater discharges only. Jumbo Dome does not treat or discharge domestic wastewater; therefore further analysis under this regulation is not required.

   The third part of the definition includes any more stringent treatment required by state law, including 18 AAC 70 and 18 AAC 72. The correct operation of equipment, visual monitoring, and implementing BMPs, as well as other permit requirements, will control the discharge and satisfy all applicable federal and state requirements. The Department concludes that all wastes

and other substances discharged will be treated and controlled to achieve the highest statutory and regulatory requirements and finds that this finding is met.

8.0 OTHER PERMIT CONDITIONS

8.1 Annual Water Quality Monitoring Summary

All discharge and receiving water monitoring results for a calendar year must be included in an Annual Water Quality Monitoring Summary and submitted by March 1st of the following year. The report must include a presentation of the analytical results and an evaluation of the results. The evaluation must include an electronic spreadsheet containing all historical data, a graphical presentation of effluent data, water quality data at each of the two monitoring stations, and a comparison of monitoring results for each station over time. The annual report may reference the monthly reports for QA/QC information.

8.2 Quality Assurance Project Plan

The permittee is required to develop procedures to ensure that the monitoring data submitted are accurate and to explain data anomalies if they occur. The permittee is required to develop a Quality Assurance Project Plan (QAPP) within 60 days of the effective date of the permit. Additionally, the permittee must submit a letter to the Department within 60 days of the effective date of the permit stating that the plan has been implemented within the required time frame. 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 plan shall be retained on site and made available to the Department upon request.

8.3 Best Management Practices Plan

In accordance with AS 46.03.110 (d), 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 plant site runoff, spillage or leaks, or erosion. The permit contains certain BMP conditions that must be included in the BMP plan. The permit requires the permittee to develop or update and implement a BMP plan within 180 days of the effective date of the final permit. The Plan must be kept on site and made available to the Department upon request.

8.4 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, and other general requirements.

9.0 OTHER CONSIDERATIONS

9.1 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 October 5, 2015, DEC solicited USFWS and NMFS for feedback about ESA impacts associated with the permit. That same day, USFWS indicated lack of concern about the permit because there are no threatened or endangered or species in the area of Jumbo Dome or Marguerite Creek or its area of impact (Sarah Conn, Fairbanks Field Office Supervisor, personal communication). To date, NMFS has not yet responded to an email inquiry about ESA impacts.

9.2 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 October 5, 2015, DEC solicited NMFS and ADF&G for feedback on EFH impacts associated with this permit. That day, ADF&G replied that there is no EFH near the area of impact (Jack Winters, Acting Regional Supervisor, Fairbanks, personal communication). In an October 15, 2015 email, Jeanne Hanson of NMFS responded to DEC's email inquiry about EFH impacts by providing links to two websites. In searching the referred websites, DEC found no mapped EFH for the project area.

9.3 Permit Expiration

The permit will expire five years from the effective date of the permit.

10.0 REFERENCES

DEC (Alaska Department of Environmental Conservation). 2003. 18 AAC 70, Water Quality Standards. State of Alaska, Department of Environmental Conservation, June 26, 2003.

DEC. 2008a. 18 AAC 83, Alaska Pollutant Discharge Elimination System. State of Alaska, Department of Environmental Conservation, October 31, 2008.

DEC. 2008b. 18 AAC 70, Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. State of Alaska, Department of Environmental Conservation, December 12, 2008.

DEC. 2009a. 18 AAC 70, Water Quality Standards. State of Alaska, Department of Environmental Conservation, September 19, 2009.

DEC. 2009b. 18 AAC 72, Wastewater Disposal. State of Alaska, Department of Environmental Conservation, December 23, 2009.

DEC. 2010a. Interim Antidegradation Implementation Methods, Effective July 14, 2010. State of Alaska, Department of Environmental Conservation, Policy and Procedure No. 05.03.103.

DEC. 2010b. Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report, July 15, 2010.

DEC. 2014. Alaska Pollutant Discharge Elimination System (APDES) Permits Reasonable Potential Analysis and Effluent Limits Development Guide.

EPA (U.S. Environmental Protection Agency). 1991. Technical Support Document for Water Quality-based Toxics Control. EPA/505/2-90-001.

EPA. 1993. Guidance Manual for Developing Best Management Practices (BMP). Office of Water, October 1993, EPA 833-B-93-004.

EPA. 1996a. NPDES Permit Writer's Manual. EPA, Office of Water, Office of Wastewater Management, Permits Division. Washington, DC. December 1996. EPA-833-B-96-003.

EPA. 1996b. The Metals Translator: Guidance for Calculation a Total Recoverable Permit Limit from a Dissolved Criterion. June 1996, EPA 823-B-96-007.

Usibelli Coal Mine, Inc., 2015. Drainage and Sediment Control Plan.

APPENDIX A. **FACILITY INFORMATION**

Figure 1: Jumbo Dome Project Location Map

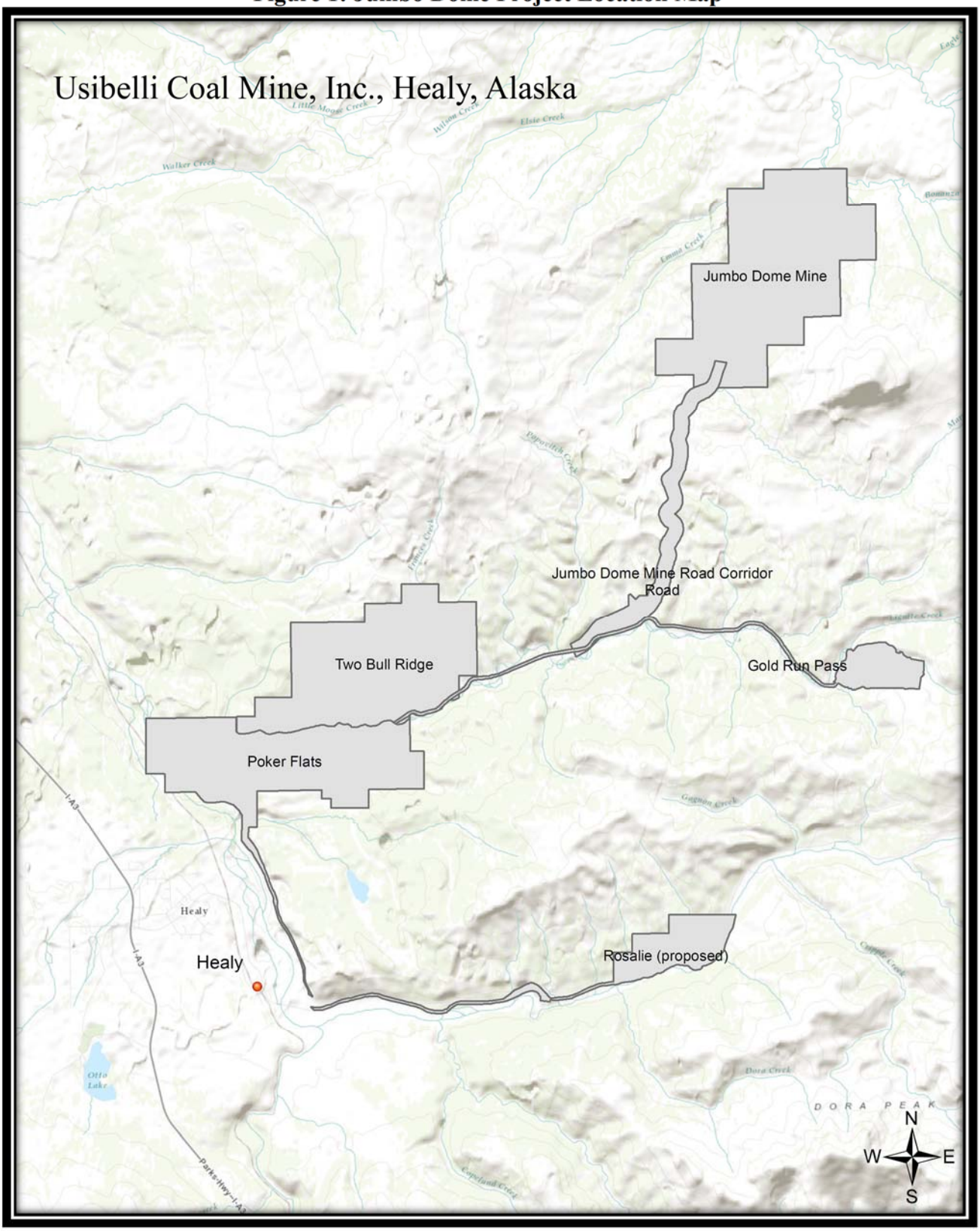


Figure 2: Site Map

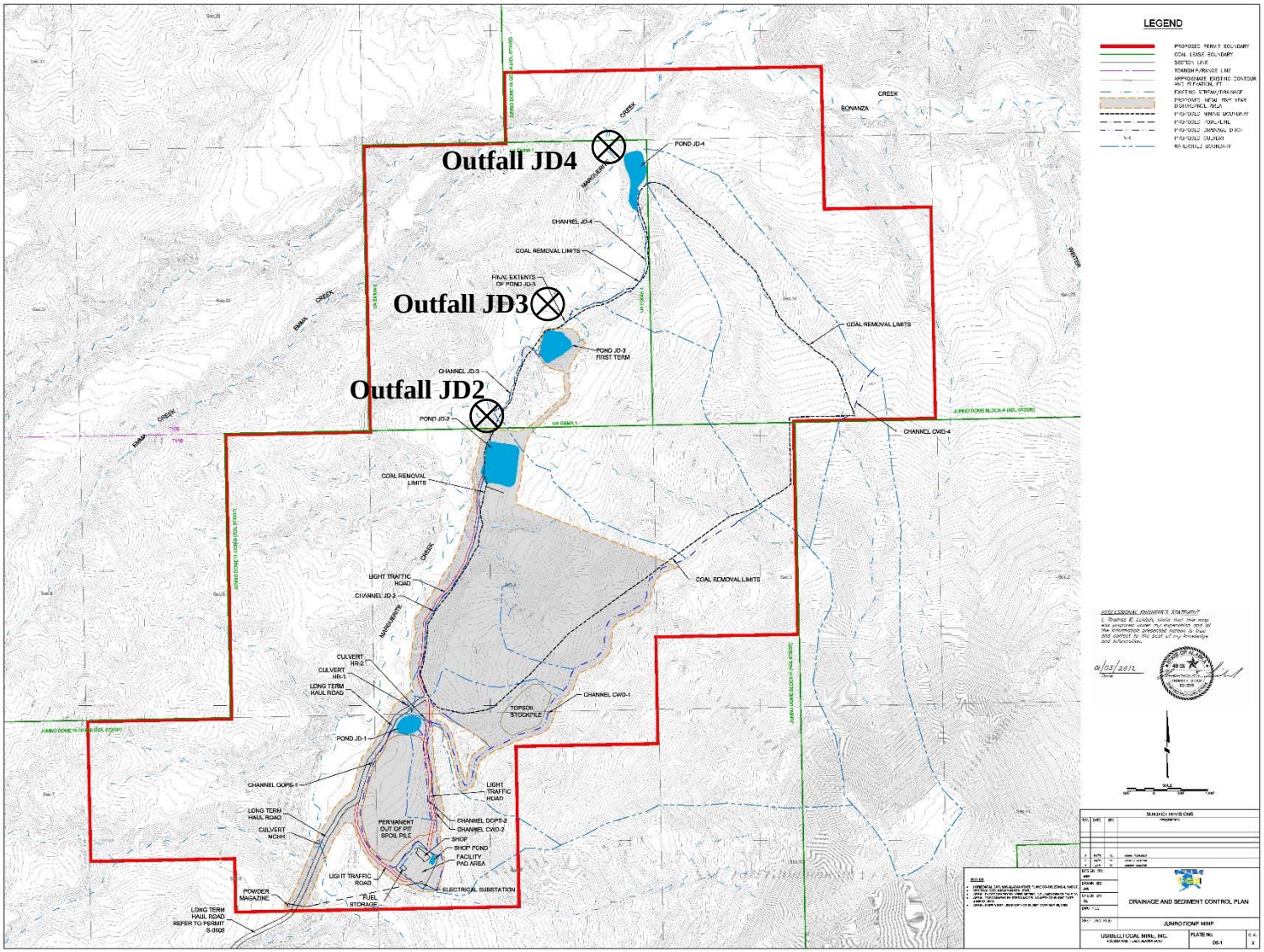
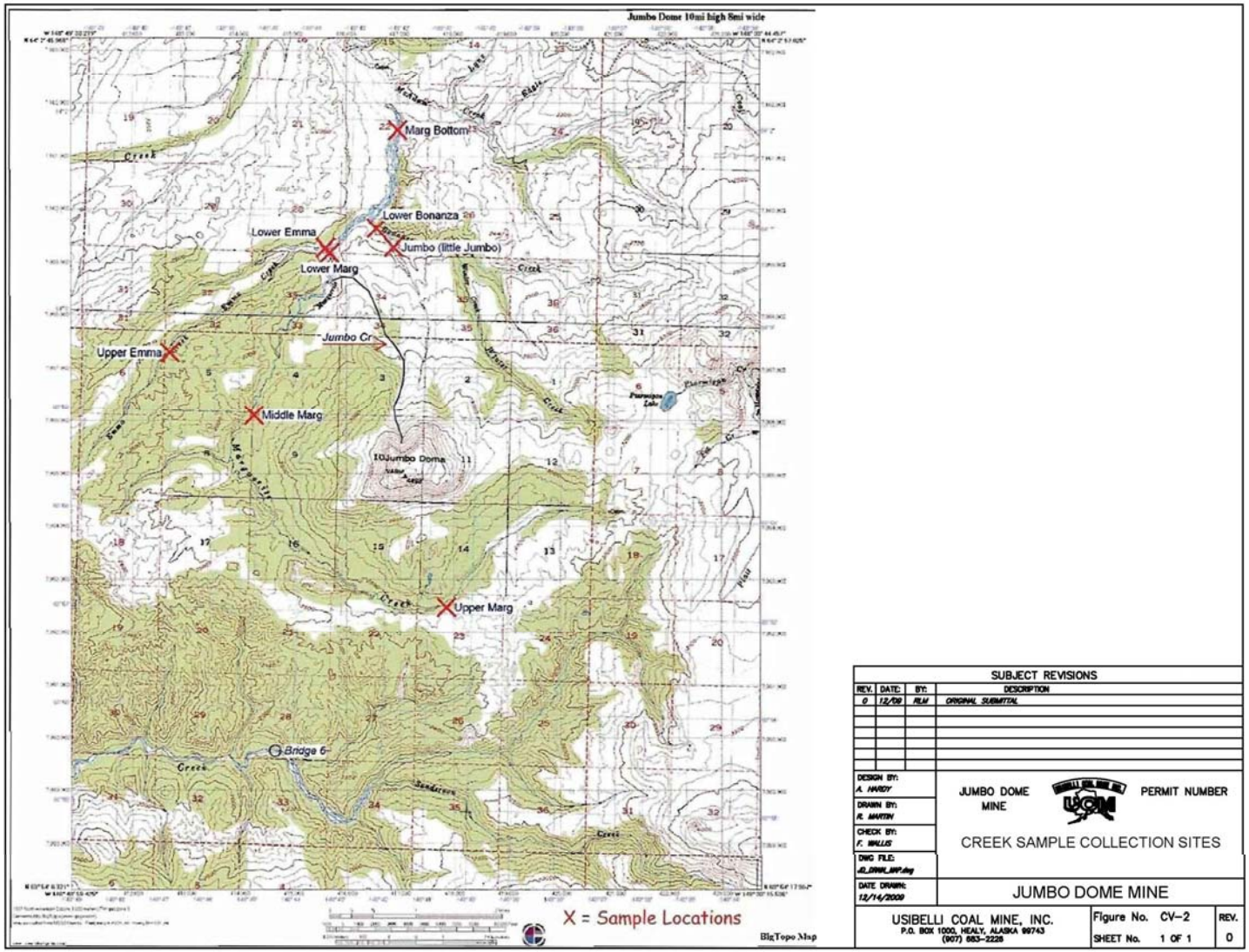


Figure 3: Monitoring Sites



APPENDIX B. BASIS FOR EFFLUENT LIMITS

This section discusses the basis for and the development of effluent limits in the permit. This section includes: an overall discussion of the statutory and regulatory basis for development of effluent limitations (Section I); discussions of the development of technology-based effluent limits (Section II) and water quality-based effluent limits (Section III); and a summary of the effluent limits developed for this permit (Section IV).

I. Statutory and Regulatory Basis for Limits

Sections 101, 301(b), 304, 308, 401, 402, and 405 of the Clean Water Act (CWA) provide the basis for the effluent limitations and other conditions in the permit. The Department evaluates the discharges with respect to these sections of the CWA and the relevant Alaska Pollutant Discharge Elimination System (APDES) regulations (Alaska Administrative Code [AAC] 18 AAC 83) to determine which conditions to include in the permit.

In general, the Department first determines if any federally-promulgated technology-based effluent limits have been developed that must be considered as minimum permit limits. The Department then evaluates the effluent quality expected to result from these controls to see if the discharge could result in any exceedances of the water quality standards (WQS) in the receiving water. If reasonable potential exists that effluent exceedances could occur, the Department must include water quality-based effluent limits in the permit. The permit limits reflect whichever requirements (technology-based or water quality-based) are more stringent.

II. Outfalls JD2, JD3, and JD4 - Technology-based Evaluation

Section 301(b) of the CWA requires industrial dischargers to meet technology-based effluent limitation guidelines (ELG) established by the Environmental Protection Agency (EPA). These limitations are enforceable through their incorporation into an APDES permit. Direct dischargers that are new sources, like Jumbo Dome, must meet New Source Performance Standards (NSPS), which are based on the best available demonstrated control technology.

In 40 CFR Part 434, EPA established ELGs for coal mining point sources. Four subparts apply to the Jumbo Dome permit. They are Subpart A—*General Provisions*, Subpart D—*Alkaline Mine Drainage*, Subpart F—*Miscellaneous Provisions*, and Subpart H—*Western Alkaline Coal Mining*. These ELGs apply NSPS to a new source coal mine, which is a source that has commenced construction after the ELGs were established on May 4, 1984. Subpart A—*General Provisions* contains applicability, requirements, and definitions, but no effluent limitations, and Subpart H—*Western Alkaline Coal Mining* contains narrative requirements that do not translate into numeric technology-based effluent limits.

Subpart D—*Alkaline Mine Drainage* provides NSPS effluent limits that apply to Jumbo Dome Mine outfalls JD2, JD3 and JD4. However, Subpart F—*Miscellaneous Provisions* offers two alternatives to Subpart D effluent limits based on the amount of precipitation causing discharge. Table B-1 presents technology-based effluent limits based on dry, moderate, and wet precipitation categories. Subpart D prescribes dry weather limits. While Subpart F allows two alternative sets of technology-based effluent limits dependent on whether precipitation is moderate or wet. When a discharge or increase in discharge is caused by precipitation that is less than or equal to the 10-year, 24-hour event (2.0 inches for Jumbo Dome Mine), then the Subpart

D effluent limitations (Table B-1) may be replaced by limits categorized as moderate in Table B-1, and when a discharge or increase in discharge is caused by precipitation that is greater than the 10-year, 24-hour event, more than 2.0 inches, Subpart D effluent limits may be replaced by the limit categorized as wet in Table B-1.

Table B- 1: Technology-based Effluent Limits for Outfalls JD2, JD3, and JD4

Precipitation-based Categories	40 CFR Citation	Parameter	Daily Maximum	Monthly Average
Dry[a] discharge not caused by a precipitation event	Subpart D §434.45	Iron	6.0 mg/L[b]	3.0 mg/L
		Total suspended solids	70 mg/L	35 mg/L
		pH	within the range 6.0 - 9.0 s.u.[c] at all times	
Moderate[a] discharge caused by a precipitation event dispensing 2.0 inches or less in a 24-hour period	Subpart F §434.63(a)(2)	Settleable solids	0.5 ml/L[d]	NA
		pH	within the range 6.0 - 9.0 s.u. at all times	
Wet[e] discharge caused by a precipitation event dispensing more than 2.0 inches in a 24-hour period	Subpart F §434.63(d)(2)	pH	within the range 6.0 - 9.0 s.u. at all times	

a. Drainage from reclamation areas, brushing and grubbing areas, topsoil stockpiling areas, and regraded areas is excluded from these limits.
b. Milligrams per liter
c. Standard units
d. Milliliters per liter
e. Drainage from brushing and grubbing areas, topsoil stockpiling areas, and regraded areas is excluded from these limits.

III. Water Quality-Based Evaluation

In addition to the technology-based limits discussed above, the Department evaluated the Jumbo Dome discharges to determine compliance with Section 301(b)(1)(C) of the CWA. This section requires permit limits necessary to meet WQS.

Under 18 AAC 83.435, the Department must implement section 301(b)(1)(C) of the CWA. It requires that APDES 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 limits must be stringent enough to ensure that WQS are met and must be consistent with any available wasteload allocation (WLA).

To determine if water quality-based limits are needed and develop those limits when necessary, the Department follows guidance in the *RPA Guidance* (2014). The water quality-based analysis consists of the following three step sequence:

1. Identify the applicable water quality criteria (see Section III.A);

2. Determine if there is “reasonable potential” for the discharge to exceed a water quality criterion in the receiving water (see Section III.B);
3. If there is “reasonable potential” or where a parameter has a technology-based limit and it requires dilution to meet WQS, develop effluent limits based on the waste load allocation (WLA) (see Section III.C).

The following sections provide a detailed discussion of each step.

A. Water Quality Criteria

The first step in determining if water quality-based limits are needed is to identify the applicable water quality criteria. Alaska’s WQS are found at 18 AAC 70. The applicable criteria are determined based on the beneficial uses of the receiving water.

The beneficial uses for Marguerite, the receiving waters of outfalls JD2, JD3, and JD4, and the regulatory citation for the water quality criteria applicable to the uses are as follows:

1. domestic water supply - 18 AAC 70.020(b)(1)(A)(i)
2. agriculture water supply - 18 AAC 70.020(b)(1)(A)(ii)
3. aquaculture water supply - 18 AAC 70.020(b)(1)(A)(iii)
4. industrial uses - 18 AAC 70.020(b)(1)(A)(iv)
5. contact recreation - 18 AAC 70.020(b)(1)(B)(i)
6. secondary recreation - 18 AAC 70.020(b)(1)(B)(ii)
7. growth and propagation of fish, shellfish, other aquatic life, and wildlife - 18 AAC 70.020(b)(1)(C)

For a given pollutant, different uses may have different criteria. To protect all beneficial uses, the reasonable potential analysis and permit limits are based on the most stringent water quality criteria for protecting those uses. For Marguerite Creek, the most stringent applicable criteria are summarized in Table B-2.

Table B- 2: Most Stringent of the Water Quality Criteria Applicable to Jumbo Dome Mine Discharges into Marguerite Creek (outfalls JD2, JD3, and JD4)

Parameter[a] (µg/L unless otherwise noted)	Acute	Chronic		
	Aquatic Life Criterion	Aquatic Life Criterion	Human Health Criterion[b]	Other
Barium	--	--	2,000	--
Cadmium[c]	1.1	0.16	--	--
Copper[c]	7.4	5.23	--	--
Iron	--	1,000	--	--
Lead[c]	34.5	1.3	--	--
Manganese[d]	--	--	--	82
Selenium	20.0	5.0	--	--
Sulfate (mg/L[e])	--	--	250	--

Parameter[a] (µg/L unless otherwise noted)	Acute	Chronic		
	Aquatic Life Criterion	Aquatic Life Criterion	Human Health Criterion[b]	Other
Total Dissolved Solids (mg/L)	--	--	500	--
pH (s.u.[f])	within the range of 6.5 - 8.5			

a. Criteria for metals have been converted to total recoverable.
b. Human health criterion for consumption of water and aquatic organisms.
c. Hardness-based limits using a hardness of 50.8 mg/L $CaCO_3$, the 15th percentile of background data.
d. The human health criterion is 50 µg/L. However, the Department finds that the prevailing highest quality natural condition, 82 µg/L, is of lower quality than the human health criterion, and the natural condition constitutes the applicable water quality criterion.
e. Milligrams per liter
f. Standard units

B. Reasonable Potential Analysis

1. Outfalls JD2, JD3, and JD4

This section discusses how reasonable potential was evaluated for outfalls JD2, JD3, and JD4. For each parameter, the Department compared the maximum projected receiving water concentration to the criteria for that pollutant to determine if there is "reasonable potential" to cause or contribute to an exceedance of a water quality criterion for each pollutant present in the discharge. If the projected receiving water concentration exceeds a criterion, there is "reasonable potential", and a limit must be included in the permit. The Department used the recommendations in the *RPA Guidance* (2014) to conduct the reasonable potential analysis.

Since there are no authorized mixing zones and for all parameters the chronic criterion is the most stringent, the maximum expected effluent concentration was compared directly to the most stringent chronic water quality criterion. However for manganese, naturally high concentrations in the receiving water exceed the most stringent chronic water quality criterion. In that case, the maximum expected effluent concentration was compared to the prevailing highest quality natural condition.

C_e (maximum expected effluent concentration or MEC): The maximum expected effluent concentration was calculated using the statistical approach recommended in the *RPA Guidance* (2014), i.e., by multiplying the maximum observed effluent concentration by a reasonable potential multiplier (RPM):

C_e = (maximum observed effluent concentration) x RPM

The RPM accounts for uncertainty in the effluent data. The RPM depends upon the amount of effluent data and variability of the data as measured by the coefficient of variation (CV) of the data. When there are not enough data to reliably determine a CV, the *RPA Guidance* recommends using 0.6 as a default value. Once the CV of the data was determined, the RPM was determined using the statistical methodology discussed in the *RPA Guidance*. In this procedure, RPMs with a 95% confidence level and a 99% probability were calculated. See

Table B-3 for a summary of the maximum reported effluent concentrations, CVs, and RPMs used in the reasonable potential analysis.

Reasonable Potential Summary: Results of the reasonable potential analysis for outfalls JD2, JD3, and JD4 are provided in Table B-3.

Table B- 3: Reasonable Potential Determination for Outfalls JD2, JD3, and JD4

Parameter[a] (µg/L unless otherwise noted)	Effluent Data					Most Stringent Water Quality Criterion	Reasonable Potential (yes or no)
	Max Observed Effluent Conc.	Coefficient of Variation (CV)[b]	Number of Samples	Reasonable Potential Multiplier (RPM)[c]	Max Expected Effluent Conc. (MEC)[d]		
Barium	230	0.6	1	9.04	2,079	2,000	Yes
Cadmium[e]	0.019	0.6	1	9.04	0.17	0.16	Yes
Copper[e]	1.98	0.6	1	9.04	17.9	5.23	Yes
Iron	283	0.6	1	9.04	2,558	1,000	Yes
Lead[e]	0.16	0.6	1	9.04	1.4	1.3	Yes
Manganese	131	0.6	1	9.04	1,184	82	Yes
Selenium	0.94	0.6	1	9.04	8.5	5.0	Yes
Sulfate (mg/L[f])	61	0.6	1	9.04	551	250	Yes
Total Dissolved Solids (mg/L)	241	0.6	1	9.04	2,179	500	Yes

a. Criteria for metals have been converted to total recoverable.
b. When the dataset population equals one, a CV cannot be calculated, and a default CV equal to 0.6 was assigned.
c. The RPM is based on the CV, number of data points, 95% confidence level and 99% probability.
d. For each parameter, the MEC equals the maximum observed effluent concentration times the RPM producing a number based on water treatment plant performance, which was used to determine if there is a reasonable potential for the effluent to exceed WQS.
e. Hardness-based limits using a hardness of 50.8 mg/L $CaCO_3$, the 15th percentile of background data.
f. Milligrams per liter

C. Water Quality–Based Effluent Limit Calculation

Once the Department determines that the effluent has a reasonable potential to exceed WQS at the end-of-pipe (see Table B-3) or a parameter has a technology-based effluent limit that exceeds WQS, a water quality-based effluent limit for the pollutant is developed. The first step in calculating a permit limit is development of a WLA for the pollutant.

End-of-Pipe WLAs

In many cases, there is no dilution available, either because the receiving waterbody exceeds the criteria or because the Department does not authorize a mixing zone for a particular pollutant. When there is no dilution available, the criterion becomes the WLA. Establishing the criterion as the WLA ensures that the Permittee's discharge does not contribute to an exceedance of the criterion. As with the mixing-zone based WLA, the acute and chronic criteria must be converted to long term averages (LTAs) and compared to determine which one is more stringent. The more stringent LTA is then used to develop permit limits.

Permit Limit Derivation

Once the appropriate LTA has been calculated, the Department applies the statistical approach described in the *RPA Guidance* to calculate maximum daily and average monthly permit limits. This approach takes into account effluent variability [using the Coefficient Variation (CV)], sampling frequency, and the difference in time frames between the average monthly and maximum daily limits.

The maximum daily limit is based on the CV of the data and the probability basis, while the average monthly limit is dependent on these two variables and the monitoring frequency. As recommended in the *RPA Guidance*, the Department used a probability basis of 95 percent for average monthly limit calculation and 99 percent for the maximum daily limit calculation.

The following is a summary of the steps to derive water quality-based effluent limits. Copper is used as an example.

Step 1- Determine the WLA

As in this case where there is no dilution, the acute and chronic aquatic life criteria become the acute and chronic WLAs (WLA_{acute} or $WLA_{chronic}$). Taking copper from Table B-2, the acute and chronic water quality criteria are 7.40 and 5.23 µg/L, respectively, or WLA_{acute} = 7.40 and $WLA_{chronic}$ = 5.23.

Step 2 - Determine the Long-Term Average (LTA)

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

Where,

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

$$\sigma^2 = \ln(0.6^2 + 1)$$

$$\sigma^2 = 0.3075$$

$$z = 2.326 \; for \; 99^{th} \; percentile \; probability \; basis$$

LTA_{acute} = 2.37

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

Where,

$$\sigma^2 = \ln\left(\frac{CV^2}{4} + 1\right)$$

$$\sigma^2 = \ln\left(\frac{0.6^2}{4} + 1\right)$$

$$\sigma^2 = 0.0862$$

$$z = 2.326 \; for \; 99^{th} \; percentile \; probability \; basis$$

$$LTA_{chronic} = 2.76$$

<u>Step 3 - Most Limiting LTA</u>

To protect a waterbody from both acute and chronic effects, the more limiting of the calculated LTA_{acute} and $LTA_{chronic}$ is used to derive the effluent limitations. LTA_{acute} is the most limiting LTA.

<u>Step 4 - Calculate the Permit Limits</u>

- The *RPA Guidance* recommends using the 95th percentile for the Average Monthly Limit and the 99th percentile for the Maximum Daily Limit. The Maximum Daily Limit and the Average Monthly Limit are calculated as follows:

$$\text{Maximum Daily Limit} = LTA_{acute} * e^{(z\sigma - 0.5\sigma^2)}$$

Where,

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

$$\sigma^2 = \ln(0.6^2 + 1)$$

$$\sigma^2 = 0.3075$$

$$z = 2.326 \; for \; 99^{th} \; percentile \; probability \; basis$$

CV = 0.6

Maximum Daily Limit = 7.4 µg/L

$$\text{Average Monthly Limit} = LTA_{acute} * e^{(z\sigma - 0.5\sigma^2)}$$

Where,

$$\sigma^2 = \ln\left(\frac{CV^2}{n} + 1\right)$$

$$\sigma^2 = \ln\left(\frac{0.6^2}{4} + 1\right)$$

$$\sigma^2 = 0.0862$$

$$z = 1.645 \; for \; 95^{th} \; percentile \; probability \; basis$$

$CV = 0.6$

n = number of sampling events required per month for copper = 4 (based on weekly sampling)

Average Monthly Limit = 3.7 µg/L

- According to the *RPA Guidance,* when a human health criterion is the most stringent applicable water quality criterion, the method for calculating permit limits varies from the procedures used above. The manganese limits are based on human health and were calculated according to the *RPA Guidance* as follows. Taking manganese from Table B-2, the chronic water quality criterion is human health-based and equal to 82 µg/L or WLA = 82. The Average Monthly Limit = WLA = 82 µg/L. Since sampling is weekly and CV = 0.6, the Maximum Daily Limit = 2.01 times the Average Monthly Limit = 165 µg/L.

IV. Summary of Permit Effluent Limitations

As discussed in Section I of this appendix, technology-based effluent and water quality-based effluent limits have been applied to the outfall discharges. Table B-4 summarizes the permit limits for outfalls JD2, JD3, and JD4 and their bases.

Table B- 4: Outfalls JD2, JD3, and JD4 Effluent Limits

Parameter	Units	Daily Maximum		Monthly Average	
		Effluent Limit	Basis for Limit	Effluent Limit	Basis for Limit
Flow	mgd[a]	0.0500	design capacity	0.0484	catchment area, precipitation, & storage
Barium	µg/L[b]	4,012	Drinking Water	2,000	Drinking Water
Cadmium[c]	µg/L	0.27	Chronic Aquatic Life	0.13	Chronic Aquatic Life
Copper[c]	µg/L	7.4	Acute Aquatic Life	3.7	Acute Aquatic Life
Iron[c]	µg/L	1,643	Chronic Aquatic Life	819	Chronic Aquatic Life
Lead[c]	µg/L	2.2	Chronic Aquatic Life	1.1	Chronic Aquatic Life
Manganese[d]	µg/L	165	Other	82	Other
Selenium[c]	µg/L	8.2	Chronic Aquatic Life	4.1	Chronic Aquatic Life
Sulfate	mg/L[e]	500	Human Health	250	Human Health
Total dissolved solids	mg/L	1,003	Human Health	500	Human Health
Settleable solids	ml/L[f]	0.5	ELG	-	
Total suspended solids	mg/L	70	ELG	35	ELG
pH	s.u.[g]	6.5 to 8.5	Aquatic Life	6.5 to 8.5	Aquatic Life

a. Million gallons per day
b. Micrograms per liter
c. Metals shall be measured as total or total recoverable.
d. The human health criterion is 50 µg/L. However, the Department finds that the prevailing highest quality natural condition, 82 µg/L, is of lower quality than the human health criterion, and the natural condition constitutes the applicable water quality criterion.
e. Milligrams per liter
f. Milliliters per liter
g. Standard units

APPENDIX C. TECHNICAL SUPPORT DOCUMENT FOR NATURAL CONDITION

Usibelli Jumbo Dome Coal Project: Natural Condition-Based Site Specific Criterion for Manganese for Marguerite Creek, Alaska

Technical Support Document

July 18, 2016
PUBLIC NOTICE DRAFT

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EXECUTIVE SUMMARY

As per 18 AAC 70.235(b) (DEC 2003), a natural condition-based site specific criterion (SSC) for total manganese is established in permit AK0053471 for the Usibelli Jumbo Dome project under the Alaska Pollutant Discharge Elimination System (APDES). A default SSC is set at 0.082 mg/L, as the prevailing highest quality natural condition, with an allowable concurrently measured natural condition at Middle Marguerite Creek up to a maximum concentration of 0.30 mg/L. The SSC applies from the Middle Marguerite Creek sampling station (upstream natural condition) to the Lower Marguerite Creek sampling station (discharge) at the convergence with Emma Creek.

Table 1. Alaska Water Quality Criteria and Site Specific Criterion (SSC).

Designated Use	Alaska Water Quality Criteria mg/L Manganese	Marguerite Creek SSC mg/L Total Manganese
(A) Water supply (i) drinking, culinary, and food processing;	Human Health for Consumption of Water + Aquatic Organisms: **0.050**	**0.082* – 0.30**** *Default criterion is prevailing highest quality natural condition of 0.082 mg/L. **The criterion may be adjusted to natural condition based on concurrent monitoring results up to a maximum of 0.30 mg/L.
(C) Growth and propagation of fish, shellfish, other aquatic life and wildlife	Human Health for Consumption of Aquatic Organisms Only: **0.10**	
(A) Water Supply (ii) agriculture, including irrigation and stock watering	Irrigation Water: **0.20**	

The SSC is based on a permit–specific condition authorized under 18 AAC 70.235(b), only applicable to the area of concern, established in Permit AK0053471, and applicable only for the duration of the permit as stated in the permit fact sheet.

Specific information associated with allowed excursions from the criterion, including frequency and duration of excursions, will be addressed through implementation and of the APDES Permit AK0052471 and associated compliance actions.

1. INTRODUCTION

Usibelli Coal Mine, Inc. (UCM) owns and operates a surface coal mining operation located in the vicinity of Healy, Alaska, 120 miles southwest of Fairbanks (Figure 1). Coal reserves are situated on the eastern portion of the Nenana coal field and are maintained as leases permitted through the Alaska Department of Natural Resources, Division of Mining, Land and Water. The operation currently encompasses 32,500 acres with over 100 million tons of proven coal reserves. Only a portion of these reserves are currently active. Coal is mined from these areas using a combination of blasting, shovel, and dragline mining methods after which it is hauled by truck to a loadout facility where it is crushed and loaded onto railcars. The SSC is for Marguerite Creek, a waterbody within the Usibelli Coal Jumbo Dome project area.

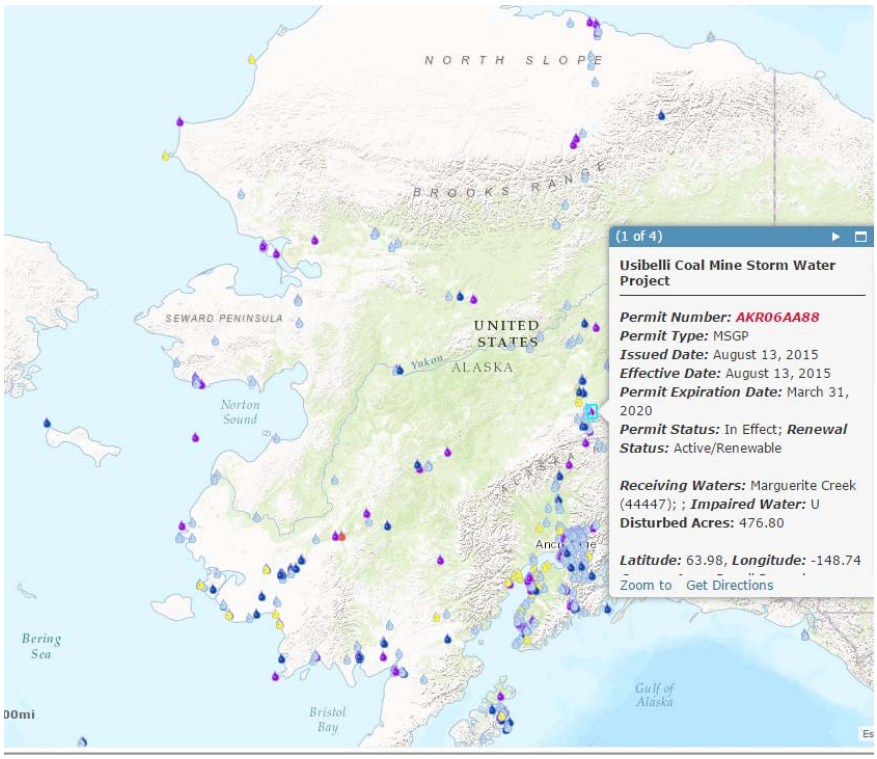


Figure 1. Location of Usibelli Coal Mine near Healy, Alaska.

1.1. Physiographic Setting

Marguerite Creek is in the subarctic physiographic province of the northern foothills of the Alaska Range. These characteristic foothills are flat-topped east-trending ridges at elevations of 2000 – 4500 ft. and are mostly unglaciated; although some valleys are noted as having been broadened by glaciers from the Alaska Range around the Pleistocene epoch (Usibelli SCMRA, 2010). The Marguerite Creek Watershed is comprised of 18 major basins and 14 minor basins, encompassing an area of approximately 15 square miles (USGS, 2009). A map illustrating the general location of surface water bodies and similar features is located in Appendix A.

The topography of the surrounding area is characteristic of a very young geology of rolling hills with streams eroding into the surrounding landscape. Marguerite Creek and its high gradient tributaries are subarctic streams with the potential for high stream velocities and sediment transport. The watershed trends east-west and then south-north, and is a tributary to the northward flowing into the Tanana River. The elevation of the downstream reach of Marguerite Creek at the north end of the mining area is approximately 1,950 feet above mean sea level (amsl) while the elevation at the

southern end is approximately 2,100 feet amsl. The natural lithology of the basin produce mass wasting that contributes to elevated sediment and metal loads in many streams within the watershed, primarily during times of high discharge (i.e. snow melt, precipitation events; Wahrhaftig 1987, Wilbur and Clark 1987, Wahrhaftig et al. 1969). A report by UCM (2002) for the Hoseanna Creek watershed (a watershed within 2-3 miles of the Marguerite Creek watershed) noted that the dominant erosional mechanisms within that basin were mass wasting and mechanical erosion. These processes are related to the freeze-thaw activities acting on bare rock located on high, steep, unforested mountain slopes. In forested areas at lower elevations of Hoseanna Creek, erosion of surficial soils occurs by solifluction, rainfall and snowmelt runoff resulting in heavy sediment loads and unstable/steep bank channels. Although not as extreme and at higher elevation than Hoseanna Creek, the Marguerite Creek watershed exhibits much of the same lithology. These characteristics underlie the elevated nature of certain water quality parameters, some of which are naturally above Alaska Water Quality Standards (WQS). Visual images of Marguerite Creek and surrounding topography are located in Appendix B of this document.

A study done by the Soil Conservation Service (SCS, 1979; Exploratory Soil Survey of Alaska, (Usibelli SCMRA, 2010) rated the major land resource areas within Alaska. Field mapping was done at a scale of 1:500,000 (about 8 miles to 1 inch). The relative significance of the SCS study is it included data from all existing soil maps as well as observations made from a small helicopter that landed frequently in roadless areas for onsite soil identification and ground truthing. Distinctive landscape patterns were identified from the air and recorded on the map. Soils were described and classified; relationships between the soils, the native vegetation, and landforms were noted; and the proportion of the area occupied by each major kind of soil was estimated.

The SCS study placed each major land resource area into two categories; suitability for agriculture and suitability for development (e.g., road location, buildings, recreation, and off-road traffic). The category of agriculture assessed suitability of the land, including but not limited to use as cropland; as rangeland for cattle, sheep, and reindeer; and for commercial forestry. In each of these subcategories, the mine area was determined to be unsuitable with the exception of rangeland for reindeer. The SCS noted that all land areas were in the "severe" to "very severe" limitation categories.

The SCS limitation on agriculture is not surprising given that the project area is at an elevation between 2,000 feet and 2,700 feet in the Alaska Range. Alaska's climate and the respective elevation combine to cause a short growing season. Usibelli Coal Mine maintains a weather station on the roof of the mine office located approximately 10 miles southwest of and approximately 1,000 feet below the project area at an elevation of 1,200 feet. 11 years of weather data have been recorded, 2004 to 2014. Assuming the normal temperature lapse rate of 3.5 °F per 1,000 feet of elevation change, the project area would be approximately 3.5 °F colder than the readings at the weather station. By applying this correction to the station's daily temperature readings, the average frost-free period at the project site was 89 days from 2004-2014. In addition, the data show there were rare, but occasional, frosts during the summer months. In 2005, the data, corrected for elevation, show a

frost on July 21st and in 2009 on June 25st. The final spring frost at the project site tend to occur between May 17th and June 12th and the first fall frost generally occur between August 8th and August 30th except for an anomalously warm year in 2007 when it occurred on September 17th.

For all these reasons, agriculture has never occurred in the mine area. Agriculture is infeasible in the location based on 1) the Soil Conservation Service's conclusion that soils all have "severe" or "very severe" limitations; 2) the high elevation; 3) the short growing season; and 4) the frequency of late-season frosts."

1.2. Human Activities

There has been little human use of the area due to the difficult access and lack of useable resources, except minerals. The Alaska Division of Forestry inventoried the Tanana Valley and found forest resources in the project area fall below the minimum quality worthy of inventory. The USGS 2011 National Land Cover Database determined approximately 95% of the project area to be within the "dwarf scrub" or "shrub/scrub" categories.[1] A detailed description completed for the Usibelli Alaska Surface Coal Mine Control and Reclamation Act (ASCMCRA) application shows 37% of the project area to be shrub habitat (<10% tree cover); 31% woodlands (10-24% tree cover); 28% open canopy forest (25-59% tree cover); and only 2% closed canopy forest (>60% tree cover); (WH Pacific, Inc. 2008. Fish and Wildlife Habitat Evaluation for Jumbo Dome Mine, Healy Alaska. Prepared for Usibelli Coal mine, Inc.)

While the area of concern for SSC is in fact part of the Nenana Coal Field and considered to be a highly mineralized area with respect to coal, very little actual development has taken place. Placer mining for gold is noted to have taken place in upper Marguerite Creek. It has been inactive for decades and is thought to only have disturbed surface gravels.[2] Other than mining exploration associated with the Jumbo Dome project, there is no record of significant water use in the project area or downstream to the Tanana River, which lies approximately 57 river miles downstream. A search of the Department of Natural Resources (DNR) water rights database indicates that there are no active or likely historic water rights[3] in the project area or approximately 57 miles downstream to the Tanana River. The search included surface and subsurface water rights, and included areas near Marguerite Creek, California Creek and the Totatlanika River. The search also turned up no

[1] The database defines dwarf scrub as being "dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs and non-vascular vegetation." The shrub/scrub category includes "areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in early successional stages or trees stunted from environmental conditions."

[2] Source: http://mrdata.usgs.gov/ardf/show-ardf.php?ardf_num=HE007. Downloaded on 5-26-16

[3] DNR's water rights mapping program shows current water rights (http://dnr.alaska.gov/MapAK/). Water rights are a property right and cannot be taken away without a showing of non-use that requires a long, and expensive due process. DNR has completed few of these since statehood. Few issued water rights have been revoked by DNR or voluntarily relinquished, and these have generally occurred only where there is significant competition for water use. Therefore, it is theoretically possible but unlikely that there has been some significant, legal use of a water downstream of the project area since just after statehood.

authorizations for temporary uses of water, though the database does not record temporary uses that are no longer authorized. To be clear, no documented mining activity or similar anthropogenic sources of disturbance have taken place within the area of concern for SSC, other than minimal trail usage which occurred during the exploration phase of project development.

In regards to recreational uses, there are no mapped trails into the project area except for those needed for mineral exploration. The lack of trails, difficult access, and the lack of particular fishing, hunting, or recreation areas means that there is limited, if any, non-mineral human use. The fish population in Marguerite Creek are mostly grayling and slimy sculpin. While grayling is a potential game fish, there are many resources closer to population centers.

The easiest access for hunting would be through other portions of the Usibelli Coal Mine property. Travel by the public through the active coal mine has been closed for decades, except for the occasional special request. Company personnel cannot recall a request by the general public for travel up into the project area.

DEC contacted Alaska Department of Fish and Game (ADF&G) Subsistence (ADFG 2016) to determine whether harvest of fish and other resources occurs within the Marguerite Creek watershed. ADF&G Community Harvest Surveys were conducting in the communities of Healy and Ferry, both of which are within 30 road miles of Marguerite Creek, in 2014 and 2015. Discussions with staff determined that participating households (35% response rate) did not report harvest of any game species within the watershed. The closest water noted in harvest studies was California Creek, of which Marguerite Creek is a tributary of. The confluence with California Creek is approximately four miles downstream of the SSC area. Grayling is the only game fish present in Marguerite Creek. ADF&G noted that less than 20% of households surveyed reported use of grayling. Decisions not to engage in harvest in the watershed was attributed to poor habitat and current land use practices that have access restrictions. 79% of the total vegetation harvest for the communities was represented by berries. The vast majority of this was blueberry followed by low bush cranberry. Both species thrive in fairly acidic conditions and are native to the area. However, no vegetation harvesting was reported in the Marguerite Creek watershed for the same reasons as game fish harvest. Areas to the west and northeast of the communities were noted as being more accessible and productive than the Jumbo Dome area.

In summary, there have been no record of significant human use of the SSC-area with the exception of exploration that preceded the Jumbo Dome Coal Mine and the reference to long-abandoned minor placer activity.

1.3. Hydrology – Flow Conditions

General characteristics of Marguerite Creek are noted in Table 2 .The average flow in Marguerite Creek, recorded at USGS gage 15515060 (Marguerite Creek above Emma Creek), is 11.1 cubic feet per second (cfs). Annual flow ranges between 0.7 and 42.0 cfs. This level of flow is likely to be too marginal and sporadic to satisfy the needs of an agricultural water supply use. Figure 2 illustrates the

flow for Marguerite and Emma Creeks indicative to the marginal and sporadic flows inherent to the streams within the Marguerite Creek drainage basin. North-facing high relief permafrost basins underlain by resistant schistose rocks create conditions for relatively high peak flows of short duration that decline during the summer to low base flows during cooler periods. In contrast, south-facing, non-permafrost low relief basins underlain by coal-bearing rocks have reduced peak flows due to higher interception and infiltration while base flows are relatively higher and sustained due to high volume aquifer storage in thick fractured coal seams. The primary surface lithology in this drainage include the Tertiary Suntrana Formation sandstones, the quart-sericite schist of the Precambrian or Paleozoic Keevy Peak Formation, the siltstones and claystones of the Tertiary Grubstake and Lignite Creek Formations, and Quaternary rubbles, alluvium, and pediment gravels of Jumbo Dome (Usibelli 2010).

Table 2. (Usibelli 2010)

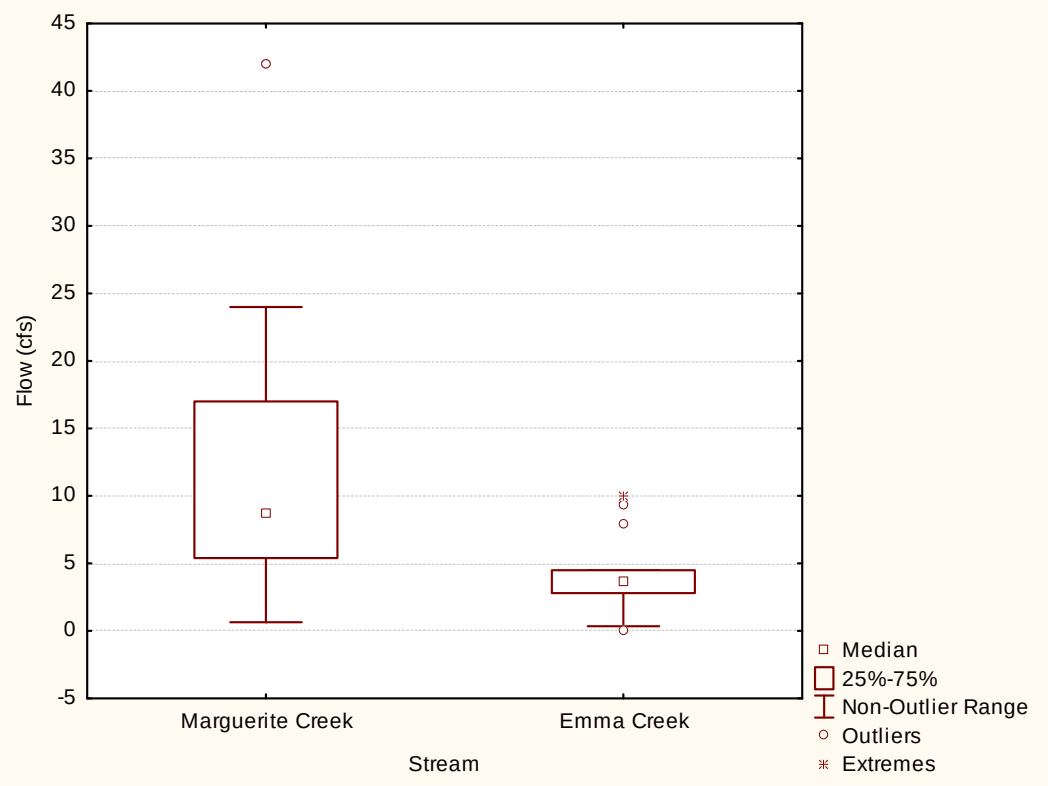
PROJECT AREA DRAINAGES[1]

Drainage Basin	Monitoring Station[2]	Drainage Area (in mi^2)[3]	Approximate Range in Drainage Elevation[3] (in feet)	Primary Surface Lithology[4,5]
Marguerite Creek	15515060	15.52	1,950 - 4,500	Qra, Qha, Qhr, Tgl, Tsn, kp

Notes:

1. Location of drainage basins shown on Figure CV-1, Drainage Areas.
2. Official USGS gage station (2009); location provided on USGS website.
3. Estimated from USGS and site topographic maps from drainage headwaters to monitoring station.
4. Qhr = Quaternary rubble of Jumbo Dome.
   Qra, Qha = Quaternary alluvium and pediment gravel.
   Tgl = Tertiary Grubstake and Lignite Creek Formation siltstones and claystones.
   Tsn = Tertiary Suntrana Formation sandstones.
   kp = Quartz-sericite schist of the Keevy Peak Formation.
5. Surface lithologies presented in Wahrhaftig (1970).

Figure 2. Distributions of flow measurements in Marguerite Creek and Emma Creek. Flow measurements are from USGS gages 15515060 and 15515080 on Marguerite and Emma Creeks, respectively. 25th Percentile – value under which 25% of the values fall; 75th percentile – value under which 75% of the values fall.

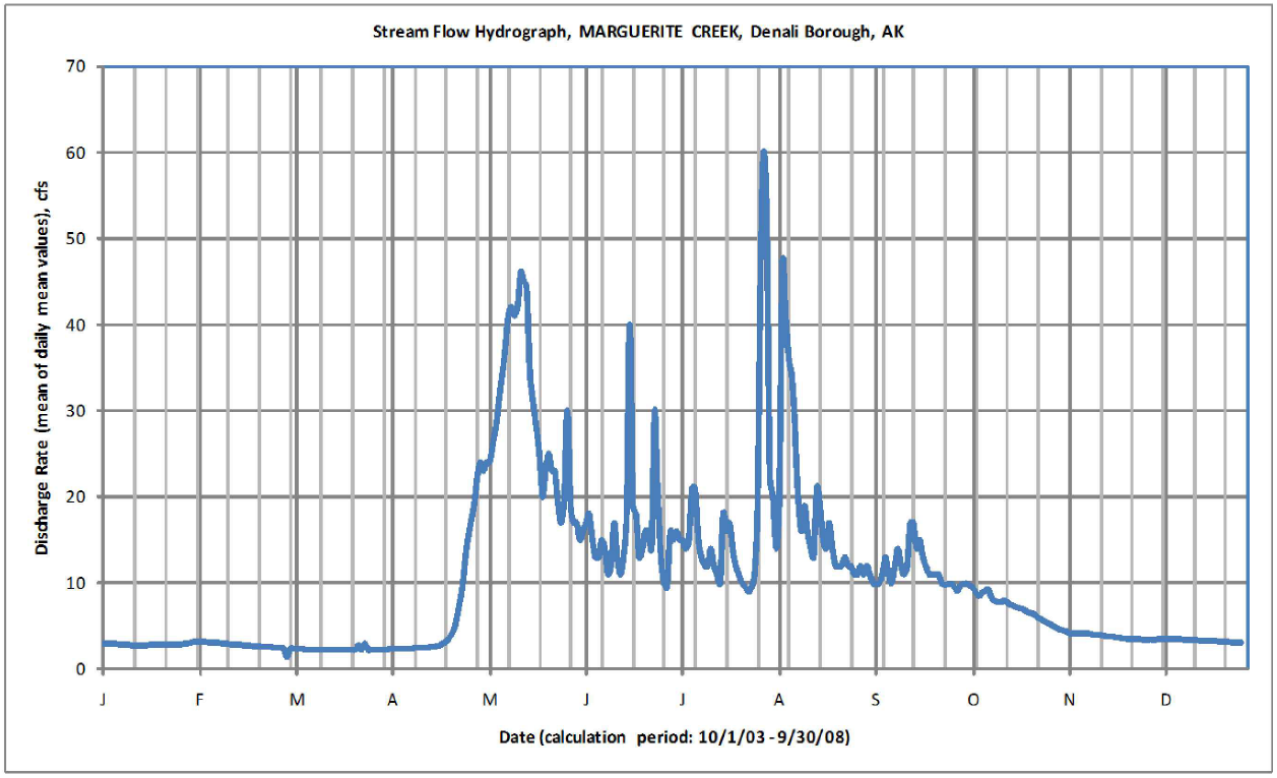


Springs and seeps are abundant in the area and contribute to base flow in Marguerite Creek. Most springs and seeps identified at Jumbo Dome occur in the general vicinity of natural drainages, some of which appear as a result of groundwater discharge from coal seams while others appear to be the result of storm water runoff infiltrating the Jumbo Dome rubble and collecting in subsurface drainages that surface randomly. Visible flow in the upper reaches of the creeks during the low-flow months is directly correlated to the location of groundwater discharge from coal-seam outcrops. Recorded discharge from seeps in the Marguerite Creek drainage basin observed within the mining area varies from less than 1 to over 80 gallons per minute (gpm).

Seasonal discharge variability within the site's creeks are best characterized by the hydrograph shown on Figure 3. Seasonal surface water flow variations, as seen during an average precipitation season, begin with peak flows from rainfall and snowmelt during May and early June. Except for short summer storms, discharge then decreases and stabilizes from mid-June to mid-July as the snowpack is diminished. August and September mark the general decline in measured flow as the hydrographs return to base flow conditions. The series of peaks on the hydrograph are the result of localized

summer rain storm events, many of which result in short-term discharge equal to peak flows from spring runoff.

Figure 3. USGS 2003-2008 Stream Flow Hydrograph for Marguerite Creek. (Usibelli 2010)

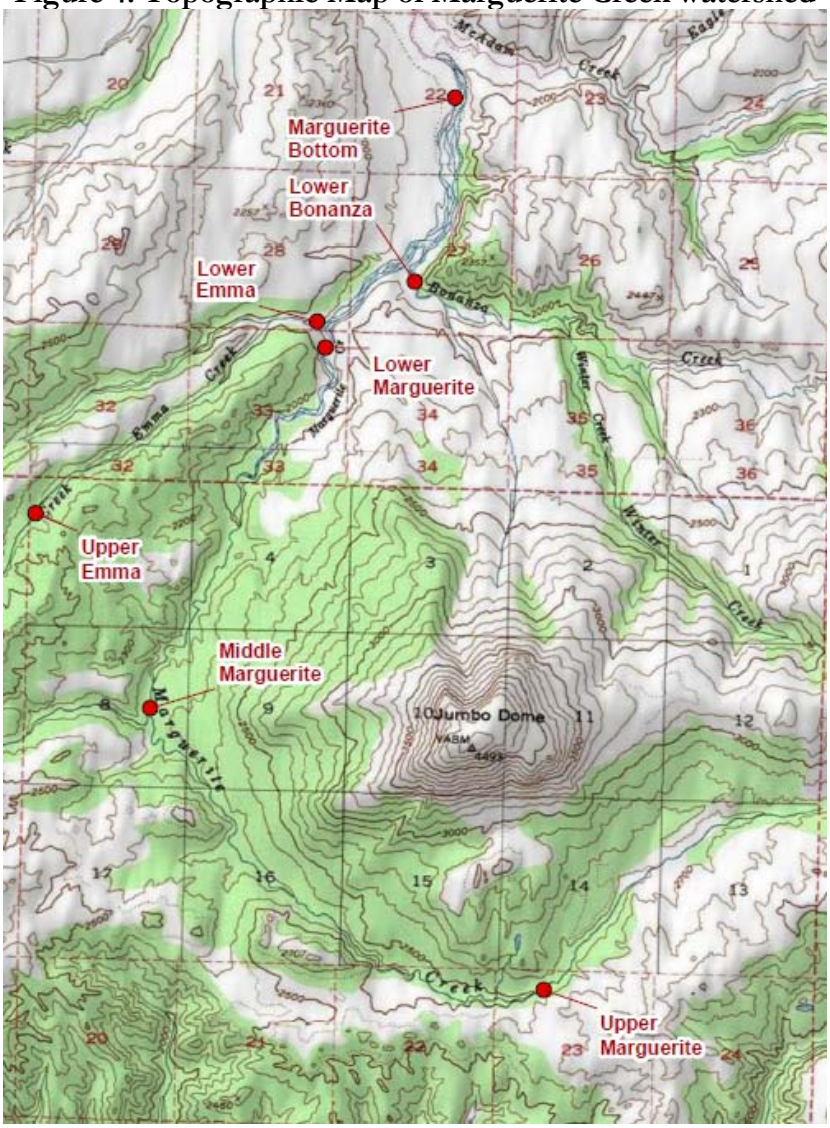


The channel is known to freeze to the streambed during winter months while evapotranspiration rates in central Alaska are known to exceed typical average precipitation amounts in the summer months. This causes a precipitation deficit in terms of water availability. Combined with the poor geologic makeup (e.g., sand and gravels), low nutrient content of the soils, and short growing season, Marguerite Creek is precluded from serving as productive fish habitat or a reliable source of water for the purposes of irrigation or stock watering.

1.4. Steam Channel Characteristics

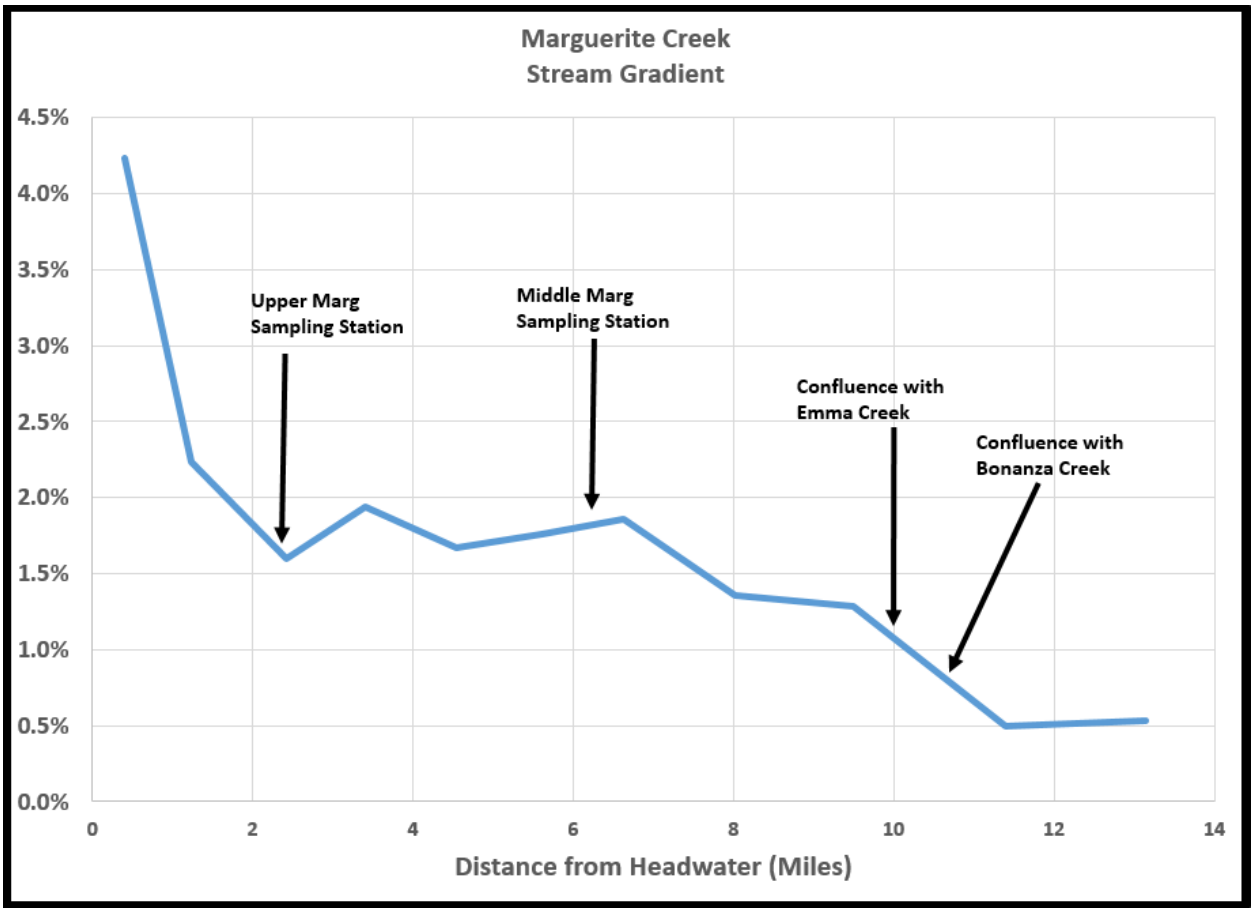
A topographic review of Marguerite Creek (Figure 4) demonstrates that the water is channelized due to the slope and surrounding landscape in the upper part of the watershed. Once the Marguerite Creek merges with Emma Creek, the slope of the watershed decreases allowing most sediment to settle out of the water column.

Figure 4. Topographic Map of Marguerite Creek watershed



An analysis of the stream channel (Figure 5) determined the gradient to range from 4.5% (Headwaters) to 0.5% (Post-Bonanza Creek Confluence).

Figure 5: Marguerite Creek Stream Gradient (Jade North 2016)[4]



The downstream end of Marguerite Creek at the north end of the proposed mining area is at an approximate elevation of 1,950 feet above mean sea level (amsl). The approximate elevation of Marguerite Creek at the southern end of the proposed mining area about 10,000 feet away is 2,100 feet amsl.

2. RECEIVING WATER QUALITY

Before planning began for the Jumbo Dome Mine, water quality data for Marguerite Creek was relatively scarce. Almost all of the available data for the Creek has been recorded within the last thirteen years (2002 – 2014) by the Alaska Department of Natural Resources. Water quality data were collected to assess baseline conditions prior to mining activities. To determine the appropriate reference condition, seven surface water stations were established (see Appendices D-E). Of the seven stations, one (Lower Marguerite Creek) was established by USGS as a gage site (See Table 2, and Figure 4) on the right bank of Marguerite Creek approximately 800 feet upstream of the mouth of Emma Creek. The other six stations are:

[4] Image provided by Jade North. 6-13-2016 via email correspondence.

1) Bottom Marguerite Creek: Marguerite Creek below the confluence with Bonanza Creek;
2) Lower Bonanza Creek: Bonanza Creek approximately 2000 feet upstream of the confluence with Marguerite Creek;
3) Lower Marguerite Creek: Marguerite Creek at the USGS gage 800 feet upstream of Emma Creek;
4) Lower Emma Creek: Emma Creek approximately 150 feet upstream of the confluence with Marguerite Creek;
5) Middle Marguerite Creek: Marguerite Creek upstream of the first road crossing on Marguerite Creek. (Appendix D).
6) Upper Marguerite Creek: Marguerite Creek approximately 6.4 miles upstream from the Middle Marguerite Creek station and approximately 2.4 miles below the headwaters.

The USGS gage station has been monitored from 2003 to the present for stream flow, sediment load (suspended solids), and temperature. Site locations were determined from initial development plans in 2002. The plan was to monitor Marguerite Creek above and below the project, within the project area at logical locations where access was available, and to monitor major tributaries. Sites above and below the project became Upper Marguerite and Bottom Marguerite, respectively. Middle Marguerite was located above the only trail in the area which has since become the main road; Lower Marguerite was located above Emma Creek which was considered an important tributary at the time. Bonanza Creek was considered an important tributary because it drains the north side of Jumbo Dome and has a different chemical signature from Marguerite Creek, and might influence the sample from Bottom Marguerite Creek.

As mine plans evolved, the Upper Marguerite site was dropped and the Middle Marguerite site became the monitoring location above the project. Similarly, Emma Creek, Bottom Marguerite, and Bonanza Creeks were dropped from regular monitoring because they were considered well outside of the evolving mine plan. Lower Marguerite became the downstream monitoring location below the project.[5]

2.1. Project Data Objectives

2.1.1. Site Specific Area of Concern

The selection of the Middle and Lower Marguerite Creek monitoring stations is considered to be representative of the area of concern for the following reasons:

1. Developed at a scale appropriate to the area of concern for the wastewater discharge permit for the Usibelli Jumbo Dome project;
2. Established in locations that are minimally or undisturbed by human activities;
3. Include a permanent benchmark (USGS gage site) for past reference;
4. Strategically located to isolate degree of potential influence on Marguerite Creek

[5] Per email communication with Jim Vohden. Provided by Jade North on 06-02-16

5. Developed by a professionally-trained hydrologist.

2.1.2. Representativeness of data

DEC finds the data submitted for this project reasonably characterizes the natural conditions because:

1. There are not significant anthropogenic sources of the pollutant upgradient or within the watershed at the time of the study (see Section 1.2).
2. The Upper, Middle and Lower Marguerite Creek sites have similar stream geomorphology.
3. The data is temporally represented as collection took place over a 13 year timespan.
4. The data is spatially representative as collection took place above, below, and within tributaries that have the potential to influence manganese concentrations in the area of concern.
5. The data is representative of the range of flow conditions that could occur.
6. The data includes seasonal and temporal variability.

Eighty water quality samples have been taken from the representative sampling stations and analyzed for manganese (Table 3).

2.2. Summary of Existing Data

Upper Marguerite Creek was sampled a total of five times. A maximum recorded concentration of 0.340 mg/L was recorded. 100% of the samples exceeding the HHC of 0.05 mg/L criteria and 100% exceeding the 0.1 mg/L criteria. The irrigation criteria was exceeded by two of the five samples for an average of 40%. Middle Marguerite Creek was sampled a total of 40 times with a maximum recorded concentration of 0.783 mg/L. 100% of the samples exceeding the HHC of 0.05 mg/L criteria and 70% (n=28) exceeding the 0.1 mg/L criteria. The irrigation criteria was exceeded by (five of the samples for an average of 12.5%. Lower Marguerite Creek had 35 samples with a maximum concentration of 0.620 mg/L. 100% of the samples exceeded the HHC 0.05 mg/L criteria and 80% (N=28) exceeding the 0.1 mg/L criteria. The irrigation criteria was exceeded by four of the 35 of samples resulting in a percentage of 11.4%. Sampling locations are noted in Appendices D-G.

Table 3. Summary of manganese concentrations (mg/L) observed in the Marguerite Creek Watershed (2002-2014) and comparison to manganese criteria. (Tetra Tech, 2015)

Reach	Manganese Concentration (mg/L)				Distribution Statistics			Percent of Samples Exceeding Manganese Criteria (mg/L)		
	Minimum	Maximum	Average	Median	CV	SD	N	0.05	0.1	0.2
Upper Marguerite Creek	0.160	0.340	0.234	0.166	0.42	0.10	5	100	100	40
Middle Marguerite Creek	0.057	0.783	0.153	0.123	0.81	0.12	40	100	70	12
Lower Marguerite Creek	0.079	0.620	0.152	0.125	0.64	0.10	35	100	80	11
Combined Marguerite Creek	0.057	0.783	0.157	0.125	0.71	0.11	80	100	76	14

CV = Coefficient of variation (i.e., standard deviation divided by the average).
SD = Standard Deviation
N = Number of samples

Average manganese concentrations in Marguerite Creek indicate levels at or near the Alaska irrigation standard of 0.2 mg/L. Occasionally there are exceedances well above the state standard (e.g. 0.783 mg/L) that occurred during periods of high flow when a higher proportion of the streamflow comes from suspended sediment. At the watershed level, manganese concentrations are exceeded even more frequently (see Table 4; Figures 6). The manganese levels are exceeded in the Marguerite Creek watershed due to natural causes because there are no other contributing factors.

Data is suggestive that seasonal spikes in metal concentrations are common throughout this region of Alaska given the erosive nature of the landscape and mineral rich soils. Table 4 and Figures 6 and 7 illustrate high manganese levels in Marguerite Creek and two of its tributaries; Emma Creek and Bonanza Creek. Sampling has indicated average levels of manganese in Emma Creek are around 0.300 mg/L, with occasional spikes above 0.600 mg/L (three times the state standard). Data from Bonanza Creek indicate a range of manganese values from 0.058 mg/L to 0.663 mg/L, which are also above the manganese criterion.

Table 4. Summary statistics for manganese concentrations measured from the Marguerite Creek watershed (Marguerite Creek, Emma Creek, and Bonanza Creek) (mg/L total manganese). (Tetra Tech 2015)

	Marguerite Creek	Emma Creek	Bonanza Creek
Minimum	0.057	0.001	0.058
Maximum	0.783	0.618	0.663
Average	0.157	0.299	0.218
Median	0.125	0.302	0.134
CV	0.071	0.353	0.881

Figure 6. Summary of the frequency with which manganese concentrations (mg/L) were observed to be equal to or exceed Alaska WQS at sampling sites in the Marguerite Creek watershed between 2002 and 2014. The red vertical lines are the Alaska water quality criteria for manganese of 0.05 mg/L, 0.1 mg/L, and 0.2 mg/L. respectively (Tetra Tech, 2015).

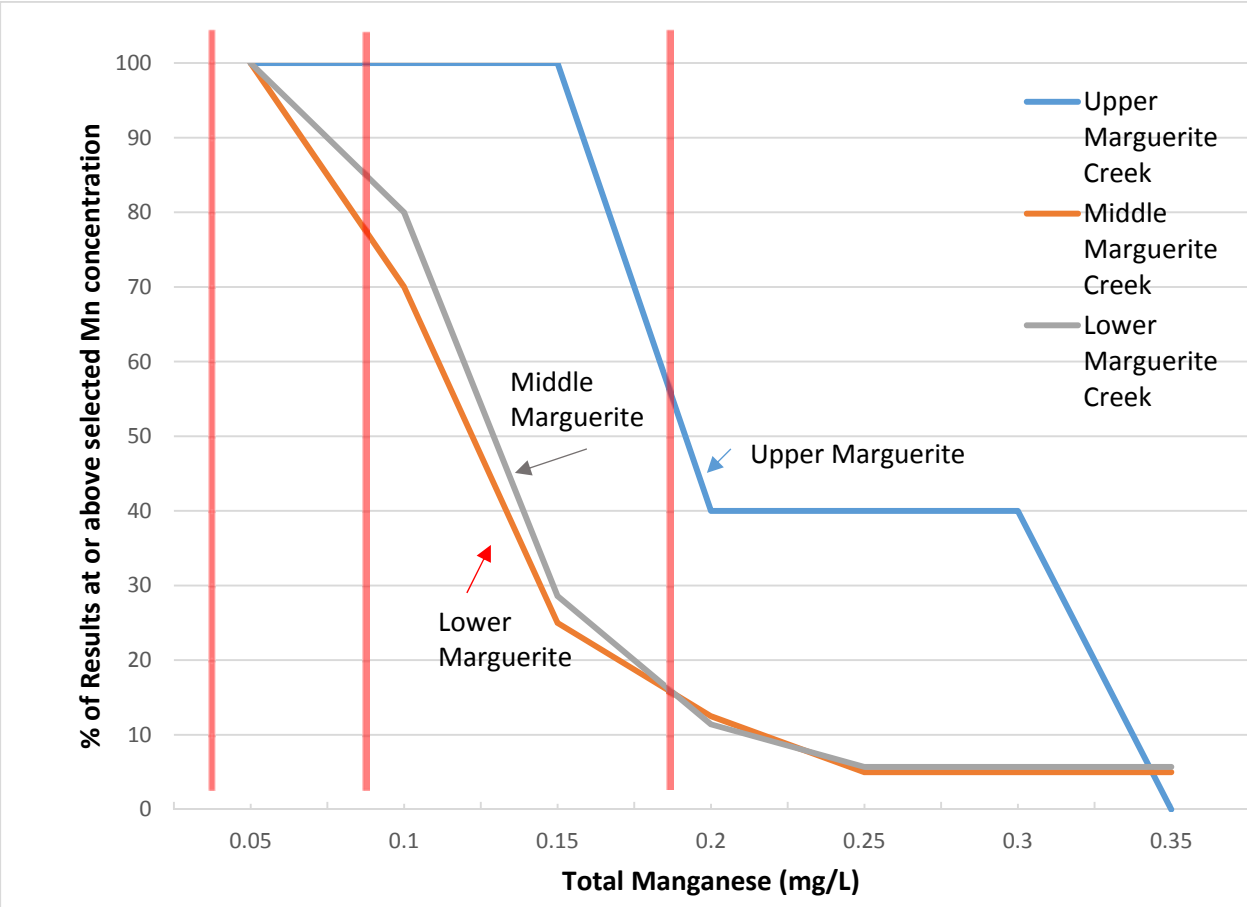


Figure 7. Minimum, maximum, average, and median concentrations of manganese recorded from upper, middle, and lower Marguerite Creek. Red horizontal lines are the Alaska water quality criteria for manganese of 0.05 mg/L, 0.1 mg/L, and 0.2 mg/L. (Tetra Tech, 2015)

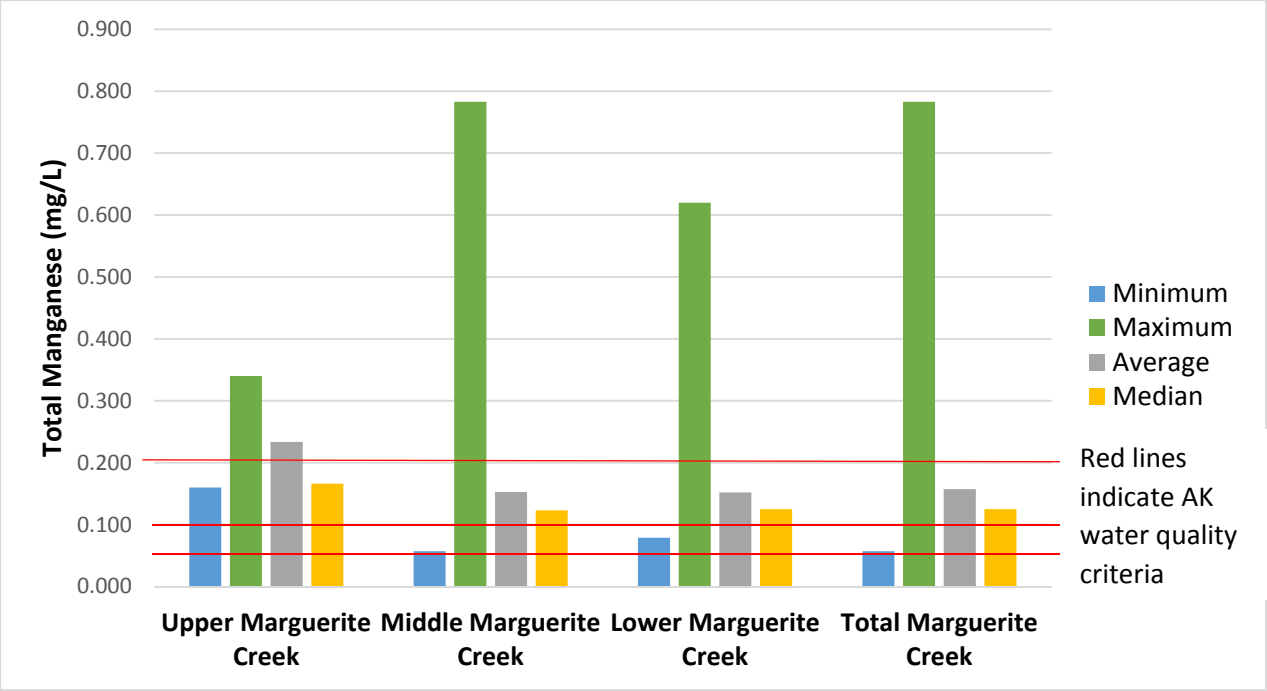
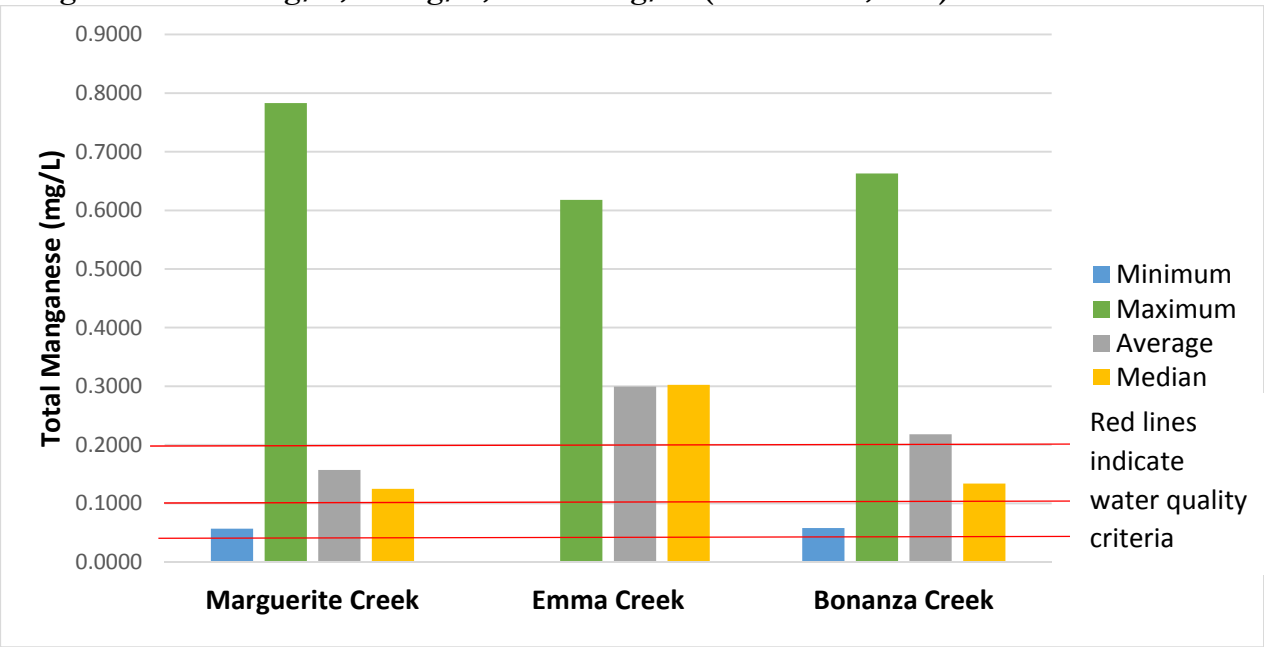


Figure 8. Manganese concentrations in Marguerite Creek and two of its tributaries, Emma Creek and Bonanza Creek. Red horizontal lines indicate Alaska water quality criteria for manganese of 0.05 mg/L, 0.1 mg/L, and 0.2 mg/L. (Tetra Tech, 2015)

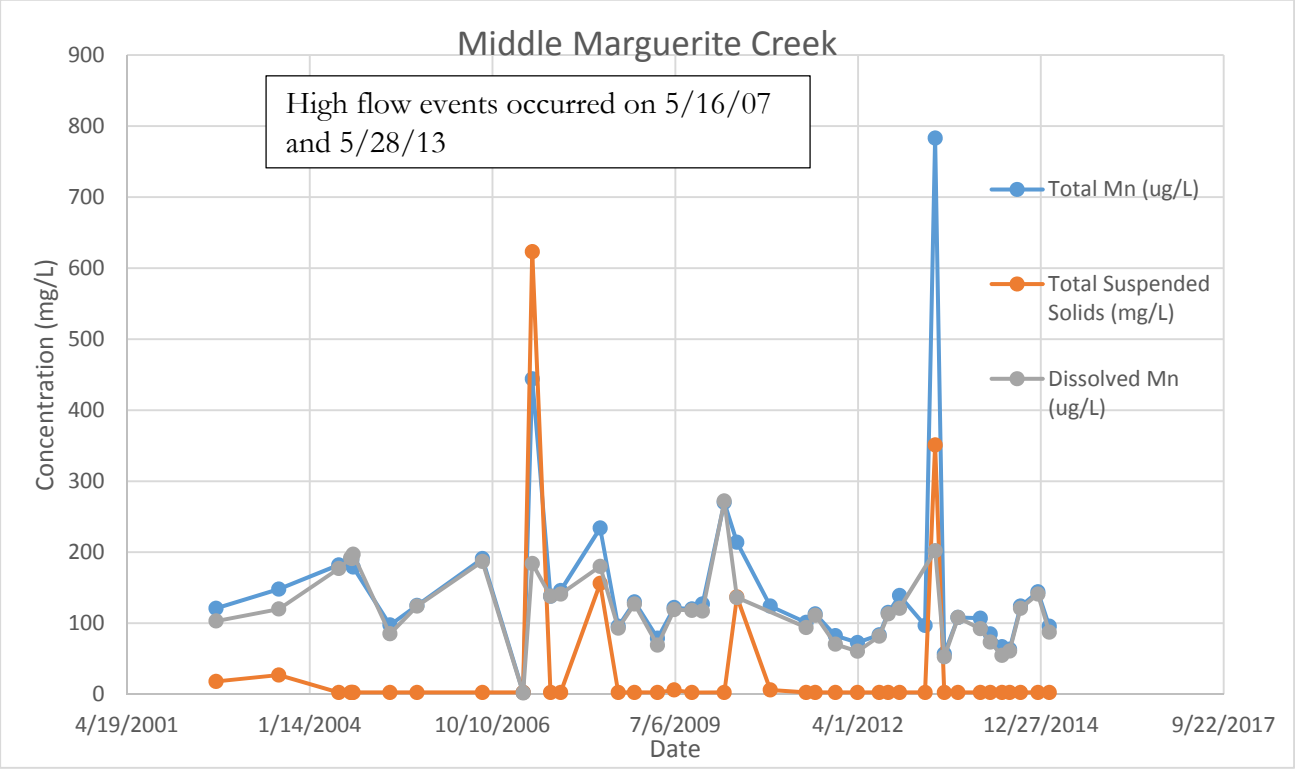


3. SOURCES OF MANGANESE

Manganese is a hard, brittle, grayish-white metal widely distributed in the Earth's rocks. The association of manganese in carbonate rocks, including coal deposits is well documented as manganese is released into water through erosion. Manganese-rich deposits of siderite, a mineral commonly associated with coal, is common in fresh-to brackish water subaqueous sediments that overlie coal. This is especially the case for coals formed in wet, tropical environments (Larsen and Mann, 2005). The majority of coal associated with the Jumbo Dome region is subbituminous and contains 0.16% magnesium oxide as determined by ash analysis.[6]

As stated above, streams in this area of Alaska are characterized by naturally-occurring episodically (flow-based) high sediment loads and correspondingly elevated concentrations of metals and other constituents. The natural geologic conditions in the area cause a high level of turbidity, suspended solids, and elevated levels of metals in the water. DEC reviewed the total suspended solids (TSS) data along with Manganese concentrations for the middle and lower reaches. The review shows that during the high spring flood flows, which presumably mobilize significant sediment and runoff, are associated with significant spikes in Manganese concentrations.

Figure 9: Total and Dissolved Manganese and TSS concentrations (mg/L) over time in Middle Marguerite Creek



[6] Information from http://www.usibelli.com/Coal-data.php. Downloaded on 05-26-16.

Figure 10: Total Manganese and TSS concentrations (mg/L) over time in Lower Marguerite Creek

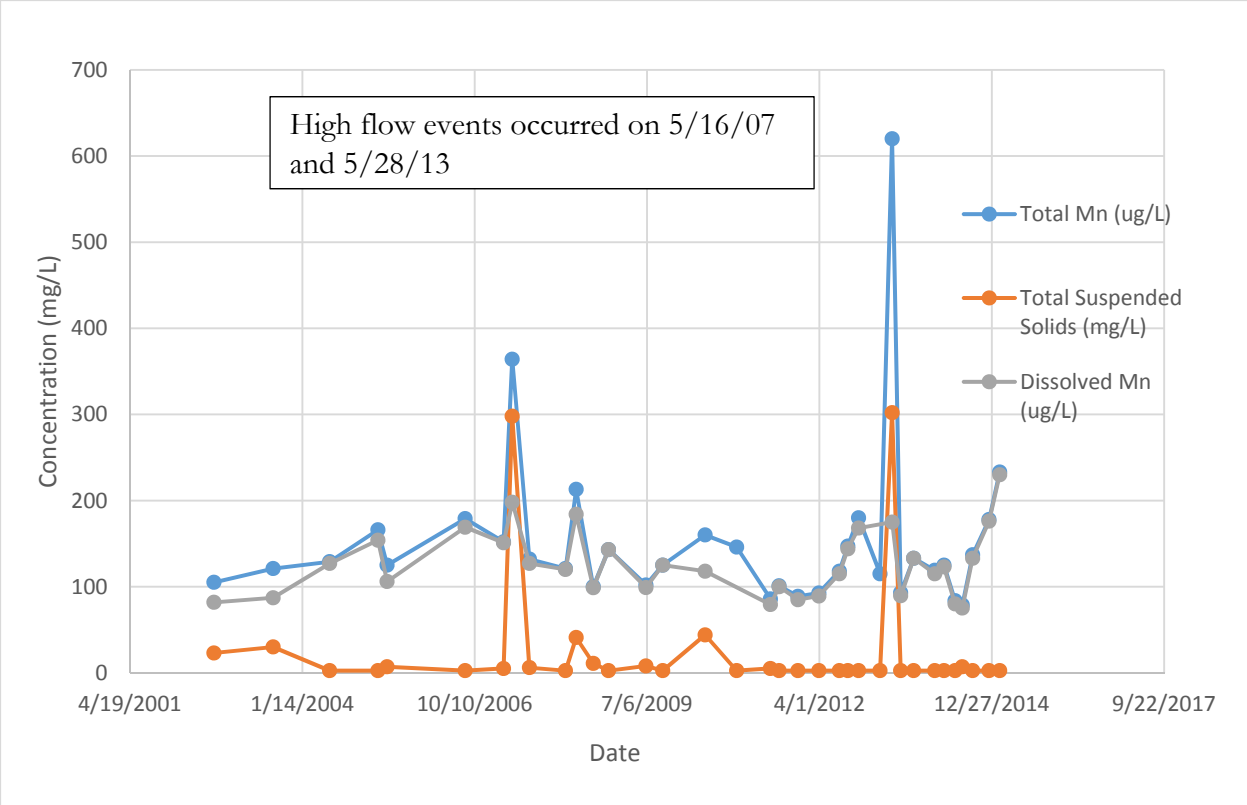
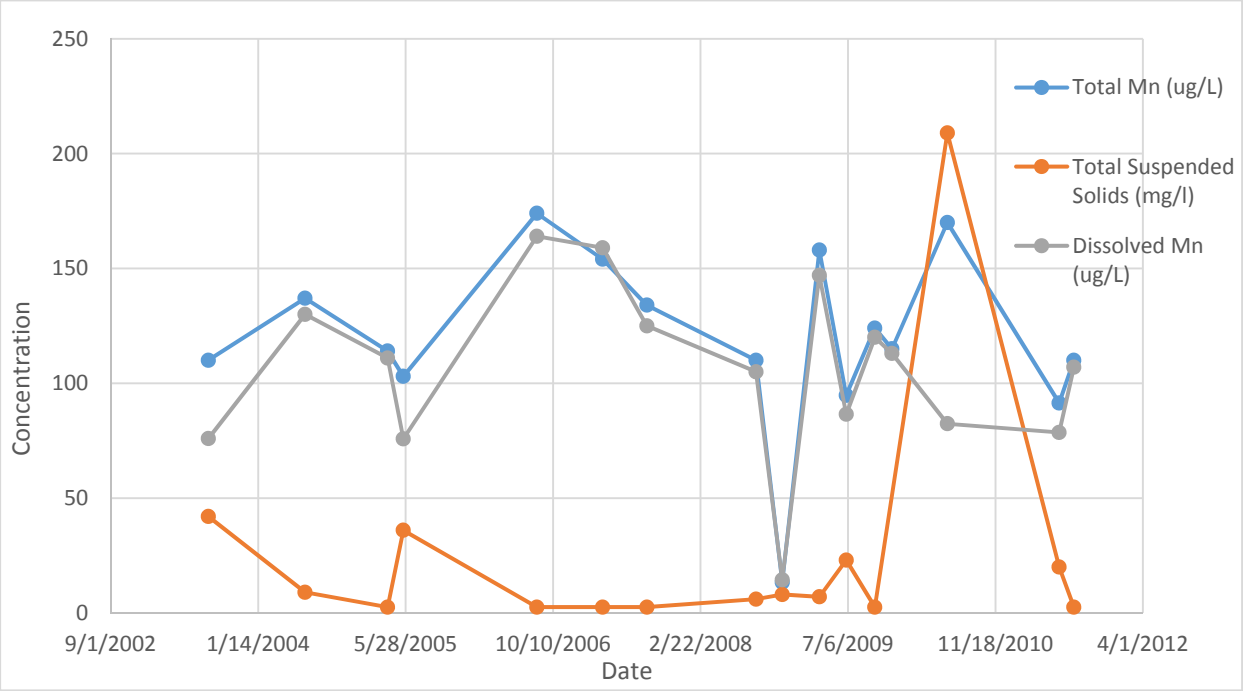


Figure 11: Total Manganese (µg/L) and TSS (mg/L) over time in Bottom Marguerite Creek



However, Bottom Marguerite Creek does not experience the same relationship between manganese and TSS (Figure 11). The slope of the creek (Figure 6) steadily diminishes from the Middle Marguerite Creek sampling station to at the Bottom Marguerite Creek sampling station. This would account for the reductions in the recorded amount of the total manganese present when evaluating concentrations by station location as TSS settles out of the water column as the speed of flow decreases.

Undissolved manganese (i.e., total – dissolved concentrations) is compared with stream discharge for Upper, Middle and Lower Marguerite Creek sites in Figure 12. The undissolved sediment is a significant component of the total manganese concentration at high flows.

Figure 12. Discharge and Undissolved Manganese (mg/L) in Upper, Middle and Lower Marguerite Creek

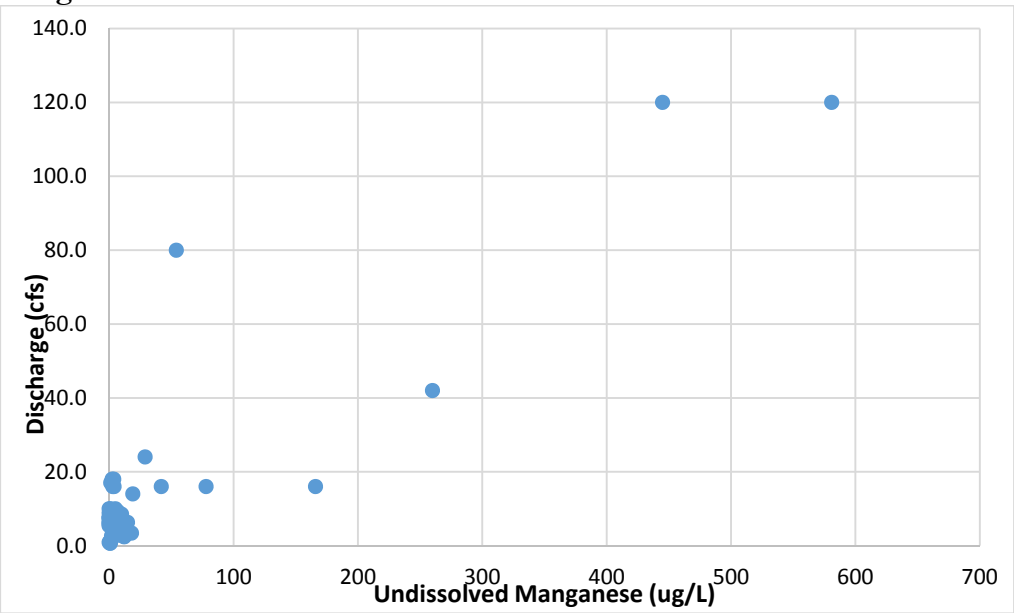


Table 5 provides a summary of selected water quality measurements. Figure 13 shows that turbidity is correlated with stream discharge. However, total manganese does not appear to increase with an increase in stream discharge (Figure 14). Studies performed for Usibelli Coal Mine Inc. (Jumbo Dome Mine Permit Application; Usibelli, 2012) indicate that the groundwater in the area was mildly acidic with a pH range of 6.3 to 7.8 with a high level of dissolved solids. Manganese was measured at levels above Alaska WQS, which is attributed to the natural conditions of the area; specifically groundwater with additional manganese in the suspended sediment during high flow events. The manganese concentrations above Alaska criteria were found at all sampling stations including above and below coal seams 3 and 4 (Appendix C).

Table 5. Selected water quality measurements from sites along Upper, Middle and Lower Marguerite Creek. (Tetra Tech, 2015)

						Percentile			
Parameter	**Sample Size**	**Average**	**Median**	**Min**	**Max**	**10th**	**25th**	**75th**	**90th**
Hardness (mg/L)	76	67.3	61.2	24.1	537	41.1	54	68.6	79.1
pH (Field)	69	7.4	7.4	6.2	9.0	6.6	7.0	7.8	7.9
pH (Lab)	40	7.4	7.5	6.7	8.0	7.0	7.2	7.7	7.8
Turbidity (Field) (NTU)	34	12.2	4.1	1.2	261	2.5	3.4	6.4	8.2
Turbidity (Lab) (NTU)	41	26.4	4.6	0.4	301	2.5	3.3	7.4	112
TSS (mg/L)	75	29.9	2.5	2.5	623	2.5	2.5	6.0	42.2
TDS (mg/L)	75	122	114	17.0	1030	81.8	96.0	130	141
Alkalinity (mg/L as CaCO3)	72	64.9	60.1	16.3	475	37.0	50.3	67.5	75.6
Total Manganese (mg/L)	76	0.152	0.125	0.057	0.783	0.083	0.10	0.16	0.22
Dissolved Manganese (mg/L)	73	0.122	0.120	0.0017	0.272	0.073	0.089	0.158	0.195
Daily Average Flow Rate (cfs)	74	12	6.7	0.65	120	2.5	3.4	9.2	17

Figure 13. Stream Discharge and Turbidity (NTU) in Upper, Middle, and Lower Marguerite Creek. (Tetra Tech, 2015)

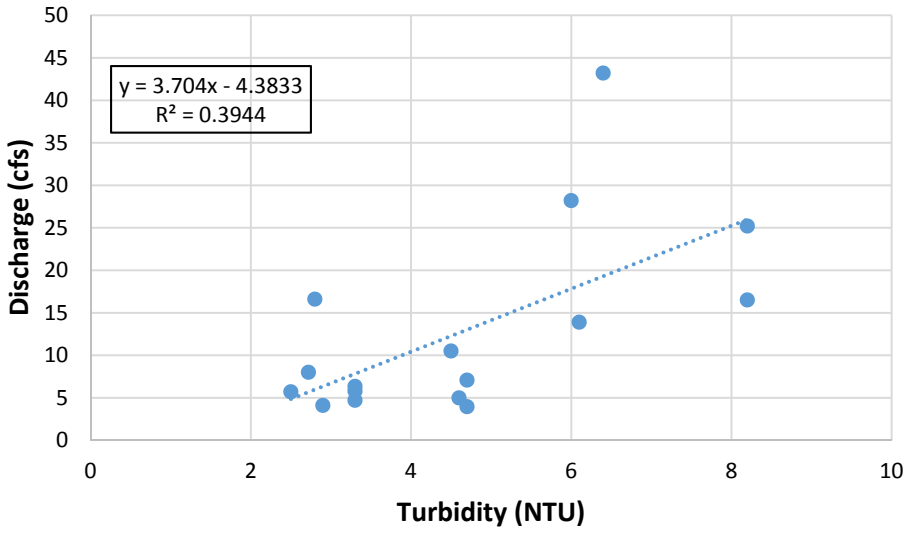
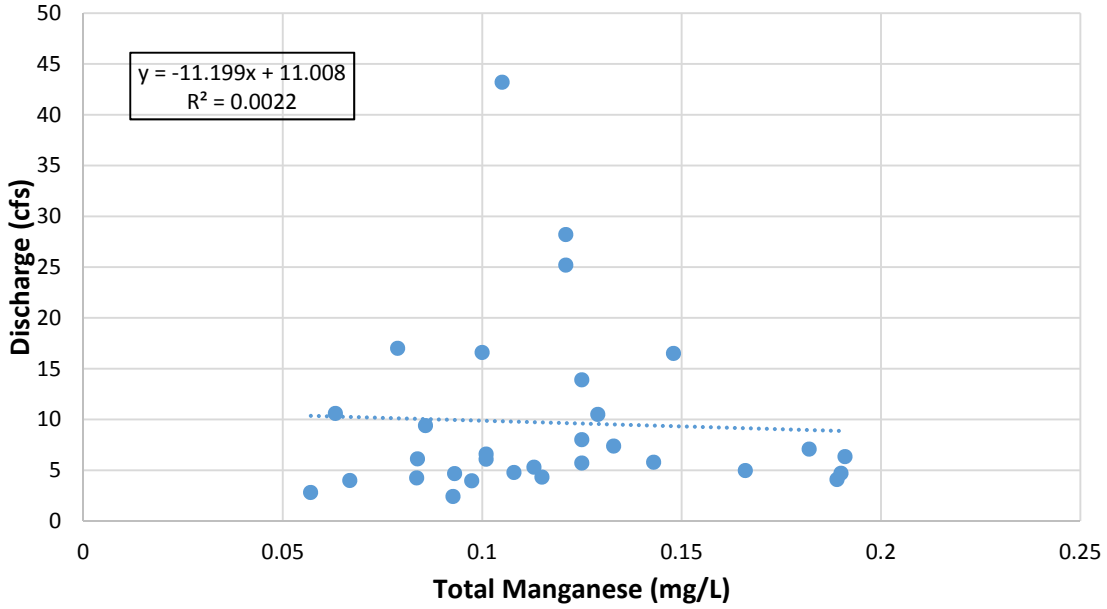


Figure 14. Stream Discharge and Total Manganese (mg/L) in Upper, Middle, and Lower Marguerite Creek. (Tetra Tech 2015)



However, when undissolved manganese (i.e., total – dissolved concentrations) is compared with stream discharge for Upper, Middle and Lower Marguerite Creek sites, the sediment is a significant component of the total manganese concentration during high flow events and is correlated with flow.

Figure 15. Stream Discharge and Dissolved Manganese concentrations (mg/L) in Upper, Middle, and Lower Marguerite Creek

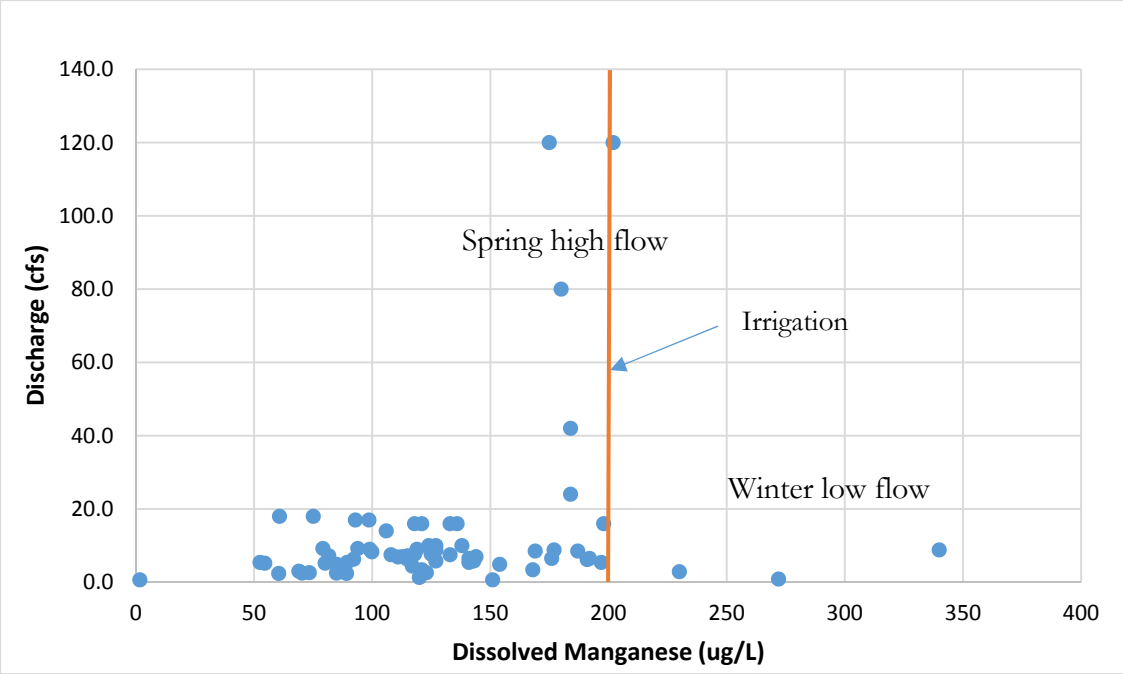
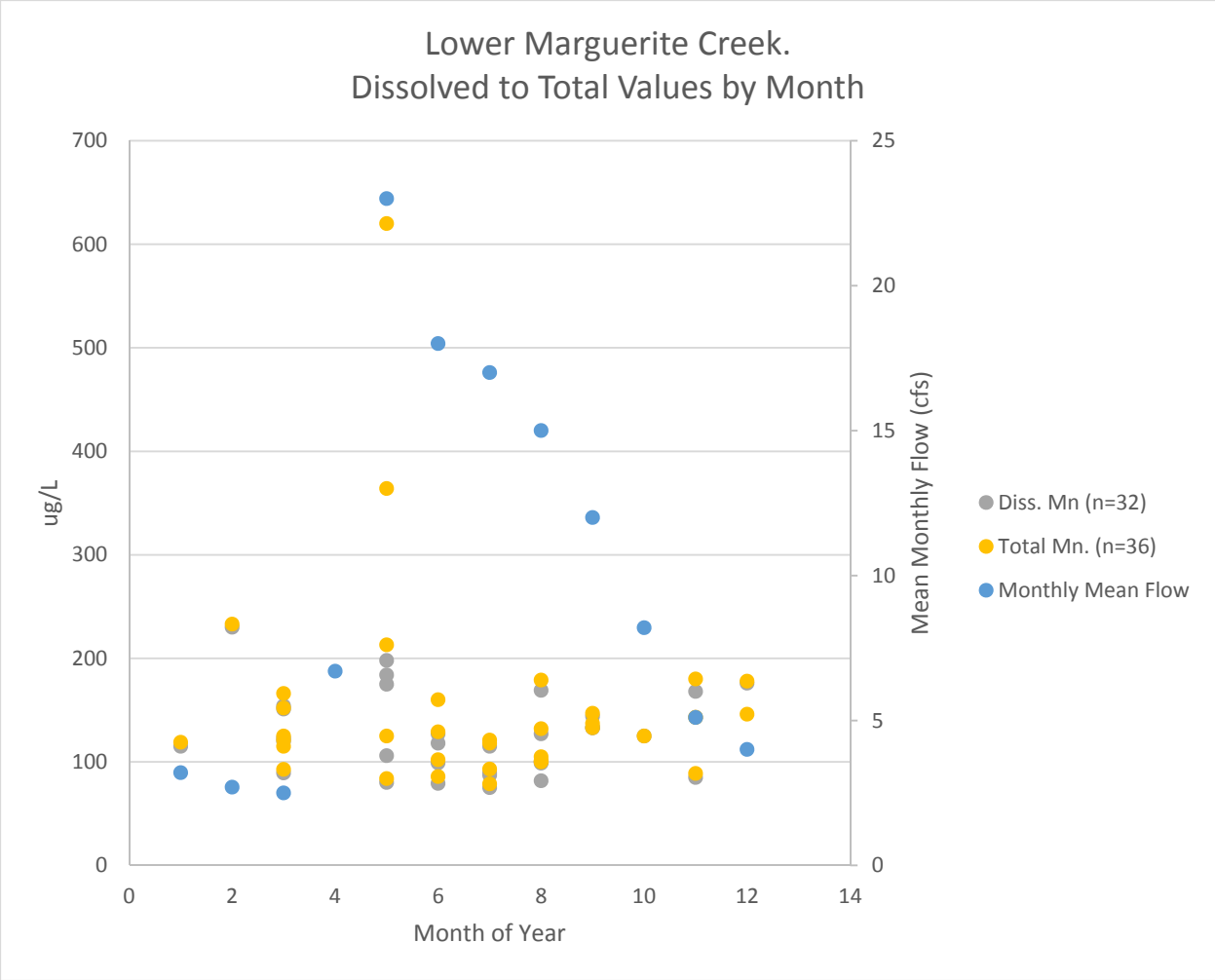


Figure 15 shows that dissolved manganese concentrations are generally higher during base flow conditions in late winter. This is attributed to groundwater, which in the mine area is mostly conveyed by the coal seams. The isolated events where high flow and elevated concentration of manganese coincide during spring high flow events which flush out groundwater that has leached manganese from the substrate during winter months. During the summer growing season (June 1 to September 1) after spring high flow, dissolved manganese does not exceed the irrigation criterion of 0.2 mg/L for the agriculture use (Figures 15 and 16). The highest total manganese concentration events tend to occur in May or early June during high flow spring snowmelt runoff events when winter groundwater is flushed and mixed with high sediment loads (Figures 9 and 10 and 16). Mean monthly flow values were established from daily data taken between 2004 and 2016 from USGS gage 15515060.[7]

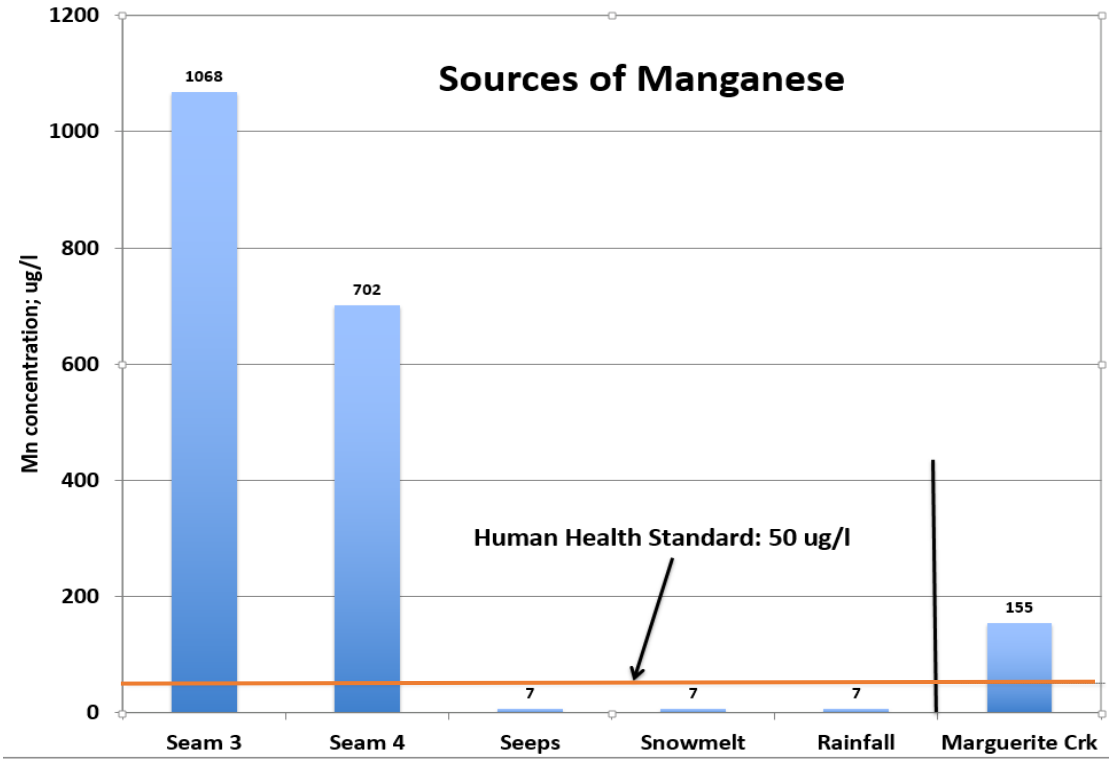
Figure 16. Dissolved and Total Manganese Concentrations (ug/L) by Month

[7] Information from:
http://waterdata.usgs.gov/ak/nwis/monthly/?referred_module=sw&site_no=15515060&por_15515060_1=2205944,00060,1,2004-03,2016-04&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list
Downloaded on 6-10-16.



Throughout the Marguerite Creek basin, the primary aquifers tend to be coal seams with permeability controlled by fractures within the coal. Groundwater recharge comes from annual precipitation, including snowmelt, and generally contributes to surface water flows where the drainage valleys intersect the coal outcrops. Surface water flow in the winter months come from groundwater discharge based on the temporal/seasonal surface flow characteristics (See Figure 3) and below freezing (32°F) average ambient air temperatures during the colder months. Groundwater in the area is demonstrated to have naturally occurring concentrations of manganese that exceed EPA's secondary drinking water standard as well as Alaska's human health criteria (water consumption plus organism). Figure 17 and Appendix C depict coal seam and seep sampling data for Marguerite Creek.

Figure 17. Supplemental information submitted with the 2016 APDES permit application



It is also useful to consider a regional view of manganese contribution from the SSC area to the watershed. Table 4 shows that Emma Creek has close to twice the average manganese concentration of Marguerite Creek (157 ug/l, and 299 ug/l). It also shows that Bonanza Creek averages approximately 40% higher concentrations (218 ug/). Further, within a few miles of the SSC area, the flow of Marguerite Creek is increased by these tributaries (with higher manganese concentrations). Marguerite Creek above Emma Creek is only 50% of the total watershed after the confluence with Emma and Bonanza Creeks. It is reduced to a quarter of the watershed by the confluence of other creeks which form California Creek.

4. STATE AND FEDERAL WATER QUALITY REGULATORY FRAMEWORK

Alaska's WQS list three classes and six subclasses of designated uses of the State's fresh water (18 AAC 70.020, (updated February 19, 2016). These classes of protected water uses are:

1. Fresh water
    A. Water supply
        i. drinking, culinary, and food processing
        ii. agriculture, including irrigation and stock watering
        iii. aquaculture
        iv. industrial

    B. Water recreation
        i. Contact recreation
        ii. Secondary recreation

    C. Growth and propagation of fish, shellfish, other aquatic life, and wildlife (i.e., aquatic life)

There are three criteria for manganese in the Alaska WQS (Table 6) which are adopted by reference in 18 AAC 70.020(b)(11) Toxic and Other Deleterious Organic and Inorganic Substances, for Freshwater Uses (ADEC 2016). The manganese criteria are listed in the *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances* (ADEC 2008).

The manganese criterion for human health for consumption of water and aquatic organisms is applied under the use for (A)(i) Water Supply – drinking, culinary and food processing. The manganese criterion for human health for consumption of aquatic organisms is applied under the use for (C) growth and propagation of fish, shellfish and other aquatic life. The manganese criterion for irrigation is applied under the use for (A)(ii) Water Supply – agriculture, including irrigation and stock watering.

Table 6. Alaska Water Quality Uses and Criteria for Manganese (values as total recoverable metal)**.**

Designated Use for Fresh Waters	Type of Criteria	Manganese Criteria (mg/L)
(A) Water supply (i) drinking, culinary and food processing	Human Health for the Consumption of Water + Aquatic Organisms	0.050
(A) Water supply (ii) agriculture, including irrigation and stock watering	Irrigation Water	0.20
(C) Growth and propagation of fish, shellfish, other aquatic life and wildlife	Human Health for the Consumption of Aquatic Organisms Only	0.10

4.1. Alaska Water Quality Criteria for Manganese

The Alaska Department of Environmental Conservation (ADEC) sets the water quality criteria based on EPA's recommendations and the best available science that work for Alaska-specific conditions.

4.1.1. Human Health Criterion: Consumption of Water and Aquatic Organisms (0.050 mg/L)

EPA's 1976 and 1986 *Quality Criteria for Water* (referred to as the "Red Book" and "Gold Book," respectively) established 50 µg/L as the recommended water quality criterion for manganese for protection of domestic water supplies. This criterion was established to protect against objectionable tastes and laundry staining. The Red Book provides that, "a criterion for domestic water supplies of 50 µg/L [for manganese] should minimize the objectionable qualities" (text in brackets added). EPA's recommendation for manganese in Water Quality Criteria 1972 (EPA, 1973) specified that 0.05 mg/L (50 µg/L) soluble manganese not be exceeded in public water sources based on user preference. One study found that consumer complaints about brownish staining of laundry and objectionable tastes in beverages arise when manganese exceeds 150 µg/L (Griffin, 1960 in EPA Red Book). The Red Book also notes that manganese concentrations of 10 to 20 µg/L are acceptable to most consumers (Oregon, 2010).

EPA suggests a manganese WQS of 0.05 mg/L for domestic water supplies (1986) based on organoleptic or aesthetic qualities (*i.e., taste, color, and odor)* of the water and not based on human health effects. When manganese exceeds 0.15 mg/L in domestic water supplies, people often complain of objectionable water flavors and discoloration of laundry.

EPA addressed such organoleptic criteria in its Human Health Water Quality Criteria guidelines (EPA 2000):

Organoleptic criteria define concentrations of chemicals or materials which impart undesirable taste and/or odor to water. Organoleptic effects, while significant from an aesthetic standpoint, are not a significant health concern. In developing and utilizing such criteria, two factors must be appreciated: (1) the limitations of most organoleptic data; and (2) the non-human health significance of organoleptic properties. In the past, EPA has developed organoleptic criteria if organoleptic data were available for a specific contaminant. The 1980 AWQC National Guidelines made a clear distinction that organoleptic criteria and toxicity-based criteria are derived from completely different endpoints, and that organoleptic criteria have no demonstrated relationship to potential adverse human health effects because there is no toxicological basis. EPA acknowledges that if organoleptic effects (i.e., objectionable taste and odor) cause people to reject the water and its designated uses, then the public is effectively deprived of the natural resource. It is also possible that intense organoleptic characteristics could result in depressed fluid intake which, in turn, might lead to an indirect human health effect via decreased fluid consumption. Although EPA has developed organoleptic criteria in the past and may potentially do so in the future, this will not be a significant part of the water quality criteria program. EPA encourages the development of organoleptic criteria

when States and Tribes believe they are needed. However, EPA cautions States and Tribes that the quality of organoleptic data is often significantly less than that of toxicological data used in establishing health-based criteria. Therefore, a comprehensive evaluation of available organoleptic data should be made, and the selection of the most appropriate database for the criterion should be based on sound scientific judgment.

Human Health Criteria are designed to protect an individual's ability to consume untreated surface water and aquatic life for the duration of a 70-year lifetime. EPA (ADEC 2003) has recommended the use of a modifying factor of three when assessing chronic exposure to manganese from drinking water. This results in a chronic RfD of 0.047 mg/kg-day value. This recommended value is based on data that suggest fasting individuals may be more susceptible to absorption of manganese, concerns associated with a lifetime consumption of drinking water containing 2 mg/L of manganese, potential neonatal effects in animal studies, and the presence of additional sources of manganese in infant formula.

In 2004 EPA developed a Lifetime Health Advisory (HA) of 0.3 mg/L for manganese in drinking water (EPA, 2004) that is protective of human health. The HA for manganese is designed to be protective against long-term, non-cancerous human health effects. The Lifetime HA is based on several factors including (1) the reference dose (RfD) which is established by EPA and estimates the daily exposure to manganese that is not likely to cause adverse human health effects following chronic exposure, and (2) a Drinking Water Equivalent Level (DWEL) that uses the RfD to determine the concentration of manganese that would be necessary to fulfill the RfD, assuming all exposure occurred via drinking water. The HA is then calculated from the DWEL, assuming that drinking water is the source of only 20% of the manganese RfD (rather than 100% as assumed for the DWEL).

4.1.2. Human Health Criterion: Consumption of Aquatic Organisms (0.10 mg/L)

Alaska Water Quality Standards include a human health criterion of 0.1 mg/L manganese for consumption of aquatic organisms only to protect the growth and propagation of fish, shellfish, other aquatic life and wildlife (ADEC 2008). This criterion is based EPA's *Quality Criteria for Water* (USEPA 1986) recommends that a criterion of 0.1 mg/L is appropriate to protect marine organisms from bioconcentrating an amount of manganese that could adversely affect humans who eat marine organisms. EPA recommended the 100 µg/L criterion in 1976, prior to the fish ingestion/bioconcentration factor derivation method, which was published in 1980. The following information is provided in the 1976 criteria document:

- The average human intake of manganese is approximately 10 mg (10,000 µg) per day.
- Very large doses of ingested manganese can cause some disease and liver damage but these are not known to occur in the United States.
- The ambient [marine] concentration of manganese is about 2 µg/L (Fairbridge, 1966). The material is rapidly assimilated and bioconcentrated into nodules that are deposited on the sea

> floor. The major problem with manganese may be concentration in the edible portions of mollusks, as bioaccumulation factors as high as 12,000(µg/L) have been reported (NAS, 1974 in EPA, 1976). In order to protect against a possible health hazard to humans by manganese accumulation in shellfish, a criterion of 100 µg/L is recommended for marine water. (Oregon, 2010)

EPA's 2002 national criteria recommendations still include the 1976 "organism only" criterion for manganese of 100µg/L as a non-priority pollutant due to potential human health concerns related to consuming oysters and other marine mollusks. The EPA criterion was recommended due to concerns about potentially high bioconcentration rates among marine mollusks. Data collected since that time show that bioconcentration factors for manganese in freshwater species are low (i.e., manganese does not accumulate in freshwater aquatic species in appreciable amounts (Oregon, 2010). Grayling are the only subsistence or sport fish that occurs in Marguerite Creek. A review of grayling consumption in the five closest native or partially native villages[8] indicates an average grayling consumption of approximately 1.1 lbs./person/year. This amount is approximately one grayling per household per year. In addition, these villages were between 40 and 146 miles away from the project site. The availability of larger grayling populations with easier access, closer to the villages, plus an inability to access the area is evidence that the humans would not consume fish from Marguerite Creek.

In addition, saltwater mussels survive, grow, and reproduce normally with manganese concentrations much higher than the 0.1 mg/L AK WQS. Aquatic toxicity testing with larval blue mussel (*Mytilus edulis)* suggests that the concentration lethal to half of the test animals (LC_{50}, the endpoint commonly used to describe the acute toxicity of a chemical) is between 10-18 mg/L of manganese (Morgan et al., 1986) or approximately 100 times the Alaska water quality criterion. Even using an acute to chronic ratio (ACR) of 10 (which is greater than the ACR reported for many toxic metals), this information suggests that chronic effects on blue mussels would not occur even at concentrations 10 times the 0.1 mg/L WQS (Tetra Tech, 2015).

Consequently, application of the 0.1 mg/L criterion value for **both** freshwater and marine fish consumption criteria for manganese is not necessarily representative of toxicity to resident species nor human health. Furthermore, no studies linking manganese toxicity and shellfish consumption have been identified by DEC.

EPA's 2002 recommended criteria are designed to protect human health from potentially elevated levels of manganese bioconcentrated in the edible tissues of saltwater mollusks. The recommended criteria are not designed for application to freshwater systems or to protect consumers of fishes or freshwater organisms. However, this water quality criterion has been inadvertently applied by Alaska

[8] Alaska Department of Fish and Game Community Harvest Information Database (http://www.adfg.alaska.gov/sb/CSIS/index.cfm?ADFG=harvInfo.harvestCommSelComm)

to protect human health against potential effects of eating freshwater organisms of all types (including salmonids).

4.1.1. Irrigation Criterion (0.20 mg/L)

DEC has adopted an irrigation criterion of 0.2 mg/L total manganese for agriculture water supply use (ADEC 2008), which is based on EPA's (1973) suggested standard for areas where crop irrigation may occur. In the Red book it is stated, "At concentrations of slightly less than 1 mg/L to a few milligrams per liter, may be toxic to plants from irrigation water applied to soils with pH values less than 6.0. The problem may be rectified by liming soils to increase the pH. Problems may develop with long-term (20 year) continuous irrigation on other soils with water containing about 10 mg/l of manganese (NAS, 1974). But as stated above, manganese rarely is found in surface waters at concentrations greater than 1 mg/L. Thus, no specific criterion for manganese in agricultural waters is proposed. In select areas, and where acidophilic crops are cultivated and irrigated, a criterion of 0.2 mg/l is suggested for consideration". This language is reiterated in the Gold book (1986).

4.2. Natural Condition-Based Site Specific Criteria

40 CFR 131.11(b)(I) requires States and authorized Tribes to adopt numeric water quality criteria that are based on section 304(a) criteria. Section 304(a) criteria may be modified to reflect site specific conditions, or other scientifically defensible methods. EPA recognizes there may be naturally occurring concentrations of pollutants which may exceed the national criteria published under section 304(a) of the CWA. EPA memo from Tudor Davis (USEPA 1997) regarding the establishment of site specific aquatic life criteria equal to natural background states,

> "For human uses, where the natural background concentration is documented, this new information should result in, at a minimum, a re-evaluation of the human health use designation. "

Alaska WQS for natural condition-based site specific criteria in 18 AAC 70.235(b) states:

> "(b) If the department finds that the natural condition of a waterbody is demonstrated to be of lower quality than a water quality criterion set out in 18 AAC 70.020(b), the natural condition constitutes the applicable water quality criterion. Upon application or on its own initiative, the department will determine whether a natural condition should be approved as a site-specific water quality criterion. Before making the determination, the department will issue public notice of a proposed approval under this subsection and provide opportunity for public comment. If a natural condition varies with time, the natural condition will be determined to be the prevailing highest quality natural condition measured during an annual, seasonal, or shorter time period before discharge or operation, or as the actual natural condition measured concurrent with discharge or operation. The department will, if necessary to adequately protect water quality,

(1) determine a natural condition for one or more seasonal or shorter periods to reflect variable ambient conditions; and

(2) require additional or continuing monitoring of natural conditions as a condition of a permit, certification, or approval."

Alaska WQS defines a natural condition in 18 AAC 70.990(41) as:

> "*Natural Condition*" means any physical, chemical, biological, or radiological condition existing in a waterbody before any human-caused influence on, discharge to, or addition of material to, the waterbody."

The natural condition-based site specific criteria regulation in 18 AAC 70.235(b) requires that DEC first determine that "the natural condition of a water of the state is of lower quality than the water quality criteria." Following that determination, "the natural condition constitutes the applicable water quality criterion."

A watershed need not be in a pristine state, however, to warrant a finding that water quality reflects the natural condition. In watersheds that are predominantly in a natural state, but include limited human activity, such as occasional personal or recreational use, or contain only minor human development, such as hiking trails or a small number of roads and road crossings that are not believed to contribute to the pollutant of concern, water quality may still reflect the natural condition. The level of human use must be limited such that it is not expected to have any measurable effect on the natural condition of the parameter being considered. The "natural condition" is a relative concept that may include minor human activity or development, but excludes watersheds with pervasive hydrologic or riparian changes.

In determining whether the quality of a waterbody reflects its natural condition, DEC staff will consider:

- The nature extent, and intensity of any human use and development within the watershed,
- Whether human use and development is historic or continuing,
- Whether the types of human use and development are generally known to affect the specific water quality parameters that fall outside of the water quality criteria-based standards, and
- Whether the natural condition can be monitored concurrently using an upstream natural condition site and one or more downstream discharge monitoring site(s) with similar stream geomorphology, or
- If concurrent upstream data is not available, the quality of the subject waterbody is similar to that of other waterbodies known or believed to reflect a natural condition.

A finding that the quality of a waterbody reflects its natural condition must include:

- An explanation of why human activities in a watershed are not directly or indirectly the cause of the exceedances of a water quality criteria for the pollutant of concern,
- Evidence that there has been minimal human activity in the watershed that would affect the water quality parameter in question, and
- An explanation as to how natural processes are adequate to explain the observed exceedances of the water quality criteria for the pollutant of concern.

5. DEC DETERMINATION OF A NATURAL CONDITION-BASED SITE SPECIFIC CRITERION

DEC has reviewed the information and water quality data for Marguerite Creek watershed near Healy, Alaska. Under 18 AAC 70.235(b), DEC makes the following findings regarding a SSC for manganese.

5.1. Applicability

DEC finds that application of SSC for manganese in Marguerite Creek, Alaska from 148°45'44" to 63°58'31"N (Middle Creek Sampling Station) to 63°58'31W and 64°0'39" (Emma Creek Confluence) is consistent with state regulation and scientific documentation as described in Sections 2 and 3.

5.2. Natural Condition Finding

In accordance to 18 AAC 70.235(b) Site Specific Criteria (ADEC 2003), DEC finds that the natural conditions of Marguerite Creek is demonstrated to be of lower quality than the water quality criterion for manganese set out in 18 AAC 70.020(b), and that the natural condition constitutes the applicable water quality criterion.

5.2.1. Evaluation of Historic and Ongoing Human Activities

DEC finds that the water quality of Marguerite Creek reflects the natural condition. As presented in Sections 1.1 and 1.2, the only historic or ongoing human activity is limited to infrequently used trails associated with mineral exploration. There are no historic or ongoing residential, recreational, subsistence, commercial, or industrial, exploration upgradient of the natural condition monitoring site at Middle Marguerite Creek. Prior to constructions of the Jumbo Dome Project in 2016, the data from Upper and Lower Marguerite Creek sites also reflects a natural condition and similar stream characteristics to the Middle Marguerite Creek site.

The remote nature of the site and control of land uses under the state mining land lease will preserve the natural condition of the monitoring sites. Starting in 2016, ongoing permitted wastewater discharge will be monitored at the Lower Marguerite Creek site to determine exceedance of the site specific criterion.

5.2.2. Evaluation of Natural Processes

DEC finds that natural processes are adequate to explain the observed exceedances of the water quality criteria for manganese as documented by Usibelli Coal and its contractors. Water quality sampling was conducted by a professional hydrologist at a series of reference sites designed to best characterize the water quality within the stream reach of the SSC and including additional watershed data from up and downstream of the SSC area, tributaries and other external sources of flow (e.g., groundwater) that influence the water quality in Marguerite Creek.

DEC finds that the spatial distribution of water quality monitoring stations are representative of the area of concern and suitable for making a natural condition determination. The locations of the different monitoring stations were based on proximity to location(s) of the project area and associated discharge, and ensures that minimal mixing of the discharge will occur prior to entering Marguerite Creek (Emma and Bonanza Creek respectively), The monitoring locations have similar geophysical characteristics (e.g., coal seams) and stream characteristics that could directly or indirectly influence water quality within the area of concern.

The monitoring locations for the natural condition uses a simple upstream downstream approach within a fairly limited area. The application of data from reference streams outside of the Marguerite Creek drainage is not necessary or feasible, because Marguerite Creek has unique features, such as surface level coal seams and groundwater seeps. The upstream/downstream approach is also consistent with the concurrent monitoring included as part of the APDES permit. To compare values anywhere except above, within the SSC area, and below the area would negate the benefit of establishing natural condition criteria based on historical and concurrent measurement of water quality to determine compliance with the natural condition-based SSC.

DEC also finds that temporal concerns regarding time of year and flow are adequately addressed by the range of data provided by the applicant in Sections 2, 3 and 5.3. The dataset used to generate percentile information was collected over multiple years and characterized the full range of flow conditions. The dataset characterizes seasonal events such as spring high flows and winter low flows sufficient to meet the seasonality analysis required in 18 AAC 70.235(b).

5.3. Site Specific Criterion

In accordance to 18 AAC 70.235(b) Site Specific Criteria (ADEC 2003), DEC finds that the natural condition-based site specific criterion is set at the prevailing highest quality natural condition, or actual natural condition measured concurrent with discharge or operation.

5.3.1. Prevailing Highest Quality Natural Condition

Under the Clean Water Act (CWA), methods are prescribed for determining the potential for exceeding water quality standards, and it's called a Reasonable Potential Analysis (RPA). Consistent with CWA requirements, DEC developed the *APDES Permits Reasonable Potential Analysis and Effluent Limits Development Guide*, which states that the 85th percentile of the background water quality data

characterizes the prevailing lowest quality natural condition for the purpose of conducting reasonable potential analyses for permits. To assure consistency throughout the permit for Jumbo Dome, the site-specific natural condition, which is the prevailing highest quality natural condition, used the inverse of the same definition, i.e. if the 85th percentile defines poor quality then the 15th percentile identifies high quality.

Necessary for preforming an RPA are the most stringent applicable water quality standards. There are seven metals whose most stringent water quality standard depends on the hardness of the background water. For these hardness-dependent standards, when hardness increases the standard increases. To protect the prevailing highest quality, guidance states that the 15th percentile of the receiving water quality should be used to calculate the hardness-dependent water quality standard. For these seven metals, the 15th percentile of the hardness explicitly defines the prevailing highest quality. Since the Jumbo Dome permit must be consistent with guidance and itself. The 15th percentile the ambient water quality demarks the prevailing highest quality natural condition

In cases where no ambient data exists, the ambient or background concentration could be set at zero and often times, depending on the permitting authority, it is. However to be more protective, DEC guidance reduces the assimilative capacity of the receiving water by conservatively setting it at 15 percent of the most stringent applicable water quality criterion. This assumption minimizes the assimilative capacity when compared to the setting unknown background concentrations at zero.

DEC reviewed ambient water quality data for Marguerite Creek collected over 14 years and determined the 15th percentile to be 0.082 mg/L at Middle and Lower Marguerite Creek. This value represents a conservative and consistent approach to establishing a natural condition in the permit. Data collected from the Upper, Middle and Lower Marguerite Creek sites (all natural condition sites) have an average total manganese concentration of 0.15 mg/L with values ranging as high as 0.618 – 0.783 mg/L during spring high flow events. The combined natural conditions data has a 10th percentile of 0.083 mg/L which is higher than the default SSC based on the 15th percentile of data recorded at the Middle Marguerite Creek station (see Appendix F and Table 4).

Per DEC permitting protocols, the 15th percentile SSC value will be re-evaluated upon permit renewal when a larger dataset will be available for consideration. If, at that time, it is determined that the 15th percentile is not an accurate accounting of the ambient water quality conditions, revision of the natural condition criterion may be considered during the permit reissuance or renewal.

5.3.2. Concurrent Measurement of Natural Condition

In addition to the prevailing highest quality natural condition value of 0.082 mg/L total manganese, the SSC also allows a range of instantaneous SSC from 0.082 to 0.30 mg/L total manganese based on concurrent measurement at Middle Marguerite Creek (upstream natural conditions monitoring site) and Lower Marguerite Creek (downstream discharge monitoring site). A concurrent sample taken from Middle Marguerite Creek monitoring station exceeding 0.082 mg/L constitutes the water

quality criterion for manganese. If the Lower Marguerite (discharge) sample is equal to or less than 0.082 mg/L, then the discharge is considered in compliance with the SSC highest prevailing condition consistent with 18 AAC 70.235(b) and discharge permit monitoring. When a sample taken from Lower Marguerite (discharge) exceeds 0.082 mg/L total manganese, then the discharge sample must have a total manganese concentration the is equal to or less than the concurrently collected sample at Middle Marguerite (natural condition) consistent with 18 AAC 70.235(b)(2) concurrent measurement and for the purpose of discharge permit monitoring. The sample in Middle Marguerite Creek monitoring station, must be taken concurrently (within one hour) with discharge monitoring in order to be considered the applicable criterion. If no concurrent sample is available, then the SSC defaults to the highest prevailing highest quality natural condition value of 0.082 mg/L.

5.3.3. Maximum Site Specific Criterion Value

Literature suggests that limiting the concentration of total manganese to 0.30 mg/L or less in freshwater will be protective of any ill health effects from manganese when considering consumption of water and aquatic organisms. To ensure the protection of human health from toxic effects of manganese when considering the consumption of water and aquatic organisms, limiting the concentration of total manganese in freshwater to no more than 0.30 mg/L should be protective based on EPA's most recently published information on this topic. The SSC will include an upper limit (shall not exceed value) of 0.30 mg/L total manganese in order to ensure the discharge does not cause toxic effects. DEC finds that EPA's 0.30 mg/L health advisory (HA) value is an acceptable criterion to apply as a maximum SSC based on the fact that:

- The EPA Lifetime HA is based on the most recent source of reference information.
- A human health criterion based on chronic exposure to manganese rather than acute.
- Any exposure to manganese via surface water consumption would be incidental and that chronic criterion values (0.047 mg/kg-day) consider *daily* (emphasis added) consumption.
- The Lifetime HA continues to allow for exposure from other sources over the course of an individual's lifetime (~70 yrs.) without compromising the allowable RfD.
- The Lifetime HA (0.30 mg/L) accounts for uncertainty regarding any health effects that could occur from chronic exposure to manganese.

A maximum SSC concentration of 0.30 mg/L total manganese is protective of human health and the environment and ensures mine-influenced water will be treated and discharged at safe levels.

5.3.4. Site Specific Criterion Duration and Frequency

To protect human health, the EPA Water Quality Standards Handbook (USEPA 2015) states

> Water quality criteria for human health contain only a single expression of allowable magnitude; a criterion concentration generally to protect against long-term (chronic) human health effects. Currently, national policy and prevailing opinion in the expert community establish that the duration for human health criteria for carcinogens should be derived assuming lifetime exposure, taken to be a 70-year time period. The duration of exposure

> assumed in deriving criteria for noncarcinogens is more complicated owing to a wide variety of endpoints: some developmental (and thus age-specific and perhaps gender-specific), some lifetime, and some, such as organoleptic effects, not duration-related at all. Thus, appropriate durations depend on the individual noncarcinogenic pollutants and the endpoints or adverse effects being considered.

In considering the protection of human health, the SSC for manganese is considered to have an endpoint of chronic health effects, so the duration is set at 70 years. While EPA guidance does not speak to frequency of excursions, but DEC has determined that the 70-year average (using all available data for Lower Marguerite Creek) should not be exceeded during any 70 period (i.e. less than once in 70 years).

In considering agricultural criteria, the EPA WQS Handbook states, "Where criteria have not been specifically developed for these [agriculture and industrial] uses, the criteria developed for human health and aquatic life are usually sufficiently stringent to protect these uses." The effects described in the nationally recommended criteria document (USEPA 1976) imply chronic exposure effects. Duration and frequency exposure values specific to the manganese criterion have not been developed for the irrigation use. DEC has determined that the four-day duration and not more than once every three year frequency exposure values used for chronic aquatic life criteria are also protective of the designated use of agriculture (irrigation).

Using the most stringent duration and frequency components, the criterion statement for the concurrently measured SSC is the four-day average manganese concentration may not exceed 0.30 mg/L more than once every three years. Since the prevailing highest quality natural condition criterion at 0.082 mg/L is set at the 15th percentile of natural condition data at Middle Marguerite Creek, then by definition 85 percent of the creek samples are expected to exceed in the absence of treatment. Nevertheless, in the absence of data from Middle Marguerite Creek measured concurrent with discharge monitoring at Lower Marguerite Creek, the four-day duration and once every three years would also apply to 0.082 mg/L manganese SSC value.

Compliance actions regarding allowed excursions from the SSC, including frequency and duration of excursions, will be addressed through implementation and of the APDES Permit AK0052471 and applicable compliance policies, which may not be constrained by the SSC statement.

5.4. Protection of Designated Uses

5.4.1. Water Supply – Drinking, Culinary and Food Processing

The SSC includes a maximum value of 0.30 mg/L total manganese for Marguerite Creek. The maximum SSC reflects the EPA lifetime advisory value for drinking water and considered to be protective of the designated use classes of Water Supply. As discussed in Section 4.1.1, the 0.050 mg/L manganese criterion for consumption of water and aquatic organisms is intended for to protect municipal water supplies based on aesthetic considerations that are not applicable to naturally elevated manganese in a remote location with no prospects for feasibility as a public water supply. The drinking water health advisory of 0.30 mg/L manganese is sufficient and an acceptably protective value to avoid any toxicity from elevated manganese including natural sources.

5.4.2. Growth and Propagation of Fish, Shellfish, Other Aquatic Life and Wildlife

The 0.1 mg/L human health criterion for consumption of aquatic organisms was derived specifically to protect against consumption of excessive manganese bioaccumulated in marine mollusks. As discussed in Section 4.1.2, freshwater organisms are unlikely to bioaccumulates significant amounts of manganese, so that any significant manganese exposure to humans would be through drinking untreated surface water. Therefore, the drinking water health advisory level of 0.30 mg/L is also considered protective of the consumption of aquatic organisms as part of the designated use for growth and propagation of fish, shellfish, other aquatic life and wildlife.

There are no manganese criteria that directly protect aquatic life, nor is there any evidence that aquatic life would be affected at the manganese concentrations found in Marguerite Creek. Aquatic life is protected by the 0.30 mg/L maximum based on EPA guidance.

The EPA criterion document (USEPA 1976) states that

> McKee and Wolf (1963 summarized data on toxicity of manganese to freshwater aquatic life. Ions of manganese are found rarely in concentrations above 1 mg/L. The tolerance values reported rage from 1.5 mg/L to over 1,000 mg/L. Thus, manganese is not considered to be a problem in fresh waters."

Data collected over 12 years of sampling in Marguerite Creek indicate a maximum observed value of 0.78 mg/L, confirming that naturally occurring manganese concentrations is very unlikely to affect aquatic life in this watershed.

EPA natural conditions guidance (USEPA 2005) states

> Criteria which are based on truly natural conditions (i.e., conditions absent human impacts) inherently protect the aquatic life uses that have "naturally" existed in the waterbody. The essential rationale for this is that the naturally occurring aquatic life uses, by definition, were supported by the water in its natural condition, prior to any human effects on water quality.

5.4.3. Water Supply - Agriculture including Irrigation and Stock Watering

The maximum SSC of 0.3 mg/L total manganese is considered to be protective of the designated use of Water Supply; Agriculture (including irrigation and stock watering) based on natural conditions in Marguerite Creek. Although total manganese has exceeded the nationally recommended irrigation criterion of 0.20 mg/L on rare occasions, the dissolved manganese concentrations only exceed the irrigation criterion during winter months as described in Section 3. With the exception of a limited number of high runoff or storm events, total manganese also does not exceed the irrigation criterion of 0.2 mg/L during the summer growing season (June 1 to September 1). In the unlikely event that the water is used for irrigation, sufficient suspended sediment would settle prior to use in irrigation infrastructure (e.g., canals, pumps, pivots) and to keep naturally occurring manganese below the recommended criterion of 0.20 mg/L during any high flow periods.

Stock watering is also protected based on the EPA criterion document (USEPA 1976) that states, "Manganese is not known to be a problem in waters consumed by livestock." There is no nationally recommended manganese criterion for stock watering.

5.5. Downstream Protection

DEC finds that downstream water quality will not be impacted and all designated uses will be protected as the discharge and SSC will not increase the manganese concentration or stream flow rate beyond what is naturally existing based on concurrent monitoring values. The extent to which the natural condition protects the designated uses, both within the SSC area of concern and downstream is discussed in Section 5.1.

To determine whether state water quality criteria would be met downstream of the applicable site specific area of concern, DEC reviewed available sampling data and a loading analysis (Tetra Tech 2014) of existing water quality data that was conducted for the purpose of establishing the loading capacity of the creek, based on state criteria and natural conditions.

Natural concentrations of manganese in the lower reach of Bottom Marguerite Creek, downstream of the SSC area (Table 7 and Appendix I), exceed the human health criteria (0.050 and 0.10 mg/L) and the default SSC (0.082 mg/L). Both total and dissolved manganese concentrations meet the irrigation criterion (0.20 mg/L) in Bottom Marguerite Creek downstream of the SSC. The 15th and mean percentiles in Emma Creek (an upstream tributary with a confluence at the lower boundary of the SSC area) exceeded all manganese criteria. The Bonanza Creek 15th and mean percentiles (a tributary downstream of the SSC area) also exceeded all manganese criteria.

As previously described, the highest values of total manganese in the Upper, Middle and Lower Marguerite Creek were recorded during spring flow conditions. A significant portion of the manganese present during spring flow events is attributed to suspended sediment, most of which is expected to settle out of the water column in Middle and Lower Marguerite Creek, (See Section 3, Figures 10-15). Similar to Middle and Lower Marguerite Creek, dissolved manganese at the Bottom Marguerite station meet the irrigation criterion during the summer growing season and are not expected to impact the agriculture use downstream of the SSC area. Dissolved manganese concentrations in the project area and downstream of the project area do not exceed the manganese health advisory level of 0.30 mg/L, so the natural conditions will result in only aesthetic and organoleptic effects on the drinking water and fish consumption (i.e., growth and propagation) uses.

Table 7. Total and Dissolved Manganese Concentrations in Marguerite Creek Watershed

	Middle Marguerite Creek N[2]=40		Lower Marguerite Creek N=35		Emma Creek N=24		Bonanza Creek N=16		Bottom Marguerite Creek N=16	
	Total	**Diss[3].**	**Total**	**Diss.**	**Total**	**Diss.**	**Total**	**Diss.**	**Total**	**Diss.**
15th	**0.082[1]**	0.070	0.093	0.087	0.237	0.193	0.070	0.061	0.096	0.077
Mean	0.122	0.121	0125	0.127	0.318	0.262	0.134	0.19	0.114	0.106
Max	0.783	0.272	0.620	0.230	0.618	0.425	0.654	0.654	0.174	0.164

1. Default SSC value.
2. Values derived from Usibelli Water Quality Database
3. N=38

Calculations of baseline loading were conducted to determine assimilative capacity and change in chemical concentration downstream of the project area. "Loading Capacity" is the stream flow rate multiplied by the water quality standard. For any given station, the loading capacity is the mass load in pounds per day (lbs./day) that equals the water quality standard at that given flow rate. The "Net Loading Capacity" is the difference between the actual measured loading and the loading capacity. If the net loading capacity is a positive value, than the calculated number represents the available loading in lbs./day before the water quality standard is exceeded at that particular location and flow rate. If the net loading capacity is negative, the value shown is the amount the mass loading in lbs./day exceeds the available capacity.

The data and loading analysis presented in Appendix I demonstrates the concentration of manganese throughout the Marguerite Creek watershed exceeds the most stringent Water Quality Criteria of 0.050 mg/L 100 percent (%) of the time, regardless of station, flow rate, or time of year. The average measured concentration across all samples was 0.160 mg/L, and consequently the actual loading always exceeds the loading capacity when applying the most stringent criterion. The range of exceedances in the mass loading of manganese ranges between 114% and 836%, with an average exceedance of 319%. The highest exceedances generally occur in Emma Creek and at the Upper Marguerite Creek stations (Appendix I). Marguerite Bottom is the lowest station historically monitored by UCM, however, it is likely that high levels of manganese continue to occur at locations further downstream in McAdam Creek and below (Appendix I).

Although, the manganese concentration downstream of the SSC area (Bottom Marguerite Creek) will naturally exceed the human health criteria for consumption of aquatic organisms (0.10 mg/L) and water plus aquatic organisms (0.050 mg/L), the uses for drinking water and consumption of aquatic organisms will be protected. As explained in sections 4.1.1 and 5.4.1, the human health criterion of 0.050 mg/L is based on aesthetic and organoleptic effects. Given that the cause of the exceedance is a natural condition, the applicable criterion for this creek should be based on the drinking water health advisory that has an endpoint appropriate for toxic effects. Aesthetic and organoleptic effects can be adequately protected at 0.30 mg/L consistent with the narrative criterion

for the drinking water use in 18 AAC 70.020(b)(11) which states, "Substances may not be introduced at concentrations that cause, or can be reasonably expected to cause, singly or in combination, odor, taste, or other adverse effects to the use." (emphasis added). The discharge will not be allowed to introduce any additional manganese loading under the permit or site specific criterion. As discussed in section 4.1.2, the criterion of 0.10 mg/L for consumption of aquatic organisms is based on consumption of marine mollusks that are not harvested from freshwater systems and therefore is not an appropriate criterion for Marguerite Creek.

Emma and Bonanza Creeks are tributaries of Marguerite Creek. The manganese data for these creeks are included for purposes of determining the loading capacity of Marguerite Creek downstream of the project area. There is insufficient information to determine the appropriateness of the designated uses in these creeks and that assessment is not the subject of this document. However, DEC finds no cause for immediate concern or substantial risk to human health based on this data.

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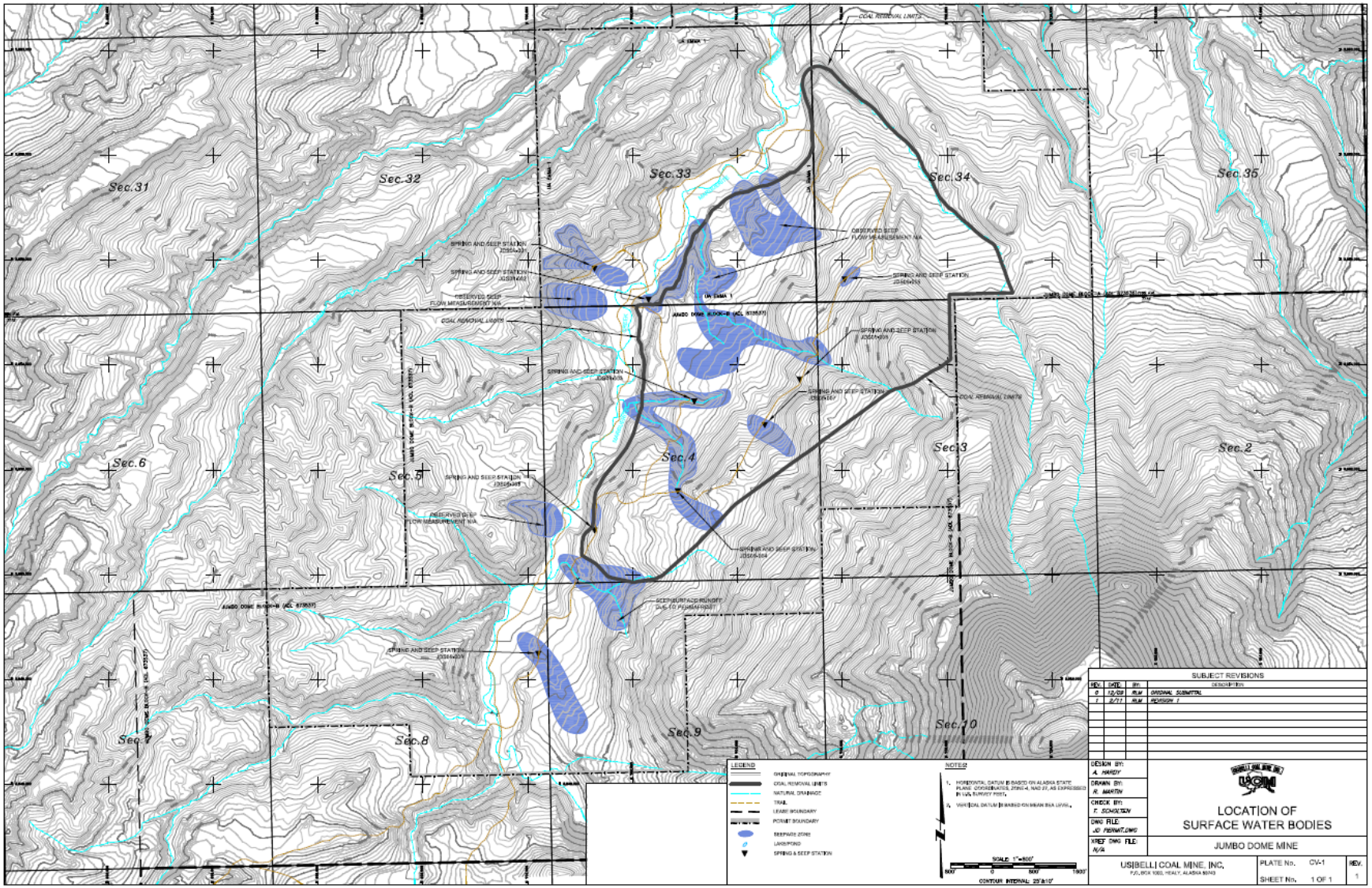
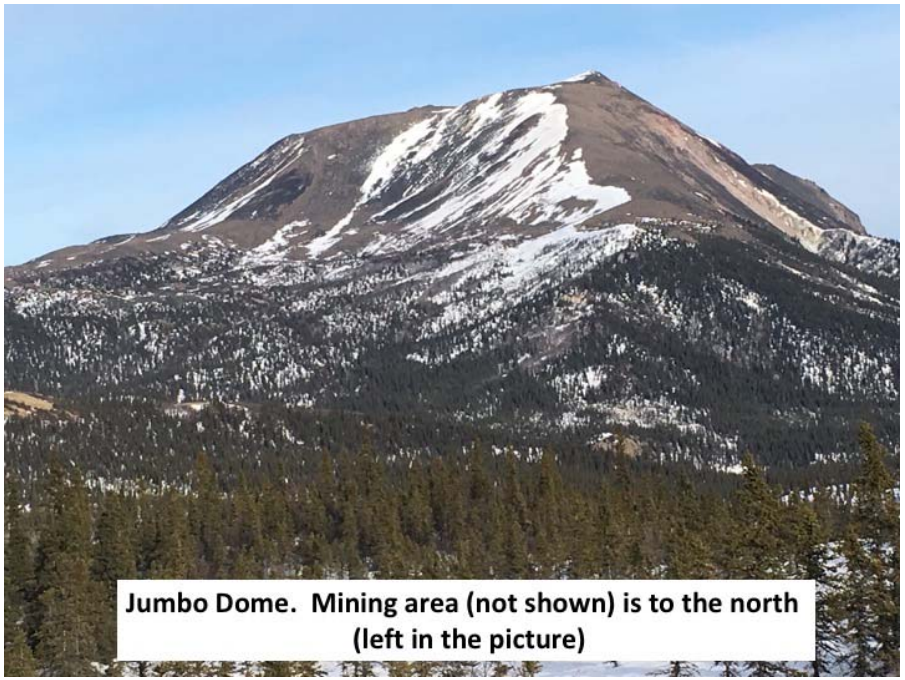
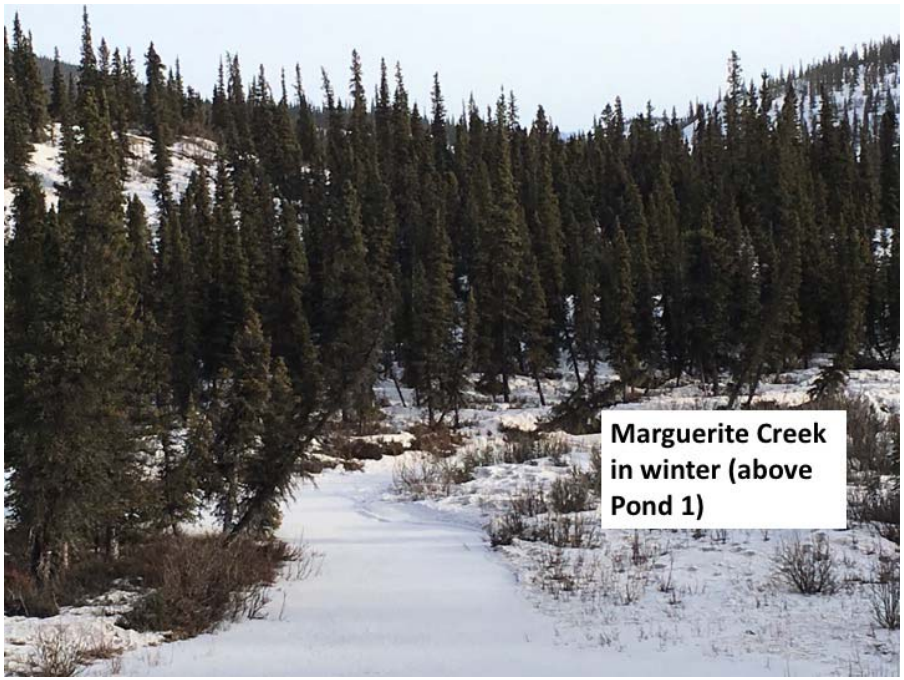
Appendix A. Location of Surface Water Bodies Associated with Jumbo Dome Project



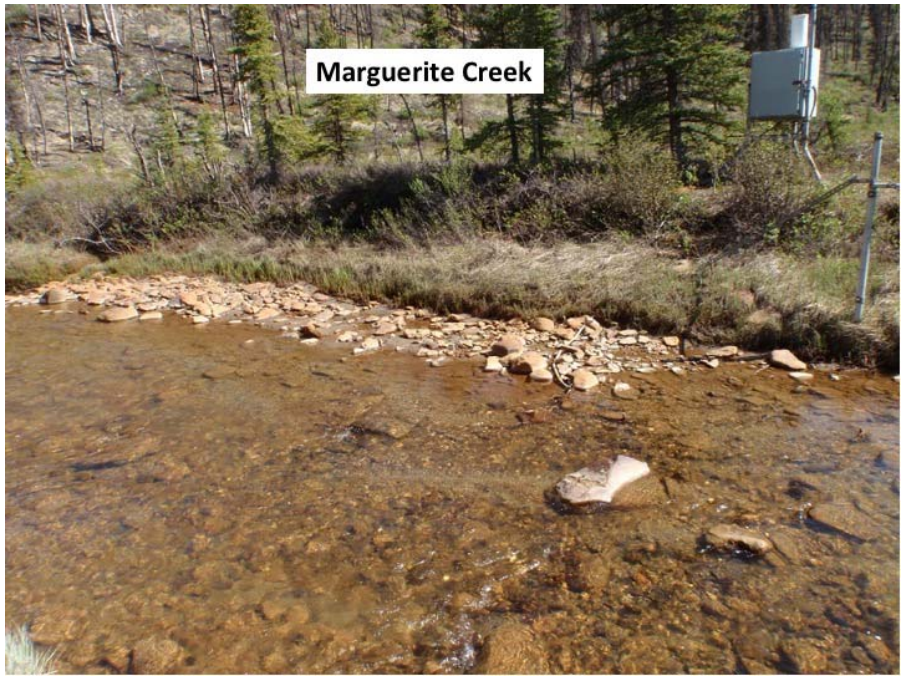
Appendix B. Photos of Site





Photos of Site

Mining Area (on the near side of the creek), Looking South
Mine Access Road
Beginning of First Box Cut
Marguerite Creek

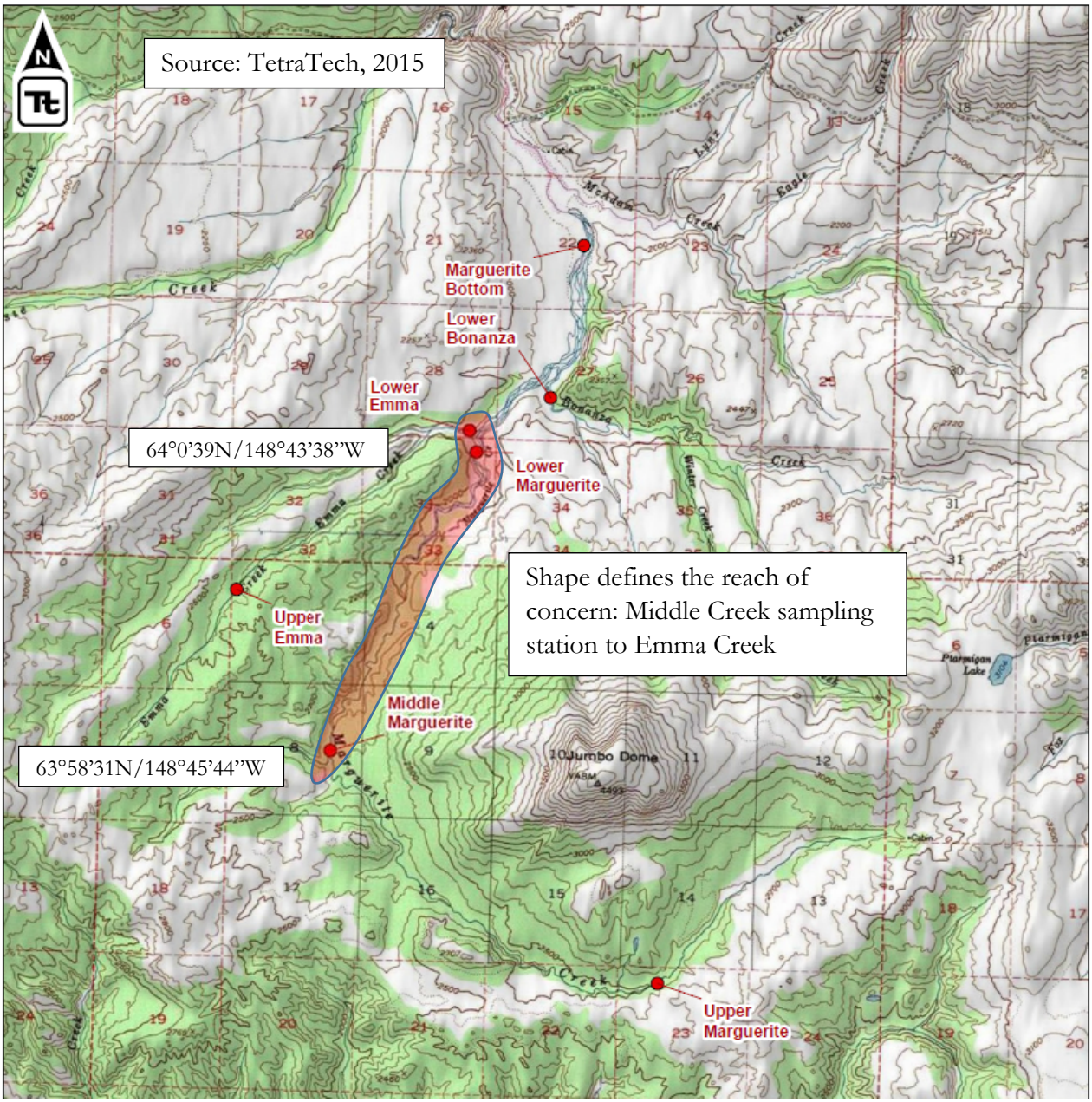

Marguerite Creek

Appendix C: Water Quality Criteria Calculated for Marguerite Creek and Groundwater/Seeps (APDES 2009)

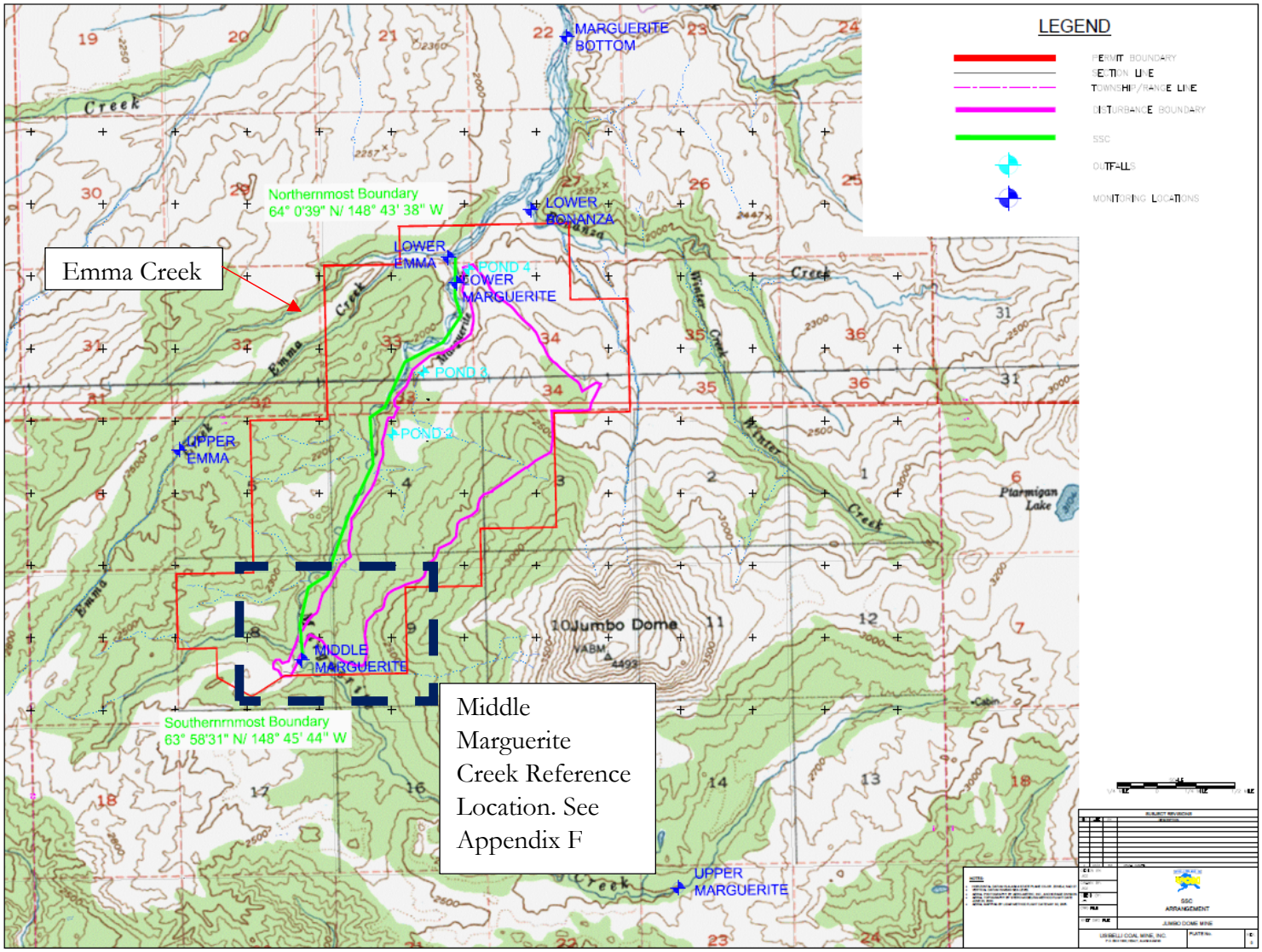
Table 1. Water Quality Criteria Calculated for Marguerite Creek Worse Case Acute and Chronic Compared to Worst Case Groundwater/SeepWater.
Used Hardness = 46.75 mg/l as CaC03

	WQS Calc 15%ile Middle Marguerite			Seam 4 10JD-02			Seam 3 10JD-01			SEEP 003			SEEP 004			SEEP 008		
Parameter	AQ Acute	Aq Chronic	Other	Max	0.85	Min	Max	0.85	Min	Max	0.85	Min	Max	0.85	Min	Max	0.85	Min
pH			6.5-8.5	6.15		5.97	6.05		5.87	7.17		6.44	71		6.63	7.38		6.87
alkalinity		2000		239		207	204		189	20010		2000	32300		13000	16800		2000
aluminum	750	87		21	17.82	6	18.5	10.78	3.6	267	230.1	92.1	480	349.95	71.6	100	77.23	33.3
antimony			6	0.05		0.05	nd		nd	0.08		0.06	0.1		0.06	0.07		0.06
arsenic			10	0.6		0.6	1.8		1.1	nd		nd	nd		nd	nd		nd
barium			2000	539		440	562		353	12.8		8.8	12.8		8.77	13.4		11.1
beryllium			4	nd		nd	nd		nd	nd		nd	nd		nd	nd		nd
boron			750	nd		nd	nd		nd	nd		nd	nd		nd	nd		nd
cadmium	0.98	0.15		nd		nd	nd		nd	nd		nd	nd		nd	nd		nd
chromium (total)			100	1.1		0.4	1		0.05	0.4		0.2	0.4		0.2	0.3		0.2
cobalt			50	1.23		0.4	0.37		0.26	0.19		0.06	0.1		0.06	0.08		0.05
copper	6.84	4.87		0.5	0.5	0.3	0.5	0.5	0.3	3.5	2.65	1	3.5	3.04	1	1.6	1.51	1.2
fluoride			1000	nd		nd	nd		nd	nd		nd	nd		nd	nd		nd
iron		1000		4240	4114	3480	7410	7176	5680	386	282.95	71	541	417.7	119	79	62.8	36
lead	31.01	1.21		0.27		0.04	0.02		0.02	0.28		0.04	0.3		0.04	0.03		0.02
manganese			50	743	710.4	570	1090	1079	879	4.93	3.92	1.5	30.8	25.9	6.5	2.07	1.65	0.8
mercury			0.05	nd		nd	nd		nd	nd		nd	nd		nd	nd		nd
molybdenum			10	nd		nd	0.05		0.05	0.13		0.09	0.35		0.3	0.28		0.26
nickel	246.59	27.42		2.7		0.5	2.8		0.8	0.6		0.3	0.9		0.4	0.6		0.5
nitrate (as N)			10000	nd		nd	nd		nd	0.59		0.47	0.52		0.48	0.49		0.43
nitrate + nitrite			10000	nd		nd	nd		nd	0.67		0.52	0.62		0.49	0.56		0.51
selenium		5		nd		nd	nd		nd	nd		nd	nd		nd	nd		nd
silver	1.1			nd		nd	nd		nd	nd		nd	nd		nd	nd		nd
thallium			1.7	nd		nd	nd		nd	nd		nd	nd		nd	nd		nd
vanadium			100	0.3		0.2	0.2		0.2	1.9		1.1	5.1		2.9	1.9		1.3
zinc	62.91	62.91		**		20.3	4		1	1.4		0.05	18.2		0.8	0.6		0.5

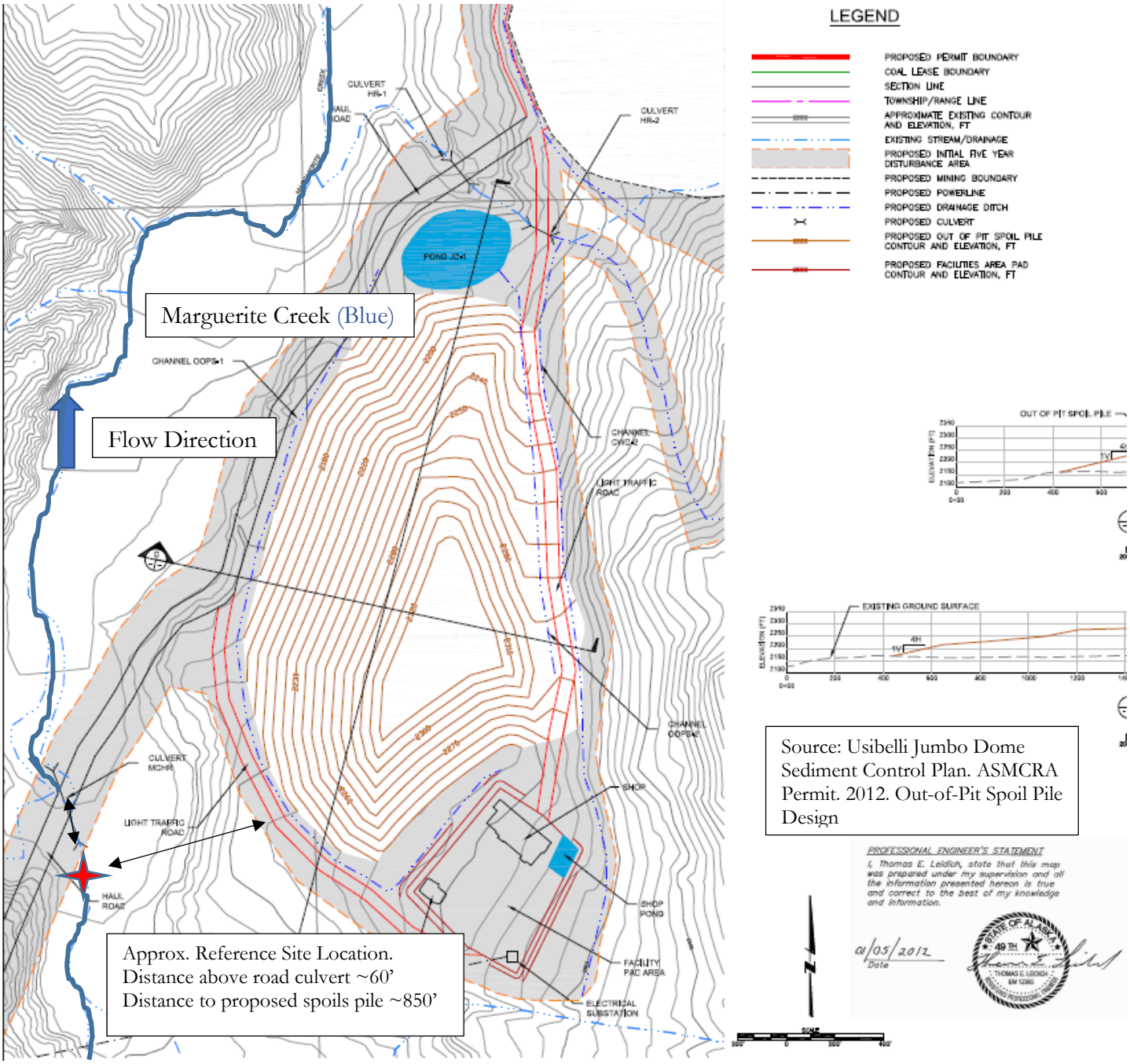
Appendix D: Monitoring Location Map



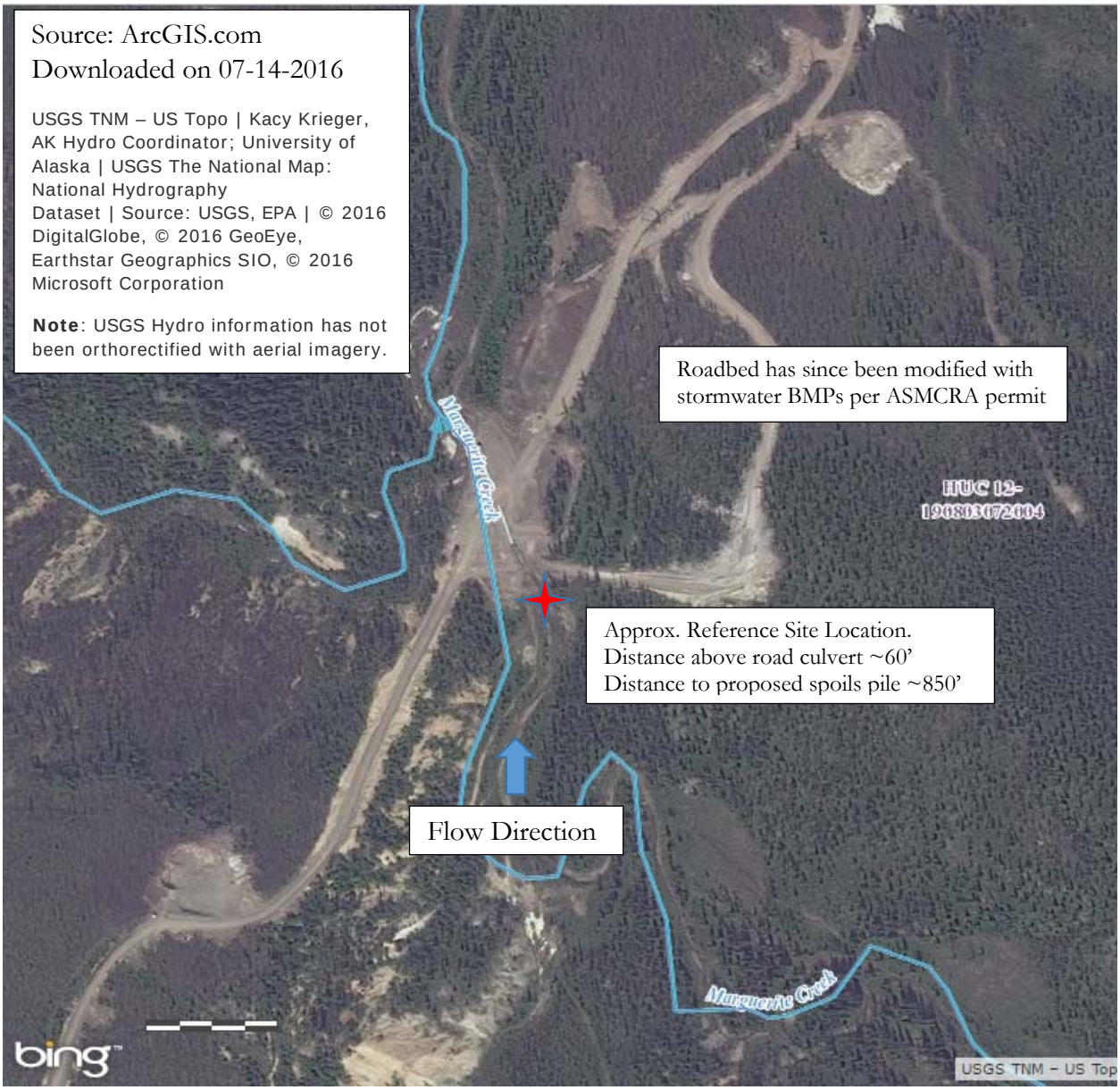
Appendix E: Discharge Location Map



Appendix F: Middle Marguerite Creek Reference Site Location



Appendix G: ArcGIS Imagery of Middle Marguerite Creek Reference Location



Appendix H: Manganese Sampling Results for Natural Condition Sites at Upper, Middle and Lower Marguerite Creek[9]

15th Percentile	Manganese, Dissolved µg/L	Manganese, Total µg/L
Middle Marguerite only	**70.0**	**82.4**
Upper, Middle and Lower Marguerite combined	**81**	**87.0**

Location Sampling date	Manganese, Dissolved µg/L	Manganese, Total µg/L
Middle Marguerite		
8/20/2002	103	121
7/29/2003	120	148
6/21/2004	177	182
8/26/2004	192	190
9/1/2004	191	189
9/8/2004	197	179
3/28/2005	85	97.4
8/23/2005	124	125
8/16/2006	187	191
3/27/2007	1.7	2.38
5/16/2007	184	444
8/24/2007	138	138
10/18/2007	141	146
5/21/2008	180	234
8/28/2008	92.9	95.6
11/25/2008	127	130
3/31/2009	69	78.7
6/30/2009	119	122
10/5/2009	118	120
12/2/2009	117	127
3/31/2010	272	270
6/8/2010	136	214
12/8/2010	--	124
6/22/2011	93.9	101

[9] Usibelli Coal LLC. Water Quality Monitoring Database.

Location Sampling date	Manganese, Dissolved µg/L	Manganese, Total µg/L
8/11/2011	111	113
11/29/2011	70.4	82.4
3/29/2012	60.5	72.7
7/26/2012	81.7	83.6
9/13/2012	113	115
11/14/2012	121	139
4/3/2013	--	96.8
5/28/2013	202	783
7/17/2013	52.6	57
9/30/2013	108	108
1/30/2014	92.2	107
3/25/2014	73.4	84.9
5/28/2014	54.6	66.8
7/9/2014	60.8	63.2
9/7/2014	121	124
12/11/2014	141	144
2/11/2015	87.3	95.6
Lower Marg		
8/20/2002	81.8	105
7/29/2003	87.1	121
6/21/2004	127	129
3/28/2005	154	166
5/20/2005	106	125
3/27/2006	--	--
8/16/2006	169	179
3/27/2007	151	152
5/16/2007	198	364
8/24/2007	127	132
3/20/2008	120	121
5/21/2008	184	213
8/28/2008	98.7	100
11/25/2008	143	143
6/30/2009	99	102
10/5/2009	125	125
6/8/2010	118	160
12/8/2010	--	146
6/22/2011	79.2	85.8
8/11/2011	99.9	101
11/29/2011	84.9	88.8

Location Sampling date	Manganese, Dissolved µg/L	Manganese, Total µg/L
3/29/2012	89.2	92.7
7/26/2012	115	118
9/13/2012	144	147
11/14/2012	168	180
3/19/2013	--	115
5/28/2013	175	620
7/17/2013	89.4	93.1
9/30/2013	133	133
1/30/2014	115	119
3/25/2014	123	125
5/28/2014	80.1	83.8
7/9/2014	75.1	78.8
9/7/2014	133	137
12/11/2014	176	178
2/11/2015	230	233
Upper Marg		
8/20/2002	--	--
7/29/2003	160	166
6/21/2004	340	340

Appendix I: Loading Analysis Results

Table 2. Historical Baseline water quality data for Mn compared to Water Quality Criteria for Human Health

Station	Date	Discharge cfs	Total Mn Concentration µg/L	Mn Loading lbs/day	Water Quality Criteria µg/L	Loading Capacity lbs/day [1]	Net Loading Capacity [2] lbs/day	Net Loading Capacity [2] %
Middle Marguerite	8/20/2002	28.2	121	18.4	50	7.6	(10.8)	242
Lower Marguerite	8/20/2002	43.2	105	24.5	50	11.7	(12.8)	210
Upper Marguerite	7/29/2003	4.6	166	4.1	50	1.2	(2.9)	332
Middle Marguerite	7/29/2003	16.5	148	13.2	50	4.4	(8.7)	296
Lower Marguerite	7/29/2003	25.2	121	16.4	50	6.8	(9.7)	242
Upper Emma Creek	7/29/2003	0.7	220	0.8	50	0.2	(0.6)	440
Lower Emma Creek	7/29/2003	7.1	248	9.5	50	1.9	(7.6)	496
Lower Bonanza Creek	7/29/2003	15.2	95.7	7.8	50	4.1	(3.7)	191
Bottom Marguerite	7/29/2003	48	110	28.5	50	12.9	(15.5)	220
Upper Marguerite	6/21/2004	2.29	340	4.2	50	0.6	(3.6)	680
Middle Marguerite	6/21/2004	7.08	182	6.9	50	1.9	(5.0)	364
Lower Marguerite	6/21/2004	10.5	129	7.3	50	2.8	(4.5)	258
Upper Emma Creek	6/21/2004	1.3	341	2.4	50	0.4	(2.0)	682
Lower Emma Creek	6/21/2004	4.56	317	7.8	50	1.2	(6.6)	634
Lower Bonanza Creek	6/21/2004	5.31	159	4.6	50	1.4	(3.1)	318
Bottom Marguerite	6/21/2004	20.6	137	15.2	50	5.6	(9.7)	274
Middle Marguerite	8/26/2004	4.7	190	4.8	50	1.3	(3.5)	380
Middle Marguerite	9/1/2004	4.1	189	4.2	50	1.1	(3.1)	378
Middle Marguerite	3/28/2005	3.96	97.4	2.1	50	1.1	(1.0)	195
Lower Marguerite	3/28/2005	4.98	166	4.5	50	1.3	(3.1)	332
Lower Emma Creek	3/28/2005	2.82	327	5.0	50	0.8	(4.2)	654
Lower Marguerite	5/20/2005	13.9	125	9.4	50	3.7	(5.6)	250
Lower Emma Creek	5/20/2005	4.54	267	6.5	50	1.2	(5.3)	534
Bottom Marguerite	5/20/2005	40.1	103	22.3	50	10.8	(11.5)	206
Middle Marguerite	8/23/2005	5.71	125	3.8	50	1.5	(2.3)	250
Middle Marguerite	8/16/2006	6.34	191	6.5	50	1.7	(4.8)	382
Lower Bonanza Creek	8/16/2006	4.58	134	3.3	50	1.2	(2.1)	268
Lower Emma Creek	2/6/2007	3.66	387	7.6	50	1.0	(6.7)	774
Lower Bonanza Creek	8/24/2007	5.09	95.7	2.6	50	1.4	(1.3)	191

[1] Assumes the current Mn Criteria of 50 µg/L for human consumption of water + fish.

[2] Net Loading Capacity = Actual Loading - Loading Capacity

Appendix I: Loading Analysis Cont.

Table 2. Historical Baseline water quality data for Mn compared to Water Quality Criteria for Human Health (Continued)

Station	Date	Discharge cfs	Total Mn Concentration µg/L	Mn Loading lbs/day	Water Quality Criteria µg/L	Loading Capacity lbs/day [1]	Net Loading Capacity [2] lbs/day	Net Loading Capacity [2] %
Lower Emma Creek	3/20/2008	56.3	418	127	50	15.2	(111.7)	836
Lower Marguerite	8/28/2008	16.6	100	9.0	50	4.5	(4.5)	200
Lower Marguerite	11/25/2008	5.8	143	4.5	50	1.6	(2.9)	286
Lower Emma Creek	11/25/2008	2.6	373	5.2	50	0.7	(4.5)	746
Lower Marguerite	10/5/2009	8.01	125	5.4	50	2.2	(3.2)	250
Lower Emma Creek	10/5/2009	3.12	234	3.9	50	0.8	(3.1)	468
Lower Bonanza Creek	10/5/2009	3.14	128	2.2	50	0.8	(1.3)	256
Middle Marguerite	6/22/2011	6.6	101	3.6	50	1.8	(1.8)	202
Lower Marguerite	6/22/2011	9.4	85.8	4.4	50	2.5	(1.8)	172
Lower Emma Creek	6/22/2011	3.9	199	4.2	50	1.1	(3.1)	398
Lower Bonanza Creek	6/22/2011	6.3	94.5	3.2	50	1.7	(1.5)	189
Bottom Marguerite	6/22/2011	22.3	91.4	11.0	50	6.0	(5.0)	183
Middle Marguerite	8/11/2011	5.3	113	3.2	50	1.4	(1.8)	226
Lower Marguerite	8/11/2011	6.1	101	3.3	50	1.6	(1.7)	202
Lower Emma Creek	8/11/2011	2.9	227	3.6	50	0.8	(2.8)	454
Lower Bonanza Creek	8/11/2011	3.62	144	2.8	50	1.0	(1.8)	288
Bottom Marguerite	8/11/2011	15.7	110	9.3	50	4.2	(5.1)	220
Lower Marguerite	3/29/2012	2.42	92.7	1.2	50	0.7	(0.6)	185
Middle Marguerite	7/26/2012	4.25	83.6	1.9	50	1.1	(0.8)	167
Middle Marguerite	9/13/2012	4.33	115	2.7	50	1.2	(1.5)	230
Middle Marguerite	7/17/2013	2.82	57	0.9	50	0.8	(0.1)	114
Lower Marguerite	7/17/2013	4.68	93.1	2.4	50	1.3	(1.1)	186
Middle Marguerite	9/30/2013	4.79	108	2.8	50	1.3	(1.5)	216
Lower Marguerite	9/30/2013	7.38	133	5.3	50	2.0	(3.3)	266
Middle Marguerite	5/28/2014	4	66.8	1.4	50	1.1	(0.4)	134
Lower Marguerite	5/28/2014	6.12	83.8	2.8	50	1.7	(1.1)	168
Middle Marguerite	7/9/2014	10.6	63.2	3.6	50	2.9	(0.8)	126
Lower Marguerite	7/9/2014	17	78.8	7.2	50	4.6	(2.6)	158

[1] Assumes the current Mn Criteria of 50 µg/L for human consumption of water + fish.

[2] Net Loading Capacity = Actual Loading - Loading Capacity